Fraser Drive, South Tweed

Volume 2 - Technical Reports

Appendix 13-20

May 2007

Prepared by

pmm
a comics company

On behalf of

MFS
DIVERSIFIED GROUP

FRASER DRIVE, TWEED HEADS
VOLUME 2 - TECHNICAL REPORTS

- Appendix 13 - Stormwater Management Plan
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Appendix 13

Stormwater Management Plan

Cardno
Engineering the Future

Villa World Ltd

Proposed Development
Fraser Drive – South Tweed

Stormwater Management Plan

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8TH DECEMBER 2006
JOB NO. 7214/29-1

PROPOSED DEVELOPMENT
FRASER DRIVE – SOUTH TWEED

STORMWATER MANAGEMENT PLAN

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CLIENT	VILLA WORLD LTD Job No. 7214/29-1
DOCUMENT NAME	PROPOSED DEVELOPMENT LOT 9 on DP1039569 FRASER DRIVE - SOUTH TWEED STORMWATER MANAGEMENT PLAN

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1.0 INTRODUCTION

1.1 PURPOSE

This Stormwater Management Plan (SWMP) has been prepared on behalf of Villa World Ltd for the proposed development on Lot 9 on DP1039569 and part of Lot 2 on DP1000385, Fraser Drive, Tweed Heads South (the subject site). The aim of this management plan is to provide detailed policies, performance criteria and procedures to minimise the impact of the development on the physical and social environment. In particular, the SWMP provides monitoring and reporting mechanisms whereby the performance of the development can be measured and that agreed corrective actions are implemented in a timely manner if problems occur.

1.2 IMPLEMENTATION

This SWMP has been prepared in accordance with Tweed Shire Council's (TSC) '*Tweed Urban Stormwater Quality Management Plan*' and Development Design Specification '*D7-Stormwater Quality*' and good local engineering and environmental practice.

2.0 WATER QUALITY ASSESSMENT

Existing Conditions

The majority of the undeveloped site has previously been cleared for agricultural and farming use and is void of major vegetation, with the exception of the wetland area in the north-west corner of the site which contains Mangroves, Melaleucas and She-oaks. The cleared areas of the site are generally well grassed. The lower area at the northern end of the lot is in the process of being filled to bring the existing surface levels up above the regional 100 year ARI flood level of 2.6m AHD. These filling works are part of a previously approved application for the subject site.

The proposed subdivision development site is divided into four main existing site catchment areas. Approximately 2.4 hectares (ha) of the subject site discharges south towards existing residential lots on Shiraz Place and Merlot Drive. Two site catchment areas of approximately 1.8ha and 5.3ha discharge east towards Fraser Drive. The largest existing site catchment of approximately 23ha discharges north towards James Street. A SEPP 14 wetland area has been identified in the north-western corner of the subject site at the downstream outlet of the existing northern catchment area. As it is intended to retain the existing wetland area within the SEPP 14 zone the northern catchment point of discharge will be situated along the southern boundary of the SEPP 14 zone. Cardno Figure No DA19 in Appendix A shows the existing internal catchments for the site and the external catchments contributing to the site.

A number of external catchment areas contribute to the subject site. These external areas include approximately 8.4ha of existing residential lots along Seaview Street, Ocean Avenue and Hillcrest Avenue and a catchment of approximately 14.8ha contributing from the eastern side of Fraser Drive.

Based on typical pollutant loads as specified in Table 5.3 of Tweed Shire Council's '*Tweed Urban Stormwater Quality Management Plan*' it was assumed that under existing site conditions the development site would generate pollutant loads equivalent to undeveloped land use loads.

TABLE 1 - TYPICAL POLLUTANT LOADS

Land Use	Typical Pollutant Loads (kg/ha/yr) for Tweed coastal areas* (Average Year)		
	Suspended Solids	Total Nitrogen	Total Phosphorus
Undeveloped	125	1.5	0.4
Rural	410	6.0	1.0
Urban	1200	18.0	3.0

* Taken from *Tweed Urban Stormwater Quality Management Plan* Table 5.3.

Proposed Site Drainage Strategy

The proposed drainage strategy for the Fraser Drive subdivision development is intended to incorporate water sensitive urban design (WSUD) wherever practical. The topography of much of the proposed development site limits the use of many WSUD techniques. It is therefore proposed to utilise conventional street drainage to convey stormwater runoff from the upper reaches of the catchment areas down to the stormwater treatment and detention devices to be constructed around the lower parts of the development site.

To assist in minimising the volume of stormwater runoff to be detained and treated from the catchment areas discharging to the south and south-east of the subject site, a number of strategies are proposed to be incorporated into the development. These strategies include minimising the density of the lots to be developed within the catchment discharging to the south and diverting catchment area from the southern catchments towards the eastern catchment.

Stormwater runoff from the northern and eastern catchment areas will be conveyed to detention and treatment devices to be located within open space areas situated at downstream outlet of each catchment. It is proposed to incorporate treatment devices such as gross pollutant traps and wetlands into the open space areas to assist in meeting Council's water quality objectives. These devices will be sufficiently sized to meet Council's 'deemed to comply' criteria outlined in the *Development Design Specification D7-Stormwater Quality*. Sufficient on-site detention storage volume will be provided within these open space areas to assist in maintaining peak flow rates equivalent to existing peak flows discharging off-site.

For the catchment areas discharging to the south and south-east it is proposed to retain the existing vegetation outside of the proposed building areas to assist in filtering and dispersing stormwater runoff from the subject site. Where necessary, areas will be revegetated to aid in this process. Inter-allotment drainage will be used to convey flows to the legal point of discharge of each catchment area.

Developed Conditions

The subject site will be developed into approximately 168 residential allotments and 66 medium density dwellings which are expected to increase pollutant loads at the stormwater discharge points. Cardno Figure No DA20 shows the catchments of the developed site. To assist in minimising the expected increase in suspended solids and nutrients discharging from the developed subject site it is proposed to install and construct gross pollutant traps and wetland areas in some of the open space areas proposed on-site.

Based on the typical pollutant loads summarised in Table 1 Council have outlined stormwater treatment objectives and maximum permissible loads that may be discharged from new urban developments. Table 5.4 of Council's *Tweed Urban Stormwater Quality Management Plan* outlines stormwater treatment objectives that new developments must demonstrate compliance with. Table 2 summarises part of the operational phase stormwater treatment objectives relating to the maximum permissible pollutant loads that may be discharged.

TABLE 2 - STORMWATER TREATMENT OBJECTIVES

Parameter	Maximum Permissible Pollutant Load Discharged (kg/ha/yr)* (Average Year)
Suspended Solids	300
Total Nitrogen	4.5
Total Phosphorus	0.8

* Taken from *Tweed Urban Stormwater Quality Management Plan* Table 5.4.

3.0 PRELIMINARY WATER QUANTITY ASSESSMENT

A preliminary water quantity assessment has been carried out by Cardno for the pre-development and post-development catchments of the site. The assessment was undertaken in accordance with Tweed Shire Council's Development Design Specification *D5 'Stormwater Drainage Design'* and QUDM Section 5, using the Rational Method.

3.1 On-site Detention

The proposed development is expected to increase the amount of impervious area on the site. The potential impacts of this increase in impervious area will be a larger volume of runoff, and possibly a shorter time of concentration. As a result there is expected to be an increase in the peak stormwater discharge leaving the site. To avoid impacts on the downstream properties and to maintain the existing peak flow rate of runoff discharging from the developed site for all rainfall events up to and including the local catchment 100 year ARI event, on-site detention is proposed to be incorporated into the development works to control the rate of discharge entering the downstream floodplain.

The on-site detention storage proposed for this site will be sized to maintain the equivalent pre-developed condition peak flows discharging from the subject site for the local catchment 100 year ARI rainfall event. To control the peak rate of discharge from the storage areas it will be necessary for the outlets to be designed for all events up to and including the 100 year event.

A preliminary assessment of the on-site detention storage requirements has been carried out for the proposed development area, using the initial sizing manual techniques in Section 6.06.1 of QUDM. These calculations indicate that estimated preliminary total storage volumes of approximately 956m^3 and 11726m^3 will be required to detain the increase in the 100 year ARI peak discharge and maintain the equivalent pre-developed 100 year ARI peak flow discharging off site for the Eastern and Northern catchments respectively. The calculations for the preliminary assessment of the detention storage volumes are included in Appendix B.

For the Northern catchment, it is proposed to provide this required storage volume within the proposed open space detention basin located in the open space area on-site. The storage volume would be provided above the permanent standing water level within the wetland. A controlled discharge point will be used in the open space detention basin to limit the flows exiting the storage area to ensure that flows discharging from the overall development site into the existing SEPP 14 wetland area are equivalent to the pre-development flows.

By utilising the wetland constructed within the open space area on the site for stormwater detention, the proposed development can be designed and constructed in such a manner that ensures there will be no increase in runoff for all storm events up to and including the local catchment 100 year ARI event, without compromising the water quality of the site.

During the detailed design phase (for the construction certificate) the required storage volume for each catchment will be optimised in conjunction with the final determination of the outlet and bypass flow structures in an effort to find a solution that best suits the layout of the site.

3.2 External Catchments

As mentioned above, there is an existing external catchment area of approximately 14.8ha contributing from the eastern side of Fraser Drive (refer Cardno Figure No DA19, Appendix A). The runoff from this catchment currently enters the subject site via 900mm diameter culvert under Fraser Drive. In larger storm events where the runoff volume is greater than the capacity of the culvert, Fraser Drive acts as a weir with the flow building up until it flows across the road into the development site.

It is proposed to catch the runoff overtopping Fraser Drive, up to the local 100 year ARI event, before it enters the subject site using sufficiently sized inlet pits. It is proposed to convey the external flow from the eastern catchment through the subject site as shown on Figure No DA21. The external catchment runoff will then be discharged into the south-east corner of the existing SEPP 14 zone in a dispersed manner in order to prevent erosion and scouring caused by high velocities. The intent of this proposed external flow by-pass network is to reduce the catchment area contributing to the proposed northern water quality treatment area, which is to be constructed as part of the proposed development.

Stormwater runoff contributing from the other external catchment areas to the west of the subject site has been allowed for in the preliminary detention calculations discussed in section 3.1.

4.0 PROPOSED TREATMENT DEVICES

To comply with Part 5.5 of Council's *Tweed Urban Stormwater Quality Management Plan* and Part 7.11 of the *Development Design Specification D7-Stormwater Quality* a number of stormwater quality management measures are proposed to be incorporated into the development of the site. To assist in minimising the expected increase in suspended solids and nutrients discharging from the developed subject site it is proposed to install and construct a number of gross pollutant traps and a wetland area into some of the open space areas proposed on-site.

The stormwater treatment process for each catchment of the project is described below.

4.1 Stormwater Treatment Trains

The proposed stormwater runoff treatment trains for the different catchments of the site are as follows:

Northern Catchment

Gross Pollutant Trap / Trash Rack ⇒ Stormwater Wetland

Eastern Catchment

Proprietary Gross Pollutant Trap

Southern & South-Eastern Catchments

Roof Area Runoff ⇒ Inter Allotment Drainage
Surface Area Runoff ⇒ Vegetated Buffer Strips

4.2 Stormwater Treatment Devices

The correct design and implementation of the following stormwater treatment devices is 'deemed to comply' with the performance criteria and stormwater treatment objectives outlined in Council's *Tweed Urban Stormwater Quality Management Plan*.

Litter Baskets/Racks

Litter baskets and trash racks are generally located upstream of other treatment measures such as extended detention basins or constructed wetlands. They are primarily used as a pre-treatment device for stormwater runoff, removing litter, debris and other gross pollutants from the runoff before it discharges into other secondary and tertiary treatment devices located downstream. A trash rack is recommended for this site upstream of the proposed northern wetland. The trash rack/litter basket device will be sized to comply with the requirements outlined in Section 7.11-2.21 of Council's *Development Design Specification D7-Stormwater Quality*.

Gross Pollutant Traps

A proprietary Gross Pollutant Trap (GPT), capable of trapping oils and removing litter and sediment, will be used as the treatment device for pipe flows leaving the proposed eastern catchment area. This GPT device will be sized to have sufficient sediment and oil storage capacity to comply with the requirements outlined in Section 7.12.1 of Council's *Development Design Specification D7-Stormwater Quality*. As required by Council this GPT device will be designed to treat runoff generated by storm events up to the 3 month ARI event for the nominated catchment area.

Maintenance for these proprietary GPT units is generally minimal and will involve the periodic removal of the accumulated oils, litter and sediment. Typically this is done on a six monthly basis by the nominated maintenance staff.

Stormwater Wetlands

Stormwater wetlands are designed to help in the removal of sediments and nutrients from stormwater runoff. The slow movement of water through the wetland allows time for the sediments suspended in stormwater runoff to settle out, while macrophytes located within the wetland absorb the nutrients transported into the waterbody via the stormwater runoff.

Stormwater wetlands work most effectively when used in-conjunction with a pre-treatment device such as a trash rack or GPT provided upstream of the wetland to remove litter and trap oils.

Sections D7.9 and D7.11 and Table 7.11-WS of Council's *D7-Stormwater Quality* specification provide design criteria for the construction of wetlands. Provided that the stormwater wetlands are appropriately designed and constructed to meet these criteria then the wetlands are 'Deemed to Comply' with the performance criteria outlined in Part 5.5 of Council's *Tweed Urban Stormwater Quality Management Plan*.

Table 7.11-WS indicates that where no formal sedimentation or pre-treatment processes are installed, such as sedimentation basins, the total wetland surface area including deep water zone and macrophyte zone shall be a minimum of $500m^2$ per 1ha of urban development catchment area. This equates to 5% of the contributing development catchment area. Table 7.11-WS provides other pre-treatment processes that may be adopted within the development to assist in reducing the total wetland size.

Rainwater Tanks

Rainwater tanks can not only provide property owners with a low cost supply of water, but can also be used to assist in the reduction of peak flow rates from runoff events. However, as rainwater tanks are installed at a lot scale and become the responsibility of the property owner, incorporating these devices into the stormwater management scheme cannot be relied upon. Property owners in Part B of the development should be encouraged to install rainwater tanks to assist in complying with the Basix assessment set by the New South Wales Government. Water collected in the rainwater tanks can be re-used within the dwellings for outdoor water use, toilet flushing and/or laundry use.

For the proposed allotments where the roof drainage cannot be connected directly to the road drainage network, the concentrating of roof water runoff at a single discharge outlet can lead to erosion and scour problems. As roof water runoff is considered to be relatively 'clean' the roof water drainage should be connected directly to the proposed inter-allotment drainage network to minimise the potential for the runoff to become contaminated with general sediments and nutrients associated with surface runoff from other hardstand areas.

Vegetated Buffers / Filter Strips

Vegetated buffers / filter strips can be either areas of planted vegetation or strips of retained vegetation left in its natural state. These vegetated areas may provide an effective way of reducing peak flows and improving stormwater runoff quality.

During the construction phase of the development, including house construction, the retention of existing vegetation in-conjunction with other erosion control measures can help to stabilise exposed areas.

In the case of proposed housing allotments in Part B of the development that grade away from the road drainage network, buffer strips along the rear of the allotments are considered one of the key stormwater management techniques, particularly where no other stormwater treatment techniques are possible. Upon completion of the housing works, any exposed areas should be turfed, seeded or landscaped as soon as possible to reduce the risk of erosion.

5.0 STORMWATER MANAGEMENT – OPERATIONAL

Cardno Figure No DA21 shows details of the proposed stormwater system and treatment devices. The intent of the proposed systems is to minimise the impact of the development on the surrounding environment by the implementation of the element below.

Element 1: STORMWATER MANAGEMENT

Policy: To minimise the impact of the development on the water quality within external water bodies and protect the biological integrity of the aquatic ecosystem.

Performance Objectives: To avoid detrimental impact on the water quality and aquatic environment, as a result of the discharge of contaminated stormwater runoff.

To comply with the *Environmental Planning and Assessment Act* and with Tweed Shire Council's *Tweed Urban Stormwater Quality Management Plan* pollutant load objectives and Development Design Specification *D7-Stormwater Quality.*

Control Measures: All stormwater treatment devices should be sized to treat the 1 in 3 month rainfall event as required by Tweed Shire Council.

The proposed stormwater treatment trains for the different catchments of the site are as follows (for further descriptions refer to Section 4.0):

Northern Catchment

Gross Pollutant Trap / Trash Rack ⇒ Stormwater Wetland

Eastern Catchment

Proprietary Gross Pollutant Trap

Southern & South-Eastern Catchments

Roof Area Runoff ⇒ Inter allotment drainage
Surface Area Runoff ⇒ Vegetated Buffer Strips

A summary of the typical pollutant removal rates for the proposed treatment techniques is contained in Table 3.

TABLE 3 SUMMARY OF TREATMENT TECHNIQUES AND EFFECTIVENESS

TREATMENT TECHNIQUE	OBJECTIVE	POLLUTANT REMOVAL EFFICIENCY (1) (Source NSW EPA 1998 & Brisbane City Council Water Quality Management Guidelines 2000)		
		SS	TP	TN
Constructed Wetland	Reduce Peak Runoff - Treat SS, TN & TP	30-50%	30-50%	30-50%
In ground GPT's	Retain coarse sediment/litter	10-30%	10-30%	10-30%
Vegetated Buffer Strip	Reduce SS, TN & TP	30-50%	10-50%	10-50%

(1) Effectiveness rating subject to adequate design
SS Suspended Sediment
TN Total Nitrogen
TP Total phosphorous

Monitoring: A monitoring program will be established for the stormwater treatment devices as detailed below and in Tables 4, 5 and 6.

To maximise the effectiveness of the stormwater management measures within the steep slope areas of the proposed development the individual property owners should be encouraged to regularly visually monitoring the condition of the vegetated areas within their allotments.

Table 4 outlines a number of activities that the owners may choose to monitor regularly upon development of their property.

TABLE 4 MONITORING PROGRAM FOR VEGETATED BUFFER STRIPS

TIME FRAME (after construction)	MONITORING ACTIVITY	FREQUENCY
0-6 months	• Erosion/scour of buffer zones • Weed inundation/presence of litter • Vegetation density/health of vegetation • Inappropriate/excessive wear or damage	Monthly following the completion of the house construction.
> 6 months	• Erosion/scour of buffer zones • Weed inundation/presence of litter • Vegetation density/health of vegetation • Inappropriate/excessive wear or damage	As required

The property owner will be responsible for all monitoring activities associated with the operation of the vegetated buffer strips within their allotments.

TABLE 5 MONITORING PROGRAM FOR GROSS POLLUTANT TRAPS (GPTs)

TIME FRAME (after construction)	MONITORING ACTIVITY	FREQUENCY
0-6 months	• Discharge water quality	After major storm event
	• Debris/litter in trash rack, blockages in oil/grit separators	After major storm events and/or every 2 months
	• Structural condition/integrity of devices	Every 3 months
	• Removal efficiency of devices	Every 3 months
	• Gross pollutant/coarse sediment accumulation	Every 2 months
	• Odour within GPT	Every 2 months
	• Erosion downstream of GPT	Every 2 months
> 6 months	• Debris/litter in trash rack, blockages in oil/grit separators	After major storm events and/or every 3 months
	• Structural condition/integrity of devices	Annually
	• Gross pollutant/coarse sediment accumulation	Every 3 months
	• Odour within GPT	Every 3 months
	• Discharge water quality	Six monthly

The Developer will be responsible for all monitoring activities associated with the operation of the Gross Pollutant Traps (GPTs) during the maintenance period, with the Council responsible for all monitoring following the maintenance period.

TABLE 6 MONITORING PROGRAM FOR STORMWATER WETPONDS/WETLANDS

TIME FRAME (after construction)	MONITORING ACTIVITY	FREQUENCY
0-6 months	• Basin/discharge water quality	Monthly, following storm events > 25mm in 24 hours
	• Sediment accumulation	6 months
	• Vegetation condition	Monthly
	• Weed invasion	Monthly
	• Algal growth	Monthly
	• Erosion/scour of pond banks, at inlet and outlet structures	Monthly
> 6 months	• Basin/discharge water quality	Monthly, following storm events > 25mm in 24 hours
	• Sediment accumulation	6 months
	• Vegetation condition	Monthly
	• Weed invasion	Monthly
	• Algal growth	Monthly
	• Erosion/scour of pond banks, at inlet and outlet structures	Monthly

The Developer will be responsible for all monitoring activities associated with the operation of the Stormwater Wetpond/Wetland during the maintenance period, with the Council responsible for all monitoring following the maintenance period.

Maintenance: The on-going performance of the treatment devices will be dependent on the maintenance conducted.

The maintenance programs detailed below and in Tables 7, 8 and 9 are to be implemented for the stormwater treatment devices.

TABLE 7 MAINTENANCE PROGRAM FOR VEGETATED BUFFER STRIPS

TIME FRAME (after construction)	MAINTENANCE ACTIVITY	FREQUENCY
0-6 months	• Irrigating (dependent on Council restrictions)	As required by monitoring
	• Erosion/scour repairs	
	• Infilling of vegetation to maintain sufficient cover	
	• Removal of weeds and accumulated litter and sediments	
> 6 months	• Irrigating (dependent on Council restrictions)	As required by monitoring
	• Erosion/scour repairs	
	• Infilling of vegetation to maintain sufficient cover	
	• Removal of weeds and accumulated litter and sediments	

The maintenance program detailed in Table 7 outlines a number of maintenance activities that the property owners within the steep slope areas should be encouraged to undertake to ensure the effective performance of the vegetated area within their property. Any maintenance works required on any level spreader devices should be undertaken by a suitably qualified technician.

All maintenance activities associated with the operation of the vegetated buffers shall be the responsibility of the property owner.

TABLE 8 MAINTENANCE PROGRAM FOR GROSS POLLUTANT TRAPS (GPTs)

TIME FRAME (after construction)	MAINTENANCE ACTIVITY	FREQUENCY
0-6 months	• Clean out device	Every 2 months, as required by monitoring
	• Remove sediment/litter/oils from device	
>6 months	• Clean out device	Every 3 months, as required by monitoring
	• Remove sediment/litter/oils from device	

The Developer will be responsible for all maintenance activities associated with the operation of the Gross Pollutant Traps (GPTs) during the first six months of operation (0-6 months). After this period Council will be responsible for the maintenance and operation of the devices.

TABLE 9 MAINTENANCE PROGRAM FOR STORMWATER WETPONDS/WETLANDS

TIME FRAME (after construction)	MAINTENANCE ACTIVITY	FREQUENCY
0-6 months	• Removal of built up sediments	As required by monitoring.
	• Check for erosion/scour of pond banks	
	• Removal of weeds and litter	
> 6 months	• Removal of built up sediments	As required by monitoring.
	• Check for erosion/scour of pond banks	
	• Removal of weeds and litter	

The Developer will be responsible for all maintenance activities associated with the operation of the Stormwater Wetpond/Wetland during the first six months of operation (0-6 months). After this period Council will be responsible for the maintenance and operation of the wetpond/wetland.

Reporting: At the completion of the maintenance period, the Developer shall prepare a report to Council on the performance of the stormwater treatment devices located within the development site based on the monitoring undertaken.

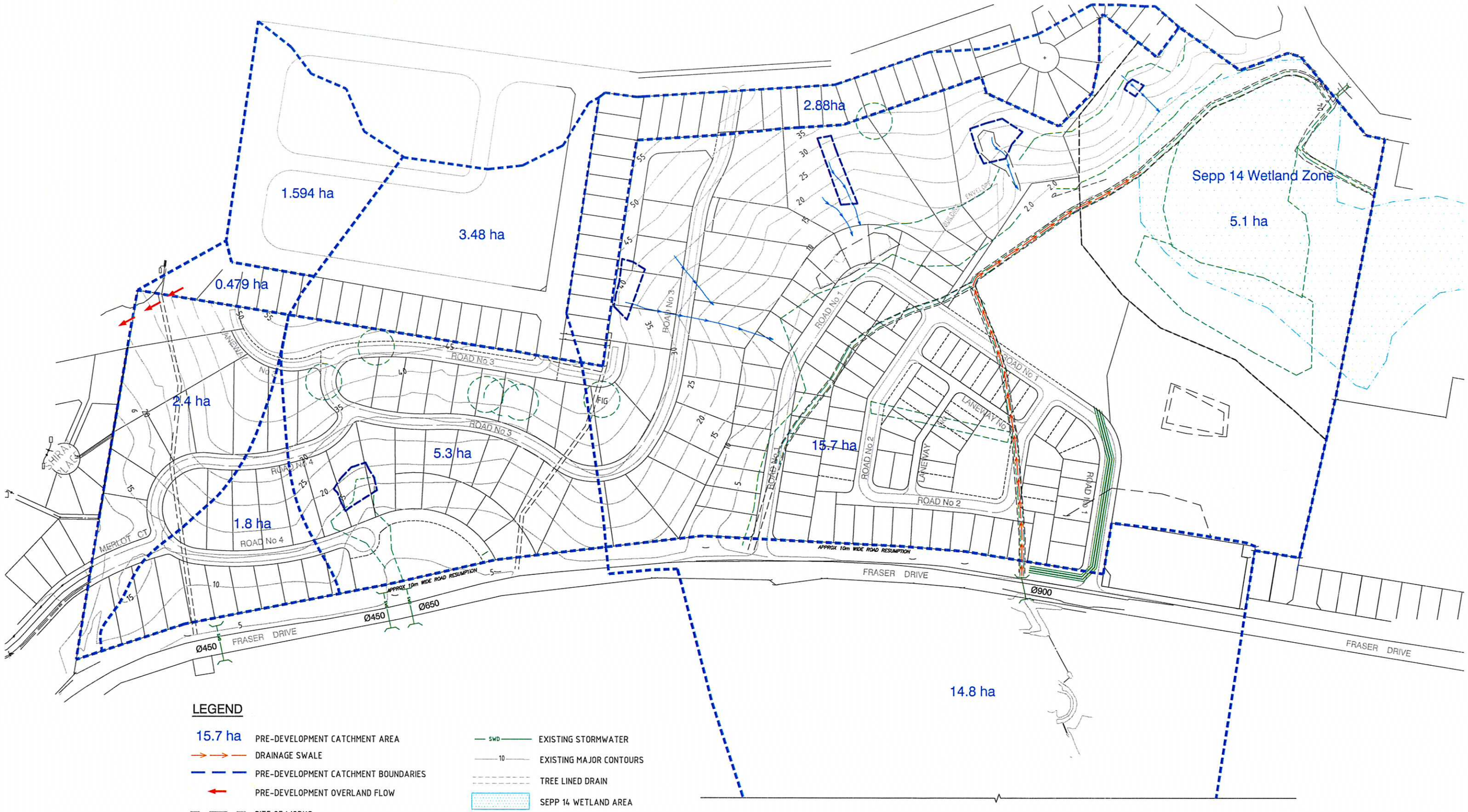
The Contractor shall notify the Developer of system failure, any incidences of non-compliance and corrective actions implemented during the maintenance period, with Tweed Shire Council to be notified of any significant failures during the maintenance period.

Corrective Action: When water quality objectives are not met investigation into cause and source of pollutants is to be carried out and remedial action taken.

APPENDIX A

DRAWINGS & FIGURES

Cardno Figure No DA19	Pre-development Stormwater Network
Cardno Figure No DA20	Post-development Stormwater Network
Cardno Figure No DA21	Proposed Stormwater Drainage Network



LEGEND

15.7 ha	PRE-DEVELOPMENT CATCHMENT AREA
	DRAINAGE SWALE
	PRE-DEVELOPMENT CATCHMENT BOUNDARIES
	PRE-DEVELOPMENT OVERLAND FLOW
	SITE OF WORKS
	EXISTING TREE AND DESCRIPTION
SWD	EXISTING STORMWATER
10	EXISTING MAJOR CONTOURS
	TREE LINED DRAIN
	SEPP 14 WETLAND AREA
	SEPP 14 BUFFER LINE
	EXISTING NATURAL WATERCOURSE

0 50 100 150m
SCALE BEFORE REDUCTION 1 : 1500

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VILLLA WORLD LIMITED

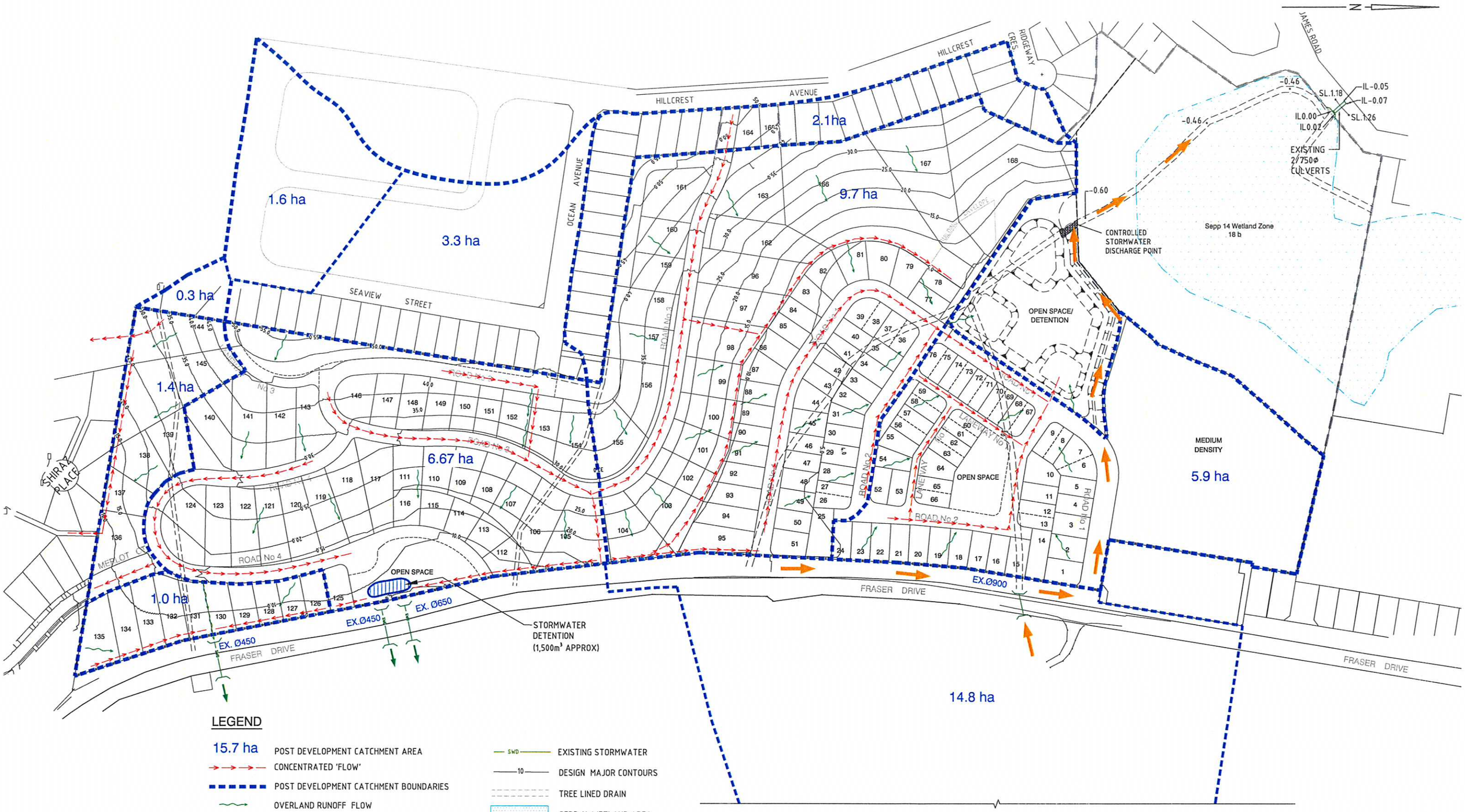
LOT 9 DP 1039569 & Part LOT 2 DP 1000385
FRASER DRIVE, SOUTH TWEED HEADS
FRASER DRIVE, SOUTH TWEED HEADS

ENGINEERING REPORT

SCALE :- 1 : 1500 A1
DATE :- 8 DECEMBER 2006 Rev.
DRAWING No.
7214/29/01-DA19

FIGURE No.DA 19

PRE DEVELOPMENT
STORMWATER NETWORK



LEGEND

15.7 ha	POST DEVELOPMENT CATCHMENT AREA
→→→	CONCENTRATED 'FLOW'
▬▬▬	POST DEVELOPMENT CATCHMENT BOUNDARIES
~~	OVERLAND RUNOFF FLOW
➡	EXTERNAL EASTERN CATCHMENT DIVERTED FLOW.
▬ ▬ ▬	SITE OF WORKS
SWD	EXISTING STORMWATER
10	DESIGN MAJOR CONTOURS
- - - -	TREE LINED DRAIN
	SEPP 14 WETLAND AREA
▬▬▬	SEPP 14 BUFFER LINE

0 50 100 150m
SCALE BEFORE REDUCTION 1 : 1500

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VILLLA WORLD LIMITED

LOT 9 DP 1039569 & Part LOT 2 DP 1000385
FRASER DRIVE, SOUTH TWEED HEADS
FRASER DRIVE, SOUTH TWEED HEADS

ENGINEERING REPORT

SCALE :- 1 : 1500 A1
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DRAWING No. 7214/29/01-DA20

FIGURE No.DA 20

POST DEVELOPMENT STORMWATER NETWORK

N

HILLCREST AVENUE

HILLCREST

RIDGEWAY CRES.

JAMES ROAD

OCEAN AVENUE

SEAVIEW STREET

Sepp 14 Wetland Zone
18 b

OPEN SPACE/
DETENTION

MEDIUM
DENSITY

ROAD No 3

ROAD No 1

ROAD No 2

ROAD No 4

LANEWAY No 3

LANEWAY No 1

LANEWAY No 2

LANEWAY

OPEN SPACE

SHIRAZ PLACE

MERLOT CT

APPROX 10m WIDE ROAD RESUMPTION

APPROX 15m WIDE ROAD RESUMPTION

FRASER DRIVE

EX.Ø450

EX.Ø600

EX.Ø900

PROPOSED Q 100
INLET STRUCTURES

PROPOSED FUTURE
ROAD RESERVE

LEGEND

- PROPOSED STORMWATER
- PROPOSED STORMWATER GULLY PIT
- SWD — EXISTING STORMWATER ROAD CULVERTS
- SITE OF WORKS
- 15.0 — DESIGN MAJOR CONTOURS
- TREE LINED DRAIN
- SEPP 14 AREA
- SEPP 14 BUFFER LINE
- PROPOSED ROAD LAYOUT

NOTE:

THE SERVICES INFORMATION SHOWN ON THIS DRAWING HAS BEEN DERIVED FROM THE FOLLOWING SOURCES: SURFACE LOCATIONS OF SERVICES LOCATED BY THE SURVEYOR PLAN DATA PROVIDED BY SERVICE AUTHORITIES THE CONTRACTOR OR CONSTRUCTION AUTHORITY IS TO CONFIRM THE ACTUAL LOCATIONS OF ALL EXISTING UNDERGROUND SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION WORKS

0 50 100 150m
SCALE BEFORE REDUCTION 1 : 1500

CAD FILE NAME: G:\7214\29\01\DA_Figures\72142901_DA21.dwg

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VILLLA WORLD LIMITED

LOT 9 DP 1039569 & Part LOT 2 DP 1000385
FRASER DRIVE, SOUTH TWEED HEADS

FRASER DRIVE, SOUTH TWEED HEADS

ENGINEERING REPORT

SCALE :- 1 : 1500 | A1
DATE :- 8 DECEMBER 2006 | Rev.
DRAWING No. 7214/29/01-DA21

FIGURE No.DA21

PROPOSED STORMWATER
DRAINAGE NETWORK

APPENDIX B

DETENTION VOLUME CALCULATIONS

Eastern Catchment - 5 year ARI flow

Existing Case

Low Density Urban Dev (Ext)			Open Space (Int)		
Area	3.5	ha	Area	5.3	ha
(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)		
C_{10}	0.78		C_{10}	0.70	
F_5xC_{10}	0.72		F_5xC_{10}	0.64	
C_5	0.72		C_5	0.64	
Time of conc	8	mins	Time of conc	8	mins
Intensity	170	mm/h	Intensity	170	mm/h
Flow	1.19	m^3/s	Flow	1.61	m^3/s
Total Flow	2.80	m^3/s			
Volume	1343.0	m^3			

Developed Case

Low Density Urban Dev (Ext)			Low Density Urban Dev (Int)		
Area	3.3	ha	Area	6.7	ha
(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)		
C_{10}	0.78		C_{10}	0.76	
F_5xC_{10}	0.72		F_5xC_{10}	0.70	
C_5	0.72		C_5	0.70	
Time of conc	8	mins	Time of conc	8	mins
Intensity	170	mm/h	Intensity	170	mm/h
Flow	1.12	m^3/s	Flow	2.21	m^3/s
Total Flow	3.33	m^3/s			
Volume	1598.6	m^3			

Detention Basin Sizing (preliminary)

Peak inflow	3.33	m^3/s
Peak outflow	2.80	m^3/s
Volume	2131.49	m^3
r	0.16	

Required storage volume

Culp	Boyd	Carroll	Basha	Average
149.97	340.88	161.90	245.43	224.55

Applying factor of safety 2

Required volume is - 449 m^3.

Assuming a rectangular basin with 1 in 4 side slopes
and maximum depth of 1.0 metres, required surface area is.....

Depth (m)	Length (m)	Width (m)	Area (m^2)	Volume (m^3)
0.0	52.0	13.0	676.0	
1.0	60.0	21.0	1260.0	968.0

Stormwater Detention Calculations
Fraser Drive, Tweed Heads South
Job No.: 7214/29-1

Eastern Catchment - 100 year ARI flow

Existing Case

Low Density Urban Dev (Ext)		Open Space (Int)	
Area	3.5 ha	Area	5.3 ha
(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)	
C_{10}	0.78	C_{10}	0.70
$F_{100}xC_{10}$	1.00	$F_{100}xC_{10}$	0.90
C_{100}	1.00	C_{100}	0.90
Time of conc	8 mins	Time of conc	8 mins
Intensity	260 mm/h	Intensity	260 mm/h
Flow	2.52 m^3/s	Flow	3.43 m^3/s
Total Flow	5.95 m^3/s		
Volume	2857.6 m^3		

Developed Case

Low Density Urban Dev (Ext)		Low Density Urban Dev (Int)	
Area	3.3 ha	Area	6.7 ha
(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)	
C_{10}	0.78	C_{10}	0.76
$F_{100}xC_{10}$	1.00	$F_{100}xC_{10}$	0.97
C_{100}	1.00	C_{100}	0.97
Time of conc	8 mins	Time of conc	8 mins
Intensity	260 mm/h	Intensity	260 mm/h
Flow	2.38 m^3/s	Flow	4.71 m^3/s
Total Flow	7.09 m^3/s		
Volume	3401.7 m^3		

Detention Basin Sizing (preliminary)

Peak inflow	7.09 m^3/s
Peak outflow	5.95 m^3/s
Volume	4535.55 m^3
r	0.16

Required storage volume

Culp	Boyd	Carroll	Basha	Average
319.12	725.36	344.51	522.24	477.81

Applying factor of safety 2

Required volume is - 956 m^3.

Assuming a rectangular basin with 1 in 4 side slopes
and maximum depth of 1.0 metres, required surface area is.....

Depth (m)	Length (m)	Width (m)	Area (m^2)	Volume (m^3)
0.0	52.0	13.0	676.0	
1.0	60.0	21.0	1260.0	968.0

Stormwater Detention Calculations
Fraser Drive, Tweed Heads South
Job No.: 7214/29-1

Cardno

Northern Catchment - 5 year ARI flow

Existing Case

Low Density Urban Dev (Ext)		Rural Res (Ext)		Open Space (Int)	
Area	2.0 ha	Area	15.2 ha	Area	17.5 ha
(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)	
C_{10}	0.78	C_{10}	0.71	C_{10}	0.70
F_5xC_{10}	0.72	F_5xC_{10}	0.65	F_5xC_{10}	0.64
C_5	0.72	C_5	0.65	C_5	0.64
Time of conc	53 mins	Time of conc	53 mins	Time of conc	53 mins
Intensity	71.1 mm/h	Intensity	71.1 mm/h	Intensity	71.1 mm/h
Flow	0.28 m^3/s	Flow	1.96 m^3/s	Flow	2.23 m^3/s
Total Flow	4.47 m^3/s				
Volume	14215.2 m^3				

Developed Case

Low Density Urban Dev (Ext)		Rural Res (Ext)		Medium Density Urban Dev (Int)		Low Density Urban Dev (Int)		Low Density Urban Dev (Int)		Open Space (Int)	
Area	2.1 ha	Area	10.8 ha	Area	2.5 ha	Area	6.6 ha	Area	6.4 ha	Area	1.5 ha
(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)	
C_{10}	0.78	C_{10}	0.71	C_{10}	0.82	C_{10}	0.76	C_{10}	0.78	C_{10}	0.70
F_5xC_{10}	0.72	F_5xC_{10}	0.65	F_5xC	0.75	F_5xC	0.70	F_5xC	0.72	F_5xC	0.64
C_5	0.72	C_5	0.65	C_5	0.75	C_5	0.70	C_5	0.72	C_5	0.64
Time of conc	15.5 mins	Time of co	15.5 mins	Tim	15.5 mins	Time	15.5 mins	Time	15.5 mins	Time	15.5 mins
Intensity	131.5 mm/h	Intensity	131.5 mm/h	Inte	131.5 mm/h	Inter	131.5 mm/h	Inter	131.5 mm/h	Inter	131.5 mm/h
Flow	0.55 m^3/s	Flow	2.58 m^3/s	Flov	0.69 m^3/s	Flow	1.69 m^3/s	Flow	1.68 m^3/s	Flow	0.35 m^3/s
Total Flow	7.53 m^3/s										
Volume	7005.1 m^3										

Detention Basin Sizing (preliminary)

Peak inflow	7.53	m^3/s
Peak outflow	4.47	m^3/s
Volume	9340.11	m^3
r	0.41	

Required storage volume

Culp	Boyd	Carroll	Basha	Average
2294.79	3797.09	2388.69	3045.94	2881.63

Applying factor of safety 2

Required volume is - 5763 m^3.

Assuming a rectangular basin with 1 in 4 side slopes
and maximum depth of 1.5 metres, required surface area is.....

Depth (m)	Length (m)	Width (m)	Area (m^2)	Volume (m^3)
0.0	77.0	88.0	6776.0	
1.5	89.0	100.0	8900.0	11757.0

Stormwater Detention Calculations
Fraser Drive, Tweed Heads South
Job No.: 7214/29-1

Cardno

Northern Catchment - 100 year ARI flow

Existing Case

Low Density Urban Dev (Ext)			Rural Res (Ext)			Open Space (Int)		
Area	2.0	ha	Area	15.2	ha	Area	17.5	ha
(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)		
C_{10}	0.78		C_{10}	0.71		C_{10}	0.70	
$F_{100}xC_{10}$	1.00		$F_{100}xC_{10}$	0.91		$F_{100}xC_{10}$	0.90	
C_{100}	1.00		C_{100}	0.91		C_{100}	0.90	
Time of conc	53	mins	Time of conc	53	mins	Time of conc	53	mins
Intensity	112.8	mm/h	Intensity	112.8	mm/h	Intensity	112.8	mm/h
Flow	0.63	m^3/s	Flow	4.33	m^3/s	Flow	4.91	m^3/s
Total Flow	9.87	m^3/s						
Volume	31377.2	m^3						

Developed Case

Low Density Urban Dev (Ext)			Rural Res (Ext)			Medium Density Urban Dev (Int)			Low Density Urban Dev (Int)			Low Density Urban Dev (Int)			Open Space (Int)		
Area	2.1	ha	Area	10.8	ha	Area	2.5	ha	Area	6.6	ha	Area	6.4	ha	Area	1.5	ha
(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)			(using QUDM Table 5.04.2)		
C_{10}	0.78		C_{10}	0.71		C_{10}	0.82		C_{10}	0.76		C_{10}	0.78		C_{10}	0.70	
$F_{100}xC_{10}$	1.00		$F_{100}xC_{10}$	0.91		$F_{100}xC_{10}$	1.05		$F_{100}xC_{10}$	0.97		$F_{100}xC_{10}$	1.00		$F_{100}xC_{10}$	0.90	
C_{100}	1.00		C_{100}	0.91		C_{100}	1.00		C_{100}	0.97		C_{100}	1.00		C_{100}	0.90	
Time of conc	15.5	mins	Time of co	15.5	mins	Time of co	15.5	mins	Time of co	15.5	mins	Time of co	15.5	mins	Time of co	15.5	mins
Intensity	203.6	mm/h	Intensity	203.6	mm/h	Intensity	203.6	mm/h	Intensity	203.6	mm/h	Intensity	203.6	mm/h	Intensity	203.6	mm/h
Flow	1.19	m^3/s	Flow	5.55	m^3/s	Flow	1.41	m^3/s	Flow	3.63	m^3/s	Flow	3.61	m^3/s	Flow	0.76	m^3/s
Total Flow	16.16	m^3/s															
Volume	15024.7	m^3															

Detention Basin Sizing (preliminary)

Peak inflow	16.16	m^3/s
Peak outflow	9.87	m^3/s
Volume	20032.96	m^3
r	0.39	

Required storage volume

Culp	Boyd	Carroll	Basha	Average
4622.81	7797.83	4821.25	6210.32	5863.05

Applying factor of safety 2

Required volume is -	11726 m^3.

Assuming a rectangular basin with 1 in 4 side slopes
and maximum depth of 1.5 metres, required surface area is.....

Depth (m)	Length (m)	Width (m)	Area (m^2)	Volume (m^3)
0.0	77.0	88.0	6776.0	
1.5	89.0	100.0	8900.0	11757.0

Appendix 14

Traffic Report

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Gordon NSW 2072
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Wollongong NSW 2520
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Fraser Drive Residential Development

Prepared for
Villa World Ltd

December 2006

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3.1 Weekday Traffic Generation Rates
4.1 Forecast Intersection Performance (DOS)

FIGURES

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2.1 2006 Existing Traffic Volumes
3.1 Fraser Drive Development Traffic Volumes
4.1 2008 Background Traffic Volumes
4.2 2018 Background Traffic Volumes
4.3 2008 Background Traffic Volumes + Fraser Drive Development
4.4 2018 Background Traffic Volumes + Fraser Drive Development

APPENDICES

A Traffic Count Surveys
B aaSIDRA Analysis Summaries

1.0 INTRODUCTION

Cardno Eppell Olsen has been commissioned by Villaworld Ltd to prepare a traffic assessment for a proposed residential development on Frasier Drive at Tweed Heads South (New South Wales). It is understood that this assessment will form part of an application to Tweed Shire Council seeking a permit for development of the subject site. The development site is depicted on Figure 1.1 of this report and is described as Lot 9 on DP1039569 and part lot 2 DP1000385. The site is bound by Frasier Drive to the east, Hillcrest Avenue to the west, Acacia Street to the north, and existing residential development known as Vintage Lakes to the south.

The development proposal involves construction of residential dwelling of varying densities across the site.

This report addresses the traffic and transport matters relevant to the development site and includes:

- existing traffic operations;
- future traffic operations with and without development of the site;
- required transport infrastructure upgrades attributable to the development;
- parking demand and provisions;
- pedestrian and cycle connectivity and facilities; and
- public transport.

Cardno Eppell Olsen

Drawing Title: Site Locality Plan

Figure No:1

Date: 01.11.06

Project No: 7214/29

C:\CK Shared Artwork Folder\7214_2p map base\7214_29_ map base_July 06.cdr

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Image © 2006 NASA
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2.0 EXISTING SITUATION

2.1 Development Site

As discussed earlier herein and presented in Figure 1.1, the development site consists of currently undeveloped land which is surrounded by existing low to medium density residential lands. It is understood that the site is one of the last remaining undeveloped land parcels in the area.

2.2 Existing Road Network

Fraser Drive, immediately east of the proposed development, provides a north-south connection within the Tweed Heads South area. According to the road hierarchy prescribed by Tweed Shire Council planning documents, Fraser Drive has an Urban Distributor function. This definition provides guidance on the intended function of Fraser Drive, which is principally a traffic carrying route. Along the development site frontage, this road has a rural cross section comprising two trafficable lanes (approximate width 3.5m) plus 1m wide unsealed shoulders on both sides. Fraser Drive, in this section is currently posted at a speed of 80kph. Existing daily traffic volumes (AADT) are in order of 5,000 vehicles per day.

West of the site, Hillcrest Avenue is defined as Urban Local Road and has a principal function of providing property access. Volumes on Hillcrest Avenue are currently in the order of 1,000 vehicles per day.

The following surrounding intersections have been determined to be within the scope of influence of the subject development traffic and therefore have been assessed herein:

- Fraser Drive/Acacia Street unsignalised t-intersection;
- Fraser Drive/Pioneer Country Access unsignalised t-intersection;
- Fraser Drive/Vintage Lakes Drive four way roundabout;
- Vintage Lakes Drive/Merlot Drive four way roundabout; and
- Hillcrest Avenue/Ocean Avenue unsignalised t-intersection.

2.3 Existing Traffic Demands

Existing traffic demands on the affected parts of the road and street network have been determined based upon manual turning movement surveys undertaken at the following intersection locations:

- Fraser Drive/Acacia Street;
- Fraser Drive/Pioneer Country Access;
- Fraser Drive/Vintage Lakes Drive;

- Vintage Lakes Drive/Merlot Drive; and
- Hillcrest Avenue/Ocean Avenue.

The above surveys were conducted by Australasian Traffic Surveys on 22 November 2006 during the AM period (6:30am to 9:30am) and the PM peak period (3:00pm to 6:00pm). In addition, an automatic traffic count was conducted on Fraser Drive from 21 November 2006 to 27 November 2006 at a location approximately 60m south of the Pioneer Country Access. Complete copies of the traffic counts are provided at Appendix A and are summarised on Figure 2.1.

It is important to note that the surveyed traffic demands include trips that are currently being generated by existing development on the subject site.

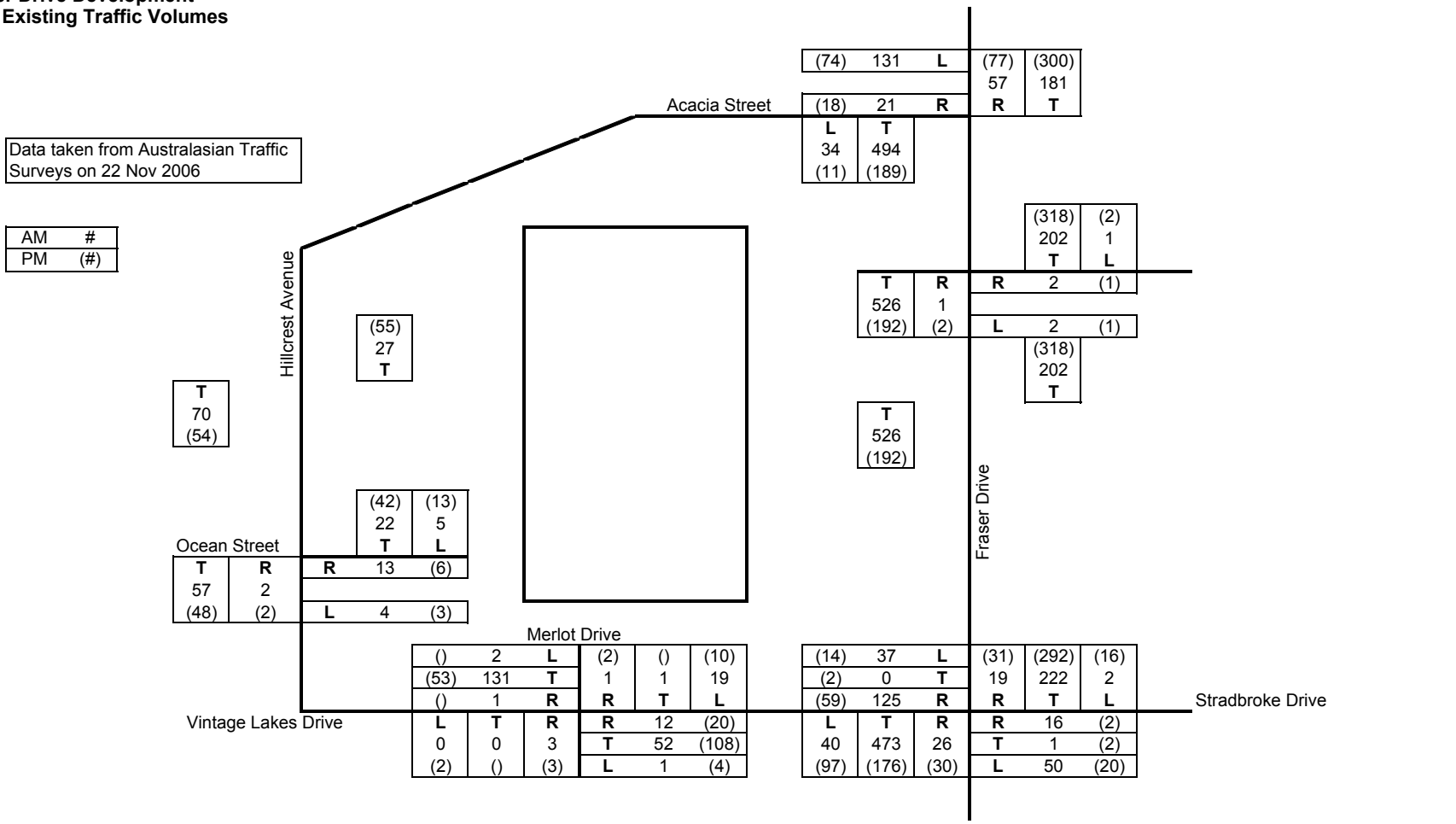
2.4 Existing Traffic Operations

The operating performance of the subject intersections has been analysed using the computer software package aaSIDRA. This analysis bases its performance evaluation on the degree of saturation (DOS) during the measured traffic peak hour. The intersection DOS represents a ratio of the measured traffic demand over the theoretical capacity for the intersection. The accepted practical DOS thresholds vary depending upon the intersection type or form. When the reported DOS is lower then the threshold limits, the intersection is considered to be operating within capacity and no upgrading works are needed. However, a DOS result that is above the identified threshold suggests that intersection upgrading may be required.

The accepted DOS thresholds for each intersection form (type) adopted for this study are as follows:

- unsignalised intersection 0.80 (80%);
- roundabout 0.85 (85%);
- signalised Intersection 0.95 (95%).

Fraser Drive Development
2006 Existing Traffic Volumes



Cardno Eppell Olsen

2006 Existing Traffic Volumes

FIGURE No: 2.1
PROJECT No: 721429
DATE: 6/12/2006

Table 2.1 below presents the results of the existing year (2006) performance analysis.

Table 2.1 ***Existing Intersection Performance (DOS)***

Intersection	Intersection Type	DOS Benchmark	AM DOS	PM DOS
Fraser Drive/ Acacia Road	Unsignalised	80%	30%	23%
Fraser Drive/ Vintage Lakes Drive	Roundabout	85%	19%	13%
Vintage Lakes Drive/ Merlot Drive	Roundabout	85%	10%	8%
Hillcrest Avenue/ Ocean Avenue	Unsignalised	80%	4%	3%

As shown in the table above, all intersections within the study area currently operate within desirable capacity limits. A summary of the existing condition aaSIDRA results, (Table S.14 extracted from aaSIDRA) and intersection geometry are presented at Appendix B.

3.0 FRASER DRIVE DEVELOPMENT

3.1 Development Masterplan

The proposed development layout is depicted on PMM Plan Number 20934-4. The development will incorporate a range of dwelling densities including:

- 50 medium density dwellings;
- 136 detached residential allotments; and
- 32 duplex houses.

3.2 Development Access

The development layout plan illustrates a total of five road/street connections between the development and the surrounding network which are described below.

- Access A – will be the major all movement access located on Fraser Drive at the north-eastern corner of this site;
- Access B – accesses Fraser Drive via a left in left out arrangement;
- Access C – local street connection to Ocean Avenue;
- Access D – local street connection to Hillcrest Avenue on the western periphery of the development ;
- Access E – local street connection as an extension to Merlot Drive at the southern end of the development.

3.2.1 Fraser Drive Northern Access (Access A)

The northern access on Fraser Drive will, it is understood, provide the principal access and connection point between the development and the external road network. The access will be located directly opposite the existing Pioneer Homestead access driveway. Fraser Drive, at this location, comprises a two lane road cross section with each lane being approximately 3.5m wide plus a 1m unsealed shoulder on both sides. Fraser Drive is posted at 60kph north of this point and 80kph south of this point. The available sight distances at this location in terms of both vertical and horizontal distance are adequate for an 80kph design speed, however minor works will be required to ensure that vegetation and earthwork obstructions do not affect the sight lines north and south on Fraser Drive.

It is understood that Tweed Shire Council has indicated a preference to align this access with the Pioneer Homestead access to create a four way signalised intersection.

3.2.2 Fraser Drive (Access B)

This access provides a secondary connection to Fraser Drive to alleviate traffic demands at the main entry point and to allow improved accessibility for the northern section of the development. It is recommended that this access be located approximately 300m south of the main Fraser Drive access (Access A) which positions it just north and opposite an existing residential property access.

Fraser Drive, in this section, again comprises a two lane cross section with 3.5m width lanes and 1m unsealed shoulders. The available sight distance to both northbound and southbound traffic is approximately 200m, which for an 80kph posted speed meets the required standards.

It is considered that this access should be limited to left in/left out movements only as a result of the proximity of this intersection to the main access intersection on Fraser Drive. It is noted that Council officers have confirmed that an intersection in this location would have to be signalised should an all movement's access be pursued. Local widening is required in the vicinity of this access to accommodate both left turn deceleration and acceleration lanes.

3.2.3 Ocean Avenue Connection (Access C)

This access would join to the existing termination of Ocean Avenue. No formal intersection is therefore required however consideration regarding any upgrading of affected adjacent intersections would be required to ensure safe traffic movements onto the surrounding road network.

Sight distance constraints exist at the Hillcrest Avenue/Ocean Avenue intersection, particularly for movements into and out of Ocean Avenue where the available sight distance is about 40m. Amelioratory works will need to be considered for this intersection prior to the imposition of additional development traffic demands.

3.2.4 Hillcrest Avenue (Access D)

This access would be located on the western side of the development where grades for both the development and the existing road network are relatively steep. It is understood that this access would connect to Hillcrest Avenue via an undeveloped piece of land intersecting just south of Lakeview Parade. The speed environment is 50km/h along Hillcrest Avenue.

Again the major constraint to this access location is the road geometry. To the south there is limited sight distance for vehicles turning right into or out of the site. The sight distance to the north is adequate therefore a left turn in and out of the development can be achieved.

It is noted on site investigations it was found that there are no driveways located on both sides of the road within 25m north and 30m south of this proposed access location.

3.2.5 Merlot Court Connection (Access E)

The fifth access provides a connection between the southern sections of the development and Merlot Drive, which is an existing residential access street. Merlot Street is defined by Tweed Shire Council as an Access Street and has an existing road width of around 8.0m. The dwelling catchment capacity for Access Streets is normally accepted as being a maximum of approximately 75 allotments. Existing development within Merlot Drive amounts to around 50 allotments and therefore, should a connection be pursued to this development, the design should encourage use by no more than approximately 25 allotments from the proposed subdivision.

3.3 Traffic Generation and Distribution

Traffic generation for this proposed development has been estimated generally in accordance with rates documented in the RTA Guide to Traffic Generating Developments. The traffic directional splits have been based upon commonly used best practice assumptions. The characteristics adopted are presented in Table 3.1.

Table 3.1 ***Weekday Traffic Generation Rates***

Land Use	Trip Basis	Traffic Generation Rates		AM Split		PM Split	
		AM Peak Hour	PM Peak Hour	% IN	% OUT	% IN	% OUT
Detached residential allotments	trips per dwelling	1.0	1.0	25%	75%	67%	33%
Duplex housing	trips per dwelling	0.8	0.8	25%	75%	67%	33%

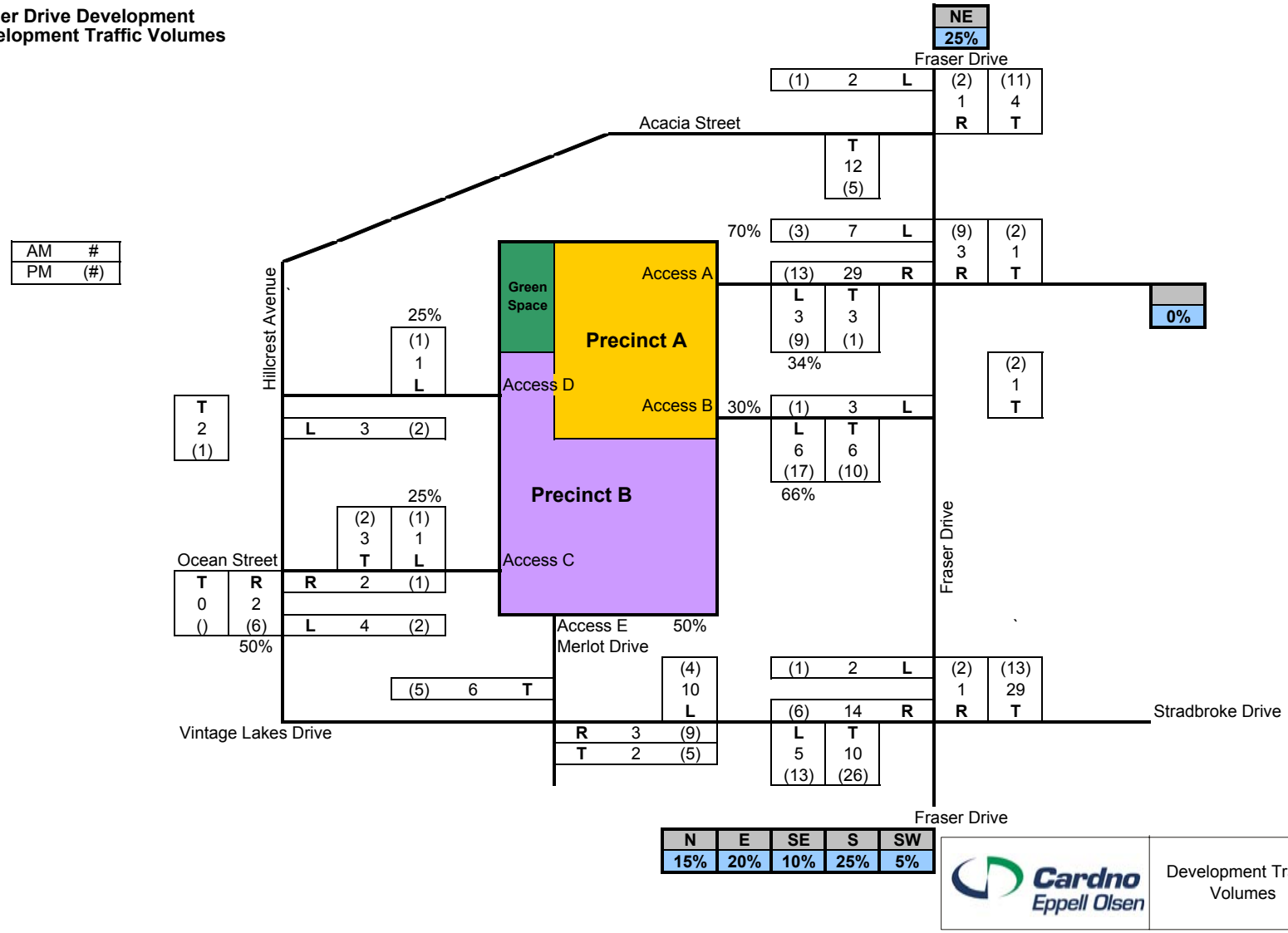
Based on the trip rates shown above and the previously discussed development yields, the Fraser Drive development is estimated to generate approximately 208 trips (52 in/156 out) during the weekday AM peak hour and 208 trips (139 in/69 out) during the weekday PM peak hour.

The trip distribution adopted for the assignment of the development generated traffic is as follows:

- 15% North to Gold Coast, M1 – via Leisure Drive;
- 25% North East to Coolangatta and Tweed Heads – via Dry Dock Road;
- 20% East to local streets within Tweed Heads South – via Leisure Drive;
- 10% South East to Kingscliff, via Leisure Drive;
- 25% South to Ballina, Pacific Hwy – via Leisure Drive;
- 5% South West to Terranora local streets - via Fraser Drive;

From the traffic generation and trip distribution assumptions above total traffic volumes by this development are calculated and shown on Figure 3.1.

Fraser Drive Development
Development Traffic Volumes



Cardno Eppell Olsen

Development Traffic Volumes

FIGURE No: 3.1
PROJECT No: 721429
DAT 6/12/2006

4.0 FUTURE TRAFFIC CONDITIONS

Future traffic conditions have been analysed for year 2008 which is the anticipated development completion (year that traffic is loaded on the surrounding road network) year and for the year 2018 being the ten year design horizon (assessment of 2018 is a requirement of the RTA). For each of the two design years, analysis of with and without development scenarios has been undertaken.

4.1 Background Traffic

The background traffic volumes in this area utilise the existing traffic count surveys and apply a growth rate to project volumes for the two design years.

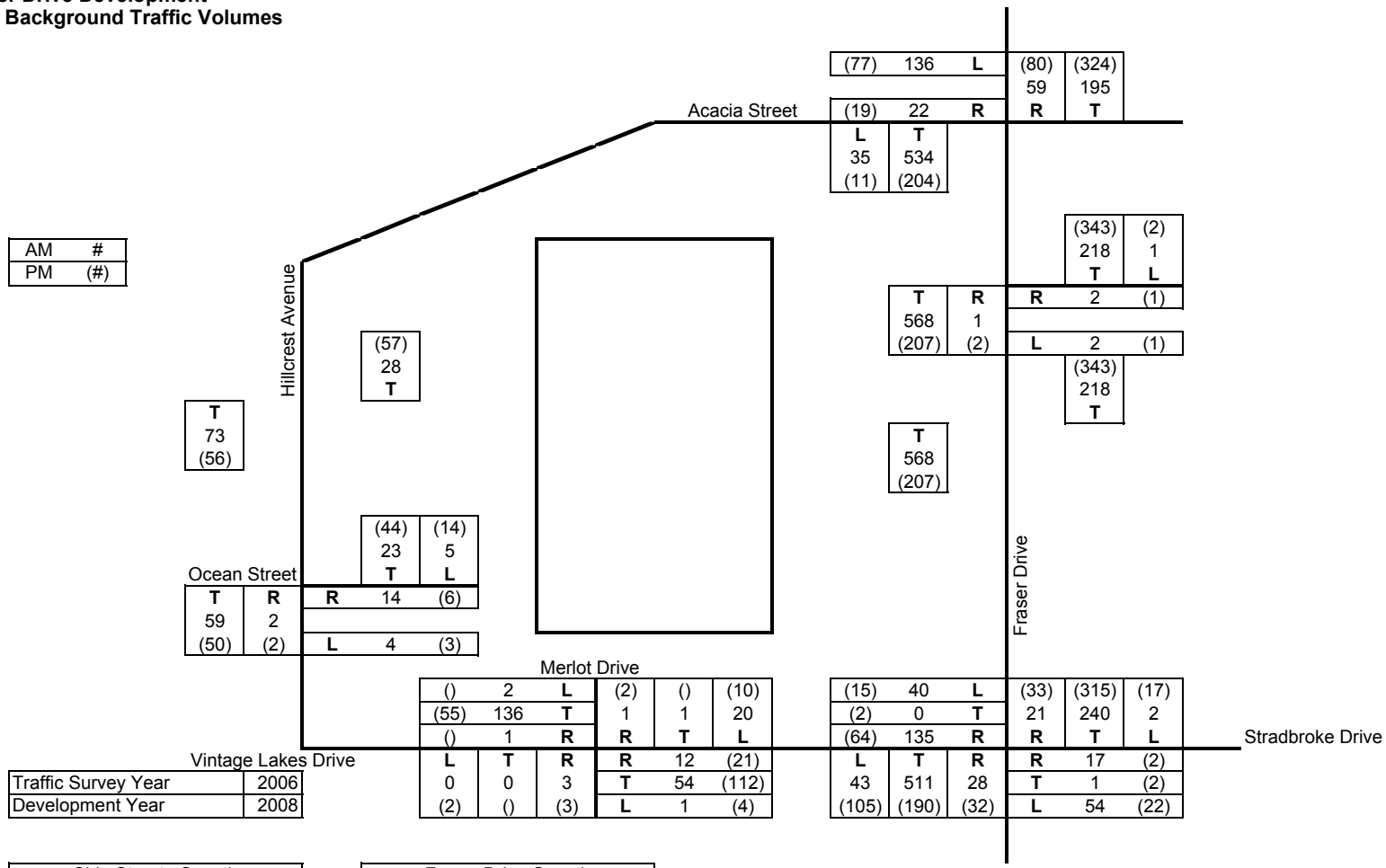
The general growth rate in this area has been based on a review of the available developable land in this area. It is noted that for Fraser Drive the background traffic growth is assumed at four percent (linear growth), is due to this road providing a suburban connector role. For all other roads, a two percent per annum linear growth rate has been assumed on the basis of the limited development potential within the catchment. The background traffic volumes for are summarised for both the years 2008 and 2018 on Figures 4.1 and 4.2 respectively.

4.2 Forecast Traffic Operations

The traffic impacts associated with the proposed development on the surrounding road network have been assessed utilising the background traffic volumes for years 2008 and 2018 to which the development traffic presented at Figure 3.1 has then been added. The volumes presented on Figure 4.3 and 4.4 show the with and without development scenarios. The operations assessment has been performed using aaSIDRA analysis software.

Table 4.1 below provides results of the peak hour intersection analysis for each design year scenario with and without the development generated traffic situation. The aaSidra outputs (Table S.14), are detailed in Appendix B.

Fraser Drive Development
2008 Background Traffic Volumes



Traffic Survey Year	2006
Development Year	2008

Side Streets Growth	
Growth Factor	1.04
Growth Years	2
Growth Rate	2%

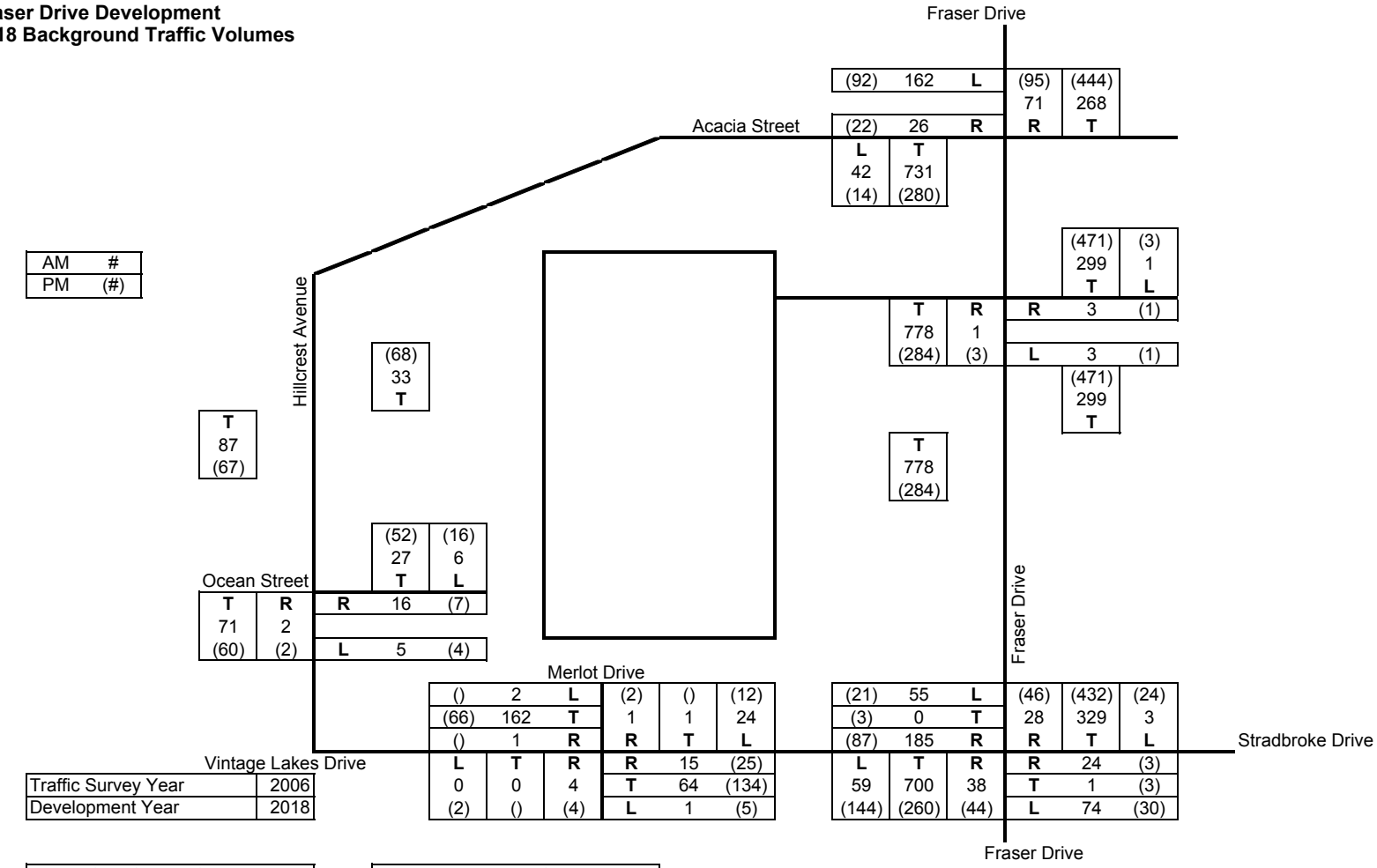
Fraser Drive Growth	
Growth Factor	1.08
Growth Years	2
Growth Rate	4%

Cardno Eppell Olsen

2008 Background Traffic Volumes

FIGURE No: 4.1
PROJECT No: 721429
DATE: 6/12/2006

Fraser Drive Development
2018 Background Traffic Volumes



Traffic Survey Year	2006
Development Year	2018

Side Streets Growth	
Growth Factor	1.24
Growth Years	12
Growth Rate	2%

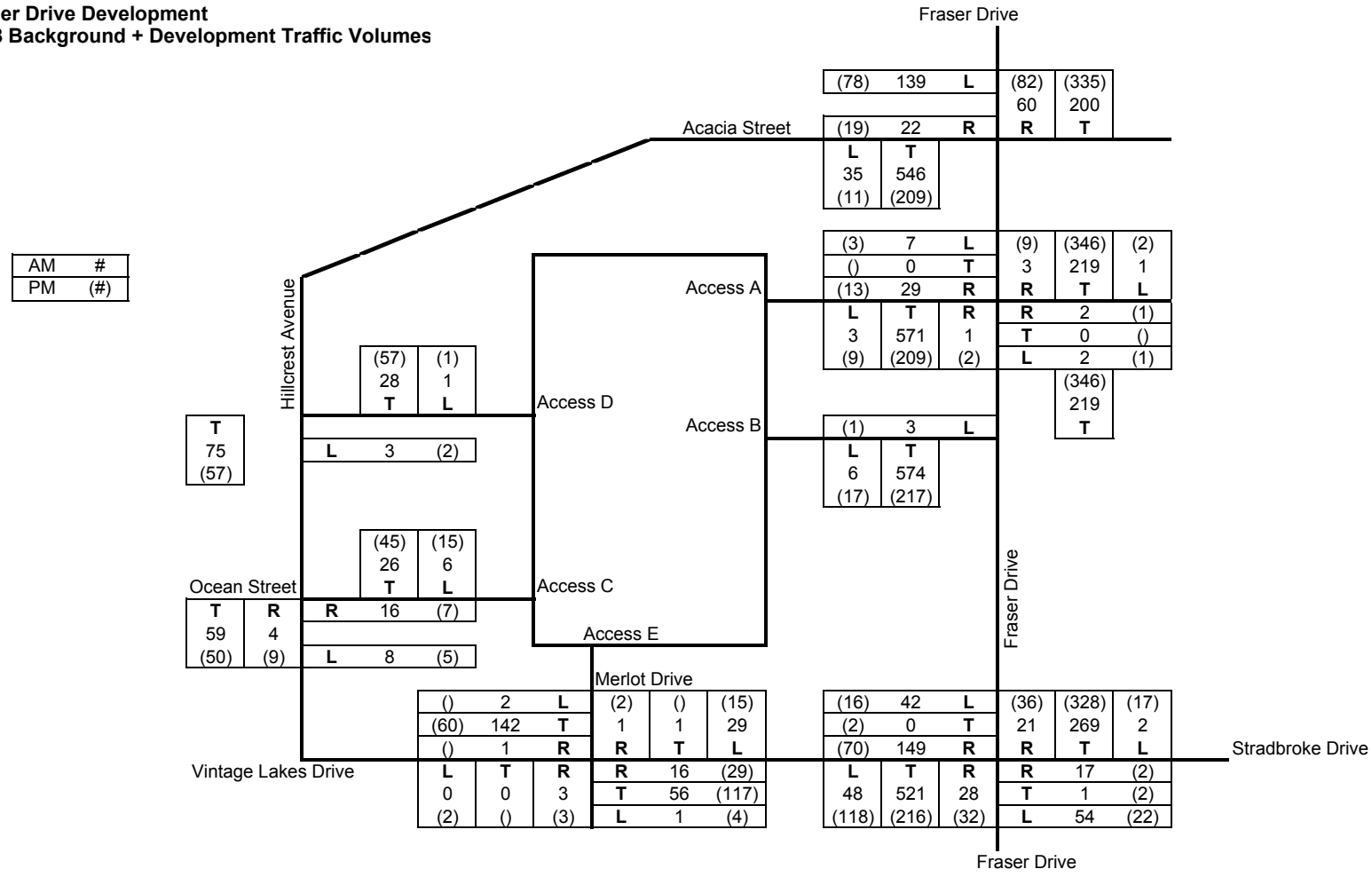
Fraser Drive Growth	
Growth Factor	1.48
Growth Years	12
Growth Rate	4%

Cardno Eppell Olsen

2018 Background Traffic Volumes

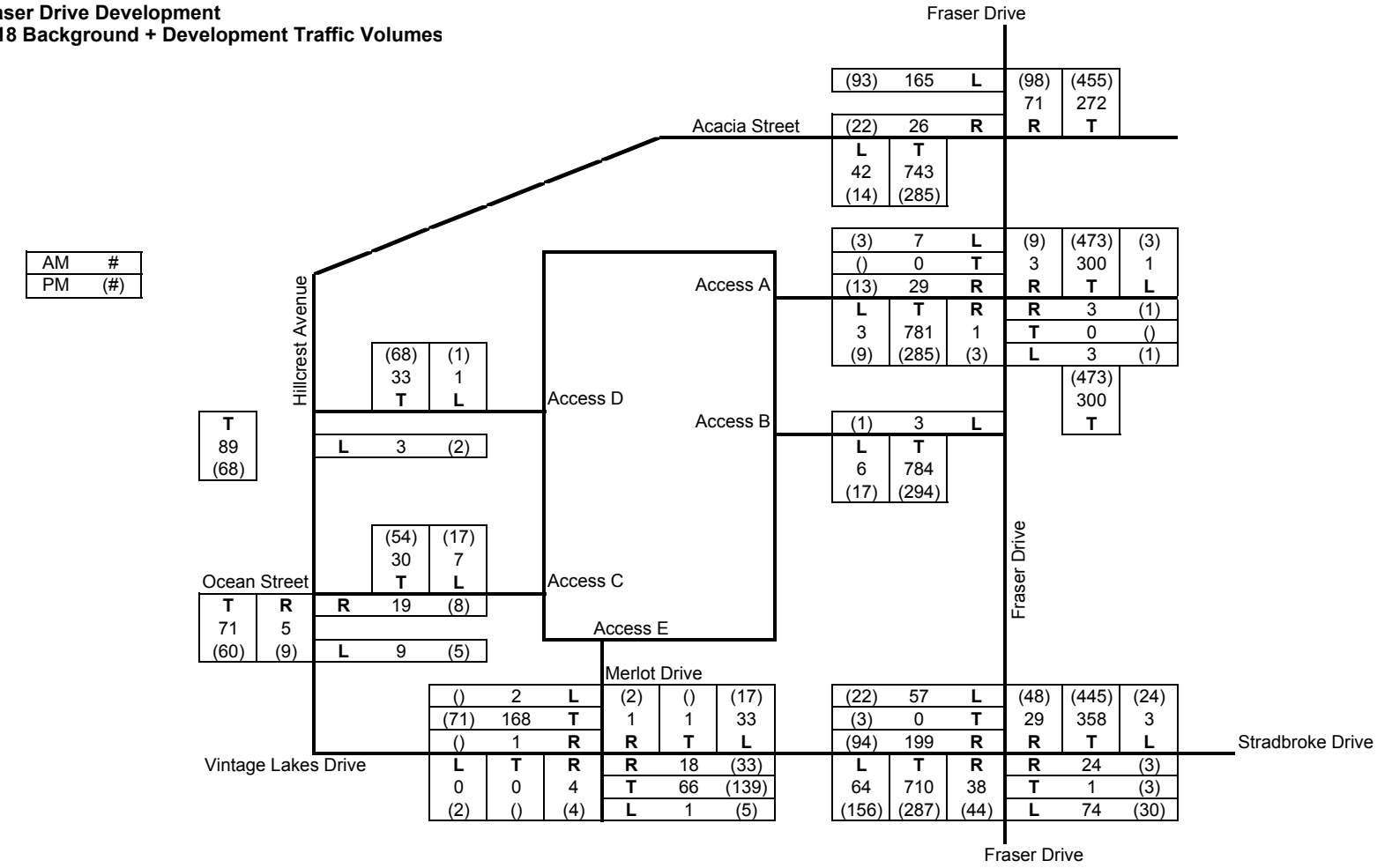
FIGURE No: 4.2
PROJECT No: 721429
DATE: 6/12/2006

Fraser Drive Development
2008 Background + Development Traffic Volumes



Cardno Eppell Olsen	2008 Background + Development Traffic Volumes
FIGURE No: 4.3	
PROJECT No: 721429	
DATE: 6/12/2006	

Fraser Drive Development
2018 Background + Development Traffic Volumes



Cardno Eppell Olsen

2018 Background + Development Traffic Volumes

FIGURE No: 4.4
PROJECT No: 721429
DATE: 6/12/2006

Table 4.1 ***Forecast Intersection Performance (DOS)***

Intersection	Opening Year 2008				Horizon Year 2018			
	Without Development		With Fraser Drive Development		Without Development		With Fraser Drive Development	
	AM	PM	AM	PM	AM	PM	AM	PM
Fraser Drive/Acacia Street (unsignalised t-intersection)	33%	25%	35%	26%	64%	34%	67%	35%
Fraser Drive/ Development Access A (signalized intersection	n/a	n/a	58%	29%	n/a	n/a	83%	40%
Fraser Drive/ Access B (left in left out)	n/a	n/a	4%	3%	n/a	n/a	5%	4%
Fraser Drive/Vintage Lakes Drive (four way roundabout)	20%	14%	21%	15%	28%	20%	28%	20%
Vintage Lakes Drive/ Merlot Drive (four way roundabout)	10%	9%	10%	10%	12%	10%	12%	11%
Hillcrest Avenue/ Ocean Avenue (unsignalised t-intersection)	4%	3%	4%	4%	4%	4%	5%	4%
Hillcrest Avenue/ Access D (left in left out)	n/a	n/a	33%	19%	n/a	n/a	5%	4%

Note: n/a indicates analysis was not required for that scenario.

Table 4.1 illustrates that all intersections, with the exception of the main access on Fraser Drive will operate within capacity limits for the extent of the design horizon. Operation of Development Access A is discussed in more detail below.

4.2.1 Fraser Drive/Development Access A

Provisions have been made within the development application to upgrade the current intersection of Fraser Drive and the Pioneer Village Access from an unsignalised t-intersection to a four-way signalised control. To ensure that this intersection operates according to the capacities of the above traffic scenarios a number of intersection elements require installation. A left turn lane is required to separate the development ingress movement with the through (along Fraser Drive) and the right turn (into the Pioneer development) manoeuvres. This left turn lane shall be a minimum of 20m in length. The intersection configuration on the northern side of this intersection shall provide a 20m right turn lane to allow for a dedicated ingress into the Fraser Drive development. Also incorporated within the traffic signals will be a pedestrian crossing facility to provide a safe and managed pedestrian movement across Fraser Drive.

5.0 PUBLIC TRANSPORT, PEDESTRIAN & CYCLE INFRASTRUCUTUE

Bus route number 604 operated by Surfside Buslines services Tweed Head South, in the vicinity of this development. This route services (in a one way direction Fraser Drive, Vintage Lakes Drive, Hillcrest Avenue and Acacia Street before connecting to both Tweed City and Tweed Heads Central). At current there is no bus stop facilities located on Fraser Drive near the main development access. It is therefore recommended, so as to encourage public transport utilisation, that a bus stop be provide on the eastern side of Fraser Drive immediately adjacent to the main access intersection.

By analysing the proposed development layout, it was found that by using a 400m radial area (centred at each bus stop location), the potential catchments encompass approximately 89% of the total dwellings. This is under the assumption that a bus stop facility will be located at the main access of this development.

Both pedestrians and cyclists are able to access the surrounding road network via the internal road layout. Provisions for both cyclists and pedestrians will be provided to ensure safe travel.

6.0 CONCLUSIONS

The following conclusions are made regarding traffic matters associated with the proposed Fraser Drive development:

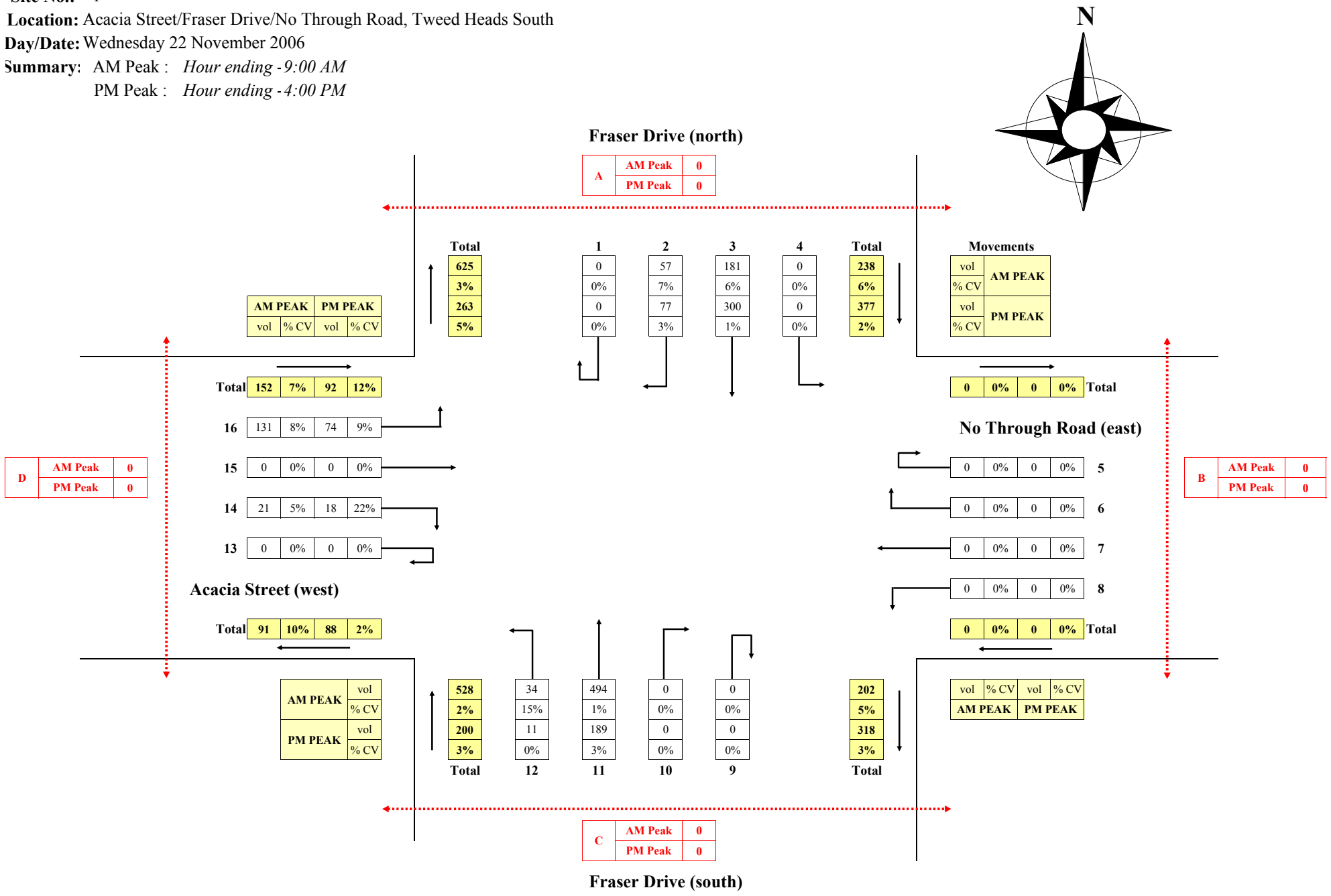
- background traffic conditions have been evaluated considering a four percent per annum growth rate on Fraser Drive and a two percent per annum growth rate on all remaining side streets;
- this development is estimated to generate 208 trips (52 in/156 out) during the weekday AM peak hour and 208 trips (139 in/69 out) during the weekday PM peak hour;
- accounting for future growth and development generated traffic, all design intersections will perform within current industry standards;
- in order to provide proper site access and ensure traffic flow does not reach saturation levels, provisions have been made for the upgrading of the current Fraser Drive/Pioneer Country Access intersection to a four-leg, signalized intersection;
- a bus stop and shelter is recommended at the main development access to allow for increased patron utilisation;

Appendix A

Traffic Count Surveys

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

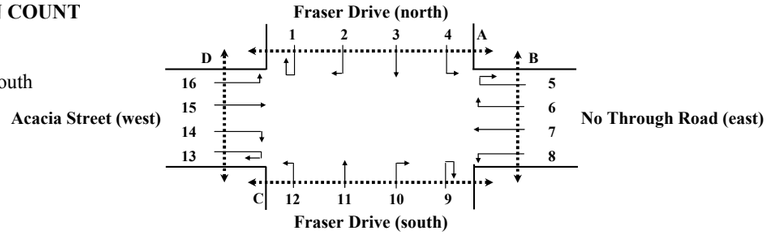
Site No.: 1
Location: Acacia Street/Fraser Drive/No Through Road, Tweed Heads South
Day/Date: Wednesday 22 November 2006
Summary: AM Peak : *Hour ending - 9:00 AM*
PM Peak : *Hour ending - 4:00 PM*



Legend
vol = total vehicle volume
% CV = percentage of commercial vehicles (trucks and buses)

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

Site No.: 1 **Weather:** Fine
Location: Acacia Street/Fraser Drive/No Through Road, Tweed Heads South
Day/Date: Wednesday 22 November 2006
AM Peak: *Hour ending - 9:00 AM*
PM Peak: *Hour ending - 4:00 PM*



TIME (1/4 hr end)	Movement 1					Movement 2					Movement 3					Movement 4					Movement 5					Movement 6					Movement 7					Movement 8				
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*
6:45 AM	0	0	0	**0**	0	2	0	0	**2**	0	12	0	0	**12**	1	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	**0**	0
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7:15 AM	0	0	0	**0**	0	5	0	0	**5**	0	13	1	0	**14**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	**0**	0
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3 hr Total	**0**	**0**	**0**	**0**	**0**	**97**	**8**	**2**	**107**	**0**	**352**	**18**	**0**	**370**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
AM Peak	**0**	**0**	**0**	**0**	**0**	**53**	**4**	**0**	**57**	**0**	**171**	**10**	**0**	**181**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

TIME (1/4 hr end)	Movement 1					Movement 2					Movement 3					Movement 4					Movement 5					Movement 6					Movement 7					Movement 8				
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*
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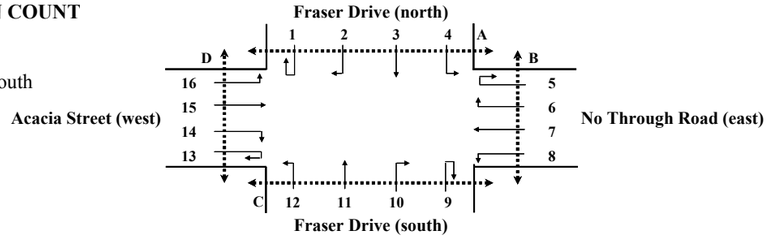
PM Peak	**0**	**0**	**0**	**0**	**0**	**75**	**2**	**0**	**77**	**0**	**296**	**4**	**0**	**300**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

Site No.: 1
Location: Acacia Street/Fraser Drive/No Through Road, Tweed Heads South
Day/Date: Wednesday 22 November 2006
AM Peak: *Hour ending - 9:00 AM*
PM Peak: *Hour ending - 4:00 PM*



TIME (1/4 hr end)	Movement 9					Movement 10					Movement 11					Movement 12					Movement 13					Movement 14					Movement 15					Movement 16					Pedestrian Movements			
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	**A**	**B**	**C**	**D**
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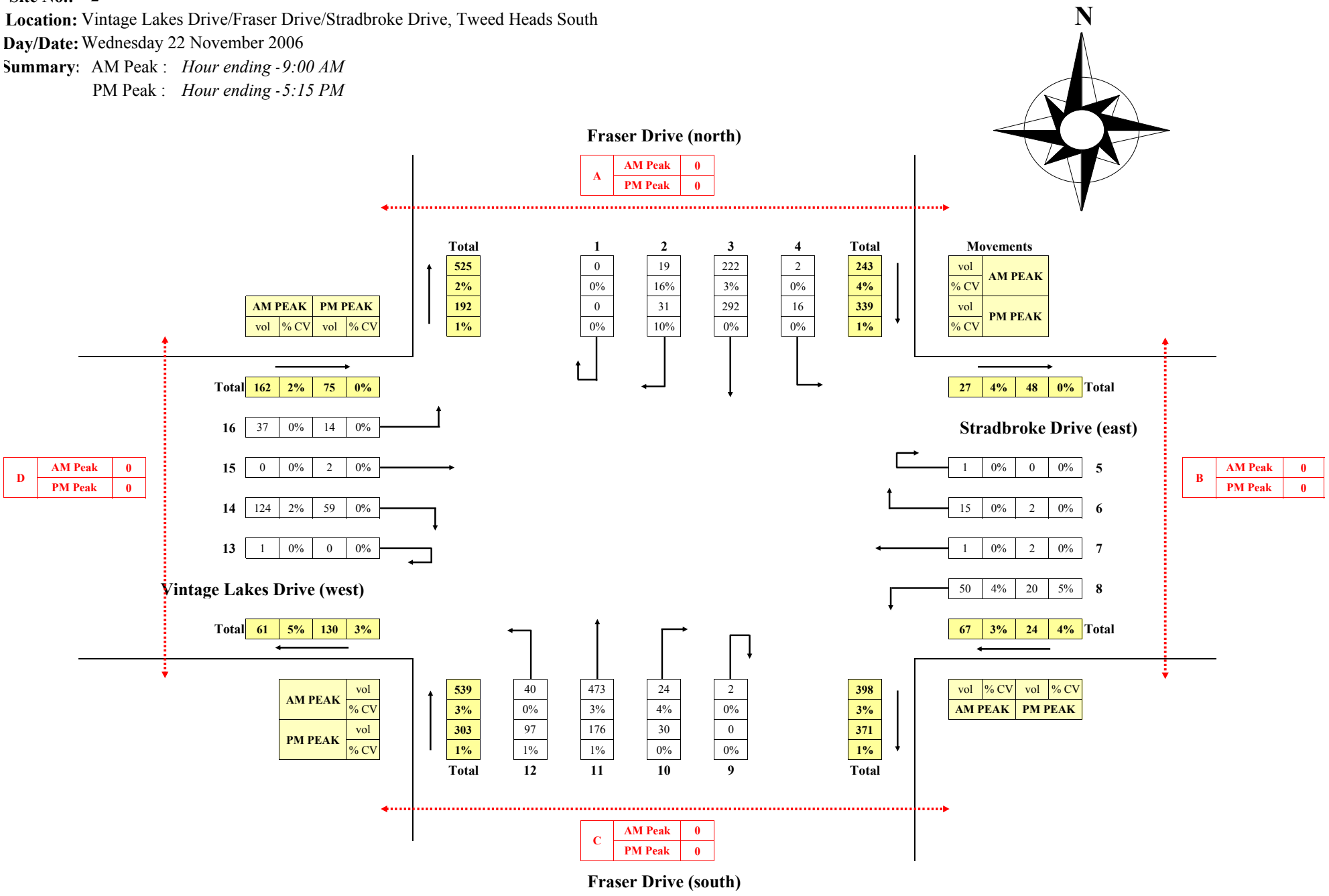
8:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	69	1	0	**70**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	11	0	0	**11**	0	0	0	0	0
8:15 AM	0	0	0	**0**	0	0	0	0	**0**	0	102	3	0	**105**	1	13	0	0	**13**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	19	1	0	**20**	1	0	0	0	0
8:30 AM	0	0	0	**0**	0	0	0	0	**0**	0	134	2	0	**136**	1	3	3	0	**6**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	34	3	0	**37**	0	0	0	0	0
8:45 AM	0	0	0	**0**	0	0	0	0	**0**	0	149	2	0	**151**	1	11	1	0	**12**	0	0	0	0	**0**	0	11	0	0	**11**	0	0	0	0	**0**	0	0	0	0	**0**	0	39	4	0	**43**	0	0	0	0	0
9:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	102	0	0	**102**	2	2	1	0	**3**	0	0	0	0	**0**	0	4	1	0	**5**	0	0	0	0	**0**	0	0	0	0	**0**	0	29	2	0	**31**	0	0	0	0	0
9:15 AM	0	0	0	**0**	0	0	0	0	**0**	0	52	0	0	**52**	0	4	0	0	**4**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	27	0	0	**27**	0	0	0	0	0
9:30 AM	0	0	0	**0**	0	0	0	0	**0**	0	62	0	0	**62**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	12	2	0	**14**	0	0	0	0	0
3 hr Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**850**	**11**	**0**	**861**	**8**	**46**	**5**	**0**	**51**	**0**	**0**	**0**	**0**	**0**	**0**	**37**	**1**	**0**	**38**	**0**	**0**	**0**	**0**	**0**	**0**	**251**	**18**	**0**	**269**	**1**	**0**	**0**	**0**	**0**
AM Peak	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**487**	**7**	**0**	**494**	**5**	**29**	**5**	**0**	**34**	**0**	**0**	**0**	**0**	**0**	**0**	**20**	**1**	**0**	**21**	**0**	**0**	**0**	**0**	**0**	**0**	**121**	**10**	**0**	**131**	**1**	**0**	**0**	**0**	**0**

TIME (1/4 hr end)	Movement 9					Movement 10					Movement 11					Movement 12					Movement 13					Movement 14					Movement 15					Movement 16					Pedestrian Movements			
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	**A**	**B**	**C**	**D**
3:15 PM	0	0	0	**0**	0	0	0	0	**0**	0	36	0	0	**36**	0	2	0	0	**2**	0	0	0	0	**0**	0	2	3	0	**5**	0	0	0	0	**0**	0	22	3	0	**25**	0	0	0	0	0
3:30 PM	0	0	0	**0**	0	0	0	0	**0**	0	46	2	0	**48**	1	3	0	0	**3**	0	0	0	0	**0**	0	4	1	0	**5**	0	0	0	0	**0**	0	11	2	0	**13**	0	0	0	0	0
3:45 PM	0	0	0	**0**	0	0	0	0	**0**	0	52	1	0	**53**	0	1	0	0	**1**	0	0	0	0	**0**	0	5	0	0	**5**	0	0	0	0	**0**	0	17	1	0	**18**	0	0	0	0	0
4:00 PM	0	0	0	**0**	0	0	0	0	**0**	0	50	2	0	**52**	0	5	0	0	**5**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	17	1	0	**18**	0	0	0	0	0
4:15 PM	0	0	0	**0**	0	0	0	0	**0**	0	38	3	0	**41**	0	1	0	0	**1**	0	0	0	0	**0**	0	4	0	0	**4**	0	0	0	0	**0**	0	14	4	0	**18**	0	0	0	0	0
4:30 PM	0	0	0	**0**	0	0	0	0	**0**	0	60	1	0	**61**	0	2	0	0	**2**	0	0	0	0	**0**	0	4	0	0	**4**	0	0	0	0	**0**	0	7	1	0	**8**	0	0	0	0	0
4:45 PM	0	0	0	**0**	0	0	0	0	**0**	0	54	1	0	**55**	0	4	0	0	**4**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	8	0	0	**8**	0	0	0	0	0
5:00 PM	0	0	0	**0**	0	0	0	0	**0**	0	42	0	0	**42**	0	2	0	0	**2**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	10	2	0	**12**	0	0	0	0	0
5:15 PM	0	0	0	**0**	0	0	0	0	**0**	0	34	0	0	**34**	0	1	0	0	**1**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	7	0	0	**7**	0	0	0	0	0
5:30 PM	0	0	0	**0**	0	0	0	0	**0**	0	40	0	0	**40**	0	4	0	0	**4**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	12	1	0	**13**	2	0	0	0	0
5:45 PM	0	0	0	**0**	0	0	0	0	**0**	0	34	2	0	**36**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	11	0	0	**11**	0	0	0	0	0
6:00 PM	0	0	0	**0**	0	0	0	0	**0**	0	37	1	0	**38**	0	2	0	0	**2**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	9	1	0	**10**	0	0	0	0	0
3 hr Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**523**	**13**	**0**	**536**	**1**	**28**	**0**	**0**	**28**	**0**	**0**	**0**	**0**	**0**	**0**	**34**	**4**	**0**	**38**	**0**	**0**	**0**	**0**	**0**	**0**	**145**	**16**	**0**	**161**	**2**	**0**	**0**	**0**	**0**
PM Peak	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**184**	**5**	**0**	**189**	**1**	**11**	**0**	**0**	**11**	**0**	**0**	**0**	**0**	**0**	**0**	**14**	**4**	**0**	**18**	**0**	**0**	**0**	**0**	**0**	**0**	**67**	**7**	**0**	**74**	**0**	**0**	**0**	**0**	**0**

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

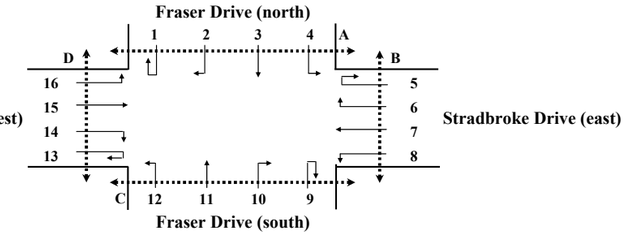
Site No.: 2
Location: Vintage Lakes Drive/Fraser Drive/Stradbroke Drive, Tweed Heads South
Day/Date: Wednesday 22 November 2006
Summary: AM Peak : *Hour ending - 9:00 AM*
PM Peak : *Hour ending - 5:15 PM*



Legend
vol = total vehicle volume
% CV = percentage of commercial vehicles (trucks and buses)

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

Site No.: 2 **Weather:** Fine
Location: Vintage Lakes Drive/Fraser Drive/Stradbroke Drive, Tweed Heads South
Day/Date: Wednesday 22 November 2006
AM Peak: *Hour ending - 9:00 AM*
PM Peak: *Hour ending - 5:15 PM*

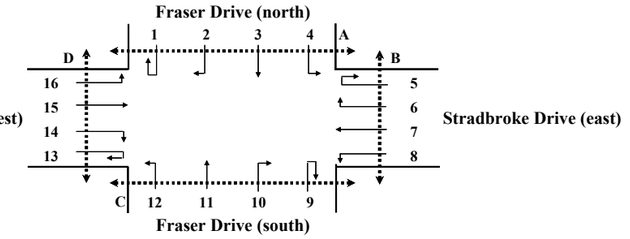


TIME (1/4 hr end)	Movement 1					Movement 2					Movement 3					Movement 4					Movement 5					Movement 6					Movement 7					Movement 8				
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*
6:45 AM	0	0	0	**0**	0	0	0	0	**0**	0	14	1	0	**15**	1	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	0
7:00 AM	0	0	0	**0**	0	1	0	0	**1**	0	13	0	0	**13**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	0
7:15 AM	0	0	0	**0**	0	0	0	0	**0**	0	10	1	0	**11**	0	1	0	0	**1**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	4	0	0	**4**	0
7:30 AM	0	0	0	**0**	0	0	0	0	**0**	0	19	1	0	**20**	0	1	0	0	**1**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	9	0	0	**9**	1
7:45 AM	0	0	0	**0**	0	0	2	0	**2**	0	34	2	0	**36**	2	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	6	0	0	**6**	0
8:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	39	0	0	**39**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	1	9	0	0	**9**	1
8:15 AM	0	0	0	**0**	0	4	0	0	**4**	0	51	1	0	**52**	1	0	0	0	**0**	0	1	0	0	**1**	0	2	0	0	**2**	0	0	0	0	**0**	0	18	2	0	**20**	2
8:30 AM	0	0	0	**0**	0	3	2	0	**5**	0	56	2	0	**58**	1	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	0	1	0	0	**1**	0	10	0	0	**10**	1
8:45 AM	0	0	0	**0**	0	8	0	0	**8**	0	47	3	0	**50**	1	1	0	0	**1**	0	0	0	0	**0**	0	5	0	0	**5**	0	0	0	0	**0**	0	13	0	0	**13**	0
9:00 AM	0	0	0	**0**	0	1	1	0	**2**	0	61	1	0	**62**	1	1	0	0	**1**	0	0	0	0	**0**	0	4	0	0	**4**	0	0	0	0	**0**	0	7	0	0	**7**	0
9:15 AM	0	0	0	**0**	0	1	0	0	**1**	0	56	3	0	**59**	0	0	0	0	**0**	0	1	0	0	**1**	0	1	0	0	**1**	0	1	0	0	**1**	0	2	0	0	**2**	0
9:30 AM	0	0	0	**0**	0	3	1	0	**4**	0	22	0	0	**22**	1	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0	0	**2**	1
3 hr Total	**0**	**0**	**0**	**0**	**0**	**21**	**6**	**0**	**27**	**0**	**422**	**15**	**0**	**437**	**8**	**4**	**0**	**0**	**4**	**0**	**2**	**0**	**0**	**2**	**0**	**23**	**0**	**0**	**23**	**0**	**2**	**0**	**0**	**2**	**1**	**88**	**2**	**0**	**90**	**6**
AM Peak	**0**	**0**	**0**	**0**	**0**	**16**	**3**	**0**	**19**	**0**	**215**	**7**	**0**	**222**	**4**	**2**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**1**	**0**	**15**	**0**	**0**	**15**	**0**	**1**	**0**	**0**	**1**	**0**	**48**	**2**	**0**	**50**	**3**

TIME (1/4 hr end)	Movement 1					Movement 2					Movement 3					Movement 4					Movement 5					Movement 6					Movement 7					Movement 8				
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*
3:15 PM	1	0	0	**1**	0	14	1	0	**15**	0	76	4	0	**80**	0	2	0	0	**2**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	4	0	0	**4**	0
3:30 PM	0	0	0	**0**	0	6	0	0	**6**	0	97	3	0	**100**	0	3	0	0	**3**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	2	5	0	0	**5**	0
3:45 PM	0	0	0	**0**	0	3	1	0	**4**	0	51	1	0	**52**	0	3	0	0	**3**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	1	7	0	0	**7**	0
4:00 PM	0	0	0	**0**	0	2	0	0	**2**	0	56	0	0	**56**	0	4	0	0	**4**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	3	0	0	**3**	0
4:15 PM	0	0	0	**0**	0	9	1	0	**10**	0	71	0	0	**71**	1	4	1	0	**5**	0	0	0	0	**0**	0	1	0	0	**1**	0	1	0	0	**1**	1	1	0	0	**1**	1
4:30 PM	0	0	0	**0**	0	8	0	0	**8**	0	77	1	0	**78**	1	4	0	0	**4**	0	0	0	0	**0**	1	1	0	0	**1**	0	0	0	0	**0**	1	4	0	0	**4**	3
4:45 PM	0	0	0	**0**	0	8	2	0	**10**	0	53	0	0	**53**	0	4	0	0	**4**	0	0	0	0	**0**	0	1	0	0	**1**	0	1	0	0	**1**	0	4	1	0	**5**	0
5:00 PM	0	0	0	**0**	0	6	0	0	**6**	0	78	0	0	**78**	1	5	0	0	**5**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	3
5:15 PM	0	0	0	**0**	0	6	1	0	**7**	0	83	0	0	**83**	0	3	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	1	7	0	0	**7**	6
5:30 PM	1	0	0	**1**	0	16	0	0	**16**	0	77	1	0	**78**	1	6	0	0	**6**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	5	0	0	**5**	5
5:45 PM	0	0	0	**0**	0	7	1	0	**8**	0	67	1	0	**68**	1	3	0	0	**3**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	1	3	0	0	**3**	1
6:00 PM	0	0	0	**0**	0	6	0	0	**6**	0	61	0	0	**61**	0	2	0	0	**2**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	1	4	0	0	**4**	0
3 hr Total	**2**	**0**	**0**	**2**	**0**	**91**	**7**	**0**	**98**	**0**	**847**	**11**	**0**	**858**	**5**	**43**	**1**	**0**	**44**	**0**	**0**	**0**	**0**	**0**	**1**	**12**	**0**	**0**	**12**	**0**	**4**	**0**	**0**	**4**	**7**	**51**	**1**	**0**	**52**	**19**
PM Peak	**0**	**0**	**0**	**0**	**0**	**28**	**3**	**0**	**31**	**0**	**291**	**1**	**0**	**292**	**2**	**16**	**0**	**0**	**16**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**2**	**0**	**2**	**0**	**0**	**2**	**2**	**19**	**1**	**0**	**20**	**12**

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

Site No.: 2
Location: Vintage Lakes Drive/Fraser Drive/Stradbroke Drive, Tweed Heads South
Day/Date: Wednesday 22 November 2006
AM Peak: *Hour ending - 9:00 AM*
PM Peak: *Hour ending - 5:15 PM*

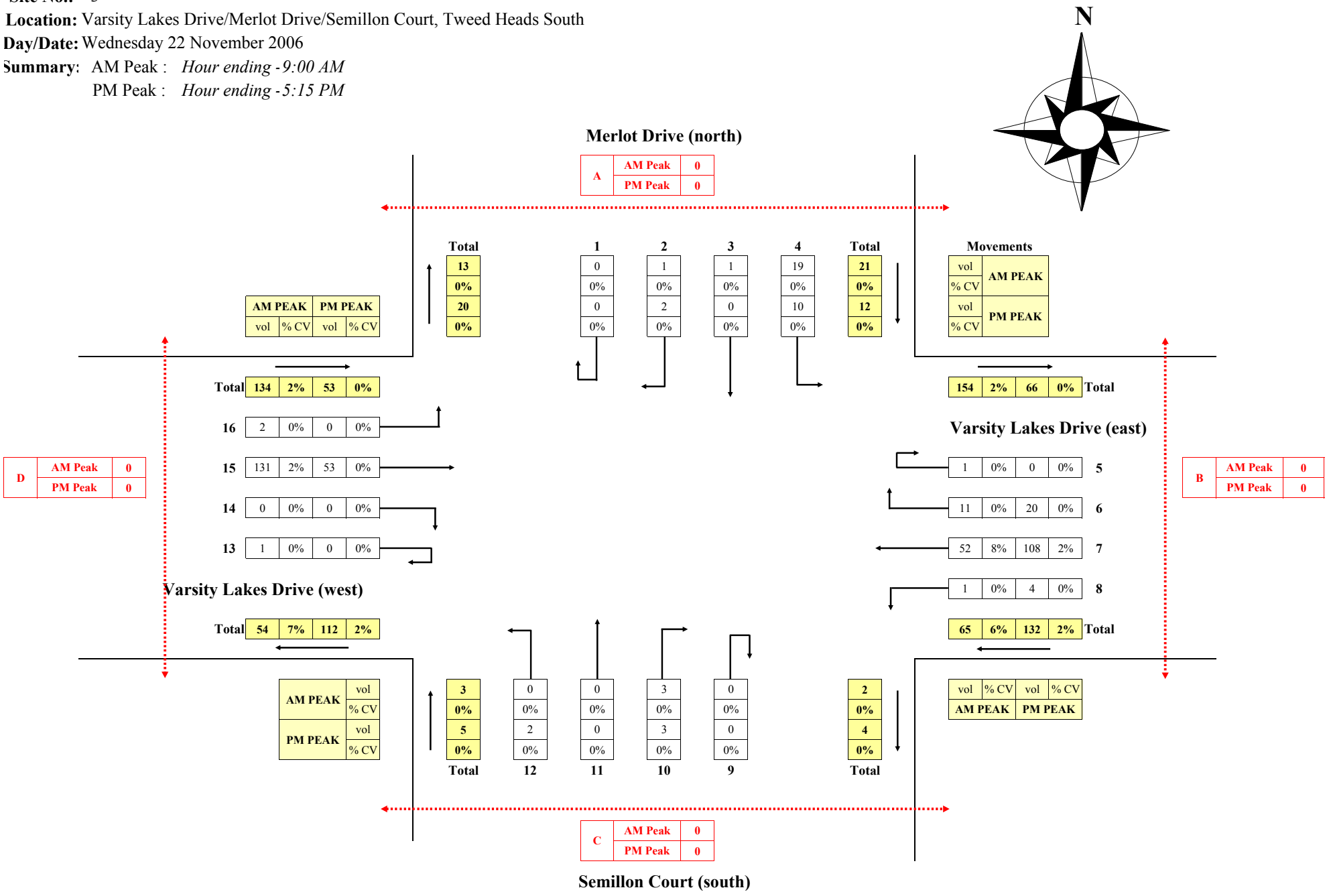


TIME (1/4 hr end)	Movement 9					Movement 10					Movement 11					Movement 12					Movement 13					Movement 14					Movement 15					Movement 16					Pedestrian Movements			
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	**A**	**B**	**C**	**D**
6:45 AM	0	0	0	**0**	0	2	0	0	**2**	0	20	0	0	**20**	0	2	0	0	**2**	0	0	0	0	**0**	0	21	0	0	**21**	0	0	0	0	**0**	1	3	0	0	**3**	0	0	0	0	0
7:00 AM	1	0	0	**1**	0	2	0	0	**2**	0	27	0	0	**27**	0	4	0	0	**4**	0	0	0	0	**0**	0	16	0	0	**16**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	0
7:15 AM	0	1	0	**1**	0	1	0	0	**1**	0	35	0	0	**35**	0	3	0	0	**3**	0	0	0	0	**0**	0	10	1	0	**11**	0	0	0	0	**0**	1	3	0	0	**3**	1	0	0	0	0
7:30 AM	1	0	0	**1**	0	1	0	0	**1**	0	26	0	0	**26**	0	6	0	0	**6**	0	0	0	0	**0**	0	11	1	0	**12**	0	0	0	0	**0**	0	1	1	0	**2**	0	0	0	0	0
7:45 AM	0	0	0	**0**	0	2	0	0	**2**	0	46	2	0	**48**	0	3	0	0	**3**	0	0	0	0	**0**	0	20	1	0	**21**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	0
8:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	78	3	0	**81**	0	4	2	0	**6**	0	0	0	0	**0**	0	28	2	0	**30**	0	0	0	0	**0**	0	4	0	0	**4**	0	0	0	0	0
8:15 AM	0	0	0	**0**	0	7	0	0	**7**	0	109	4	0	**113**	1	6	0	0	**6**	0	0	0	0	**0**	0	22	1	0	**23**	0	0	0	0	**0**	0	11	0	0	**11**	0	0	0	0	0
8:30 AM	1	0	0	**1**	0	6	0	0	**6**	0	158	3	0	**161**	0	15	0	0	**15**	0	0	0	0	**0**	0	35	1	0	**36**	0	0	0	0	**0**	0	5	0	0	**5**	0	0	0	0	0
8:45 AM	1	0	0	**1**	0	5	1	0	**6**	0	117	5	0	**122**	0	8	0	0	**8**	0	1	0	0	**1**	0	30	0	0	**30**	0	0	0	0	**0**	1	12	0	0	**12**	1	0	0	0	0
9:00 AM	0	0	0	**0**	0	5	0	0	**5**	0	76	1	0	**77**	1	11	0	0	**11**	0	0	0	0	**0**	0	34	1	0	**35**	0	0	0	0	**0**	0	9	0	0	**9**	0	0	0	0	0
9:15 AM	0	0	0	**0**	0	4	0	0	**4**	0	57	2	0	**59**	0	11	0	0	**11**	0	0	0	0	**0**	0	23	0	0	**23**	0	0	0	0	**0**	0	5	0	0	**5**	0	0	0	0	0
9:30 AM	1	0	0	**1**	0	3	0	0	**3**	0	55	3	0	**58**	0	5	0	0	**5**	0	0	0	0	**0**	0	26	0	0	**26**	0	1	0	0	**1**	0	5	0	0	**5**	0	0	0	0	0
3 hr Total	**5**	**1**	**0**	**6**	**0**	**38**	**1**	**0**	**39**	**0**	**804**	**23**	**0**	**827**	**2**	**78**	**2**	**0**	**80**	**0**	**1**	**0**	**0**	**1**	**0**	**276**	**8**	**0**	**284**	**0**	**1**	**0**	**0**	**1**	**3**	**63**	**1**	**0**	**64**	**2**	**0**	**0**	**0**	**0**
AM Peak	**2**	**0**	**0**	**2**	**0**	**23**	**1**	**0**	**24**	**0**	**460**	**13**	**0**	**473**	**2**	**40**	**0**	**0**	**40**	**0**	**1**	**0**	**0**	**1**	**0**	**121**	**3**	**0**	**124**	**0**	**0**	**0**	**0**	**0**	**1**	**37**	**0**	**0**	**37**	**1**	**0**	**0**	**0**	**0**

TIME (1/4 hr end)	Movement 9					Movement 10					Movement 11					Movement 12					Movement 13					Movement 14					Movement 15					Movement 16					Pedestrian Movements			
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	**A**	**B**	**C**	**D**
3:15 PM	0	0	0	**0**	0	8	0	0	**8**	0	42	0	0	**42**	0	14	1	0	**15**	0	0	0	0	**0**	0	12	0	0	**12**	0	1	0	0	**1**	0	5	0	0	**5**	0	0	0	0	0
3:30 PM	0	0	0	**0**	0	9	0	0	**9**	0	40	3	0	**43**	0	27	1	0	**28**	0	0	0	0	**0**	0	16	0	0	**16**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	0
3:45 PM	2	0	0	**2**	0	5	0	0	**5**	0	49	2	0	**51**	0	27	0	0	**27**	0	0	0	0	**0**	0	22	4	0	**26**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	0
4:00 PM	0	0	0	**0**	0	4	0	0	**4**	0	40	2	0	**42**	0	18	3	0	**21**	0	0	0	0	**0**	0	15	0	0	**15**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	0
4:15 PM	0	0	0	**0**	0	2	0	0	**2**	0	36	2	0	**38**	0	16	3	0	**19**	0	0	0	0	**0**	0	15	0	0	**15**	0	0	0	0	**0**	0	3	1	0	**4**	0	0	0	0	0
4:30 PM	0	0	0	**0**	0	6	0	0	**6**	0	51	0	0	**51**	1	26	1	0	**27**	0	0	0	0	**0**	0	21	0	0	**21**	0	1	0	0	**1**	0	5	0	0	**5**	0	0	0	0	0
4:45 PM	0	0	0	**0**	0	5	0	0	**5**	0	49	0	0	**49**	0	29	0	0	**29**	0	0	0	0	**0**	0	14	0	0	**14**	0	0	0	0	**0**	0	4	0	0	**4**	0	0	0	0	0
5:00 PM	0	0	0	**0**	0	6	0	0	**6**	0	38	2	0	**40**	0	21	0	0	**21**	0	0	0	0	**0**	0	11	0	0	**11**	0	1	0	0	**1**	0	5	0	0	**5**	0	0	0	0	0
5:15 PM	0	0	0	**0**	0	13	0	0	**13**	0	36	0	0	**36**	0	20	0	0	**20**	0	0	0	0	**0**	0	13	0	0	**13**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0
5:30 PM	0	0	0	**0**	0	3	0	0	**3**	0	39	0	0	**39**	0	15	0	0	**15**	0	0	0	0	**0**	0	18	0	0	**18**	0	2	0	0	**2**	0	2	0	0	**2**	0	0	0	0	0
5:45 PM	0	0	0	**0**	0	7	0	0	**7**	0	35	1	0	**36**	0	23	0	0	**23**	0	0	0	0	**0**	0	12	0	0	**12**	0	0	0	0	**0**	1	4	0	0	**4**	0	0	0	0	0
6:00 PM	0	0	0	**0**	0	6	0	0	**6**	0	38	2	0	**40**	0	26	0	0	**26**	0	0	0	0	**0**	0	7	0	0	**7**	0	0	0	0	**0**	0	7	0	0	**7**	0	0	0	0	0
3 hr Total	**2**	**0**	**0**	**2**	**0**	**74**	**0**	**0**	**74**	**0**	**493**	**14**	**0**	**507**	**1**	**262**	**9**	**0**	**271**	**0**	**0**	**0**	**0**	**0**	**0**	**176**	**4**	**0**	**180**	**0**	**5**	**0**	**0**	**5**	**1**	**42**	**1**	**0**	**43**	**0**	**0**	**0**	**0**	**0**
PM Peak	**0**	**0**	**0**	**0**	**0**	**30**	**0**	**0**	**30**	**0**	**174**	**2**	**0**	**176**	**1**	**96**	**1**	**0**	**97**	**0**	**0**	**0**	**0**	**0**	**0**	**59**	**0**	**0**	**59**	**0**	**2**	**0**	**0**	**2**	**0**	**14**	**0**	**0**	**14**	**0**	**0**	**0**	**0**	**0**

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

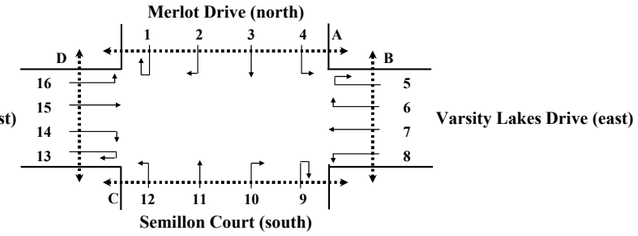
Site No.: 3
Location: Varsity Lakes Drive/Merlot Drive/Semillon Court, Tweed Heads South
Day/Date: Wednesday 22 November 2006
Summary: AM Peak : *Hour ending - 9:00 AM*
PM Peak : *Hour ending - 5:15 PM*



Legend
vol = total vehicle volume
% CV = percentage of commercial vehicles (trucks and buses)

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

Site No.: 3 **Weather:** Fine
Location: Varsity Lakes Drive/Merlot Drive/Semillon Court, Tweed Heads South
Day/Date: Wednesday 22 November 2006
AM Peak: *Hour ending - 9:00 AM*
PM Peak: *Hour ending - 5:15 PM*

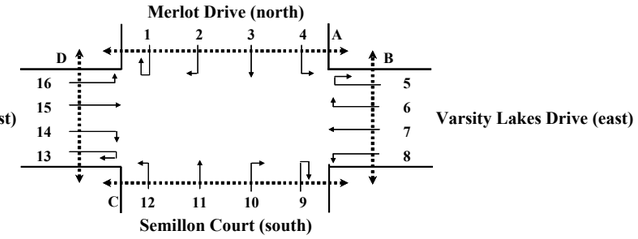


TIME (1/4 hr end)	Movement 1					Movement 2					Movement 3					Movement 4					Movement 5					Movement 6					Movement 7					Movement 8				
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*
6:45 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	1	0	0	**1**	0	1	0	0	**1**	0	0	0	0	**0**	0
7:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	6	1	0	**7**	0	0	0	0	**0**	0
7:15 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	1	0	0	**1**	0	3	0	0	**3**	0	0	0	0	**0**	0
7:30 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	6	0	0	**6**	0	0	0	0	**0**	0
7:45 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	5	0	0	**5**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	2	0	**4**	0	0	0	0	**0**	0
8:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	0	1	0	0	**1**	0	0	0	0	**0**	0	7	2	0	**9**	0	1	0	0	**1**	0
8:15 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	5	0	0	**5**	2	0	0	0	**0**	0	4	0	0	**4**	0	3	0	0	**3**	0	0	0	0	**0**	0
8:30 AM	0	0	0	**0**	0	1	0	0	**1**	0	1	0	0	**1**	0	7	0	0	**7**	0	0	0	0	**0**	0	4	0	0	**4**	0	19	2	0	**21**	0	0	0	0	**0**	0
8:45 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	0	0	0	0	**0**	0	1	0	0	**1**	0	15	1	0	**16**	0	0	0	0	**0**	0
9:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	3	0	0	**3**	0	1	0	0	**1**	0	2	0	0	**2**	0	11	1	0	**12**	0	1	0	0	**1**	1
9:15 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	5	0	0	**5**	0	0	0	0	**0**	0	0	0	0	**0**	0	12	0	0	**12**	0	0	0	0	**0**	0
9:30 AM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	6	0	0	**6**	0	0	0	0	**0**	0	0	0	0	**0**	0	8	1	0	**9**	0	0	0	0	**0**	0
3 hr Total	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**1**	**0**	**45**	**0**	**0**	**45**	**2**	**2**	**0**	**0**	**2**	**0**	**13**	**0**	**0**	**13**	**0**	**93**	**10**	**0**	**103**	**0**	**2**	**0**	**0**	**2**	**1**
AM Peak	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**19**	**0**	**0**	**19**	**2**	**1**	**0**	**0**	**1**	**0**	**11**	**0**	**0**	**11**	**0**	**48**	**4**	**0**	**52**	**0**	**1**	**0**	**0**	**1**	**1**

TIME (1/4 hr end)	Movement 1					Movement 2					Movement 3					Movement 4					Movement 5					Movement 6					Movement 7					Movement 8				
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*
3:15 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	0	0	0	0	**0**	0	7	0	0	**7**	0	23	2	0	**25**	0	0	0	0	**0**	1
3:30 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	3	0	0	**3**	1	1	0	0	**1**	0	6	0	0	**6**	1	27	0	0	**27**	0	1	0	0	**1**	0
3:45 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	5	0	0	**5**	0	0	0	0	**0**	0	2	0	0	**2**	1	24	0	0	**24**	4	2	0	0	**2**	0
4:00 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0	0	**2**	0	1	0	0	**1**	0	3	0	0	**3**	0	14	0	0	**14**	2	0	0	0	**0**	2
4:15 PM	0	0	0	**0**	0	1	0	0	**1**	1	1	0	0	**1**	0	3	0	0	**3**	0	1	1	0	**2**	0	5	0	0	**5**	0	19	0	0	**19**	2	1	0	0	**1**	0
4:30 PM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	4	0	0	**4**	0	0	0	0	**0**	0	7	0	0	**7**	0	25	0	0	**25**	0	1	0	0	**1**	0
4:45 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	6	0	0	**6**	0	28	2	0	**30**	1	0	0	0	**0**	0
5:00 PM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	3	0	0	**3**	0	21	0	0	**21**	1	1	0	0	**1**	0
5:15 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	0	32	0	0	**32**	3	2	0	0	**2**	0
5:30 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	3	0	0	**3**	0	17	0	0	**17**	0	3	0	0	**3**	0
5:45 PM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	3	0	0	**3**	0	1	0	0	**1**	0	9	0	0	**9**	0	28	0	0	**28**	3	1	0	0	**1**	0
6:00 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	2	0	0	**2**	0	25	0	0	**25**	1	0	0	0	**0**	0
3 hr Total	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**4**	**1**	**1**	**0**	**0**	**1**	**0**	**34**	**0**	**0**	**34**	**1**	**4**	**1**	**0**	**5**	**0**	**57**	**0**	**0**	**57**	**2**	**283**	**4**	**0**	**287**	**17**	**12**	**0**	**0**	**12**	**3**
PM Peak	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**20**	**0**	**0**	**20**	**0**	**106**	**2**	**0**	**108**	**5**	**4**	**0**	**0**	**4**	**0**

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

Site No.: 3
Location: Varsity Lakes Drive/Merlot Drive/Semillon Court, Tweed Heads South
Day/Date: Wednesday 22 November 2006
AM Peak: *Hour ending - 9:00 AM*
PM Peak: *Hour ending - 5:15 PM*

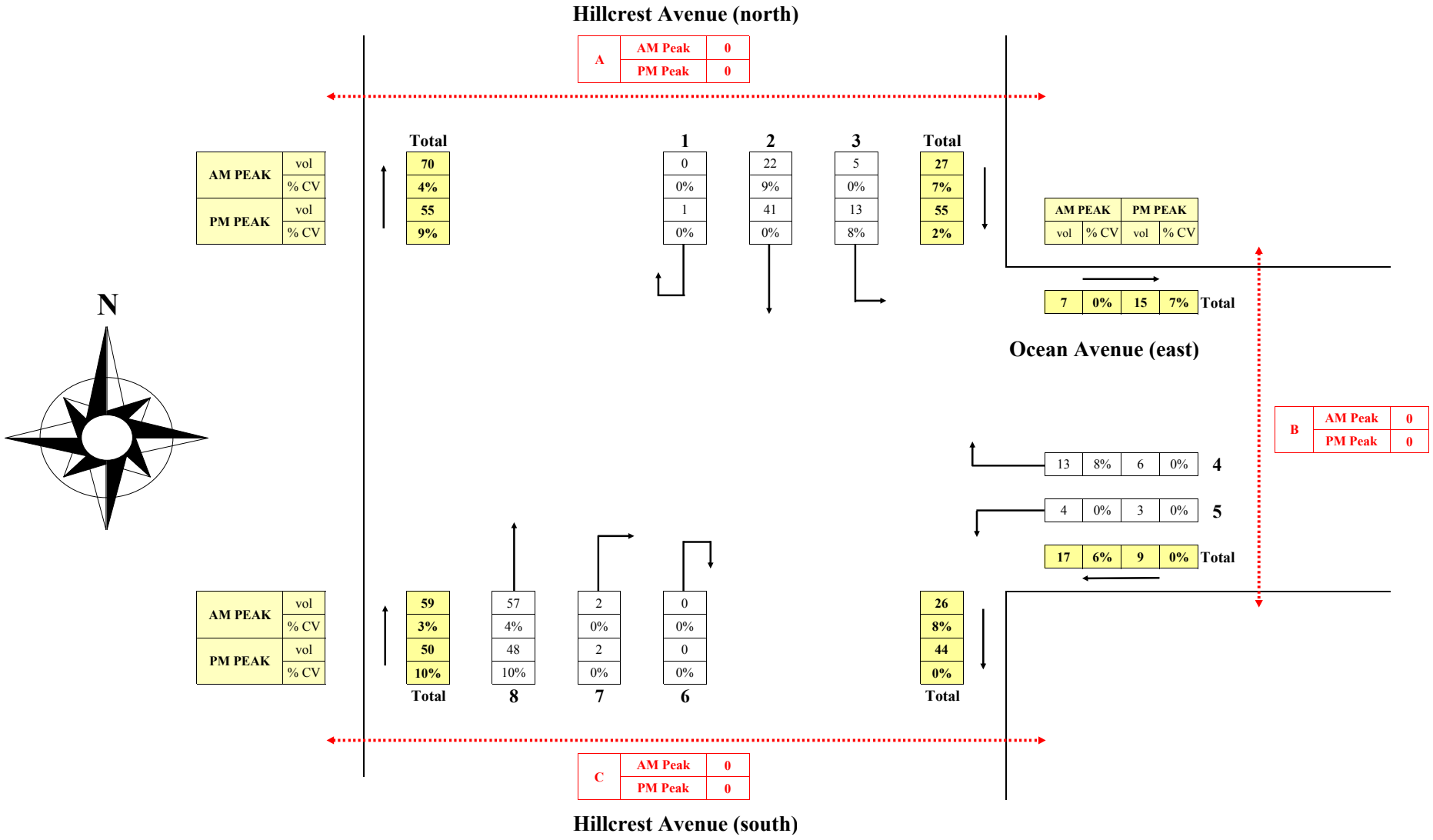


TIME (1/4 hr end)	Movement 9					Movement 10					Movement 11					Movement 12					Movement 13					Movement 14					Movement 15					Movement 16					Pedestrian Movements			
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	**A**	**B**	**C**	**D**
6:45 AM	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	22	0	0	**22**	0	0	0	0	**0**	0	0	0	0	0
7:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	15	0	0	**15**	0	0	0	0	**0**	0	0	0	0	0
7:15 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	12	1	0	**13**	2	0	0	0	**0**	0	0	0	0	0
7:30 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	11	2	0	**13**	0	0	0	0	**0**	0	0	0	0	0
7:45 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	14	1	0	**15**	0	0	0	0	**0**	0	0	0	0	0
8:00 AM	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	27	2	0	**29**	2	0	0	0	**0**	0	0	0	0	0
8:15 AM	0	0	0	**0**	0	0	0	0	**0**	1	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	32	1	0	**33**	3	0	0	0	**0**	0	0	0	0	0
8:30 AM	0	0	0	**0**	0	2	0	0	**2**	2	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	31	1	0	**32**	2	0	0	0	**0**	0	0	0	0	0
8:45 AM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	32	0	0	**32**	1	0	0	0	**0**	0	0	0	0	0
9:00 AM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	33	1	0	**34**	0	2	0	0	**2**	0	0	0	0	0
9:15 AM	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0	0	**2**	0	20	0	0	**20**	0	0	0	0	**0**	0	0	0	0	0
9:30 AM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	22	0	0	**22**	0	0	0	0	**0**	0	0	0	0	0
3 hr Total	**0**	**0**	**0**	**0**	**0**	**8**	**0**	**0**	**8**	**3**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**2**	**0**	**0**	**2**	**0**	**271**	**9**	**0**	**280**	**10**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**
AM Peak	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**128**	**3**	**0**	**131**	**6**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**

TIME (1/4 hr end)	Movement 9					Movement 10					Movement 11					Movement 12					Movement 13					Movement 14					Movement 15					Movement 16					Pedestrian Movements			
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	**A**	**B**	**C**	**D**
3:15 PM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	15	0	0	**15**	1	1	0	0	**1**	0	0	0	0	0
3:30 PM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	1	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	13	0	0	**13**	0	0	0	0	**0**	0	0	0	0	0
3:45 PM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	17	3	0	**20**	0	1	0	0	**1**	2	0	0	0	0
4:00 PM	0	0	0	**0**	0	0	0	0	**0**	2	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	12	0	0	**12**	0	0	0	0	**0**	1	0	0	0	0
4:15 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	14	0	0	**14**	0	0	0	0	**0**	0	0	0	0	0
4:30 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	20	0	0	**20**	2	0	0	0	**0**	0	0	0	0	0
4:45 PM	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	12	0	0	**12**	0	0	0	0	**0**	0	0	0	0	0
5:00 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	7	0	0	**7**	0	0	0	0	**0**	0	0	0	0	0
5:15 PM	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	14	0	0	**14**	0	0	0	0	**0**	0	0	0	0	0
5:30 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	15	0	0	**15**	0	2	0	0	**2**	0	0	0	0	0
5:45 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	15	0	0	**15**	0	0	0	0	**0**	0	0	0	0	0
6:00 PM	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	10	0	0	**10**	0	0	0	0	**0**	0	0	0	0	0
3 hr Total	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**6**	**2**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**164**	**3**	**0**	**167**	**3**	**4**	**0**	**0**	**4**	**3**	**0**	**0**	**0**	**0**
PM Peak	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**53**	**0**	**0**	**53**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

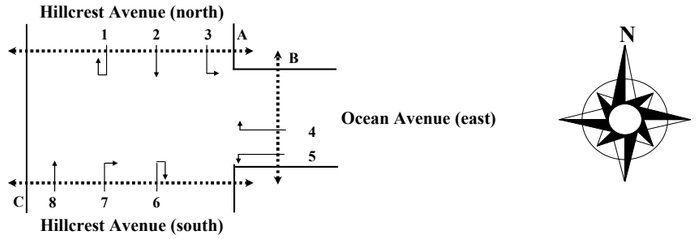
Site No.: 4
Location: Hillcrest Avenue/Ocean Avenue, Tweed Heads South
Day/Date: Wednesday 22 November 2006
Summary: AM Peak : *Hour ending - 9:15 AM*
PM Peak : *Hour ending - 4:30 PM*



Legend
vol = total vehicle volume
% CV = percentage of commercial vehicles (trucks and buses)

AUSTRALASIAN TRAFFIC SURVEYS MANUAL INTERSECTION COUNT

Site No.: 4 **Weather:** Fine
Location: Hillcrest Avenue/Ocean Avenue, Tweed Heads South
Day/Date: Wednesday 22 November 2006
AM Peak: *Hour ending - 9:15 AM*
PM Peak: *Hour ending - 4:30 PM*



TIME (1/4 hr end)	Movement 1					Movement 2					Movement 3					Movement 4					Movement 5					Movement 6					Movement 7					Movement 8					Pedestrian Movements		
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	**A**	**B**	**C**
6:45 AM	1	0	0	**1**	0	4	0	0	**4**	0	1	0	0	**1**	0	2	0	0	**2**	0	3	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	8	1	0	**9**	0	0	0	0
7:00 AM	0	0	0	**0**	0	3	0	0	**3**	0	0	0	0	**0**	0	1	0	0	**1**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0
7:15 AM	0	0	0	**0**	0	2	0	0	**2**	1	1	0	0	**1**	0	1	0	0	**1**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	2	1	0	**3**	0	0	0	0
7:30 AM	0	0	0	**0**	0	5	1	0	**6**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	9	0	0	**9**	0	0	0	0
7:45 AM	0	0	0	**0**	0	3	2	0	**5**	1	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	2	0	**2**	0	0	0	0
8:00 AM	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	2	0	0	**2**	0	1	0	0	**1**	1	0	0	0	**0**	0	0	0	0	**0**	0	7	1	0	**8**	0	0	0	0
8:15 AM	0	0	0	**0**	0	6	0	0	**6**	0	0	0	0	**0**	0	4	0	0	**4**	0	4	0	0	**4**	2	0	0	0	**0**	0	0	0	0	**0**	0	7	0	0	**7**	0	0	0	0
8:30 AM	0	0	0	**0**	0	9	1	0	**10**	0	1	0	0	**1**	0	5	1	0	**6**	0	2	0	0	**2**	0	0	0	0	**0**	0	1	0	0	**1**	0	17	1	0	**18**	0	0	0	0
8:45 AM	0	0	0	**0**	0	3	0	0	**3**	0	2	0	0	**2**	0	4	0	0	**4**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	13	0	0	**13**	0	0	0	0
9:00 AM	0	0	0	**0**	0	3	1	0	**4**	0	1	0	0	**1**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	9	1	0	**10**	0	0	0	0
9:15 AM	0	0	0	**0**	0	5	0	0	**5**	0	1	0	0	**1**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	16	0	0	**16**	0	0	0	0
9:30 AM	0	0	0	**0**	0	12	0	0	**12**	0	4	0	0	**4**	0	3	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	7	1	0	**8**	0	0	0	0
3 hr Total	**1**	**0**	**0**	**1**	**0**	**57**	**5**	**0**	**62**	**2**	**12**	**0**	**0**	**12**	**0**	**26**	**1**	**0**	**27**	**0**	**14**	**0**	**0**	**14**	**3**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**3**	**0**	**97**	**8**	**0**	**105**	**0**	**0**	**0**	**0**
AM Peak	**0**	**0**	**0**	**0**	**0**	**20**	**2**	**0**	**22**	**0**	**5**	**0**	**0**	**5**	**0**	**12**	**1**	**0**	**13**	**0**	**4**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0**	**55**	**2**	**0**	**57**	**0**	**0**	**0**	**0**

TIME (1/4 hr end)	Movement 1					Movement 2					Movement 3					Movement 4					Movement 5					Movement 6					Movement 7					Movement 8					Pedestrian Movements		
	Light Vehicles	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	*Light Vehicles*	*Heavy Vehicles*	*Not Applicable*	***Total***	*Not Applicable*	**A**	**B**	**C**
3:15 PM	0	0	0	**0**	0	7	0	0	**7**	0	5	0	0	**5**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	7	1	0	**8**	0	0	0	0
3:30 PM	0	0	0	**0**	0	8	0	0	**8**	0	2	0	0	**2**	0	3	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	9	1	0	**10**	0	0	0	0
3:45 PM	0	0	0	**0**	0	10	0	0	**10**	0	1	1	0	**2**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	13	0	0	**13**	0	0	0	0
4:00 PM	0	0	0	**0**	0	8	0	0	**8**	0	4	0	0	**4**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	11	2	0	**13**	0	0	0	0
4:15 PM	0	0	0	**0**	0	10	0	0	**10**	0	3	0	0	**3**	0	1	0	0	**1**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	11	3	0	**14**	0	0	0	0
4:30 PM	1	0	0	**1**	0	13	0	0	**13**	0	4	0	0	**4**	0	3	0	0	**3**	0	1	0	0	**1**	0	0	0	0	**0**	0	1	0	0	**1**	0	8	0	0	**8**	0	0	0	0
4:45 PM	0	0	0	**0**	0	9	0	0	**9**	0	2	0	0	**2**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	4	0	0	**4**	0	4	1	0	**5**	0	0	0	0
5:00 PM	0	0	0	**0**	0	10	0	0	**10**	0	2	0	0	**2**	1	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	6	0	0	**6**	0	0	0	0
5:15 PM	0	0	0	**0**	0	10	0	0	**10**	0	5	0	0	**5**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	8	1	0	**9**	0	0	0	0
5:30 PM	0	0	0	**0**	0	11	0	0	**11**	0	4	0	0	**4**	0	1	0	0	**1**	0	1	0	0	**1**	0	0	0	0	**0**	0	1	0	0	**1**	0	7	0	0	**7**	0	0	0	0
5:45 PM	0	0	0	**0**	0	6	1	0	**7**	0	2	0	0	**2**	0	4	0	0	**4**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	13	0	0	**13**	0	0	0	0
6:00 PM	0	0	0	**0**	0	7	0	0	**7**	0	2	0	0	**2**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	1	0	0	**1**	0	5	1	0	**6**	0	0	0	0
3 hr Total	**1**	**0**	**0**	**1**	**0**	**109**	**1**	**0**	**110**	**0**	**36**	**1**	**0**	**37**	**1**	**19**	**0**	**0**	**19**	**0**	**6**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**0**	**10**	**0**	**102**	**10**	**0**	**112**	**0**	**0**	**0**	**0**
PM Peak	**1**	**0**	**0**	**1**	**0**	**41**	**0**	**0**	**41**	**0**	**12**	**1**	**0**	**13**	**0**	**6**	**0**	**0**	**6**	**0**	**3**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**	**0**	**43**	**5**	**0**	**48**	**0**	**0**	**0**	**0**

Summary Statistics

AUSTRALASIAN TRAFFIC SURVEYS

JOB NUMBER 6134 - 1

Suburb Tweed Heads South

CLIENT CEO

SITE Fraser Drive, 60m South of Pioneer Country Homestead Access

SURVEY DATE Tue, 21 Nov 06 Until Mon, 27 Nov 06

		DIRECTION OF TRAVEL		
		TWO-WAY	Northbound	Southbound
TRAFFIC VOLUME:	Weeks Days Only	6,507	3,118	3,389
[VEH/DAY]	7 Days Average	6,175	2,942	3,233
PEAK HOUR **AM**	8:00	744	502	242
VOLUME: **PM**	15:00	573	222	351
TOTAL SPEEDS:	85th Percentile	83.6	72.2	94.1
Km/Hr	Average	76.0	66.6	84.8
PACE SPEED	15Km/h Upper Limit		74.5	90.5
% COMM. VEHICLES:	CLASS 3> %	22.4%	2.5%	40.6%

NOTES : (OBSERVATIONS)

* CLASS 1 - Short Vehicles up to 5.5m

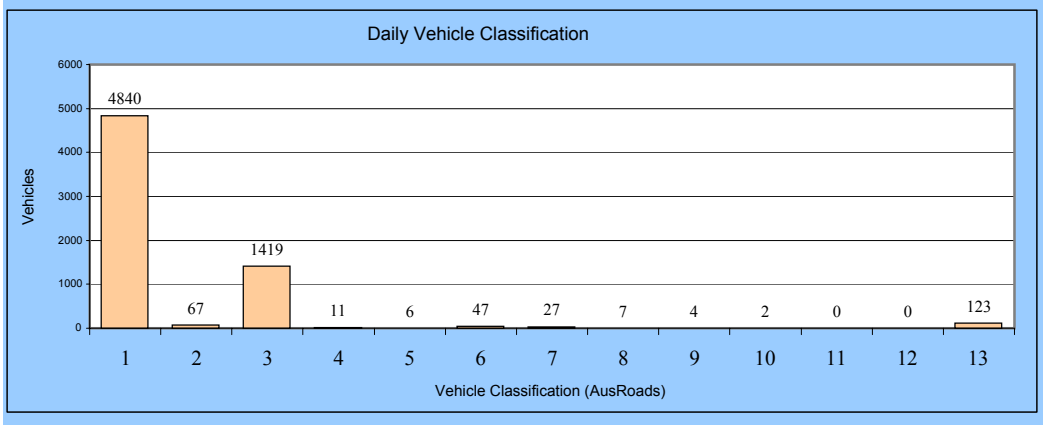
AUSTRALASIAN TRAFFIC SURVEYS

Road	Fraser Drive	AADT	6,553
Location	60m South of Pioneer Country Homestead Access	Ave Speed	76.8
Site No.	1	85%ile	84
Direction	Combined	% Heavy's	23.2%
Day	Thursday	AM Peak	8:00 719
Date	23/11/2006	PM Peak	15:00 594
Start Date	Tuesday 21/11/2006		

Choose Direction: Combined

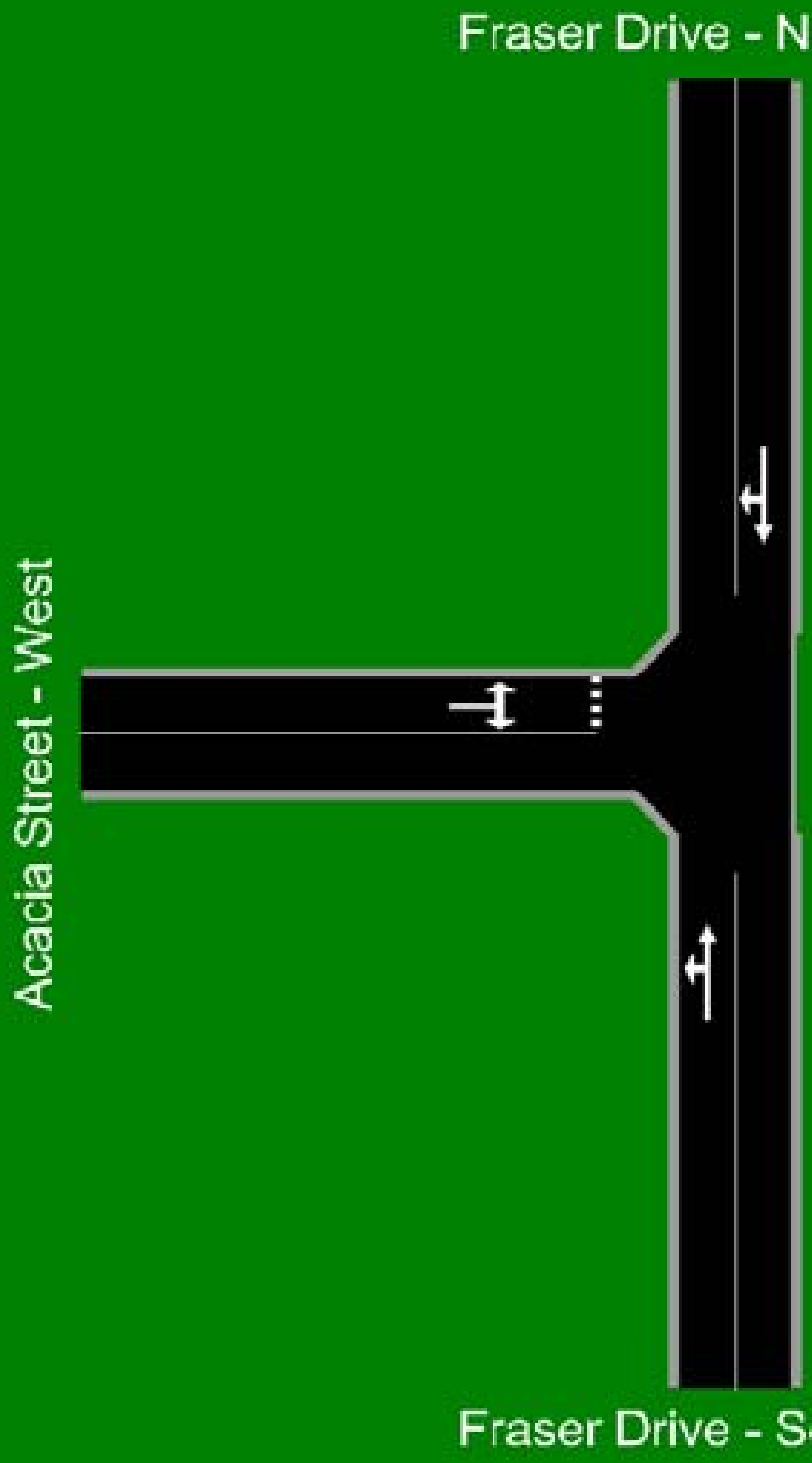
Choose Day: Thursday

Time	Vehicle Classification													Hour	Speed	
Starting	1	2	3	4	5	6	7	8	9	10	11	12	13	Total	Ave.	85%ile
0:00	11	0	5	0	0	0	0	0	0	0	0	0	0	16	90.8	101
1:00	4	0	3	0	0	0	0	0	0	0	0	0	0	7	83.3	93
2:00	4	0	2	0	0	0	0	0	0	0	0	0	0	6	92.3	103
3:00	6	0	0	0	0	0	0	0	0	0	0	0	0	6	72.8	79
4:00	8	0	2	0	0	0	0	0	0	0	0	0	0	10	79.9	87
5:00	33	0	11	0	0	0	0	0	0	0	0	0	0	44	77.8	91
6:00	123	1	30	2	0	0	0	0	1	0	0	0	0	157	73.8	81
7:00	233	10	41	0	0	1	3	1	0	0	0	0	6	295	72.7	81
8:00	572	7	103	1	1	9	3	0	1	0	0	0	22	719	73.3	79
9:00	382	1	82	3	0	2	0	1	0	0	0	0	12	483	72.5	79
10:00	277	8	81	1	0	4	2	1	0	0	0	0	9	383	74.8	82
11:00	247	8	75	0	0	4	2	0	0	0	0	0	3	339	76.1	85
12:00	267	3	88	2	0	2	2	0	1	0	0	0	5	370	75.1	83
13:00	264	5	83	1	1	2	0	0	0	0	0	0	7	363	77.4	84
14:00	363	7	122	0	3	6	1	0	0	0	0	0	13	515	76.1	83
15:00	409	3	153	0	0	4	2	2	0	0	0	0	21	594	77.7	85
16:00	381	6	119	0	0	4	2	1	0	2	0	0	10	525	79.3	87
17:00	364	0	121	0	0	2	5	0	0	0	0	0	3	495	81.1	89
18:00	329	4	106	0	1	6	2	0	0	0	0	0	6	454	77.5	85
19:00	196	2	60	1	0	0	2	1	1	0	0	0	1	264	78.7	88
20:00	137	1	58	0	0	1	1	0	0	0	0	0	5	203	81.7	90
21:00	124	1	39	0	0	0	0	0	0	0	0	0	0	164	81.2	88
22:00	67	0	25	0	0	0	0	0	0	0	0	0	0	92	83.5	92
23:00	39	0	10	0	0	0	0	0	0	0	0	0	0	49	84.1	91
Total	4840	67	1419	11	6	47	27	7	4	2	0	0	123	6553	76.8	84
%Class	74	1	22	0	0	1	0	0	0	0	0	0	2			



Appendix B

aaSIDRA Analysis Summaries


Fraser Drive - North
Acacia Street - West
Fraser Drive - South

721429 Fraser Drive FA06AXU
2006 AM Existing Unsignalized Intersection
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	34	494		528	5				0.296	0.5	0	
	34	494	0	528	5				0.296	0.5		
North: Fraser Drive - North												
1 TR		181	57	238	5				0.174	5.3	12	
	0	181	57	238	5				0.174	5.3	12	
West: Acacia Street - West												
1 LR	131		21	152	5				0.294	13.6	11	
	131	0	21	152	5				0.294	13.6	11	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	918	5	0.296	3.9	12

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA06PXU
2006 PM Existing Unsignalized Intersection
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	11	189		200	5				0.112	0.4	0	
	11	189	0	200	5				0.112	0.4		
North: Fraser Drive - North												
1 TR		300	77	377	5				0.233	2.7	14	
	0	300	77	377	5				0.233	2.7	14	
West: Acacia Street - West												
1 LR	74		18	92	5				0.129	10.0	4	
	74	0	18	92	5				0.129	10.0	4	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	669	5	0.233	3.0	14

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA08AXU
2008 AM Existing Unsignalized Intersection
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	35	534		569	5				0.319	0.5	0	
	35	534	0	569	5				0.319	0.5		
North: Fraser Drive - North												
1 TR		195	59	254	5				0.189	5.8	14	
	0	195	59	254	5				0.189	5.8	14	
West: Acacia Street - West												
1 LR	136		22	158	5				0.332	14.8	13	
	136	0	22	158	5				0.332	14.8	13	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	981	5	0.333	4.2	14

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA08PXU
2008 PM Existing Unsignalized Intersection
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	11	204		215	5				0.120	0.4	0	
	11	204	0	215	5				0.120	0.4		
North: Fraser Drive - North												
1 TR		324	80	404	5				0.250	2.7	16	
	0	324	80	404	5				0.250	2.7	16	
West: Acacia Street - West												
1 LR	77		19	96	5				0.140	10.3	5	
	77	0	19	96	5				0.140	10.3	5	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	715	5	0.250	3.0	16

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA08ADU
2008 AM Background + Devlopment Volumes - Unsignalized
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	35	546		581	5				0.325	0.5	0	
	35	546	0	581	5				0.325	0.5		
North: Fraser Drive - North												
1 TR		200	60	260	5				0.194	6.0	14	
	0	200	60	260	5				0.194	6.0	14	
West: Acacia Street - West												
1 LR	139		22	161	5				0.345	15.2	14	
	139	0	22	161	5				0.345	15.2	14	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1002	5	0.346	4.2	14

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA08PDU
2008 PM Background + Devlopment Volumes - Unsignalized
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	11	209		220	5				0.123	0.4	0	
	11	209	0	220	5				0.123	0.4		
North: Fraser Drive - North												
1 TR		335	82	417	5				0.258	2.8	16	
	0	335	82	417	5				0.258	2.8	16	
West: Acacia Street - West												
1 LR	78		19	97	5				0.144	10.4	5	
	78	0	19	97	5				0.144	10.4	5	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	734	5	0.258	3.1	16

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA18AXU
2018 AM Existing Unsignalized Intersection
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	42	731		773	5				0.433	0.4	0	
	42	731	0	773	5				0.433	0.4		
North: Fraser Drive - North												
1 TR		268	71	339	5				0.286	10.1	30	
	0	268	71	339	5				0.286	10.1	30	
West: Acacia Street - West												
1 LR	162		26	188	5				0.635	27.4	30	
	162	0	26	188	5				0.635	27.4	30	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1300	5	0.635	6.8	30

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA18PXU
2018 PM Existing Unsignalized Intersection
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	14	280		294	5				0.165	0.4	0	
	14	280	0	294	5				0.165	0.4		
North: Fraser Drive - North												
1 TR		444	95	539	5				0.337	3.4	25	
	0	444	95	539	5				0.337	3.4	25	
West: Acacia Street - West												
1 LR	92		22	114	5				0.214	12.4	7	
	92	0	22	114	5				0.214	12.4	7	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	947	5	0.338	3.5	25

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA18ADU
2018 AM Background + Devlopment Volumes - Unsignalized
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	42	743		785	5				0.439	0.4	0	
	42	743	0	785	5				0.439	0.4		
North: Fraser Drive - North												
1 TR		272	71	343	5				0.292	10.4	31	
	0	272	71	343	5				0.292	10.4	31	
West: Acacia Street - West												
1 LR	165		26	191	5				0.662	28.9	32	
	165	0	26	191	5				0.662	28.9	32	
ALL VEHICLES				Total Flow 1319	% HV 5				Max X 0.667	Aver. Delay 7.1	Max Queue 32	

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FA18PDU
2018 PM Background + Devlopment Volumes - Unsignalized
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	14	285		299	5				0.167	0.4	0	
	14	285	0	299	5				0.167	0.4		
North: Fraser Drive - North												
1 TR		455	98	553	5				0.347	3.5	26	
	0	455	98	553	5				0.347	3.5	26	
West: Acacia Street - West												
1 LR	93		22	115	5				0.220	12.6	7	
	93	0	22	115	5				0.220	12.6	7	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	967	5	0.347	3.6	26

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Fraser Drive - North
30
Pioneer Country Access -E
Access A - West
30
Fraser Drive - South

721429 Fraser Drive FD08AMDS
2008 AM Background + Devlopment - Development Access A Proposed Signals
Intersection ID: 2
Fixed-Time Signals, Cycle Time = 150

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 L	4			4	25	1869	82		0.025	24.4	2	30
2 TR		571	2	573	5	1869	82		0.583	23.9	201	
	4	571	2	577	5				0.583	23.9	201	
East: Pioneer Country Access -E												
1 LTR	3	2	3	8	38	1869	16		0.052	72.4	8	
	3	2	3	8	38				0.052	72.4	8	
North: Fraser Drive - North												
1 LT	2	219		221	5	1869	100		0.184	10.0	56	
2 R			4	4	25	1869	12		0.050	78.5	4	30
	2	219	4	225	6				0.184	11.2	56	
West: Access A - West												
1 LTR	8	2	29	39	8	1869	16		0.216	75.6	28	
	8	2	29	39	8				0.216	75.6	28	
Pedestrians												
Across S approach				50			6	7	0.048	62.6	0.2	
Across E approach				50			79		0.008	16.8	0.1	
Across N approach				50			6		0.104	69.1	0.2	
Across W approach				50			79	7	0.007	13.7	0.1	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	849	6	150	0.583	23.4	201

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

Intersection ID: 2
Fixed-Time Signals, Cycle Time = 150

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 L	10			10	10	1869	82		0.056	24.5	4	30
2 TR		209	3	212	5	1869	82		0.220	18.5	69	
	10	209	3	222	5				0.220	18.8	69	
East: Pioneer Country Access -E												
1 LTR	2	2	2	6	50	1869	16		0.042	71.3	6	
	2	2	2	6	50				0.042	71.3	6	
North: Fraser Drive - North												
1 LT	3	346		349	5	1869	100		0.290	10.9	87	
2 R			10	10	10	1869	12		0.113	79.0	8	30
	3	346	10	359	5				0.290	12.8	87	
West: Access A - West												
1 LTR	4	2	13	19	16	1869	16		0.110	74.3	15	
	4	2	13	19	16				0.110	74.3	15	
Pedestrians												
Across S approach				50			6	7	0.048	62.6	0.2	
Across E approach				50			79		0.008	16.8	0.1	
Across N approach				50			6		0.104	69.1	0.2	
Across W approach				50			79	7	0.007	13.7	0.1	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	606	6	150	0.290	17.5	87

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

Intersection ID: 2
Fixed-Time Signals, Cycle Time = 150

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 L	4			4	25	1869	82		0.025	24.4	2	30
2 TR		781	2	783	5	1869	82		0.795	28.9	324	
	4	781	2	787	5				0.795	28.8	324	
East: Pioneer Country Access -E												
1 LTR	4	2	4	10	30	1869	16		0.063	73.1	9	
	4	2	4	10	30				0.063	73.1	9	
North: Fraser Drive - North												
1 LT	2	300		302	5	1869	100		0.251	10.5	75	
2 R			4	4	25	1869	12		0.050	78.5	4	30
	2	300	4	306	6				0.251	11.4	75	
West: Access A - West												
1 LTR	8	2	29	39	8	1869	16		0.216	75.6	28	
	8	2	29	39	8				0.216	75.6	28	
Pedestrians												
Across S approach				50			6	7	0.048	62.6	0.2	
Across E approach				50			79		0.008	16.8	0.1	
Across N approach				50			6		0.104	69.1	0.2	
Across W approach				50			79	7	0.007	13.7	0.1	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	1142	6	150	0.833	26.2	324

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

721429 Fraser Drive FD18PMDS
2018 PM Background + Devlopment - Development Access A Proposed Signals
Intersection ID: 2
Fixed-Time Signals, Cycle Time = 150

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 L	10			10	10	1869	82		0.056	24.5	4	30
2 TR		285	4	289	5	1869	81		0.302	20.1	94	
	10	285	4	299	5				0.302	20.2	94	
East: Pioneer Country Access -E												
1 LTR	2	2	2	6	50	1869	16		0.042	71.3	6	
	2	2	2	6	50				0.042	71.3	6	
North: Fraser Drive - North												
1 LT	4	473		477	5	1869	100		0.396	12.0	121	
2 R			10	10	10	1869	12		0.113	79.0	8	30
	4	473	10	487	5				0.396	13.3	121	
West: Access A - West												
1 LTR	4	2	13	19	16	1869	16		0.110	74.3	15	
	4	2	13	19	16				0.110	74.3	15	
Pedestrians												
Across S approach				50			6	7	0.048	62.6	0.2	
Across E approach				50			79		0.008	16.8	0.1	
Across N approach				50			6		0.104	69.1	0.2	
Across W approach				50			79	7	0.007	13.7	0.1	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	811	6	150	0.400	17.7	121

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

Fraser Drive - North
Vintage Lakes Drive - W
Stradbroke Drive - East
Fraser Drive - South

721429 Fraser Drive FV06AXR
2006 AM Existing Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	40	240		280	5				0.185	5.3	8	
2 TR		233	26	259	5				0.185	5.8	8	
	40	473	26	539	5				0.185	5.5	8	
East: Stradbroke Drive - East												
1 LTR	20	2	16	38	8				0.038	8.2	1	
	20	2	16	38	8				0.038	8.2	1	
North: Fraser Drive - North												
1 LT	3	121		124	6				0.098	5.7	4	115
2 TR		101	19	120	5				0.098	6.5	4	
	3	222	19	244	5				0.098	6.1	4	
West: Vintage Lakes Drive - W												
1 LTR	37	2	125	164	5				0.166	10.3	5	
	37	2	125	164	5				0.166	10.3	5	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	985	5	0.185	6.6	8

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV06PXR
2006 PM Existing Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	97	60		157	5				0.107	5.6	4	
2 TR		116	31	147	5				0.107	6.3	4	
	97	176	31	304	5				0.107	5.9	4	
East: Stradbroke Drive - East												
1 LTR	20	3	3	26	12				0.027	6.3	1	
	20	3	3	26	12				0.027	6.3	1	
North: Fraser Drive - North												
1 LT	16	155		171	5				0.129	5.5	5	115
2 TR		137	31	168	5				0.129	6.4	5	
	16	292	31	339	5				0.129	5.9	5	
West: Vintage Lakes Drive - W												
1 LTR	14	3	59	76	7				0.070	9.6	2	
	14	3	59	76	7				0.070	9.6	2	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	745	6	0.129	6.3	5

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV08AXR
2008 AM Existing Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	43	260		303	5				0.200	5.4	8	
2 TR		251	28	279	5				0.200	5.8	8	
	43	511	28	582	5				0.200	5.6	8	
East: Stradbroke Drive - East												
1 LTR	54	2	17	73	7				0.073	7.3	2	
	54	2	17	73	7				0.073	7.3	2	
North: Fraser Drive - North												
1 LT	3	126		129	6				0.107	5.8	4	115
2 TR		114	21	135	5				0.107	6.5	4	
	3	240	21	264	5				0.107	6.1	4	
West: Vintage Lakes Drive - W												
1 LTR	40	2	135	177	6				0.182	10.4	5	
	40	2	135	177	6				0.182	10.4	5	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1096	5	0.200	6.6	8

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV08PXR
2008 PM Existing Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	105	65		170	5				0.115	5.6	5	
2 TR		126	32	158	5				0.115	6.3	5	
	105	191	32	328	5				0.115	5.9	5	
East: Stradbroke Drive - East												
1 LTR	22	3	3	28	11				0.030	6.3	1	
	22	3	3	28	11				0.030	6.3	1	
North: Fraser Drive - North												
1 LT	17	168		185	5				0.139	5.5	6	115
2 TR		147	33	180	5				0.139	6.4	6	
	17	315	33	365	5				0.139	6.0	6	
West: Vintage Lakes Drive - W												
1 LTR	15	3	64	82	6				0.075	9.7	2	
	15	3	64	82	6				0.075	9.7	2	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	803	5	0.139	6.3	6

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV08ADR
2008 AM Background + Development Volumes - Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	48	263		311	5				0.205	5.4	9	
2 TR		258	28	286	5				0.205	5.8	9	
	48	521	28	597	5				0.205	5.6	9	
East: Stradbroke Drive - East												
1 LTR	54	2	17	73	7				0.074	7.4	2	
	54	2	17	73	7				0.074	7.4	2	
North: Fraser Drive - North												
1 LT	3	140		143	5				0.120	5.8	5	115
2 TR		129	21	150	5				0.120	6.5	5	
	3	269	21	293	5				0.120	6.2	5	
West: Vintage Lakes Drive - W												
1 LTR	42	2	149	193	5				0.198	10.4	6	
	42	2	149	193	5				0.198	10.4	6	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1156	5	0.205	6.6	9

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV08PDR
2008 PM Background + Development Volumes - Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	118	71		189	5				0.128	5.6	5	
2 TR		145	32	177	5				0.128	6.2	5	
	118	216	32	366	5				0.128	5.9	5	
East: Stradbroke Drive - East												
1 LTR	22	3	3	28	11				0.030	6.4	1	
	22	3	3	28	11				0.030	6.4	1	
North: Fraser Drive - North												
1 LT	17	178		195	5				0.145	5.6	6	115
2 TR		150	36	186	5				0.145	6.5	6	
	17	328	36	381	5				0.145	6.0	6	
West: Vintage Lakes Drive - W												
1 LTR	16	3	71	90	7				0.084	9.8	2	
	16	3	71	90	7				0.084	9.8	2	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	865	5	0.145	6.4	6

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV18AXR
2018 AM Existing Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	59	356		415	5				0.277	5.4	13	
2 TR		344	38	382	5				0.277	5.9	13	
	59	700	38	797	5				0.277	5.6	13	
East: Stradbroke Drive - East												
1 LTR	74	2	24	100	6				0.106	7.7	3	
	74	2	24	100	6				0.106	7.7	3	
North: Fraser Drive - North												
1 LT	4	172		176	5				0.154	6.1	7	115
2 TR		157	28	185	5				0.154	6.7	7	
	4	329	28	361	5				0.154	6.4	7	
West: Vintage Lakes Drive - W												
1 LTR	55	2	185	242	5				0.264	10.9	8	
	55	2	185	242	5				0.264	10.9	8	
ALL VEHICLES				Total Flow	% HV				Max X	Aver. Delay	Max Queue	
				1500	5				0.277	6.8	13	

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV18PXR
2018 PM Existing Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	144	87		231	5				0.159	5.7	7	
2 TR		173	44	217	5				0.159	6.3	7	
	144	260	44	448	5				0.159	6.0	7	
East: Stradbroke Drive - East												
1 LTR	31	4	4	39	10				0.043	6.7	1	
	31	4	4	39	10				0.043	6.7	1	
North: Fraser Drive - North												
1 LT	24	233		257	5				0.195	5.7	8	115
2 TR		199	46	245	5				0.195	6.6	8	
	24	432	46	502	5				0.195	6.1	8	
West: Vintage Lakes Drive - W												
1 LTR	21	4	87	112	5				0.106	9.9	3	
	21	4	87	112	5				0.106	9.9	3	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1101	5	0.195	6.5	8

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV18ADR
2018 AM Background + Development Volumes - Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	64	360		424	5				0.283	5.4	13	
2 TR		351	38	389	5				0.283	5.9	13	
	64	711	38	813	5				0.283	5.6	13	
East: Stradbroke Drive - East												
1 LTR	74	2	24	100	6				0.108	7.8	3	
	74	2	24	100	6				0.108	7.8	3	
North: Fraser Drive - North												
1 LT	4	186		190	5				0.168	6.1	7	115
2 TR		172	29	201	5				0.168	6.7	8	
	4	358	29	391	5				0.168	6.4	8	
West: Vintage Lakes Drive - W												
1 LTR	57	2	199	258	5				0.283	10.9	9	
	57	2	199	258	5				0.283	10.9	9	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1562	5	0.283	6.9	13

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FV18PDR
2018 PM Background + Development Volumes - Roundabout
Intersection ID: 3
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	156	96		252	5				0.173	5.7	7	
2 TR		191	44	235	5				0.173	6.3	7	
	156	287	44	487	5				0.173	6.0	7	
East: Stradbroke Drive - East												
1 LTR	31	4	4	39	10				0.044	6.7	1	
	31	4	4	39	10				0.044	6.7	1	
North: Fraser Drive - North												
1 LT	24	241		265	5				0.202	5.7	9	115
2 TR		204	48	252	5				0.202	6.6	9	
	24	445	48	517	5				0.202	6.2	9	
West: Vintage Lakes Drive - W												
1 LTR	22	4	94	120	6				0.115	10.0	3	
	22	4	94	120	6				0.115	10.0	3	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1163	5	0.202	6.5	9

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Vintage Lakes Drive - N
Merlot Drive - West
Merlot Drive - East
Vintage Lakes Drive - S

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	2	2	4	8	38				0.009	7.9	0	
	2	2	4	8	38				0.009	7.9	0	
East: Merlot Drive - East												
1 LTR	2	52	12	66	8				0.043	5.3	2	
	2	52	12	66	8				0.043	5.3	2	
North: Vintage Lakes Drive - N												
1 LTR	19	2	2	23	13				0.022	6.3	1	
	19	2	2	23	13				0.022	6.3	1	
West: Merlot Drive - West												
1 LTR	3	131	2	136	7				0.095	4.6	4	
	3	131	2	136	7				0.095	4.6	4	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	233	9	0.095	5.1	4

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	3	2	4	9	33				0.010	8.0	1	
	3	2	4	9	33				0.010	8.0	1	
East: Merlot Drive - East												
1 LTR	5	108	20	133	5				0.084	5.2	4	
	5	108	20	133	5				0.084	5.2	4	
North: Vintage Lakes Drive - N												
1 LTR	11	2	3	16	19				0.015	6.2	1	
	11	2	3	16	19				0.015	6.2	1	
West: Merlot Drive - West												
1 LTR	2	53	2	57	9				0.044	4.7	2	
	2	53	2	57	9				0.044	4.7	2	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	215	8	0.084	5.3	4

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	2	2	4	8	38				0.009	7.9	0	
	2	2	4	8	38				0.009	7.9	0	
East: Merlot Drive - East												
1 LTR	2	54	12	68	7				0.044	5.3	2	
	2	54	12	68	7				0.044	5.3	2	
North: Vintage Lakes Drive - N												
1 LTR	20	2	2	24	13				0.023	6.3	1	
	20	2	2	24	13				0.023	6.3	1	
West: Merlot Drive - West												
1 LTR	3	136	2	141	6				0.098	4.6	4	
	3	136	2	141	6				0.098	4.6	4	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	241	8	0.098	5.1	4

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	3	2	4	9	33				0.010	8.1	1	
	3	2	4	9	33				0.010	8.1	1	
East: Merlot Drive - East												
1 LTR	5	112	21	138	6				0.087	5.2	4	
	5	112	21	138	6				0.087	5.2	4	
North: Vintage Lakes Drive - N												
1 LTR	11	2	3	16	19				0.015	6.2	1	
	11	2	3	16	19				0.015	6.2	1	
West: Merlot Drive - West												
1 LTR	2	55	2	59	8				0.046	4.7	2	
	2	55	2	59	8				0.046	4.7	2	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	222	9	0.087	5.3	4

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

2008 AM Background + Development Volumes - Roundabout
Intersection ID: 4
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	2	2	4	8	38				0.009	8.0	0	
	2	2	4	8	38				0.009	8.0	0	
East: Merlot Drive - East												
1 LTR	2	56	16	74	7				0.048	5.5	2	
	2	56	16	74	7				0.048	5.5	2	
North: Vintage Lakes Drive - N												
1 LTR	29	2	2	33	9				0.031	6.3	1	
	29	2	2	33	9				0.031	6.3	1	
West: Merlot Drive - West												
1 LTR	3	142	2	147	6				0.103	4.6	5	
	3	142	2	147	6				0.103	4.6	5	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	262	8	0.103	5.2	5

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Intersection ID: 4
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	3	2	4	9	33				0.010	8.2	1	
	3	2	4	9	33				0.010	8.2	1	
East: Merlot Drive - East												
1 LTR	5	117	29	151	5				0.095	5.4	4	
	5	117	29	151	5				0.095	5.4	4	
North: Vintage Lakes Drive - N												
1 LTR	15	2	3	20	15				0.018	6.1	1	
	15	2	3	20	15				0.018	6.1	1	
West: Merlot Drive - West												
1 LTR	2	60	2	64	8				0.050	4.7	2	
	2	60	2	64	8				0.050	4.7	2	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	244	8	0.095	5.4	4

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive VM18AXR
2018 AM Existing Roundabout
Intersection ID: 4
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	2	2	5	9	33				0.010	8.3	0	
	2	2	5	9	33				0.010	8.3	0	
East: Merlot Drive - East												
1 LTR	2	64	15	81	6				0.052	5.4	2	
	2	64	15	81	6				0.052	5.4	2	
North: Vintage Lakes Drive - N												
1 LTR	24	2	2	28	11				0.027	6.4	1	
	24	2	2	28	11				0.027	6.4	1	
West: Merlot Drive - West												
1 LTR	3	162	2	167	6				0.116	4.6	5	
	3	162	2	167	6				0.116	4.6	5	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	285	7	0.116	5.1	5

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	2	66	2	70	7				0.064	5.4	3	
	2	66	2	70	7				0.064	5.4	3	
East: Merlot Drive - East												
1 LTR	6	134	25	165	5				0.103	5.2	5	
	6	134	25	165	5				0.103	5.2	5	
North: Vintage Lakes Drive - N												
1 LTR	12	2	3	17	18				0.016	6.2	1	
	12	2	3	17	18				0.016	6.2	1	
West: Merlot Drive - West												
1 LTR	2	66	2	70	7				0.060	5.0	3	
	2	66	2	70	7				0.060	5.0	3	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	322	7	0.103	5.3	5

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

2018 AM Background + Development Volumes - Roundabout
Intersection ID: 4
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	2	2	5	9	33				0.010	8.3	0	
	2	2	5	9	33				0.010	8.3	0	
East: Merlot Drive - East												
1 LTR	2	66	18	86	6				0.055	5.5	3	
	2	66	18	86	6				0.055	5.5	3	
North: Vintage Lakes Drive - N												
1 LTR	33	2	2	37	11				0.035	6.5	2	
	33	2	2	37	11				0.035	6.5	2	
West: Merlot Drive - West												
1 LTR	3	168	2	173	6				0.122	4.6	6	
	3	168	2	173	6				0.122	4.6	6	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	305	7	0.121	5.2	6

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Intersection ID: 4
Roundabout

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

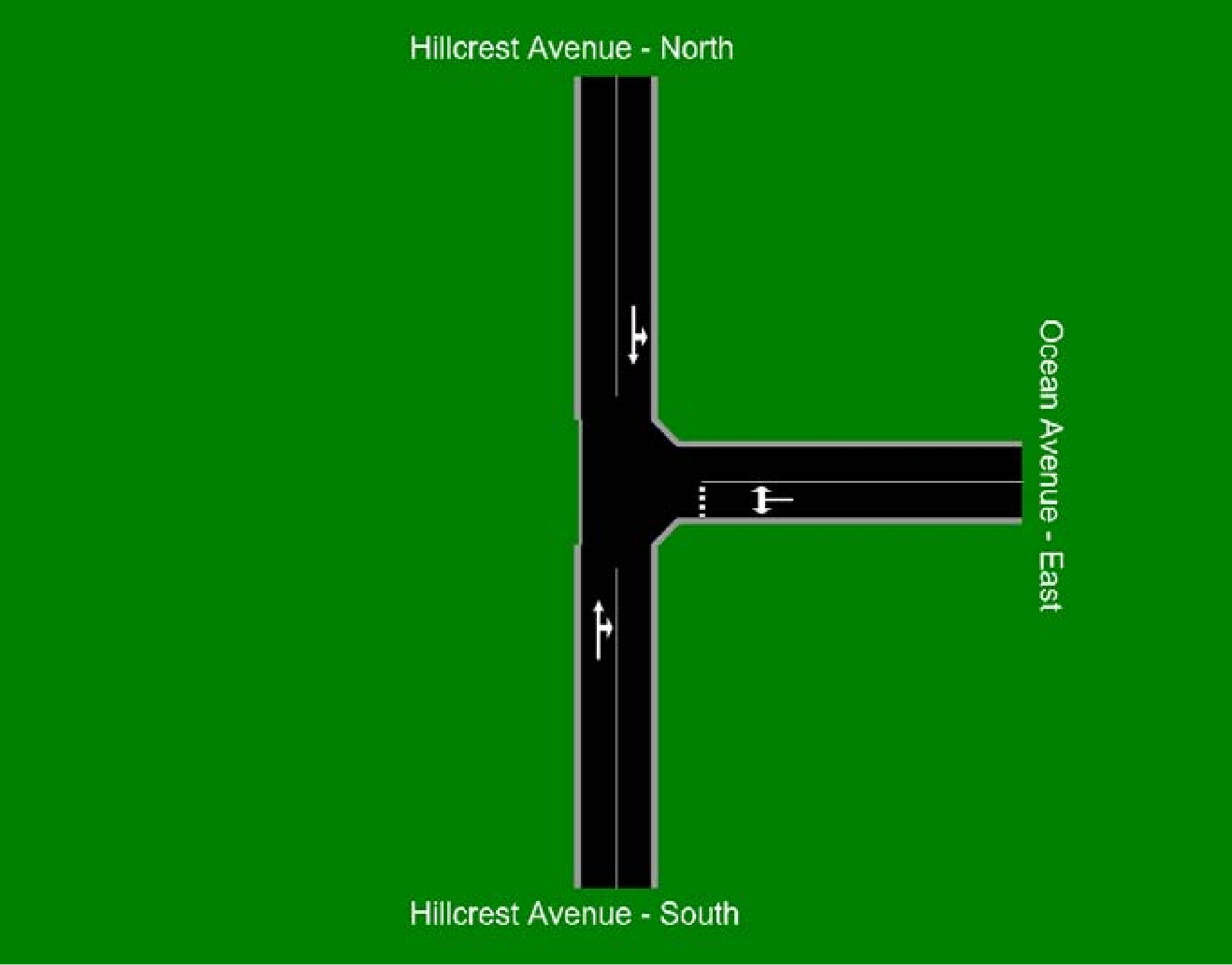
Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Vintage Lakes Drive - S												
1 LTR	3	2	5	10	30				0.012	8.6	1	
	3	2	5	10	30				0.012	8.6	1	
East: Merlot Drive - East												
1 LTR	6	139	33	178	6				0.111	5.4	5	
	6	139	33	178	6				0.111	5.4	5	
North: Vintage Lakes Drive - N												
1 LTR	17	2	3	22	14				0.020	6.1	1	
	17	2	3	22	14				0.020	6.1	1	
West: Merlot Drive - West												
1 LTR	2	71	2	75	8				0.059	4.7	3	
	2	71	2	75	8				0.059	4.7	3	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	285	8	0.111	5.4	5

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.


Hillcrest Avenue - North
Ocean Avenue - East
Hillcrest Avenue - South

721429 Fraser Drive HO06AXU
2006 AM Existing Unsignalized Intersection
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		57	3	60	7				0.035	0.4	2	
	0	57	3	60	7				0.035	0.4	2	
East: Ocean Avenue - East												
1 LR	5		13	18	11				0.022	7.4	1	
	5	0	13	18	11				0.022	7.4	1	
North: Hillcrest Avenue - North												
1 LT	6	22		28	7				0.016	1.4	0	
	6	22	0	28	7				0.016	1.4		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	106	8	0.035	1.8	2

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive HO06PXU
2006 PM Existing Unsignalized Intersection
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		48	3	51	6				0.030	0.6	2	
	0	48	3	51	6				0.030	0.6	2	
East: Ocean Avenue - East												
1 LR	4		7	11	18				0.014	7.5	1	
	4	0	7	11	18				0.014	7.5	1	
North: Hillcrest Avenue - North												
1 LT	13	42		55	5				0.031	1.5	0	
	13	42	0	55	5				0.031	1.5		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	117	7	0.031	1.7	2

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive HO08AXU
2008 AM Existing Unsignalized Intersection
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		59	3	62	6				0.036	0.4	2	
	0	59	3	62	6				0.036	0.4	2	
East: Ocean Avenue - East												
1 LR	5		14	19	11				0.023	7.4	1	
	5	0	14	19	11				0.023	7.4	1	
North: Hillcrest Avenue - North												
1 LT	6	23		29	7				0.017	1.4	0	
	6	23	0	29	7				0.017	1.4		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	110	7	0.036	1.8	2

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive HO08PXU
2008 PM Existing Unsignalized Intersection
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		51	3	54	7				0.031	0.6	2	
	0	51	3	54	7				0.031	0.6	2	
East: Ocean Avenue - East												
1 LR	4		7	11	18				0.014	7.5	1	
	4	0	7	11	18				0.014	7.5	1	
North: Hillcrest Avenue - North												
1 LT	14	44		58	5				0.033	1.6	0	
	14	44	0	58	5				0.033	1.6		
ALL VEHICLES				Total Flow	% HV				Max X	Aver. Delay	Max Queue	
				123	7				0.033	1.7	2	

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive HO08ADU
2008 AM Background + Development Volumes - Existing Unsignalized
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		59	5	64	6				0.037	0.6	2	
	0	59	5	64	6				0.037	0.6	2	
East: Ocean Avenue - East												
1 LR	9		16	25	8				0.029	7.3	1	
	9	0	16	25	8				0.029	7.3	1	
North: Hillcrest Avenue - North												
1 LT	7	26		33	6				0.019	1.4	0	
	7	26	0	33	6				0.019	1.4		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	122	7	0.037	2.2	2

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

2008 PM Background + Development Volumes - Existing Unsignalized
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		51	10	61	7				0.036	1.3	2	
	0	51	10	61	7				0.036	1.3	2	
East: Ocean Avenue - East												
1 LR	6		8	14	14				0.017	7.5	1	
	6	0	8	14	14				0.017	7.5	1	
North: Hillcrest Avenue - North												
1 LT	15	45		60	5				0.034	1.6	0	
	15	45	0	60	5				0.034	1.6		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	135	7	0.036	2.1	2

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive HO18AXU
2018 AM Existing Unsignalized Intersection
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		71	3	74	7				0.043	0.4	3	
	0	71	3	74	7				0.043	0.4	3	
East: Ocean Avenue - East												
1 LR	6		16	22	9				0.027	7.5	1	
	6	0	16	22	9				0.027	7.5	1	
North: Hillcrest Avenue - North												
1 LT	7	27		34	6				0.019	1.3	0	
	7	27	0	34	6				0.019	1.3		
ALL VEHICLES				Total Flow 130	% HV 7				Max X 0.043	Aver. Delay 1.8	Max Queue 3	

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive HO18PXU
2018 PM Existing Unsignalized Intersection
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		67	3	70	6				0.040	0.6	3	
	0	67	3	70	6				0.040	0.6	3	
East: Ocean Avenue - East												
1 LR	5		8	13	15				0.017	7.7	1	
	5	0	8	13	15				0.017	7.7	1	
North: Hillcrest Avenue - North												
1 LT	16	52		68	6				0.039	1.5	0	
	16	52	0	68	6				0.039	1.5		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	151	7	0.040	1.6	3

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive HO18ADU
2018 AM Background + Development Volumes - Existing Unsignalized
Intersection ID: 7
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		71	6	77	6				0.045	0.6	2	
	0	71	6	77	6				0.045	0.6	2	
East: Ocean Avenue - East												
1 LR	10		19	29	7				0.034	7.5	1	
	10	0	19	29	7				0.034	7.5	1	
North: Hillcrest Avenue - North												
1 LT	8	31		39	8				0.022	1.3	0	
	8	31	0	39	8				0.022	1.3		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	145	7	0.045	2.2	2

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive HO18PDU
2018 PM Background + Development Volumes - Existing Unsignalized
Intersection ID: 7
Give-Way Sign Controlled Intersection

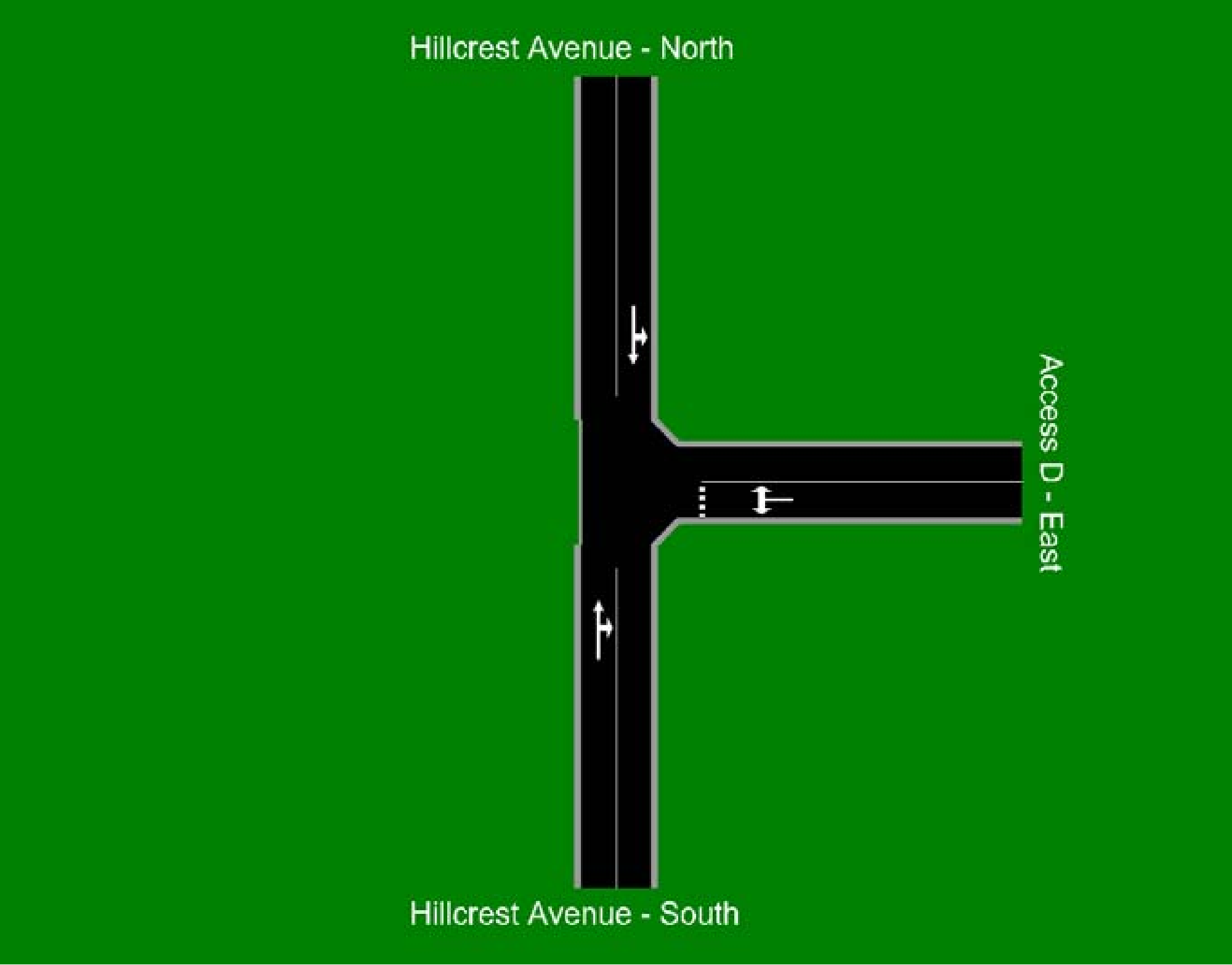
Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 TR		60	10	70	6				0.041	1.2	2	
	0	60	10	70	6				0.041	1.2	2	
East: Ocean Avenue - East												
1 LR	6		9	15	13				0.019	7.7	1	
	6	0	9	15	13				0.019	7.7	1	
North: Hillcrest Avenue - North												
1 LT	17	54		71	6				0.040	1.6	0	
	17	54	0	71	6				0.040	1.6		
ALL VEHICLES				Total Flow	% HV				Max X	Aver. Delay	Max Queue	
				156	6				0.041	2.0	2	

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.


Hillcrest Avenue - North
Access D - East
Hillcrest Avenue - South

721429 Fraser Drive FB08ADU
2008 AM Background + Development Volumes - Development Access B
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	7	574		581	5				0.325	0.1	0	
	7	574	0	581	5				0.325	0.1		
North: Fraser Drive - North												
1 T		219		219	5				0.122	0.0	0	
	0	219	0	219	5				0.122	0.0		
West: Development Access B - W												
1 L	4			4	25				0.010	13.5	0	
	4	0	0	4	25				0.010	13.5	0	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	804	5	0.325	0.1	0

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FB08PDU
2008 PM Background + Development Volumes - Development Access B
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	17	217		234	5				0.131	0.6	0	
	17	217	0	234	5				0.131	0.6		
North: Fraser Drive - North												
1 T		346		346	5				0.193	0.0	0	
	0	346	0	346	5				0.193	0.0		
West: Development Access B - W												
1 L	2			2	50				0.003	9.5	0	
	2	0	0	2	50				0.003	9.5	0	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	582	5	0.193	0.3	0

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FB18ADU
2018 AM Background + Development Volumes - Development Access B
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	7	784		791	5				0.442	0.1	0	
	7	784	0	791	5				0.442	0.1		
North: Fraser Drive - North												
1 T		300		300	5				0.167	0.0	0	
	0	300	0	300	5				0.167	0.0		
West: Development Access B - W												
1 L	4			4	25				0.016	19.4	1	
	4	0	0	4	25				0.016	19.4	1	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	1095	5	0.442	0.1	1

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Fraser Drive FB18PDU
2018 PM Background + Development Volumes - Development Access B
Intersection ID: 1
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

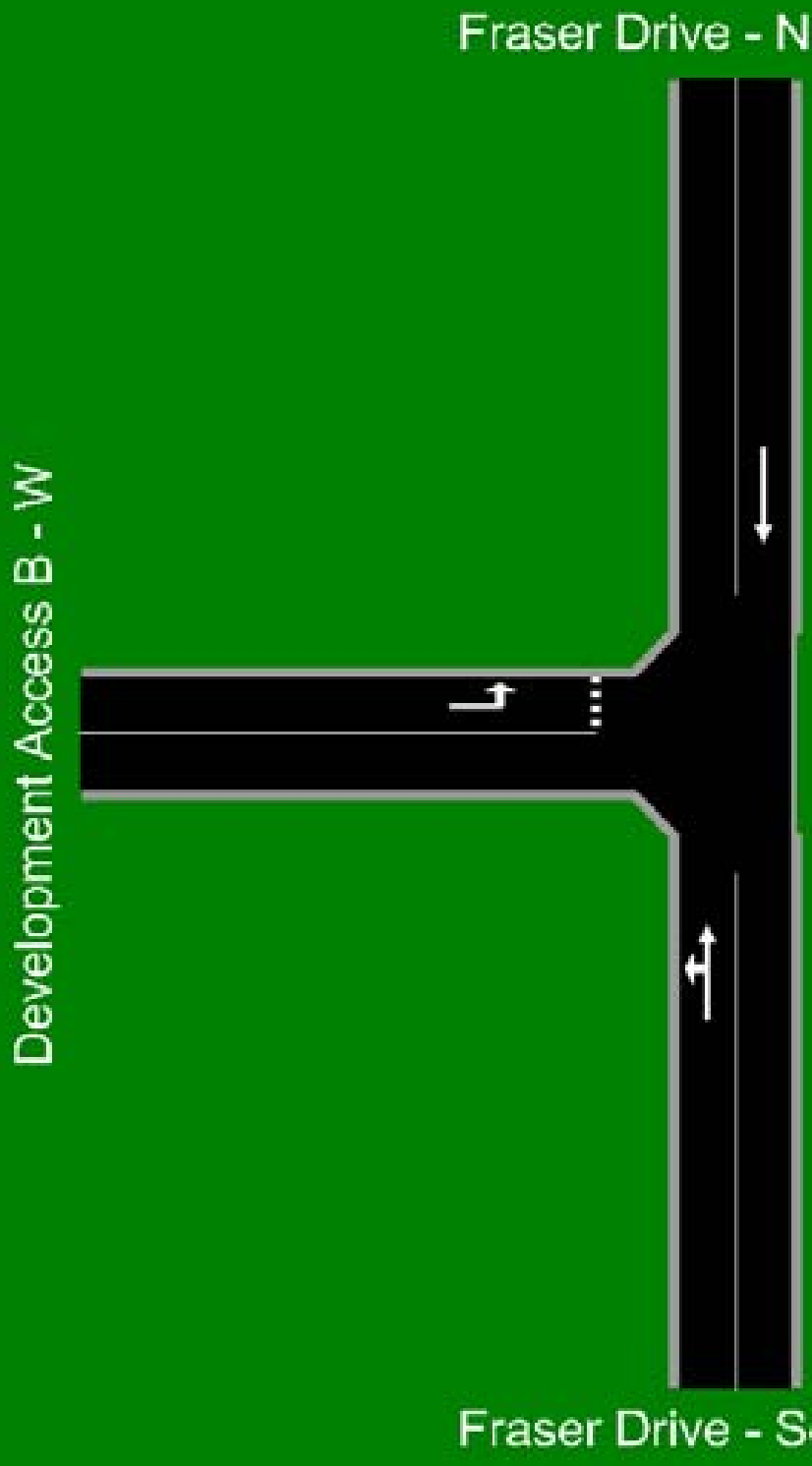
Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Fraser Drive - South												
1 LT	17	294		311	5				0.174	0.4	0	
	17	294	0	311	5				0.174	0.4		
North: Fraser Drive - North												
1 T		473		473	5				0.264	0.0	0	
	0	473	0	473	5				0.264	0.0		
West: Development Access B - W												
1 L	2			2	50				0.004	10.6	0	
	2	0	0	2	50				0.004	10.6	0	

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	786	5	0.264	0.2	0

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.


Fraser Drive - North
Development Access B - W
Fraser Drive - South

Intersection ID: 8
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 T		75		75	5				0.042	0.0	0	
	0	75	0	75	5				0.042	0.0		
East: Access D - East												
1 L	4			4	25				0.004	6.7	0	
	4	0	0	4	25				0.004	6.7	0	
North: Hillcrest Avenue - North												
1 LT	2	28		30	7				0.017	0.4	0	
	2	28	0	30	7				0.017	0.4		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	109	6	0.042	0.4	0

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 T		57		57	5				0.032	0.0	0	
	0	57	0	57	5				0.032	0.0		
East: Access D - East												
1 L	3			3	33				0.003	6.8	0	
	3	0	0	3	33				0.003	6.8	0	
North: Hillcrest Avenue - North												
1 LT	2	57		59	7				0.033	0.2	0	
	2	57	0	59	7				0.033	0.2		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	119	7	0.033	0.3	0

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 T		89		89	4				0.050	0.0	0	
	0	89	0	89	4				0.050	0.0		
East: Access D - East												
1 L	4			4	25				0.004	6.7	0	
	4	0	0	4	25				0.004	6.7	0	
North: Hillcrest Avenue - North												
1 LT	2	33		35	9				0.020	0.4	0	
	2	33	0	35	9				0.020	0.4		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	128	6	0.050	0.3	0

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

721429 Frasier Drive HD18PDU
2018 PM Background + Development Volumes - Development Access D
Intersection ID: 8
Give-Way Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Hillcrest Avenue - South												
1 T		68		68	4				0.038	0.0	0	
	0	68	0	68	4				0.038	0.0		
East: Access D - East												
1 L	3			3	33				0.004	6.9	0	
	3	0	0	3	33				0.004	6.9	0	
North: Hillcrest Avenue - North												
1 LT	2	68		70	6				0.039	0.2	0	
	2	68	0	70	6				0.039	0.2		

ALL VEHICLES	Total Flow	% HV	Max X	Aver. Delay	Max Queue
	141	6	0.039	0.2	0

Total flow period = 60 minutes. Peak flow period = 60 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Appendix 15

Visual Assessment Report

VISUAL ASSESSMENT REPORT

Fraser Drive, Tweed Heads South

Client:

VILLA WORLD PTY LTD

Prepared by:

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December 2006

Document: 71887_R_VA_01_01.doc

ISSUE	AMENDMENT/REVISION DETAILS	DATE	SIGNED OFF
01	Client / Consultant Coordination	01.12.2006	GMP
02	**Development Application Submission**	**07.12.2006**	**GMP**

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1.0 BACKGROUND

This report has been prepared to evaluate the visual impact of the proposed residential subdivision development as per the layout in Appendix A when viewed from key points in the surrounding area.

The development proposed is to be located on the following lot:

Lot 6 on DP 1039569, Fraser Drive, Tweed South

This report is divided into the following sections:

- Methodology – describing the method used to determine the probable visual impact;
- Findings – the assessment of the visual impact utilising the described methodology;
- Synthesis – the collation of the findings to form assumptions and reach conclusions to enable recommendations to be developed; and,
- Recommendations – proposed development guidelines, which will minimise the visual impact of the proposed development.

2.0 METHODOLOGY

The methodology employed in this study uses traditional desktop and site analysis techniques. The scale of the study is local, with local vantage points and visual impacts used as the basis for the analysis.

2.1 BACKGROUND MATERIAL

A review of the relevant documents and reports have informed the visual assessment and provide the policy framework for this report:

- Coastal Design Guidelines for NSW
- NSW Coastal policy 1997
- Fraser Drive Preliminary Environmental Assessment Report

2.2 DESKTOP ANALYSIS

A contextual analysis was performed which utilised aerial photographs and local maps. By examining the site topography it was possible to identify key vantage points from which the subject site would be visible. The local maps identified the land uses in these areas allowing assumptions to be made about the likely visual impact of the proposed development.

2.3 SITE VISIT

A site visit was conducted on the 21st of November, 2006. Photographic records were taken both from the site at key points and to the site from viewpoints in the surrounding areas. A site analysis was conducted to identify any factors relevant to the visual assessment such as quality and appearance of vegetation, character of local area, existing buildings and land uses etc.

2.4 SYNTHESIS

Once the information was collated the following synthesis tasks were conducted:

- Assessment of **landscape sensitivity** by defining character precincts, slope analysis and visual prominence.
- Determination of **visual absorption capacity** within the site to mitigate visual impacts of the proposed residential development
- Analysis of the visual **constraints and opportunities** on the site

2.5 RECOMMENDATIONS

Once the information was gathered and synthesised, recommendations were made to minimise any visual impact of the proposed development to allow the retention of the landscape character of the area. Development strategies have been formulated that cover site planning, lot planning and plant species and materials selection considerations.

3.0 FINDINGS

3.1 BACKGROUND MATERIAL REVIEW

- The 1997 Coastal Policy highlights new directions for coastal management, planning and conservation in NSW. In particular, it addresses protection and enhancement of aesthetic qualities of the coastal zone. The policies relevant to the visual analysis of the subject site involve designing and locating development to complement the surrounding environment and to recognise good aesthetic qualities.

- The Coastal Design Guidelines for NSW identifies Tweed Heads as a 'coastal city. The guidelines outlines visual sensitivity in terms of the views of public reserves and conservation areas, views of and vistas from and to the coast, rivers and other water bodies and coastal vegetation, views and vistas of headlands, escarpments and mountains and other natural features, and vistas of the surrounding rural and natural lands. It directs that all views from public places are retained and reinstated, where they have been lost through inappropriately located development. The visual quality of the settlement is designed as part of an overall desired future outcome or vision.

- The Fraser Drive – Preliminary Environmental Assessment Report outlines the results of a number of environmental, engineering and urban design studies conducted on the subject site. The report highlights constraints to development on the site - particularly with regards to slope, visual impacts and ecological issues. The report makes assessments into viability of the development given these constraints and makes recommendations for appropriate development solutions.

3.2 DESKTOP ANAYSIS

The subject site is located 7kms south-east of Coolangatta and 4kms inland of the coast line of NSW. The site lies in the suburb of Tweed Heads South.

A study of aerial photographs and mapping data revealed that the site is located in a RURAL residential setting.

It is also noted that the top of the ridgeline had been previously developed with existing homes lining the ridgeline. Homes are set down just in front of both sides of the ridgeline facing east over the coastline and west over the Terranora Broadwater. These existing residential homes are exposed and visible from the north-east. Views from the east are screened by the opposite ridgeline contained in Pioneer Country. Views from the south-east are screened by the ridgeline to the south of the development site. Part A of the development is at a considerably lower level to that of Part B and the ridgeline. Views towards the ridgeline will also need to be addressed.

The two high points of the site are located to the west along the property boundary, adjacent to Ocean Avenue and Seaview Street. The northern boundary faces the Lakeside Christian High School. The ridgeline along Hillcrest Avenue, Ridgeway Street, Ocean Avenue and Seaview Street provides a number of vantage points for observing views from the site towards Coolangatta and the coastline.

3.3 SITE VISIT

A site analysis was performed to provide the framework for visual analysis. Refer to Appendix D for a summary of the views photographed surrounding and within the site which are referred to in the following sections of this report.

3.3.1 TOPOGRAPHY

The western and southern boundary of the site is positioned at the top of a ridgeline sloping down to the east. The eastern side of the site is flat with a flat plan to the north of the site. There is a SEPP 14 wetland located in the north-western corner of the site. This area is isolated from other significant vegetation corridors and is connected to the Terranora Broadwater via a drainage corridor through James Road.

3.3.2 VEGETATION

The lower, eastern portion (Part A) of the site has been predominantly cleared with some canopy trees remaining.

The undulating and sloping topography of Part B of the development contains largely tree species There is very little understorey and the general appearance of vegetation in this area is grass and tall native and exotic trees.

The density of vegetation, typically made up of Melaleuca and Casuarina species, is highest to the wetland.

3.3.3 NEIGHBOURHOOD CHARACTER / CONTEXT

The existing character of the area is rural residential with old and new housing estates established throughout the local vicinity.

Houses are established along both sides of the ridgeline (refer image A). The proposed development would therefore not contribute further to the view of the ridgeline from any surrounding public or private location, however, the following visual analysis will provide recommendations as to how it could be improved.

Image A- View from the lower, Part A, portion of the site looking south up to the existing settlement on Seaview Street.

Located opposite the development site on Fraser drive is a visually prominent tourist homestead property. To the north of this tourist node are two more recent housing developments, one of which is a gated community level with Fraser Drive, the other located on a slope facing the proposed development. There is a distinct lack of neighbourhood character, however, Fraser Drive does provide a more rural feel considering the surrounding suburbs of Banora Point and Coolangatta are high density residential areas.

3.3.4 VIEWS

Views were observed and recorded both from and to the site during the site visit (refer Appendix D). Views from the ridgeline on the western boundary to the ridgelines east and north-east of Fraser Drive in Pioneer Country and further out towards Coolangatta were observed (refer image 1).

Image 1- View from Hillcrest Avenue to ridgelines to the east

The southern area of the site is highly visible when travelling north along Fraser Drive due to the road sloping up towards the site (refer to Image 2).

Image 2 - View from Fraser Drive at the south-eastern most tip of the development and at the base of the road reserve

Views of the subject site when travelling south along Fraser Drive are visually absorbed by the vegetation that lines the sides of the road. Existing eucalypt species on the eastern side of the road and the street trees on the western side create a gun-barrel effect which focuses one view of the subject site (refer image 3).

Image 3 - View of the subject site from Dry Dock Road (turning into Fraser Drive) and the ridgeline beyond the street trees (arrow indicates high point of site in front of ridgeline).

The subject site has views north-east to a new residential development to the north of 'Pioneer Country'. This development may have a visual impact on the site due to the following:

- rooflines breaking the horizon and canopy line of trees from Part A of the development, however, Part B of the development will largely see over this to vegetation above;
- Portions of the topography of the subject site slopes towards this new development with views across Fraser Drive.

Image 4 - View from Wren Court looking across 'Pioneer Country' to the subject site

Views from south of the subject site will be screened by dense vegetation on the south facing slopes. Vintage Lakes Drive has a direct view to the southern most ridgeline of the development, however, the ridgeline and vegetation should remain untouched due to the severity of the slope of the hill.

The proposed development may have a visual impact on the surrounding area to the base of this slope if rooflines break the canopy line of trees (refer image 5).

Image 5 - View from Vintage Lakes Drive looking up towards the southern end of the subject site.

The subject site is not visible from surrounding community nodal points south and south-east of the subject site such as sporting fields, shopping centres and clubs. This is due to existing vegetation and the topography of the surrounding areas (refer images 6 and 7).

Image 6 - View from Shopping Centre on the corner of Leisure Drive and Darlington Drive in Banora Point looking towards the subject site (arrow indicates location of site).

Image 7 - View from Sports fields (Twin Towns Juniors) looking up towards the southern end of the subject site.

The site is visible from some points immediately surrounding the subject site, notably from a bridge crossing over the nearby Terranora Creek canal, however, this is the only view of the site when travelling to it before turning into Fraser Drive as seen in image 3 (refer image 8)

Image 8 - View from bridge crossing along Dry Dock Road

The site is visible from some points in the southern parts of Coolangatta, notably from the Boyds Bay Bridge, a regular transport corridor (refer to Image 9).

Image 9 - View from Boyds Bay Bridge - Minjunbal Drive (arrow indicates location of site in front of ridgeline).

The existing residential settlements surrounding Mount Toonbarabah in Tweed Heads, to the north-east of the site will have views to the proposed development from some locations (refer image 10). There is some visual absorption due to the undulating topography occurring between the suburb and the subject site, which features trees to the top of ridges.

Image 10 - View from Alva Street to subject site (arrow indicates location of site)

4.0 SYNTHESIS

4.1 LANDSCAPE SENSITIVITY

The site forms part of a semi-developed ridgeline on the western edge of Tweed Heads South and is surrounded by settlements with a rural residential landscape character, and is adjacent to a higher density residential development at Banora Point.

The topography of the site is undulating, with the general slope facing east. The visual prominence is greater at the western end of the site at the top of the ridge, which is able to be seen from the settlements at Coolangatta and Tweed Heads.

The slope on the site is predominantly steepest along the top of the ridge. Development to these areas – unless appropriately managed will be prominent from vantage points to the north, north-east and Fraser Drive section approaching the subject site south-east of the development.

However as the site is adjacent and below the visually prominent existing development to the top of the ridgeline along Hillcrest Avenue, it is considered that the casual observer will have a low sensitivity to the proposed development

4.2 VISUAL ABSORPTION CAPACITY

Visual attenuation through the use of vegetation is currently evident external to the site. The Terranora Creek esplanade planting and undulating topography of the 'Pioneer Country' land will act as buffers, absorbing any visual impact of the development on motorists on the Pacific Motorway. Similarly, the existing vegetation along Fraser Drive will also absorb visual impact of the development on motorists.

In addition, the views to the subject site from surrounding settlements are buffered with tree plantings within the development (refer to Image 11).

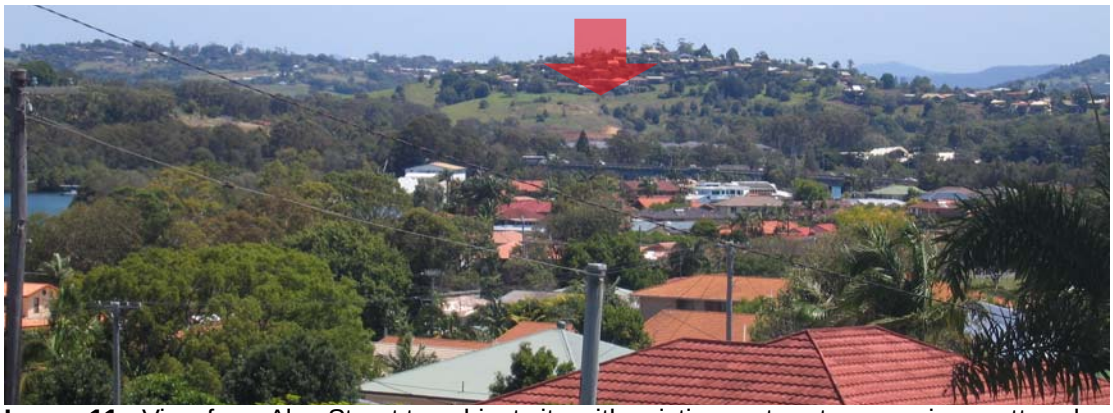


Image 11 - View from Alva Street to subject site with existing mature tree species scattered amongst the existing settlement (arrow indicates location of site)

Internally, the proposed subdivision plan (Appendix A) allows for some visual absorption with the use of vegetation. The neighbourhood access road generally runs along the contours, which allows for thicker buffer planting within the road reserve. This also minimises cut and fill and therefore maximises potential for retention of existing vegetation.

4.3 VISUAL CONSTRAINTS AND OPPORTUNITIES

The undulating topography provides an opportunity to focus higher density development in areas that will have limited visual impact, for example, providing the higher density lots on the levelled Area A section which are within gully slopes and also avoid minor ridgelines. Refer to Appendix A for the proposed subdivision plan and the division of part A and B.

The steep slopes on the subject site pose some challenges when managing the visual impact of the proposed development. Refer to attached Potential and Constraints plan (Appendix B).

However where the steep slopes are prevalent, management of any visual impact will be regulated (eg. limits on the height of retaining walls etc.).

The potential for retention of existing vegetation on the subject site provides an opportunity for visual absorption. The canopy of the trees will screen buildings and civil elements and reduce the effects of glare.

5.0 REVIEW OF PROPOSED SUBDIVISION PLAN

Generally, the proposed subdivision plan (Appendix A) has been designed to minimise the visual impact of the development.

Larger lots (over 1,000m2) have been allocated to the area set down from the ridgeline (in front of and below existing homes) which will minimise the visual impact.

Typically, all of the roads follow contours which allows for a reduction in the amount of cut and fill required.

The proposed streetscapes through the site will form a green strips throughout the development as well as providing green links between open space areas including the SEPP 14 wetland.

6.0 RECOMMENDATIONS

Part of the site is located at the top of a visual ridgeline, and visible from several residential settlements and transport corridors. It is therefore important to implement design guidelines to ensure that any visual impact of development is reduced to an acceptable level.

The design guidelines are suggested to assist in the amelioration of any impacts and cover three scales, which are site planning, lot planning and plant and materials selection.

6.1 SITE PLANNING

The elements of site planning are an important consideration in minimising the visual impact of a development.

The allocation of larger lots (approx. 900m2 and over) to the top of ridgelines and on steep slopes (20% and over) minimises visual impact in a number of ways. Positioning the larger lots on the ridgeline allows space for the houses to be positioned at the lower end of the properties to prevent rooflines breaking the top of the ridge profile. We recommend establishment of set building envelopes on these ridgeline lots. These larger lots also retain the capacity for a planted buffer to the top of the ridgeline.

The incorporation of landscape buffers and green pockets into the subdivision plan allows for visual absorption of the development.

The retention of existing vegetation is an effective way to reduce visual impact. Design of roads and placement of buildings around existing trees to maximise retention softens the landscape and reinforces the rural residential character of the area.

6.2 LOT PLANNING

At the lot planning scale, guidelines can be set to ensure residents and other users make the best decisions to minimise visual impact within their own property.

It is recommended that the maximum numbers of existing trees within property boundaries are retained. This can be done via the establishment of appropriate design guidelines.

The siting of the house within the lot is an important consideration. On the lots located on the steeper slopes, different architectural solutions should be explored (e.g. houses that step down the slope to prevent the extent of cut/fill). Avoid benching of lots where possible.

Guidelines that restrict building heights in high visual impact areas to below the line of canopy (this will minimise visual breaks in the tree line).

Lots should be designed so that the height of retaining walls should be restricted to less than one metre. This effectively reduces visual impact by minimising hard vertical surfaces on the slope (refer Appendix C).

6.3 PLANT AND MATERIALS SELECTION

The plant species as well as the building materials selected can help to minimise the visual impact of the proposed development.

We recommend the use of darker coloured hard surfaces such as building walls, retaining walls and fences as they are effective in reducing the visual impact of the proposed development.

Rooflines should not break any ridgeline canopy and non-reflective materials should always be selected.

Articulated facades to buildings create aesthetic interest and would minimise visual impact by breaking up building bulk.

A covenant that limits the use of exotic plants is recommended. The use of local endemic plant species will ensure a consistent vegetation appearance across the ridge.

7.0 SUMMARY

The areas with the steep slopes and gully formations on the site create construction and site / lot planning constraints. However any visual impact of this will be able to be offset by retaining a large proportion of the existing trees occurring on the site, providing appropriate guidelines are put in place.

Any visual impact of the proposed development will be minimised with the provision of the following:

- Larger lots along the ridgelines (as per Appendix A - 'Proposed Subdivision Plan');
- Internal road system which generally follows existing contours (as per Appendix A - 'Proposed Subdivision Plan');
- Design guidelines for lots on slopes of 20% or greater which maximise retention of existing vegetation and minimise cut and fill requirements;
- Design guidelines for ridgeline lots, which ensure that rooflines are located below the ridgeline;
- Design guidelines, which limit use of reflective building materials, and encourage the use of endemic plant species and local building materials.

The visual impact of the proposed residential development can be managed and minimised with development controls that dictate guidelines for site planning, lot planning, plant species and materials selection.

8.0 APPENDIX A – PROPOSED SUBDIVISION PLAN

(Refer Attached)

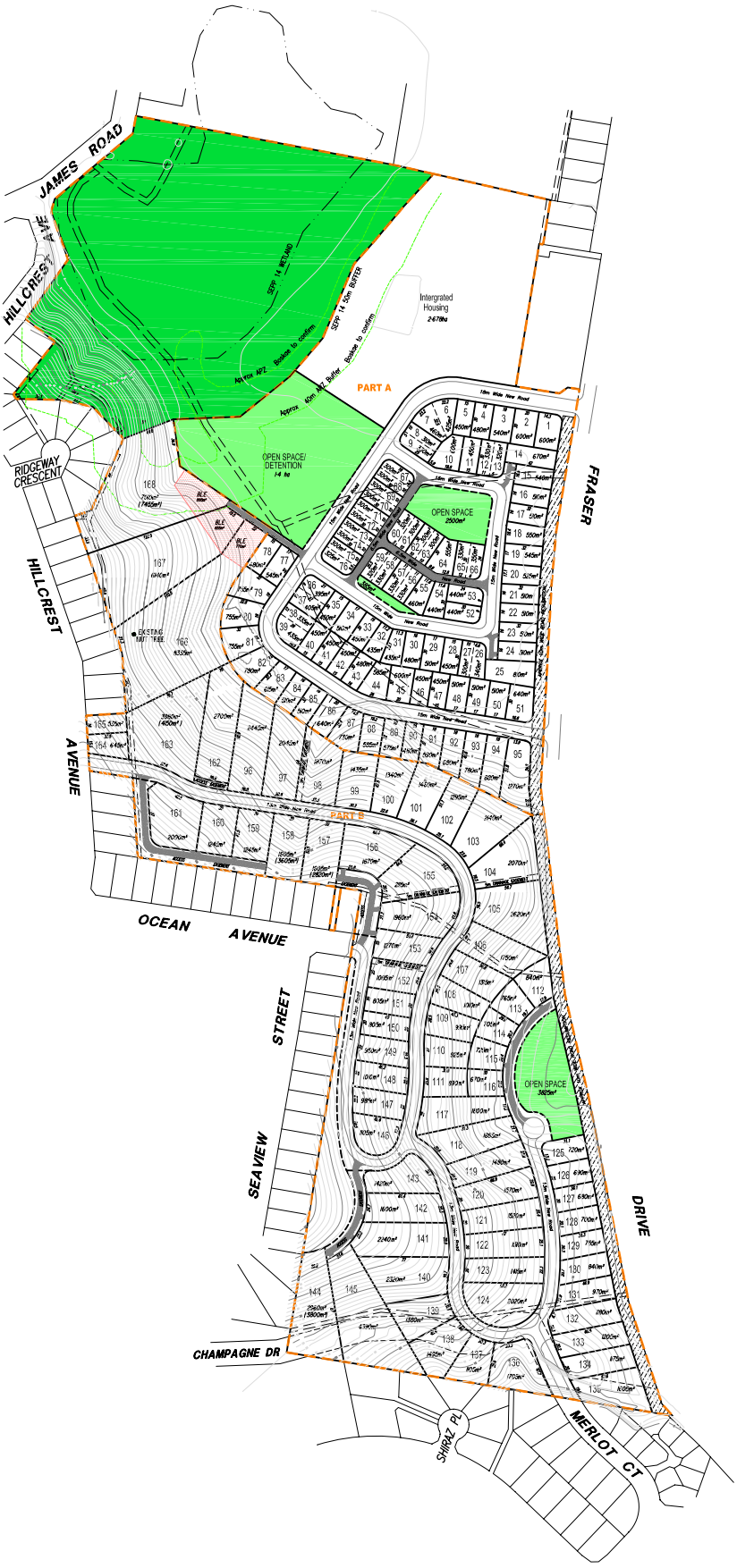
PRELIMINARY ONLY

Note
All dimensions and areas are approximate only, and are subject to survey and Council approval.

Dimensions have been rounded to the nearest 0.1 metres.

The boundaries shown on this plan should not be used for final detailed engineers design.

Base information, contours and road widening, retaining walls provided by Cardno Bulk Earthworks Plan Ref: 7214/29/01.



LEGEND

- Part A & Part B Site Boundaries
- Building Location Envelope
- Open Space/Detention
- SEP 14 Wetland and Buffer
- 10m Wide Road Widening

DEVELOPMENT STATISTICS

Total Site Area	32.89 ha
Part A	
Total Area	11.07 ha
Total No. of Lots	95
< 449m²	5
450m² - 479m²	11
480m² - 509m²	5
510m² - 539m²	14
540m²+	28
duplex 600m²+	16 - 32 dwellings
Integrated Housing (2.678 ha) @ 25 dwellings per/ha	66 dwellings
Total Area of Open Space	1.68 ha
Road Widening	3340 sqm
Part B	
Total Area	21.82 ha
Total No. of Lots	73
540m² - 1.33 ha	73
Total Area of Open Space	3825 m²
Road Widening	5140 m²

Level Datum	Date 22 NOV 2006	CLIENT	PROJECT
Origin	Surveyed	VILLA WORLD LIMITED	PROPOSED SUBDIVISION
	Comp By. KCH	PROPOSED LAYOUT FRASER DRIVE TWEED HEADS	Plan Reference 20934-5
	DWG Name. 20934-PRO		
Scale 1:2000@A1	Local Authority TWEED SHIRE COUNCIL		
	Job Reference 20934		

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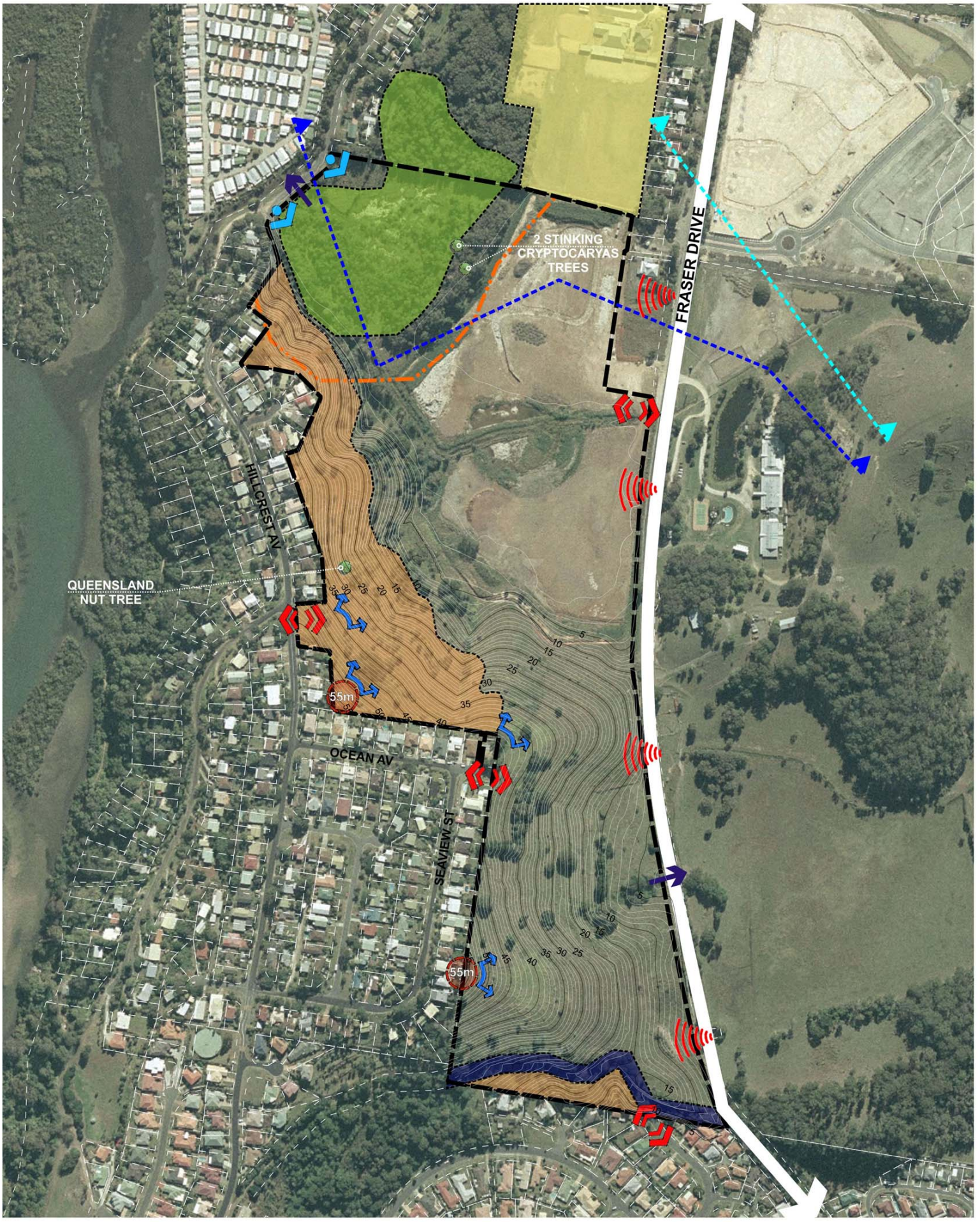
9.0 APPENDIX B – POTENTIAL AND CONSTRAINTS PLAN

(Refer Attached)



LEGEND

- POTENTIAL ACCESS POINT
- HIGH POINT
- SEPP 14 WETLAND
- 50M BUFFER
- EXISTING TREES TO BE PRESERVED
- POTENTIAL SLIP AREA
- YEAR 2010 AUSTRALIAN NOISE EXPOSURE FORECAST
- YEAR 2020 AUSTRALIAN NOISE EXPOSURE FORECAST
- EXISTING ROAD RESERVE
- SCHOOL SITE UNDER CONSTRUCTION
- VIEWS
- POTENTIAL PEDESTRIAN LINK
- POTENTIAL NOISE FROM FRASER DRIVE
- EXISTING DRAIN
- SITE BOUNDARY

VILLAWORLD

FRASER DRIVE Opportunity and Constraint Plan

Note: The contents of this plan are preliminary only and for discussion purposes only. Subject to detailed design, engineering, survey and Council approval.

N

0 50 100metres

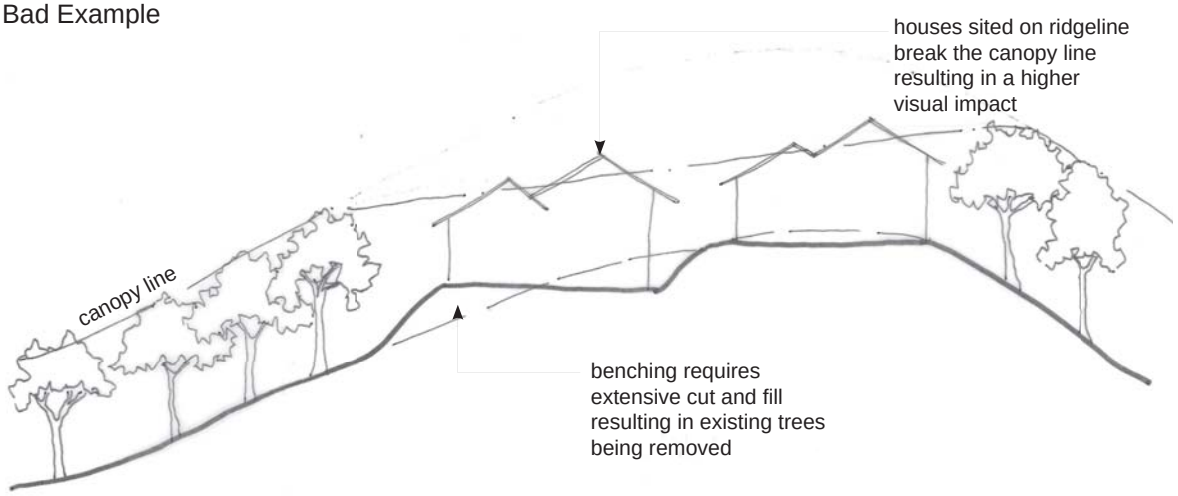
Date: 06.06.06 Scale 1:2000@A1 Job No. 06072 BAS04 Rev no.-

pmm SYDNEY

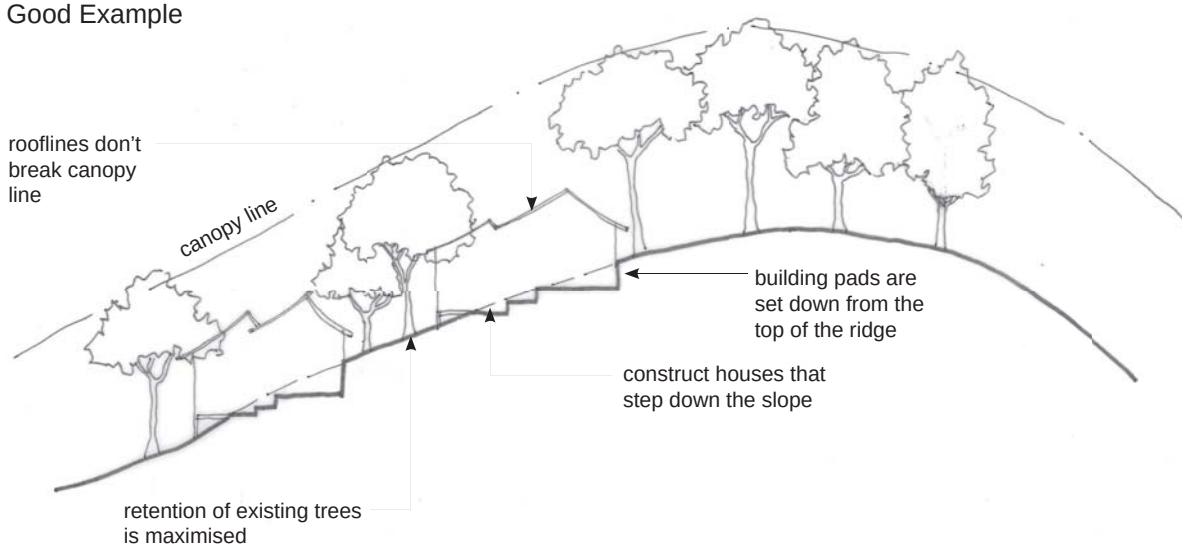
10.0 APPENDIX C – RIDGELINE LOT DIAGRAMS

(Refer Attached)

Ridgeline and Steep Lots
Bad Example



Ridgeline and Steep Lots
Good Example



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11.0 APPENDIX D - SITE VISIT VIEW SUMMARY

(Refer Attached)

LEGEND

- A **Image A-** View from the lower, Part A, portion of the site looking south up to the existing settlement on Seaview Street.
- 1 **Image 1** - View from Hillcrest Avenue to ridgelines to the east
- 2 **Image 2** - View from Fraser Drive at the south-eastern most tip of the development and at the base of the road reserve
- 3 **Image 3** - View from the subject site from Dry Dock Road (turning into Fraser Drive) and at the ridgeline beyond the street trees
- 4 **Image 4** - View from Wren Court looking across 'Pioneer Country' to the subject site
- 5 **Image 5** - View from Vintage Lakes Drive looking up towards the southern end of the subject site
- 6 **Image 6** - View from the shopping centre on the corner of Leisure Drive and Darlington Drive in Banora Point looking towards the subject site
- 7 **Image 7** - View from sports fields (Twin Towns Juniors) looking up towards the southern end of the subject site
- 8 **Image 8** - View from bridge-crossing along Dry Dock Road
- 9 **Image 9** - View from Boyds Bay Bridge - Minjunbal Drive
- 10 **Image 10** - View from Alva Street to subject site
- 11 **Image 11** - View from Alva Street to subject site with existing mature tree species scattered amongst the existing settlement

VIVO design

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Appendix 16

Water Reticulation Report

Cardno
Engineering the Future

Villa World Ltd

Proposed Development
Fraser Drive – South Tweed

WATER RETICULATION REPORT

CARDNO QLD PTY LTD
COMMERCIAL CENTRE
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8TH DECEMBER 2006
JOB NO. 7214/29-1

PROPOSED DEVELOPMENT
FRASER DRIVE – SOUTH TWEED

WATER RETICULATION REPORT

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3.0 DESIGN CRITERIA

4.0 DEVELOPMENT POPULATION AND FLOW

5.0 WATER RETICULATION NETWORK

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APPENDIX A: Figures and Sketches

CLIENT	VILLA WORLD LTD		Job No. 7214/29-1
DOCUMENT NAME	WATER RETICULATION REPORT – FRASER DRIVE		
Preliminary ☐		Author	S. Walter
Draft ☐		Signature	SW
Draft Final ☐		Date	11/12/06
Final ☐		Reviewer	A. Macrae
Superseded ☐		Signature	
Other (Specify) ☐		Date	11/12/2006

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1.0 INTRODUCTION

Cardno were commissioned by Villa World Ltd to undertake a hydraulic analysis to determine the water supply infrastructure required to provide a satisfactory water supply to the proposed development on Lot 9, DP1039569 and part of Lot 2, DP1000385 Fraser Drive, Tweed Heads South, which consists of approximately 168 residential allotments and 66 integrated housing dwellings.

2.0 BACKGROUND

The proposed project is situated at Tweed Heads South adjacent to Fraser Drive (Refer Cardno Figure No DA01 in Appendix A).

The development is supplied with water from the Terranora Reservoir via a 600mm diameter trunk main that runs down the eastern side of Fraser Drive. There are also existing 50mm and 100mm diameter mains running along the western side of Fraser Drive past the northern end of the site. A 200mm diameter main also runs along the western side of Fraser drive, stopping approximately 100m north of the site. The development will not connect directly into the existing trunk main, but to smaller existing lines running from the 600mm diameter trunk main shown on Cardno Figure No DA23 (Appendix A) and listed below:

- 150mm diameter main in Merlot Ct at the southern boundary
- 200mm diameter main in Fraser Dr, to the north of the site
- 100mm diameter main in Ocean Ave, at the western boundary
- 100mm diameter main in Hillcrest Avenue, at the western boundary

This servicing of the site is compliant with previous requests from council, with the exception of the Fraser Drive connection. Council's previous request was to connect the development into an existing watermain to the north of the site, but access to this connection is un-available due to new development in the area. Instead it is proposed to extend the existing 200mm diameter main south along Fraser Drive to connect into the northern end of the development.

3.0 DESIGN CRITERIA

The design criteria adopted for the study area are outlined below. The design criteria have been derived from the Tweed Shire Council's "Development Design Specification – D11" (Tweed Shire Council, 2004), NSW "Water Supply Investigation Manual" (NSW Public Works, 1986) and various communications with Tweed Shire Council Officers.

Unit Consumption and Peaking Factors

- Peak Daily Demand = 850 L/EP/day
- Occupancy Ratio = 3.2 EP/ET
- Peak Instantaneous Demand (PID) = 0.15 L/s/ET
  (Based on developments < 1000 ET)

Fire Fighting

- Fire Flow 1 = 11 L/s
  (for common residential buildings)
- Fire Flow 2 = 22 L/s
  (for shops, restaurants, hotels and motels, considered to include resorts)
- Minimum allowable pressure at fire flow and PID = 118 kPa (12 m)

Residential Pressures

- Minimum allowable pressure = 200 kPa (20 m)
- Maximum allowable pressure = 780 kPa (78 m)

Hazen-Williams Coefficient

The following Hazen Williams Roughness Coefficient were adopted for this study assuming all pipes were made of DICL.

Nominal Diameter (mm)	Roughness Coefficient (C)
100-150	100
>150-250	110

4.0 DEVELOPMENT POPULATION AND FLOW

The population and flow projections for the water supply investigation were developed from the total number of proposed allotments in the development (refer Cardno Figure No DA03, Appendix A). Each allotment has been assigned an ET value based on the land use (refer to Table 4.1 for adopted ET for each land use type).

TABLE 4.1 ET Adopted For each Land Use Type

Land Use Type	Adopted ET Radio
Residential Allotment	1 ET/lot
Integrated Housing (3 Bedroom)	1 ET/dwelling

Table 4.2 illustrates the population projections in calculated ET's and projected flows. Refer to Appendix A for detailed demands.

TABLE 4.2 Estimated Development Population and Flow

Population (ET)	Residential Allotments	168
	Integrated Housing (3 bedroom)	66
Demand (L/S)	Peak Daily Demand $(L/s)_1$	7.37
	Peak Daily Demand $(kL/d)_1$	636
	Peak Instantaneous Demand $(L/s)_2$	35.1

1 – derived from 850 L/EP/day and 3.2EP/ET from TSC's Development Specification D11
2 – derived from PID of 0.15 L/ET/s from TSC's Development Specification D11

5.0 WATER RETICULATION NETWORK

The proposed water reticulation mains within the area to be serviced are sized to provide a water supply to the proposed development meeting Tweed Shire Council's Standards of Services, including the relevant fire flow requirements.

The proposed reticulation mains within the study area will comprise 63mm, 100 mm and 150mm diameter water pipes, arranged in looped configurations where practical, to ensure pressures are relatively uniform throughout the areas serviced and to provide a cost effective network.

The proposed water main infrastructure is shown in Cardno Figure No DA23 in Appendix A. The proposed reticulation network had been sent to council for approval. As the proposed development is surrounded by a network of existing trunk water mains, it is envisaged that the site demand can be adequately catered for.

If requested by Council, a water analysis of the development will be carried out during the detailed design stage of the development.

APPENDIX A

FIGURES AND SKETCHES

Cardno Figure No DA01	Site Plan
Cardno Figure No DA03	Lot Layout and Stage Plan
Cardno Figure No DA23	Proposed Water Reticulation Network

N

LOT 9
DP 1039569

LOT 2
DP 1000385

DP 28390
PUBLIC RESERVE

SCHOOL
PROPOSED
8
DP 1039569

Sepp 14 Wetland Zone
18 b

OPEN SPACE/
DETENTION

OPEN SPACE

MEDIUM
DENSITY

HILLCREST AVENUE

RIDGEWAY CRES.

HILLCREST AVE

JAMES ROAD

CHAMPAGNE DR

SEAVIEW STREET

OCEAN AVENUE

MERLOT CT

ROAD No 1

ROAD No 2

ROAD No 3

ROAD No 4

LANEWAY No 1

LANEWAY No 2

LANEWAY No 3

FRASER DRIVE

Approx 40m WIDE ROAD RESERVATION

0 50 100 150m
SCALE BEFORE REDUCTION 1 : 1500

CAD FILE NAME: G:\7214\29\01\DA_Figures\72142901_DA01.dwg

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VILLLA WORLD LIMITED

LOT 9 DP 1039569 & Part LOT 2 DP 1000385
FRASER DRIVE, SOUTH TWEED HEADS

FRASER DRIVE, SOUTH TWEED HEADS

ENGINEERING REPORT

SCALE :- 1 : 1500 A1
DATE :- 8 DECEMBER 2006 Rev.
DRAWING No. 7214/29/01-DA 01

FIGURE No.DA 01

SITE PLAN

N

HILLCREST AVENUE

HILLCREST

RIDGEWAY CRES.

HILLCREST AVE

JAMES ROAD

OCEAN AVENUE

SEAVIEW STREET

CHAMPAGNE DR

Sepp 14 Wetland Zone
18 b

OPEN SPACE/
DETENTION

MEDIUM
DENSITY

OPEN SPACE

ROAD No 1

ROAD No 2

ROAD No 3

ROAD No 4

LANEWAY No 1

LANEWAY No 2

LANEWAY No 3

MERLOT CT

FRASER DRIVE

LEGEND

PARK A - (95 LOTS + 66 DWELLING INTEGRATED HOUSING)

PARK B - (73 LOTS)

SITE BOUNDARY

0 50 100 150m
SCALE BEFORE REDUCTION 1 : 1500

CAD FILE NAME: G:\7214\29\01\DA_Figures\72142901_DA03.dwg

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VILLLA WORLD LIMITED

LOT 9 DP 1039569 & Part LOT 2 DP 1000385
FRASER DRIVE, SOUTH TWEED HEADS

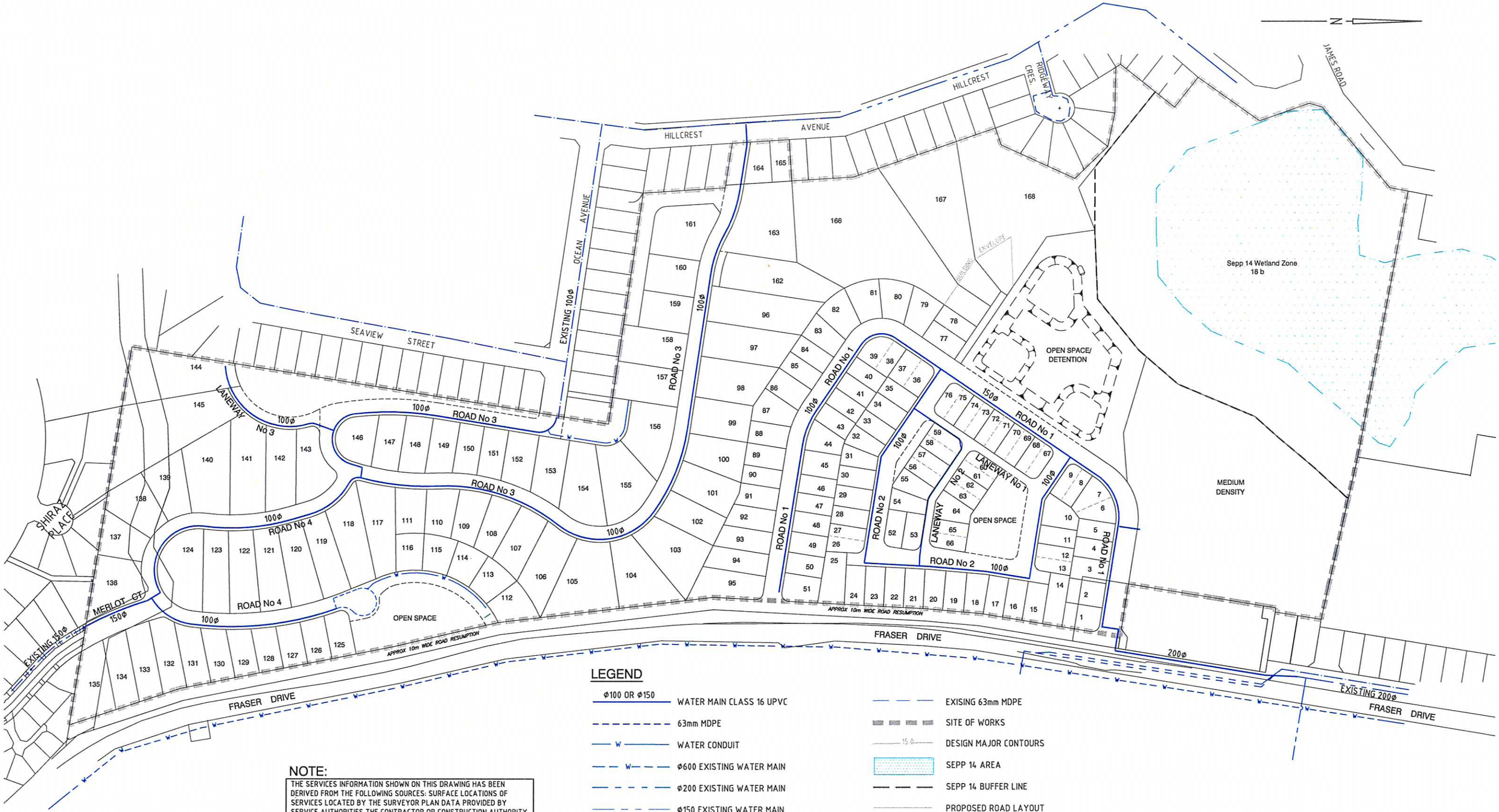
FRASER DRIVE, SOUTH TWEED HEADS

ENGINEERING REPORT

SCALE :- 1 : 1500 A1
DATE :- 8 DECEMBER 2006 Rev.
DRAWING No. 7214/29/01-DA03

FIGURE No.DA 03

LOT LAYOUT AND
STAGING PLAN



LEGEND

- ø100 OR ø150 — WATER MAIN CLASS 16 UPVC
- 63mm MDPE
- W — WATER CONDUIT
- W — ø600 EXISTING WATER MAIN
- ø200 EXISTING WATER MAIN
- ø150 EXISTING WATER MAIN
- ø100 EXISTING WATER MAIN
- EXISING 63mm MDPE
- SITE OF WORKS
- 15.0 — DESIGN MAJOR CONTOURS
- SEPP 14 AREA
- SEPP 14 BUFFER LINE
- PROPOSED ROAD LAYOUT

NOTE:

THE SERVICES INFORMATION SHOWN ON THIS DRAWING HAS BEEN DERIVED FROM THE FOLLOWING SOURCES: SURFACE LOCATIONS OF SERVICES LOCATED BY THE SURVEYOR PLAN DATA PROVIDED BY SERVICE AUTHORITIES THE CONTRACTOR OR CONSTRUCTION AUTHORITY IS TO CONFIRM THE ACTUAL LOCATIONS OF ALL EXISTING UNDERGROUND SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION WORKS

100 50 0 100

SCALE BEFORE REDUCTION

1 : 2000

CAD FILE NAME: G:\7214\29\01\DA_Figures\72142901_DA23.dwg

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VILLLA WORLD LIMITED

LOT 9 DP 1039569 & Part LOT 2 DP 1000385
FRASER DRIVE, SOUTH TWEED HEADS
FRASER DRIVE, SOUTH TWEED HEADS

ENGINEERING REPORT

SCALE :- 1 : 1500 A1
DATE :- 8 DECEMBER 2006 Rev.
DRAWING No. 7214/29/01-DA 23

FIGURE No.DA 23

PROPOSED WATER RETICULATION NETWORK

Appendix 17

Engineering Report

Cardno
Engineering the Future

Villa World Ltd

Proposed Development
Fraser Drive – South Tweed

ENGINEERING REPORT

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8TH DECEMBER 2006
JOB NO. 7214/29-1

PROPOSED DEVELOPMENT
FRASER DRIVE – SOUTH TWEED

ENGINEERING REPORT

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7.0	WATER CONNECTION	4
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9.0	BUSHFIRE MANAGEMENT	5
10.0	NOISE FROM FRASER DRIVE	5
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APPENDIX A Geotechnical Report by Shaw-Urquhart
APPENDIX B Bushfire Assessment by Boskae Environmental Planning
APPENDIX C Cardno DA Engineering Plans (Bound Seperately)

CLIENT	Villa World Ltd		Job No. 7214/29-1	
DOCUMENT NAME	Engineering Report			
	Preliminary	☐	Author	S Walter
	Draft	☐	Signature	
	Draft Final	☐	Date	11/12/06
	Final	☑	Reviewer	A Macrae
	Superseded	☐	Signature	
	Other (Specify)	☐	Date	11/12/2006

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1.0 INTRODUCTION

This report has been prepared on behalf of Villa World Ltd in support of a proposed development located on Lot 9, DP1039569 and part of Lot 2, DP1000385, Fraser drive, South Tweed. The site covers an area of approximately 31 hectares and varies in elevation from approximately RL2.5 to over RL55 AHD. The northern end of the site it relatively flat while the southern area grades from the lower levels along Fraser drive up to the ridge located to the west of the site.

The site is well grassed, but mostly clear of major vegetation as a result of previous agricultural use. The lower, flat areas contain a wetland with mangroves and other plant species. Some of the low area has been subject to filling under an existing bulk earthworks approval.

The site is divided into two parts. Part A consists of the lower portion of the site, including the open space/detention area and the medium density housing area. Part B consists of the steeper portion of the site.

The report has been based on preliminary DA Drawing layouts prepared by PMM Drawing Reference 20934-5. The report will provide preliminary civil engineering advice on the proposed development suitable for the DA application phase.

2.0 DEVELOPMENT POPULATION

The proposal is for a development consisting of approximately 168 residential lots, 2ha of park area and a medium density housing area, consisting of approximately 66 dwellings. The overall equivalent tenements (ET) for design of water and sewer demands have been calculated at 234 ET or an equivalent population (EP) of 749.

3.0 SITE ACCESS

There will be a number of access points to the development due to its size and terrain. The main access to Part A of the development will be from Fraser Drive, where it is proposed to have one main controlled intersection at the northern end of the development. A secondary access 275m south of the main access will provide a 'left in, left out' turning movement. The existing Merlot Court will continue into the proposed development from the southern boundary, as will Ocean Street from the western boundary providing access to Part B of the development. A third access point will be incorporated at the northern end of Part B, connecting to Hillcrest Avenue. Due to the existing road geometry and limited site distance at the intersection with Hillcrest Avenue, turning movements at this intersection will be restricted.

The proposed access road running through Part B of the development includes sections with grades approaching the upper limits allowed by council (up to 16%). These grades are necessary to comply with all the geotechnical restraints regarding lot grading and retaining wall heights. Alternate routes to access the upper portion of the site are provided for heavy vehicles.

Cardno Eppell Olsen, specialist traffic engineers have provided a traffic assessment for this project. Please refer to their report titled "Fraser Drive Residential Development" dated December 2006 for further information regarding access, car parking, onsite manoeuvring for service vehicles and proposed turning restrictions for the Hillcrest Avenue intersection. The development access roads will generally have 9m, 7.5m and 6m carriageways depending on location and be formed to a high standard of finish.

4.0 SITE EARTHWORKS

A geotechnical investigation of the site has been carried out by Shaw-Urquhart Geotechnical Services. The principal Geotechnical Engineers of this company, Mr Phillip Shaw and Mr Keith Urquhart, reported on this site back in 2002. The findings of the report (see Appendix A) are summarised as follows:

- Existing slope varies from 10° to 25°;
- The site contains groundwater seepage and areas of existing slope instability in the higher regions;
- Building areas should not lie on land steeper than 1 in 3 slope and no areas on-site should have an un-supported slope steeper than 1 in 2;
- Areas of existing slope instability should be remediated;
- Retaining walls, meeting Council's criteria, are preferable to the excavating and potentially over steepening the hill slopes.

Due to the existing geography of the site, earthworks will be required for access to areas of the site and to ensure all allotments are graded according to Council's Development Design Specification D6 '*Site Regrading'.*

An area of Part A of the site is being filled under the existing TSC development application DA02/0837 and TSC construction certificate CC02/1692. Minor reshaping of the placed fill will be undertaken as part of the proposed civil works for Part A of the development. Part B of the site will require re-profiling to remove gullies and ridges and minor earthworks to tie the roadways in with the existing surface. Due to the slopes on the site, it is proposed to use some retaining wall structures in an effort to do away with excessive batters. The preliminary design of Part B has been done to achieve a balance of the earthworks cut/fill volumes. It is not envisaged that any imported fill will be required on the site.

Slope stabilisation works will also be carried out in the areas that require the same. These areas are located on the steep slopes towards the northern end of the site. Previous geotechnical investigations carried out on the site have indicated that, with the exception of topsoil, any material removed from the steeper, Part B portion of the site will be suitable for use as structural fill, providing proper pre-treatment (ie drying) is carried out prior to placement. Remediation of the existing slip areas located in Part B of the site will be carried out in accordance with the geotechnical reports. These works will be carried out during the earthworks for Part A of the site.

Details of the proposed earthworks and retaining walls are shown on Cardno Figure No's DA04 and DA09 in Appendix C.

All retaining wall heights will conform to Council's maximum permissible height Table 6.1, *Development Design Specification D6 Site Regrading, Version 1.3.*

5.0 STORMWATER MANAGEMENT

The site is divided into four main existing site catchment areas. Approximately 2.4 hectares (ha) of the subject site discharges south towards existing residential lots on Shiraz Place and Merlot Drive. Two site catchment areas of approximately 1.8ha and 5.3ha discharge east towards Fraser Drive. The largest existing site catchment of approximately 23ha discharges north towards James Street. A SEPP 14 wetland area (18b) has been identified in the north-western corner of the subject site at the downstream outlet of the existing northern catchment area. As it is intended to retain the existing wetland area within the SEPP 14 zone the northern catchment point of discharge will be situated along the southern boundary of the SEPP 14 zone.

The proposed drainage strategy for the Fraser Drive site is intended to incorporate water sensitive urban design (WSUD) wherever practical. The topography of much of the proposed development site limits the use of many WSUD techniques. It is proposed to utilise conventional street drainage to convey stormwater runoff from the upper reaches of the catchment areas down to the stormwater treatment and detention devices to be constructed around the lower parts of the development site.

Stormwater runoff from the northern and eastern catchment areas will be conveyed to detention and treatment devices to be located within open space areas situated at downstream outlet of each catchment. It is proposed to incorporate treatment devices such as gross pollutant traps and wetlands into the open space areas which will be sized to meet Council's 'deemed to comply' criteria outlined in the *Development Design Specification D7-Stormwater Quality*. Sufficient on-site detention storage volume will be provided within these open space areas to assist in maintaining peak flow rates equivalent to existing peak flows discharging off-site.

A Stormwater Management Plan has been produced for the proposed development. Refer to Cardno report "Proposed Development on Fraser Drive, South Tweed Stormwater Management Plan" dated 8th December 2006.

6.0 SEWER CONNECTION

The proposed development will increase sewerage discharge from the site. Cardno have produced a Sewer Reticulation Report for the site to show the inpact the new development will have on the existing reticulation system. Refer to Sewer Reticulation report dated 8th December 2006.

The site and the surrounding areas are serviced by an existing sewer network. There are three sewer catchments to the west of the subject site, all of which gravitate through the subject site towards Fraser Drive.

The northern existing catchment runs through the subject site along the western boundary, gravitating north, eventually discharging into pump station PS3022 adjacent to the eastern boundary of the site. The central existing catchment gravitates from the rear of the lots on Ocean Avenue directly through the subject site to Fraser Drive, where it joins into the gravity line flowing to PS3021. The southern existing catchment gravitates through the subject site along the southern boundary towards Fraser Drive where it discharges into PS3021. Pump station PS3022 pumps through an existing rising main before discharging into the gravity main along Fraser Drive which gravitates to PS3021.

For the proposed sewer reticulation system, the development had been split into two catchments. The northern catchment will gravitate to pump station PS3022 while the southern catchment will gravitate to pump station PS3021.

Also, it is proposed to re-align the two existing gravity lines running through the centre and along the southern boundary of the site to accommodate the proposed lot layout.

7.0 WATER CONNECTION

The proposed development will increase the water demand on the existing reticulation system. Cardno have produced a Water Reticulation Report to detail how the proposed development will join into the existing system. Refer to Water Reticulation Report dated 8th December 2006.

There is an existing 600mm diameter trunk main that runs down the eastern side of Fraser Drive. The development will not connect directly into the existing trunk main, but to smaller existing lines running from the 600mm diameter line listed below:

- 150mm diameter main in Merlot Ct at the southern boundary
- 200mm diameter main in Fraser Dr, to the north of the site
- 100mm diameter main in Ocean Ave, at the western boundary
- 100mm diameter main in Hillcrest Avenue, at the western boundary

By utilising these four connection points, it can be shown that the proposed water supply infrastructure achieves Tweed Shire Council's (TSC) adopted Standards of Service for the development.

8.0 ACID SULFATE SOILS

A detailed acid sulfate soils investigation was prepared for the site by Gilbert & Sutherland which reported that the chances of encountering Acid Sulfate Soils would be NIL to Slight. No recommendation for liming was required. However should Potential Acid Sulphate Soils be encountered during the excavation for earthworks or deep services, then treatment will be required in accordance with the approved site Acid Sulfate Soils Management Plan, Fraser Drive, South Tweed.

9.0 BUSHFIRE MANAGEMENT

A Bushfire Assessment Report of the development site has been prepared by Boskae Environmental Planning dated October 2006 (attached Appendix B). The report gives background information on the site and the surrounding area and provides recommendations to be undertaken on the site in an effort to minimise the threat of bushfire. The recommendations in the report are as follows:

- Asset Protection Zones are to be maintained on all aspects of the lots;
- All dwellings on lot facing the SEPP14 Coastal Wetland/Tall Open Ecotonal Forest shall be constructed to a Level 2 performance level (AS3959-1999);
- Fire hydrants located on the reticulated water supply should comply with Section 6.4.3 of *Planning for Bushfire Protection (2001);*
- Underground electrical transmission lines are recommended on the development;
- The internal road system should be designed to comply with Section 4.3.1 of *Planning for Bushfire Protection (2001).*

10.0 NOISE FROM FRASER DRIVE

As part of the development application, Cardno have provided an assessment of traffic noise from Fraser Drive and the required acoustic performance of building elements for the development as determined in accordance with Australian Standard AS3671-1989 "Acoustics – Road Traffic Noise Intrusion-Building Siting and Construction". See separate Acoustic Report.

11.0 FLOODING ASSESSMENT & EMERGENCY FLOOD EGRESS

The development site has had the bulk earthworks filling approved and constructed under an existing approval. (Tweed Shire reference DA 02/083 determined on 2nd October 2002) No filling of any significance is proposed as part of this application. Part A earthworks will only involve the existing fill being reshaped to suit the new road layout with minor cut/fill being carried out.

The filled area is no longer prone to flooding (i.e. it has been filled to above the Q100 flood event level), therefore no additional regional flood modelling has been carried out for this application. Drawing No. DA 4 shows the intended flood evacuation route for the Part A land up to Ocean Avenue should this be necessary if a regional flood closes off Fraser Drive.

The development proposal will not alter the existing land drainage patterns to the east of Fraser Drive (Sullivan's Land) as the new Stormwater System has been designed to collect stormwater flows from the existing cross drainage on Fraser Drive and re-divert it past the new treatment/ detention pond. Refer to figure DA 21 which show details of the system.

Please note the 3x1500dia stormwater lines cannot cross Fraser Drive in any case as they would clash with the 600 dia trunk watermain in the location, see DA 23 for information locations.

12.0 CONCLUSION

This report has been prepared on behalf of Villa World Ltd for the proposed development on Lot 9 DP1039569 and part of Lot 2 DP1000385, Fraser Drive in South Tweed being an area of 31 hectares.

The proposal for the development site is to construct 168 allotments and 66 dwellings in a medium density housing area. The overall equivalent tenements (ET) for design of water and sewer demands for the site have been calculated at 234 ET or an equivalent population (EP) of 749.

The site will be accessed from a number of points. The main access to Part A of the development will be from Fraser drive with access points for Part B from Hillcrest Avenue, Merlot Court and Ocean Avenue.

The Part A of the site requires further filling to ensure all allotments are above the flood level. The Part B will require minor re-profiling to remove gullies and ridges and to tie the roadways in with the existing surface. Due to the slopes on the site, retaining walls will be used in an effort to do away with excessive batters. Slope stabilisation works will also be carried out in the areas that require such.

A Stormwater Management Plan has been produced for the development. Refer to Cardno report "Proposed Development, Fraser Drive – South Tweed, Stormwater Management Plan" dated 8th December 2006.

The proposed development will increase sewerage discharge from the site. The site and the surrounding areas are serviced by an existing sewer network. For the proposed sewer reticulation system, the development had been split into two catchments. The northern catchment will gravitate to pump station PS3022 while the southern catchment will gravitate to pump station PS3021. Also, it is proposed to re-align the two existing gravity lines running through the centre and along the southern boundary of the site to accommodate the proposed lot layout.

The proposed development will increase water reticulation demands on the site. There is an existing 600mm diameter trunk main that runs down the eastern side of Fraser Drive. The development will not connect directly into the existing trunk main, but to smaller existing lines running from the 600mm diameter line. By utilising the four existing connection points, it can be shown that the proposed water supply infrastructure achieves Tweed Shire Council's (TSC) adopted Standards of Service for the development.

A detailed acid sulphate soils investigation was prepared for the site by Gilbert & Sutherland in March 2003 which reported that the chances of encountering Acid Sulfate Soils would be NIL to Slight. No recommendation for liming was required.

The development site has had the bulk earthworks filling approved and constructed under an existing approval. (Tweed Shire reference DA 02/083 determined on 2nd October 2002) No filling of any significance is proposed as part of this application.

The new residential land has been filled to above the regional Q100 flood level and is no longer prone to flooding. Therefore no additional regional flood modelling has been carried out for this application. Drawing No. DA 4 shows the intended flood evacuation route for the Part A land up to Ocean Avenue should this be necessary if a regional flood blocks off Fraser Drive.

This engineering report concludes that the proposed development as described in the attached documents - being 168 residential allotments and 66 medium density dwellings can be constructed with limited impact on infrastructure and the environment. Cardno can engineer acceptable solutions to meet the requirements and constraints of the various specialist reports pertaining to this land and proposal.

APPENDIX A

Geotechnical Report by Shaw Urquhart

shaw:urquhart
consulting
geotechnical +
environmental
services

06282/1-C Rev.2 ku:
11 December 2006

Cardno (Qld) Pty Ltd

Commercial Centre

ISLE OF CAPRI QLD 4217

Attention: Mr Alaister MacRae

RE: PROPOSED RESIDENTIAL DEVELOPMENT, FRASER DRIVE, TWEED HEADS SOUTH

1. INTRODUCTION

At the request of Cardno (Qld) Pty Ltd (Cardno), Shaw:Urquhart has carried out a geotechnical review of the allotment layout master-plan for the above development. The geotechnical review was based on information provided to Shaw:Urquhart by Cardno. This information includes the following:

- Allotment layout plans and cross-sections for discussion.
- Copies of geotechnical reports prepared by Coffey Geosciences Pty Ltd (Coffey). These reports are ref. B17439/1-B dated 4 April 2002, B17439/1-F Revision 1 dated 30 September 2002, B17439/1-I dated 12 November 2002 and B17439/1-J dated 6 December 2002.

No geotechnical investigations have been carried out by Shaw:Urquhart.

2. SITE DESCRIPTION

The overall development consists of two distinct areas. On the eastern side of the site is an area of flat-lying alluvial flood plain which is currently under construction. This area was not included in the current allotment layout assessment.

On the western side of the site is an area of raised ground on the eastern side of a prominent ridge line. This area runs the full length of the site and is around 900m long (north-south) by 100m to 150m wide (east-west).

This area and the associated master-plan allotment layout was the subject of the geotechnical review. For the purposes of this report, this area is referred to as "the site".

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shaw:urquhart

3. GEOTECHNICAL REVIEW OF ALLOTMENT LAYOUT

Based of the geotechnical information provided in the Coffey reports, the main potential geotechnical issues relating to development of the site are considered to be as follows:

- Slope angles, which vary from around 10° to 25°, depending on location.
- Local geology, in particular the presence of an interface layer between the overlying basalt-derived materials and the underlying metamorphic-derived materials.
- Groundwater seepage and associated areas of existing slope instability, which are mainly located towards the northern end of the site.

In order to mitigate the potential risks associated with the above geotechnical issues, the following geotechnical constraints were applied to the allotment layout:

- Building areas within allotments should not lie on land with slopes steeper than 3H:1V (approx. 18°). No un-supported slopes should be steeper than 2H:1V (approx. 26°). The vertical heights of cuts and fills within proposed building areas should be no greater than 1.2m.
- Allotments should not include areas of existing slope instability unless in-filling of the allotments and removal of areas of disturbed ground results in a significant and appropriate improvement in the slope stability of such areas.
- Areas of existing slope instability located outside of allotments should be remediated.
- Measures to maintain the stability of the slopes within allotment areas are to include subsoil drainage around the basalt/metamorphic interface zone on each allotment and collection and containment of all stormwater discharge from gutters, downpipes driveways, paths and hardstandings.

The above constraints relate to the design of the allotments layouts. Other, more specific geotechnical constraints relating to development of individual allotment building areas and individual structures will be provided at the detailed design stage.

The application of the above constraints is recommended to reduce the likelihood of significant ground movement to "Unlikely' and the associated risk level to "Low to Medium" with reference to the methodology and terminology outlined in Appendix G (Landslide Risk Assessment - Example of Qualitative Terminology for Use in Assessing Risk to Property) of "Landslide Risk Management Guidelines" published by The Australian Geomechanics Society (March 2000). Based on the results of the geotechnical review combined with constraints applied by other considerations and disciplines, Cardno has prepared a master-plan allotment layout for the proposed development. A copy of the Cardno master-plan allotment layout is attached.

shaw:urquhart

The proposed allotment layout is considered to be generally in accordance with the geotechnical constraints on the development of the site. It is expected that further geotechnical investigations will be carried out at the design stage to confirm the results of the review.

It is understood that areas of existing landslips will be remediated in accordance with the recommendations outlined in the Coffey reports. These recommendations should be reviewed if site observations indicate that surface conditions (for instance, local surface drainage or topography) have changed significantly since the Coffey report was completed.

The allotment layout includes the construction of a number of retaining structures to allow road formations to be constructed without over-steepening of the slopes above and below the road. In this geological environment, it is considered that construction of appropriate retaining structures in accordance with Council constraints is preferable to excavating and potentially over-steepening of the hill slopes.

The retaining structures have not yet been designed but the design process will include an assessment of the local and global slope stability of the retaining structures.

In general, it is recommended that the design and construction of excavations, earthworks and other structures on the site conform with the guidelines presented in Appendix J (Some Guidelines for Hillside Construction) from "Landslide Risk Management Guidelines" published by The Australian Geomechanics Society (March 2000).

If you have any questions or if you wish to discuss or clarify any of the issues raised in this report, please Keith Urquhart or Philip Shaw at our Brisbane office.

For and on behalf of

SHAW URQUHART PTY LTD

KEITH URQUHART

Principal Engineering Geologist

Att. Copy of Cardno Master-Plan Allotment Layout

Copy of Appendix G from "Landslide Risk Management Guidelines" published by The Australian Geomechanics Society (March 2000).

Copy of Appendix J from "Landslide Risk Management Guidelines" published by The Australian Geomechanics Society (March 2000).

APPENDIX G

LANDSLIDE RISK ASSESSMENT – EXAMPLE OF QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

Qualitative Measures of Likelihood

Level	Descriptor	Description	Indicative Annual Probability
A	ALMOST CERTAIN	The event is expected to occur	$>=10^{-1}$
B	LIKELY	The event will probably occur under adverse conditions	$=10^{-2}$
C	POSSIBLE	The event could occur under adverse conditions	$=10^{-3}$
D	UNLIKELY	The event might occur under very adverse circumstances	$=10^{-4}$
E	RARE	The event is conceivable but only under exceptional circumstances.	$=10^{-5}$
F	NOT CREDIBLE	The event is inconceivable or fanciful	$<10^{-6}$

Note: "=" means that the indicative value may vary by say ±□ order of magnitude, or more.

Qualitative Measures of Consequences to Property

Level	Descriptor	Description
1	CATASTROPHIC	Structure completely destroyed or large scale damage requiring major engineering works for stabilisation.
2	MAJOR	Extensive damage to most of structure, or extending beyond site boundaries requiring significant stabilisation works.
3	MEDIUM	Moderate damage to some of structure, or significant part of site requiring large stabilisation works.
4	MINOR	Limited damage to part of structure, or part of site requiring some reinstatement/stabilisation works.
5	INSIGNIFICANT	Little damage.

Note: The "Description" may be edited to suit a particular case.

Qualitative Risk Analysis Matrix – Level of Risk to Property

LIKELIHOOD	CONSEQUENCES to PROPERTY				
	1: CATASTROPHIC	2: MAJOR	3: MEDIUM	4: MINOR	5: INSIGNIFICANT
A – ALMOST CERTAIN	VH	VH	H	H	M
B – LIKELY	VH	H	H	M	L-M
C – POSSIBLE	H	H	M	L-M	VL-L
D – UNLIKELY	M-H	M	L-M	VL-L	VL
E – RARE	M-L	L-M	VL-L	VL	VL
F – NOT CREDIBLE	VL	VL	VL	VL	VL

Risk Level Implications

Risk Level		Example Implications(1)
VH	VERY HIGH RISK	Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to acceptable levels; may be too expensive and not practical
H	HIGH RISK	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels
M	MODERATE RISK	Tolerable provided treatment plan is implemented to maintain or reduce risks. May be accepted. May require investigation and planning of treatment options.
L	LOW RISK	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (1) The implications for a particular situation are to be determined by all parties to the risk assessment; these are only given as a general guide.

(2) Judicious use of dual descriptors for Likelihood, Consequence and Risk to reflect the uncertainty of the estimate may be appropriate in some cases.

APPENDIX J

SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

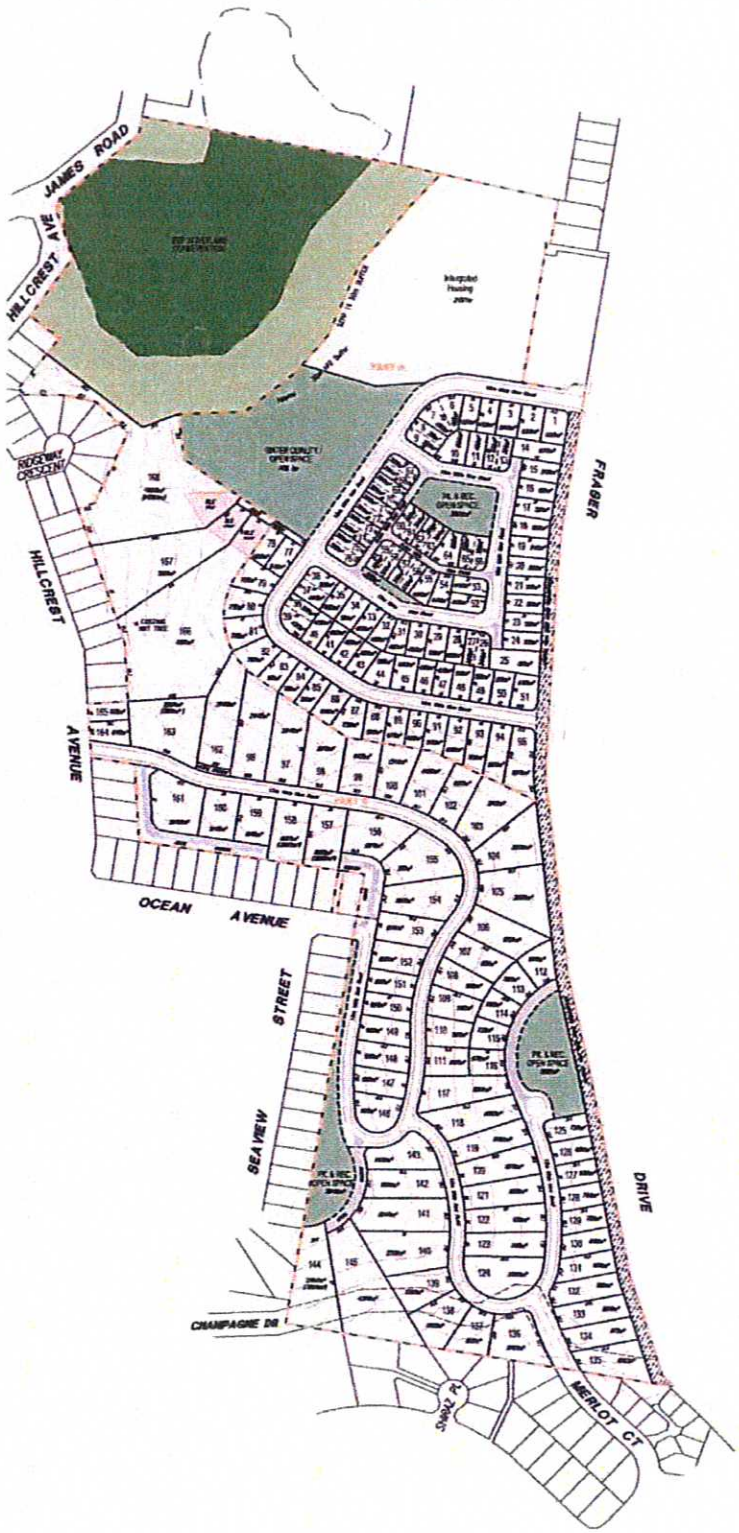
ADVICE	*GOOD ENGINEERING PRACTICE*	*POOR ENGINEERING PRACTICE*
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminant bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements.
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

Note
All dimensions and areas are approximate only, and are subject to survey and Council approval.

Dimensions have been rounded to the nearest 0.1 metres.

The boundaries shown on this plan should not be used for final detailed engineers design.

Base information, contours and road widening, retaining walls provided by Cardno Built. Earthworks Plan Ref: 72140/9/1.



LEGEND

- Part A & Part B Site Boundaries
- Building Localities Envelope
- Park and Recreation / Water Quality
- SEP 14 Wetland Conservation
- SEP 14 Wetland Buffer
- 10m Wide Road Widening

DEVELOPMENT STATISTICS

Total Site Area	32.89 ha
Part A	
Total Area	11.07 ha
Total No. of Lots	96
< 449m²	5
450m² - 479m²	11
480m² - 509m²	5
510m² - 539m²	14
540m²+	28
duplex 600m²+	16 - 32 dwellings
Integrated Housing (2.517 ha)	
@ 25 dwellings per ha	62 dwellings
Total Area of Open Space	
Park and Recreation	2885 m²
Water Quality	1.36 ha
Road Widening	3349 sqm
Part B	
Total Area	21.82 ha
Total No. of Lots	73
540m² - 1.33 ha	73
Total Area of Open Space	
Park and Recreation	7465 m²
Sep 14 Wetland Conservation	3.15 ha
Sep 14 Wetland Buffer	2.4 ha
Road Widening	5140 m²

Level Datum	Date: 22 NOV 2006	CLIENT: VILLA WORLD LIMITED	PROJECT: PROPOSED SUBDIVISION
Origin	Surveyed:	PROPOSED LAYOUT FRASER DRIVE TWEED HEADS	Plan Reference: 20934-5a
	Comp By: KCH		
	DWG Name: 20934-PRO		
Scale: 1:2000@A1	Local Authority: TWEED SHIRE COUNCIL		
	Job Reference: 20934		

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APPENDIX B

Bushfire Assessment by Boskae Environmental Planning

BOSKAE
ENVIRONMENTAL PLANNING

BUSHFIRE ASSESSMENT FOR A PROPOSED RESIDENTIAL SUBDIVISION FRASER DRIVE, SOUTH TWEED

October 2006

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PO Box 7240
Lismore NSW 2480

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Bushfire Assessment
Proposed residential subdivision
Fraser Drive, South Tweed
Lot 9 DP 1039569

October 2006

Prepared by:

Boskae Environmental Planning
PO Box 7240 Lismore Heights NSW 2480
T: (02) 6625 1704 F (02) 6625 2376

ABN: 23 558 219 895

Prepared for:

Villa World
PO Box 7720 GCMC Bundall QLD 9726

The expression of our views about this Bushfire Assessment, our acceptance of the client's instructions, and our understanding of this assessment do not constitute any representation or warranty as to the ability of the development to withstand bushfire.

Due to the unpredictable nature of wild fires and associated extreme weather conditions, Boskae Environmental Planning, in its preparation of this Bushfire Assessment and the recommendations contained herein, do not express or imply a guarantee or warranty to protect persons or property against the identified bushfire threat. The owner of the property accepts the risks associated with knowingly developing a site within a designated bushfire prone area, where a potential bushfire threat exists.

Signature:

Bridget Aulton
Bushfire Consultant

Date: 19 October 2006

Signature:

Brad Carmady
Principal

Date: 19 October 2006

EXECUTIVE SUMMARY

Boskae Environmental Planning has undertaken a Bushfire Protection Assessment to support the development application for the proposed Fraser Drive residential subdivision.

The site comprises 33.8 hectares of land on the eastern side of Terranora Creek, South Tweed, and is described as Lot 9 DP 1039569.

The site is located on the western side of Fraser Drive, approximately 1km south of the coastal town of Tweed Heads in Northern New South Wales.

The site is currently vacant land, however at times it is used for cattle grazing. The site has been used previously for banana farming and other agricultural uses.

The land surrounding the site includes residential land to the north, south and west, and tourist, residential and grazing land to the east.

The proposed development is a residential subdivision comprising 153 lots.

This Bushfire Protection Assessment provides an assessment of the potential level of bushfire risk to the proposed future development and provides recommendations on the implementation of Asset Protection Zones, the provision of water supplies, access requirements and fuel management practices necessary to mitigate the potential bushfire threat.

Asset Protection Zones ensure that a progressive reduction of bushfire fuels occurs between the bushfire hazard and future dwellings within the development.

Water supplies are essential for firefighting purposes and the subdivision will be serviced by a reticulated water supply and associated fire hydrants.

Access requirements include construction of the internal road system in accordance with Planning for Bushfire Protection (2001).

The features of the site as discussed in this report, together with these strategies, provide that the site is suitable in terms of its intended use.

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1 Introduction

Boskae Environmental Planning has been engaged by Villa World to prepare a Bushfire Risk Assessment for a proposed residential subdivision of the Fraser Drive site at South Tweed. The aim of the report is to provide an indication of bushfire hazard and necessary bushfire management practices.

1.1 Aims

We have perused the Concept Plan and completed a detailed inspection of the site. This report serves to:

- identify statutory requirements;
- identify the site and proposed development;
- identify fire management responsibilities;
- detail information relating to bushfire risk including vegetation, slope, and fire history;
- determine the bush fire threat;
- recommend alleviation measures, such as the provision of Asset Protection Zones, to provide an adequate level of protection to life on the site; and
- identify work required, if necessary, in order to improve the chances of building survival in the event of a bush fire.

This report provides bushfire risk mitigation recommendations and concludes by providing a future development consent authority with a degree of confidence that the chances of building survival in a bushfire situation will be significantly improved.

1.2 Statutory Requirements

This report has been prepared having regard to the following legislative and planning requirements.

1.2.1 Legislation

***Environmental Planning and Assessment Act* (EPA Act)**

- Section 91(1) defines residential subdivision and special protection development as integrated development which requires authorisation under Section 100B of the *Rural Fires Act* 1997.

***Rural Fires Act 1997* (Amended)**

- Section 100B provides for the issue by the Commissioner of the NSW Rural Fire Service of bushfire safety authorities for subdivision of bushfire prone land that could lawfully be used for residential or rural residential purposes.

- Sections 63(1) and 63(2) require public authorities and owners/occupiers of land to take all practicable steps to prevent the occurrence of bushfires on, and to minimise the danger of the spread of bushfires.

1.2.2 Planning Policies

Planning for Bushfire Protection 2001

This document was prepared by the Rural Fire Service in collaboration with Planning NSW and provides guidance on the planning and development control processes in relation to bushfire protection measures for subdivision and residential developments in bushfire prone areas.

1.3 Documentation reviewed

- Concept Plan prepared by PMM Sydney (2006)
- Preliminary Environmental Assessment Report prepared by PMM Sydney (2006)
- Flora and Fauna Assessment prepared by James Warren & Associates (2002)
- Aerial photo 2006
- Tweed Bush Fire Risk Management Plan prepared by the Tweed Shire Bush Fire Management Committee (2002)
- Tweed Shire Council Bushfire Prone Lane Map
- *Planning for Bushfire Protection 2001* prepared by NSW Rural Fire Service and Planning NSW

1.4 Site Inspection

Bridget Aulton of Boskae Environmental Planning inspected the development property on the 1st of September 2006 to assess the topography, vegetation classification and land use within and adjoining the development site.

2 The Site and Proposed Development

2.1 Site Description

The Fraser Drive development is located south of the coastal town of Tweed Heads in Northern New South Wales. Fraser Drive is identified as Lot 9 DP 1039569 and comprises approximately 33.8 hectares. The site is of a roughly rectangular shape with a frontage of approximately 800 metres to Fraser Drive. Under the Tweed Local Environmental Plan 2000 the land is zoned 2(c) Urban Expansion.

The site has been identified as bushfire prone land in accordance with Section 146(2) of the *Environmental Planning and Assessment Act 1979*. Tweed Shire Council's Bushfire Prone Lane Map indicates the site to comprise or be located in close proximity to vegetation considered bushfire prone. Areas affected within the proposed development are the northern end and very small areas in the south-east of the site. Refer to Appendix A for Bushfire Prone Land Map.

The site is accessed from Fraser Drive and several other access roads are proposed.

Refer to Appendix B for photographs of the site.

2.2 Existing Land Use

The site is currently vacant land, however at times it is used for cattle grazing. The site has been used previously for banana farming and other agricultural uses.

In more recent times, Tweed Shire Council issued a consent for filling in October 2002.

2.3 Surrounding Land Use

The land surrounding the site includes residential land to the north, south and west, and tourist, residential and grazing land to the east.

The following Zones surround the site:-
6(a) Open Space and 2(c) Urban Expansion – north
2(e) Residential Tourist – east
6(a) Open Space and 2(c) Urban Expansion – south
2(c) Urban Expansion – west

2.4 Proposed Development

This assessment is based upon the Concept Plan prepared by PMM Sydney for a 153 residential lot subdivision.

Primary access to the site will be gained from Fraser Drive. It is proposed the northern portion of the site be accessed from two access points via a single T-intersection in both instances. Access to the steeper parts of the site will be facilitated by minor access points along the western boundary at Ocean Avenue and Hillcrest Avenue. Further it is proposed to provide access to the southern portion of the site from Merlot Street at the southern boundary.

3 Fire Management Responsibilities

Fire management responsibilities within the proposed development site are the responsibility of the following organisations.

3.1 Tweed Shire Council

Tweed Shire Council has the responsibility, under Section 66 of the Rural Fires Act, to issue a notice in writing requiring an owner/occupier of any land within the Shire to carry out bushfire hazard reduction works on that land. Section 100E of the Rural Fires Act requires Council to issue bushfire hazard reduction certificates for hazard reduction to be undertaken on private lands.

3.2 New South Wales Rural Fire Service

The NSW Rural Fire Service (RFS) has the responsibility for undertaking fire suppression activities, hazard management activities and other functions relative to emergency management, within its areas of operation.

Section 73 of the Rural Fires Act (1997) enables the Commissioner to carry out bushfire hazard reduction works on any land as required by a bushfire risk management plan if the work has not been carried out satisfactorily. Incurred costs can be recovered as a debt owed to the Crown.

3.3 New South Wales Fire Brigade

The NSW Fire Brigade has the responsibility for undertaking fire suppression activities, and other functions relative to emergency management, within its area of operation and through Mutual Aid Agreements, provide assistance to the NSW Rural Fire Service, particularly for structural fire operations within the NSW Rural Fire Brigade Districts. Hazmat management within NSW is the responsibility of the NSW Fire Brigade.

3.4 Tweed Shire Bush Fire Management Committee

The Tweed Shire Fire Management Committee has the responsibility for preparing a Bush Fire Risk Management Plan for the area. The aim of the Tweed Bush Fire Risk Management Plan is to provide for the coordinated prevention and mitigation of bush fires for:

(a) the protection of life, property and the environment within the community; and

(b) the protection, maintenance and wherever possible the enhancement of the natural and cultural values of the area through the management of appropriate fire regimes.

The Tweed Shire Bush Fire Management Committee is supported by the Rural Fires Act 1997 in which:

- Section 50 (1) of the Act states that *'the Bush Fire Co-ordinating Committee must constitute a Bush Fire Management Committee for the whole of the area of any local authority for which a rural fire district is constituted.'*
- Section 51 (1A) requires *'a Bush Fire Management Committee must, within 2 months after the end of each financial year, report to the Bush Fire Co-ordinating Committee on implementation of each bush fire risk management plan in force for the rural fire district or other part of the State for which the Bush Fire Management Committee is constituted.'*
- Section 52 (1) requires *'each Bush Fire Management Committee must, in accordance with this Division, prepare and submit to the Bush Fire Co-ordinating Committee a draft of each of the following kinds of bush fire management plans for the rural fire district or other part of the State for which it is constituted:*

  (a) a plan of operations, and

  (b) a bush fire risk management plan.'
- Section 54 of the Act specifies:

  (1) A draft bush fire risk management plan for a rural fire district or other part of the State is to set out schemes for the reduction of bush fire hazards in the rural fire district or other part of the State.

  (2) Without limiting the matters that may be contained in a draft bush fire risk management plan, it may restrict or prohibit the use of fire or other particular fire hazard reduction activities in all or specified circumstances or places to which the plan applies.

3.5 Private Land Owners & Occupiers

The Rural Fires Act 1997 presents several legislative opportunities to require land owners and occupiers to manage hazardous fuels.

Section 63 states that:
(2) It is the duty of the owner or occupier of land to take the notified steps (if any) and any other practicable steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of bush fires on or from, that land'.

(3) A public authority or owner or occupier is liable for the costs incurred by it in performing the duty imposed by this section.

(4) The Bush Fire Co-ordinating Committee may advise a person on whom a duty is imposed by this section of any steps (whether or not included in a bush fire risk management plan) that are necessary for the proper performance of the duty.

(5) In this section: "notified steps" means:

(a) any steps that the Bush Fire Co-ordinating Committee advises a person to take under subsection (4), or

(b) any steps that are included in a bush fire risk management plan applying to the land.

Section 87 states that:

(1) A person who lights a fire on land for the purpose of land clearance or for burning any fire break during a bush fire danger period that applies to the land is guilty of an offence unless the person:

(a) is authorised to do so by a fire permit issued by the appropriate authority and the person complies with any conditions set out in the fire permit, and

(b) has given notice in accordance with section 86.

Maximum penalty: 50 penalty units or imprisonment for 12 months, or both.

(2) Nothing in this section requires an authorised officer of a fire fighting authority who lights a fire for the purpose of back burning to be authorised to do so by a fire permit or to give any notice before lighting such a fire.

4 Information relating to Bushfire Risk

4.1 Vegetation

The vegetation within the site consists largely of grassland used for pasture with scattered paperbark and regrowth rainforest species on the southern slopes. In the northern part of the site an area of SEPP 14 wetland is bordered by open swamp sclerophyll/brushbox forest. The site is also surrounded by patches of eucalypt forest. (See Flora and Fauna Assessment prepared by James Warren & Associates for further information regarding vegetation species.)

The vegetation can be classified as:

- SEPP 14 Coastal Wetland – Trees 10-30m high; 30-70% (or greater) foliage cover
- Open Forest - Trees 10-30m high; 30-70% foliage cover; understorey of sclerophyllous low trees and tall shrubs or grass; dominated by eucalypts
- Woodland – Trees 10-30m high; 10-30% foliage cover; foliage cover dominated by eucalypts; understorey low trees to tall shrubs
- Grassland (pasture) – usually dominated by introduced grass species but may include bladey grass dominated grasslands.

Refer to Appendix C for photographs of the vegetation.

4.2 Slope of the land

Slope is an important dynamic when assessing bush fire risk and probable fire behaviour.

The proposed subdivision site is situated on the eastern slope of a ridgeline which runs along the western boundary. The southern and western portions of the site comprise minor ridges off the principal ridge to the west, and associated side slopes. Steeper slopes are found in the southern portion of the site, with the northern portion of the site being relatively level (refer to Concept Plan for contour information).

In accordance with Planning for Bushfire Protection (2001), an assessment of the slope over an approximate distance of 100m in all directions from the proposed building line on the development site was undertaken. Details of these slopes can be seen in Tables 1-3 in Section 5.1 of this report.

4.3 Fire History

According to the Tweed Bush Fire Risk Management Plan (2002), the Tweed does not possess large tracts of unmanaged land and indiscriminate burning, together with carelessness or vandalism, are the greatest problems in the Tweed.

The main areas of fire activity are the fast growing Tweed Coast and Cudgen areas and those areas to the west of the shire that have evolved from grazing properties to multiple occupancy sites and hobby farms such as Byrrill Creek, Kunghur and Rowlands Creek.

The Tweed experiences almost identical fire incidences every year. Fires are usually lit by arsonists on the western boundaries of Pottsville village and in the surrounding wetlands. These fires often spread rapidly presenting a direct threat to the village of Pottsville. Fires are also lit by arsonists in pine plantations behind Kingscliff and Cudgen and these fires almost always threaten small intensive farming and residential communities. In the western parts of the shire fires are more often the result of mis-managed burn offs which run through multiple occupancies and grazing properties where proper access, availability of water and household fire prevention are not well planned or executed.

Reliable fire history has only been kept in the Tweed Shire since 1990.

4.4 Bush Fire Season

The start of the bush fire season coincides with the arrival of strong north-west to westerly winds in late winter or spring. The majority of serious bushfires occur from this period until the onset of summer rains which normally start from December and continue through to autumn. Longer fire seasons are experienced when summer rainfall is lower than normal, with the bush fire season extending through summer to early autumn.

4.5 Climate and Weather

The Tweed Shire has a subtropical climate with the moist air and sea breezes having a noticeable effect on summer temperatures, particularly along the coastal strip. The Border Ranges to the north and west of the Tweed Shire have a strong orographic effect, contributing to the mean annual rainfall of 1500-2000mm. There is a distinct wet season over summer and autumn, with winter and spring generally being drier. February to March is the wettest period and August to September are on average the driest months, receiving only 3% of the average annual rainfall.

By definition, the most extreme fire weather conditions will involve all the following conditions:-

- 40° C temperature
- Relative humidity of around 15%
- Average wind speed of 55 km/h
- Extended drought for 6 - 8 weeks
- Unstable atmospheric conditions
- Abundant and well distributed fuel

In general, bushfires occurring outside these critical times are much less likely to get out of control.

Analyses of the frequency of high bush fire danger days in the Tweed suggest that very high or extreme fire weather conditions are rare. The analysis (over the past 13 years) suggests that on average there were less than three days per year with a sufficient combination of high temperature and low humidity to support such fire danger ratings.

4.6 Threatened Species, Population Communities or Ecological Communities within the Site

Flora and fauna matters are addressed in detail in the assessment prepared by James Warren & Associates. The assessment concludes that the proposed development will not have a significant impact on matters of National Environmental Significance.

The proposed development will result in the loss of a single specimen of rough-shelled Queensland nut. At least 10 seedlings are recommended to be propagated from this tree prior to removal and replaced on the site. Two stinking cryptocaryas located near the SEPP 14 wetland will be retained within the proposed 50m buffer.

Impacts on threatened fauna will be minimal and will consist of loss of foraging habitat for the grey-headed flying-fox, eastern long-eared bat and little bent-wing bat.

The establishment of Asset Protection Zones, as detailed in Section 5.1 of this report, should not have any additional impact on threatened flora and fauna identified by the James Warren report.

4.7 Aboriginal and European Heritage

An assessment prepared by Adrian Piper in 2000 analysed the site for potential value as a culturally significant site and archaeological significant site for indigenous peoples. An analysis was also undertaken to determine if the site retained any European heritage values. The assessment indicated that no evidence or record exists that indicates the site contains any significant heritage values. Therefore, the establishment of Asset Protection Zones, as detailed in Section 5.1 of this report, should not have any impact on Aboriginal or European heritage within the site.

5 Planning for Bushfire Protection

Planning for Bushfire Protection (2001) provides a methodology for determining setback distances (Asset Protection Zones) required for habitable buildings in residential development that is designated as bushfire prone.

Section 5.1 below uses this methodology to determine Asset Protection Zones required for future dwellings.

5.1 Bushfire Protection Assessment

Section A2.3.1 of Planning for Bushfire Protection (2001) requires the following procedure for determining whether a development is bushfire prone and, if so, an appropriate Asset Protection Zone:-

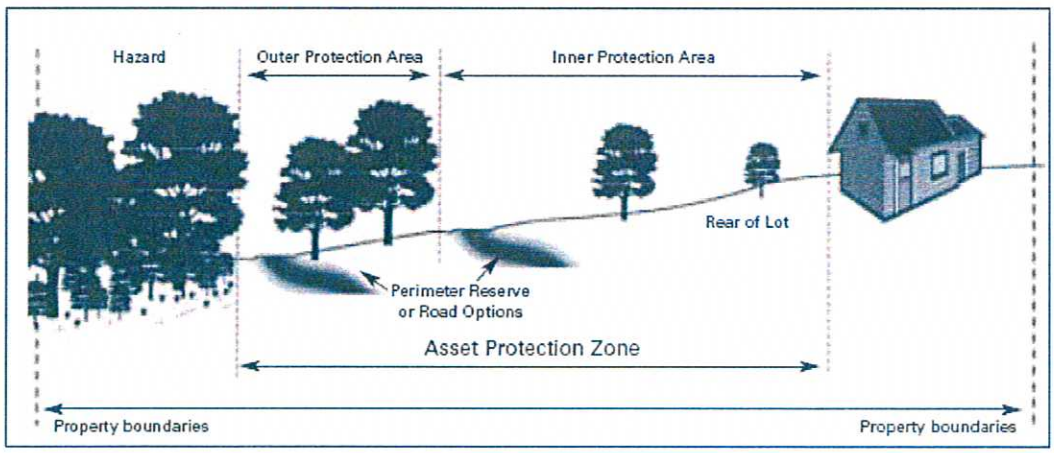
(a) Determine predominant vegetation type, class and separation distance;

(b) Determine average slope of the land between the predominant vegetation class and the site; and

(c) Consult Tables A2.2- A2.4 to determine appropriate Asset Protection Zone.

It is important to note that an Asset Protection Zone must be contained wholly within the boundaries of the subject site.

An Asset Protection Zone consists of an Inner Protection Area (IPA) and an Outer Protection Area (OPA). The Inner Protection Area extends from the edge of the development to the Outer Protection Area and is an area in which fuels are discontinuous and there is minimal fine fuel at ground level which could be set alight by a bushfire. The Outer Protection Area is located adjacent to the hazard and is an area in which fuel loadings are reduced. Figure 4.1 of Planning for Bushfire Protection (2001), as shown below, illustrates an example Asset Protection Zone.



A Bushfire Protection Assessment was completed on the entire site using the above methodology. The following assessment concentrates on those areas found to be bushfire prone.

The assessment has been divided into three areas:- (1) lots in the south-east of site adjoining Fraser Drive, (2) lots in the east of site adjoining Fraser Drive and (3) lots adjoining the SEPP 14 wetland. The number of lots along Fraser Drive that are bushfire prone are limited (see Bushfire Map at Appendix A). Tables 1 to 3 below provide a summary of this assessment.

Table 1 – Bushfire Protection Assessment for lots in south-east of site adjoining Fraser Drive

Aspect	Predominant Vegetation within 140m of development	Predominant Vegetation Class (Fig A2.2 and Table A2.1)	Average Slope of Land	Recommended width of Asset Protection Zone (Tables A2.2-A2.4)	IPA + OPA (metres)
North	Grassland – to be cleared for residential development	-	Level	-	-
East	Woodland	Group 2	>5° upslope	20 metres	20 + 0
South	Residential development	-	Level	-	-
West	Grassland – to be cleared for residential development	-	>5° upslope	-	-

Although Asset Protection Zones must generally be contained wholly within the boundaries of the subject site, Fraser Drive provides a 30m permanent Asset Protection Zone between the adjoining lots and the hazard, thereby eliminating the need for further setbacks within the site.

Table 2 – Bushfire Protection Assessment for lots in east of site adjoining Fraser Drive

Aspect	Predominant Vegetation within 140m of development	Predominant Vegetation Class (Fig A2.2 and Table A2.1)	Average Slope of Land	Recommended width of Asset Protection Zone (Tables A2.2-A2.4)	IPA + OPA (metres)
North	Grassland – to be cleared for residential development	-	Level	-	-
East	Open Forest (less than 1ha)	Group 3	>5° upslope	20 metres	20 + 0
South	Residential development	-	0-5° upslope	-	-
West	Grassland – to be cleared for residential development	-	>5° upslope	-	-

Although open forest vegetation is normally classified as group 1, small remnant forest areas less than 1 hectare may be considered equivalent to specifications in vegetation group 3.

Again, although Asset Protection Zones must generally be contained wholly within the boundaries of the subject site, Fraser Drive provides a 30m permanent Asset Protection Zone between the adjoining lots and the hazard, thereby eliminating the need for further setbacks within the site.

Table 3 – Bushfire Protection Assessment for lots adjoining SEPP 14 wetland

Aspect	Predominant Vegetation within 140m of development	Predominant Vegetation Class (Fig A2.2 and Table A2.1)	Average Slope of Land	Recommended width of Asset Protection Zone (Tables A2.2-A2.4)	IPA + OPA (metres)
Integrated Housing (east of SEPP 14 wetland)					
North	Residential development	-	Level	-	-
East	Grassland – to be cleared for residential development	-	Level	-	-
South	Grassland – to be cleared for residential development	-	Level	-	-
West	SEPP 14 Coastal Wetland/Tall Open Ecotonal Forest	1	0-5° Downslope	40 metres	30 + 10
Lots south of SEPP 14 wetland					
North	SEPP 14 Coastal Wetland/Tall Open Ecotonal Forest	1	0-5° Downslope	40 metres	30 + 10
East	Grassland – to be cleared for residential development	-	Level	-	-
South	Grassland – to be cleared for residential development	-	>5° upslope	-	-
West	Grassland – to be cleared for residential development	-	>5° upslope	-	-

The Concept Plan has incorporated a 50m buffer alongside the SEPP 14 wetland which is proposed to contain public recreational facilities such as boardwalks and footpaths. The Outer Protection Area of 10m could be contained within this buffer area, with the 30m Inner Protection Area situated adjacent to the buffer. The Inner Protection Area of 30m is based upon Level 2 construction in accordance with AS3959-1999.

Other areas

A small area along the western boundary of the site adjoining residential lots on Hillcrest Avenue is also classified as bushfire prone land. As no residential lots are affected by the bushfire prone classification and the area is separated from the bushfire prone vegetation by two rows of residential lots and a street, no Asset Protection Zones are required.

6 Services

6.1 Water

The subject site has access to water infrastructure connected to the town water supply.

The water system should comply with Section 6.4.3 of Planning for Bushfire Protection (2001) which specifies that:-

- In Urban Subdivisions the water supply to the perimeter road should be delivered by a ring main system.
- Fire hydrants must be accessible and located such that a tanker can park within a distance serviceable by a 20m hose and the habitable building must be located such that a fire at the furthest extreme can be attacked by the tanker using a 60m hose and 10m jet of water. A clear unobstructed path between the hydrant and the most distant point of the building cannot exceed 90m allowing for the tanker to be parked inline. Obstructions to the path will reduce the distances. Australian Standard 2419.1 – 1994 details the location of external fire hydrants.
- If the building is located such that the distances do not comply with AS 2419 for the location of hydrants, then a static supply of water (5000 litres minimum), or an additional hydrant must be supplied.
- In major bushfires there is a possibility that the mains water supply will fail due to excessive demand. The installation of a water supply independent of the mains system on properties along the hazard interface is recommended.

6.2 Gas

Planning for Bushfire Protection (2001) states that any reticulated or bottled gas shall be installed and maintained in accordance with AS1596 "Storage and Handling of LP Gas" and comply with any requirements of relevant authorities.

Large gas cylinders should be kept clear of flammable materials.

If a gas cylinder must be kept close to a building the release valve must be directed away from the building and other combustible materials.

The above standards are recommended to be applied to future residential development on the subdivided lot.

6.3 Electricity

Underground electrical transmission lines are favoured by Planning for Bushfire Protection (2001) and are recommended for the proposed subdivision. Where overhead electrical transmission lines are necessary the following guidelines apply:-

- pole spacing is short unless crossing gullies, gorges or riparian areas; and
- regular inspections are carried out to ensure that no part of a tree is closer to a power line than the distance set out in Appendix 4 of Planning for Bushfire Protection (2001) as shown in Table 3 below.

Table 3 – Typical Tree Pruning Clearances

Voltage	Clearance at pole to nearest conductor in rest position	Clearance along middle 2/3 of span to nearest conductor in rest position
Insulated service wires	0.5m	0.5m
Up to 650V (additional clearance of 0.5m should be added to nominated clearances for fire hazard areas)	1.0m	1.0m or sag at 50°C plus 0.5m (whichever is greater)
>650V to 22kV	1.5m	1.5m or sag at 50°C plus 0.5m (whichever is greater)
>22kV up to 66kV	2.25m	2.25m or sag at 50°C plus 1.0m (whichever is greater)
>66kV up to 132kV	3.0m	3.0m or sag at 50°C plus 1.0m (whichever is greater)

7 Access/Egress

Principal access to the site will be gained from Fraser Drive, a bitumen sealed two lane road, which borders the eastern boundary of the site. There is a possibility that the road will be upgraded to four lanes sometime in the future.

The Concept Plan indicates that access will also be provided to the site from Hillcrest Avenue, Ocean Avenue and Merlot Court.

A future interchange is currently being negotiated by the Tweed Shire Council and the Roads and Traffic Authority that will allow direct access from Fraser Drive to the Pacific Highway. The Pacific Highway is approximately one kilometre to the west of the site.

Approximately 2kms of internal access roads will be constructed to provide access to the proposed lots.

Roads will be two-wheel drive, all weather roads and be two-way, that is, at least two traffic lane widths with shoulders on each side, allowing traffic to pass in opposite directions.

Fraser Drive, as the perimeter road in Part 'A' of the development, will be linked to the internal road system at an interval of approximately 300 metres.

Roads will be through roads, however, where dead end roads are greater than 200m in length, as will be the case with the road constructed off Hillcrest Avenue, a minimum 12m radius turning circle will be incorporated. Such roads will be clearly sign posted as dead ends.

Curves will have a minimum inner radius of approximately 25m and be minimal in number to allow for rapid access and escape. The minimum distance between inner and outer curves will be approximately 12m.

The internal road system should also generally comply with Section 4.3.1 of Planning for Bushfire Protection (2001). Specifically, these roads shall address the following design criteria:

- Restrict the use of speed humps and chicanes to control traffic;
- The capacity of road surfaces and bridges should be sufficient to carry fully loaded firefighting vehicles;
- There must be a minimum vertical clearance to a height of 6m above the road at all times;
- Roads should provide sufficient width to allow firefighting vehicle crews to work with firefighting equipment about the vehicle; and
- Road should be clearly sign-posted (with easily distinguished names) and buildings should be clearly numbered. Bridges should clearly indicate load rating.

8 Recommendations and Conclusion

In summary, the following measures are recommended to be applied to the Concept Plan for the proposed Fraser Drive residential subdivision:-

(a) Asset Protection Zones, where required, are to be maintained on all aspects of the lots as specified in Section 5.1 of this report.

(b) The elevation of the integrated housing and residential lots facing the SEPP 14 Coastal Wetland/Tall Open Ecotonal Forest is to be constructed in accordance with Level 2 performance levels AS3959-1999.

(c) The subdivision will be serviced by a reticulated water supply. The water system and installed fire hydrants should comply with Section 6.4.3 of Planning for Bushfire Protection (2001).

(d) Underground electrical transmission lines are recommended, although where overhead electrical transmission lines are installed these should comply with Section 6.4.1 of Planning for Bushfire Protection (2001).

(e) The internal road system should be constructed to comply with Section 4.3.1 of Planning for Bushfire Protection (2001).

The determining authorities and RFS officers may suggest additional or alternative measures be included in the planning and construction of individual dwellings.

It is considered that should the recommendations in this assessment be incorporated in the design and construction of the proposed subdivision, that the fire hazard present is containable to a level considered necessary to provide an adequate level of protection to life on the site. While it is believed that the implementation of the measures and recommendations contained within this report would contribute to the amelioration of the potential impact of any bushfire upon this site, they do not and cannot guarantee that the area will not be affected by bushfire at some time.

If there is a need to discuss any matter raised in this report, please do not hesitate to contact Bridget Aulton on (02) 6625 1704.

9 References

Councils of Standards Australia AS3959 (1999) *Australian Standard "Construction of buildings in bushfire-prone areas".*

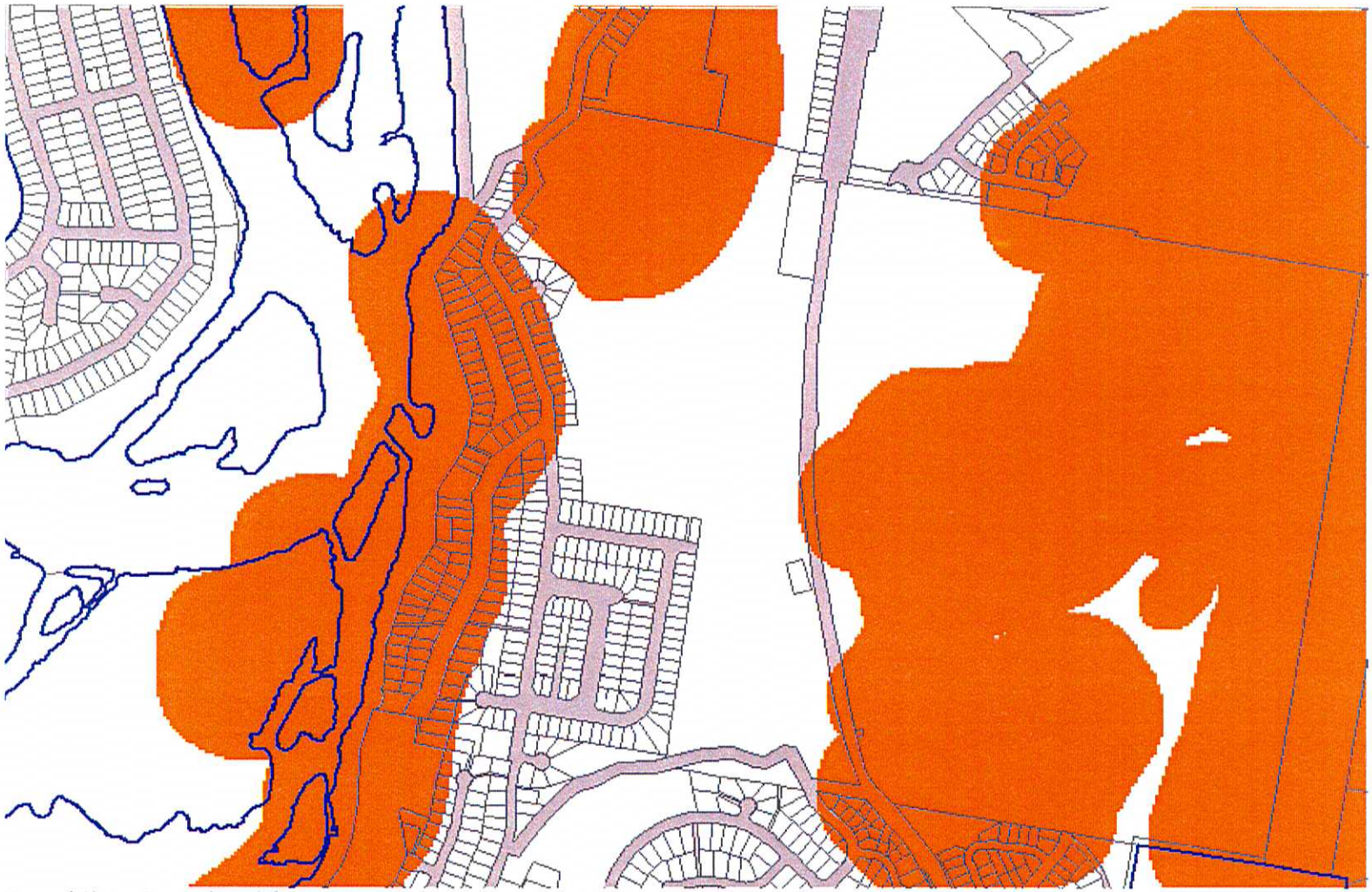
NSW Rural Fire Service (2001) *Planning for Bushfire Protection – A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners.*

Warren, J (2002) *Flora and Fauna Assessment.*

Tweed Shire Bush Fire Management Committee (2002) *Tweed Bush Fire Risk Management Plan.*

Tweed Shire Council (2000) *Tweed Local Environmental Plan.*

APPENDIX A – TWEED SHIRE COUNCIL BUSHFIRE MAP



Tweed Shire Council Bushfire Prone Land Map. Date Plotted: 1 September 2006

APPENDIX B - SITE PHOTOS

Northern aspect showing north-east corner of site

Southern aspect showing south-east corner of site

North-western slopes of site

Eastern slopes of site

North-west aspect from south-east corner of site

APPENDIX C – VEGETATION PHOTOS

Close up of vegetation adjacent Fraser Drive in south-east corner of site

Long shot of vegetation adjacent Fraser Drive in south-east corner of site

Vegetation adjacent Fraser Drive in east of site

Vegetation adjacent Fraser Drive in east of site

SEPP 14 Vegetation in north of site

SEPP 14 Vegetation in north of site

APPENDIX D – CONCEPT PLAN

CONCEPT PLAN

DEVELOPMENT STATISTICS

Total Site Area	**33.8ha (approx)**
Part 'A'	
Total Area	11.06ha
Total No of allotments	
'a' 15m Frontage, min 450m²	18
'b' 16m Frontage, min 480m²	15
'c' 17m Frontage, min 510m²	13
'd' 18m Frontage, min 540m²	7
'e' 20m Frontage, min 600m²	5
'f' 20m Frontage Duplex, min 600+m²	18(36 dwellings)
Total	76 (94dwellings)
Integrated Precinct (2.6 ha) @ 25 dwellings per/ha	65 dwellings
Part 'B'	
Total Area	22.74ha
Total No. Of Allotments Min 20m Frontage, 640 - 5450m²	77

Note:
1. Part A and B areas include Detention basins, open space & road widening.
2. Develop within Champagne Drive subject to review.
3. Road widening to Fraser Drive to be confirmed.
4. Engineering and hydraulic subject to detail design.

LEGEND

- EXISTING DRAIN
- HIGH POINT
- SEPP 14 WETLAND
- 50M BUFFER
- EXISTING TREES TO BE PRESERVED
- POTENTIAL SLIP AREA
- YEAR 2010 AUSTRALIAN NOISE EXPOSURE FORECAST
- YEAR 2020 AUSTRALIAN NOISE EXPOSURE FORECAST
- EXISTING ROAD RESERVE
- SCHOOL SITE UNDER CONSTRUCTION
- VIEWS
- POTENTIAL PEDESTRIAN LINK
- POTENTIAL NOISE FROM FRASER DRIVE
- SITE BOUNDARY
- OPEN SPACE

PRELIMINARY
FOR DISCUSSION PURPOSES ONLY

0 50 100 150 200

Job No. 20934-04a Date: 10.08.2006 Scale 1:2000@A1

VILLAWORLD FRASER DRIVE

Note: The contents of this plan are preliminary only and for discussion purposes only. Subject to detailed design, engineering, survey and Council approval.

pmm BRISBANE
urban designers town planners land surveyors
A TENICA COMPANY

APPENDIX C

Cardno DA Engineering Plans

(bound separately)

Appendix 18

Community Consultation Letters

Our Ref: **20934**

PMM Sydney Pty Ltd
ABN 75 117 672 474
www.pmm.com.au
T +61 2 8270 8300
F +61 2 8270 8899
E pmmsydney@pmm.com.au
Suite 412, King Street Wharf
15 Lime Street Sydney
NSW Australia 2000
GPO Box 4401 Sydney
NSW Australia 2001

To the Resident

RE: Proposed Residential Subdivision, Fraser Drive Tweed.

MFS Diversified Pty Ltd and Greenview Developments Pty Ltd (the applicant) have commenced discussions with Tweed Shire Council and the Department of Planning on a proposal to subdivide land known as Fraser Drive, South Tweed. A development application proposing to subdivide the land for residential uses, open space and environmental conservation will be submitted to the Department of Planning for assessment in the near future. A preliminary application can be viewed at: www.planning.nsw.gov.au/asp/register2006.asp#tweed.

To date, the applicants have been negotiating with a range of State and local government agencies to ensure that any future development addresses issues such as the protection of rare and threatened flora and fauna species, conservation of the wetland, and providing access to adjoining residential areas.

Public comments are being sought prior to submitting our Environmental Assessment Report. It would be appreciated if you could forward you comments on the proposed plan via email to: pmmsydney@pmm.com.au. Written correspondence can be addressed to:

Pradesh Ramiah
Senior Planner
GPO Box 4401
SYDNEY NSW 2001

Comments should be forwarded by 23 March 2007. We trust this information is sufficient for your purposes; however should you require any further details or clarification, please do not hesitate to contact the writer by telephone.

Yours faithfully
PMM SYDNEY PTY LTD

Pradesh Ramiah
Senior Planner

PMP 1up PROOF 25776.indd 1 28/2/07 1:20:10 PM

Pradesh Ramiah
Senior Planner
PMM Sydney Pty Ltd
GPO Box 4401
Sydney NSW 2001

RECEIVED
27 MAR 2007
BY:.....

Dear Sir,

Proposed Residential Subdivision, Fraser Drive Tweed

I believe I should draw to your attention a characteristic of the proposed area that should be considered.

On the attached photocopy of the proposed subdivision I have marked, in red, the general area of a natural spring on the area.

This spring is not active under normal conditions but when we have significant heavy rain there is a considerable head of water that is absorbed on the higher land bordered by Ocean Avenue, Seaview Street and Hillcrest Avenue that finds its way deep in the earth and emerges as a spring in the marked area.

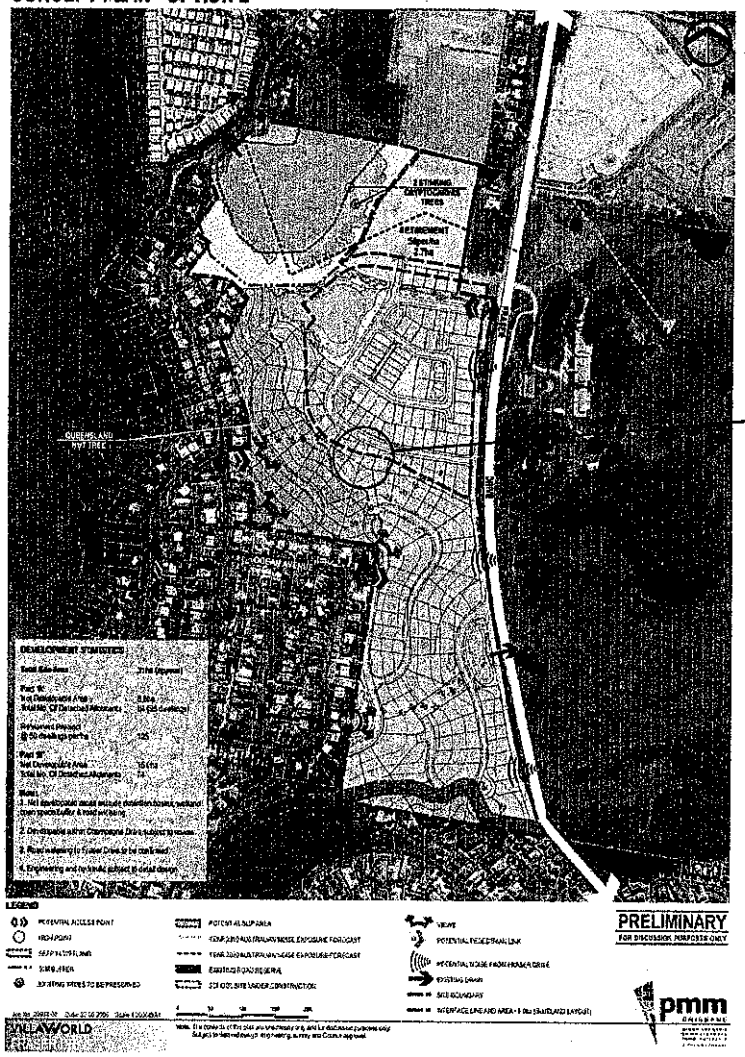
It is not unusual in recent times for the owner of the land to dump soil on the area after the spring has dried up following heavy rain and evidence of this can be seen in the photos attached.

There would be residents that have photos of the land taken in the 1990's prior to the land being raised with fill. These photos would show the extent of the spring and the fact that when the owner at that time mowed the area he was unable to mow the area around the spring as the mower would bog.
I unfortunately do not have such photos but I have seen the area at that time following prolonged heavy rain.

I fear that any residential buildings on the area of the spring would experience problems over time and it is not out of the realm of possibility that you may end up with litigation. You may consider this.

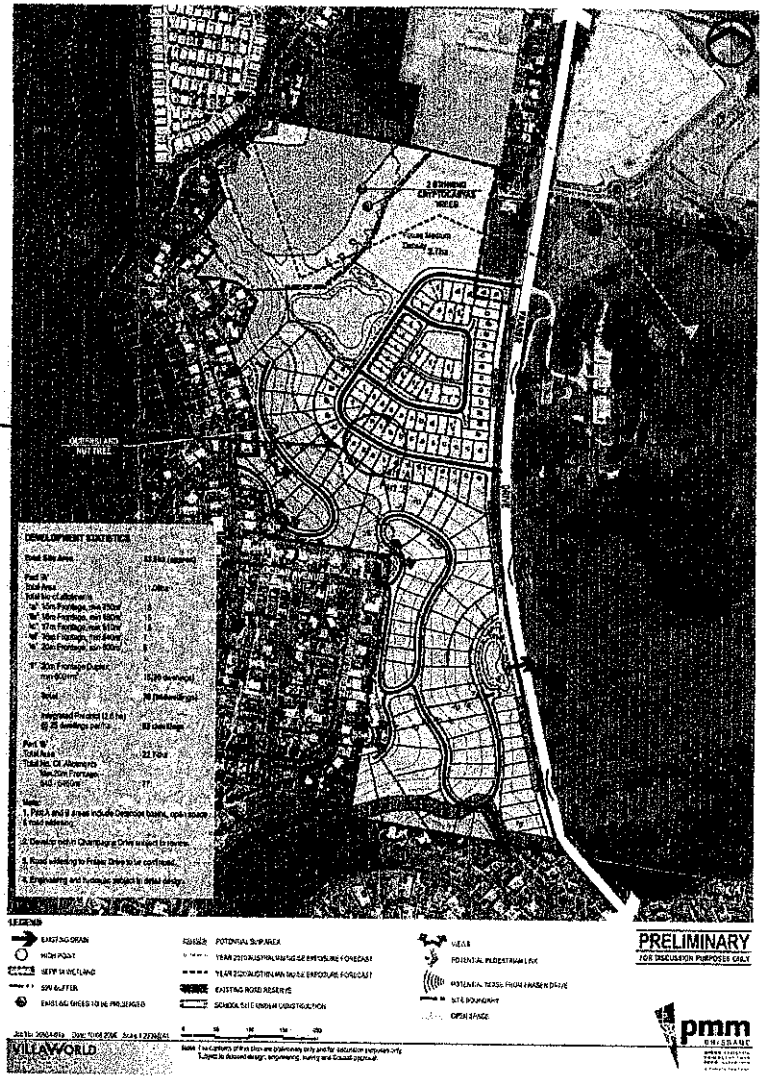
You may consider this feature of the area to be of little importance but you should at least know of the spring.

CONCEPT PLAN - OPTION 2



SPRING

PREFERRED CONCEPT PLAN



RECEIVED
27 MAR 2007
BY:.....

Appendix 19

Electricity Supply Letter

Temple Street, Ballina
PO Box 54
Ballina NSW 2478
Phone: 02 6686 1727
Facsimile: 02 6686 1740

country

Enquiry No:

28 October 2002

Greenview Developments Pty Ltd
C/- Martin Findlater & Associates Pty Ltd
PO Box 216
MURWILLUMBAH NSW 2484

Attention: Martin

Dear Sir

ELECTRICITY SUPPLY TO HOMESTEAD WEST, LOT 9 DP 1039569 FRASER DRIVE, TWEED HEADS SOUTH.

Reference is drawn to your correspondence regarding electricity supply to the proposed subdivision at the above location.

Country Energy wishes to advise that electricity supply can be made available to the development site by the extension of high voltage and low voltage underground mains as the development proceeds. The site is traversed by overhead mains at present and these may be placed underground and incorporated within road and public reserves as the stages progress.

Should you wish to discuss any of the above matters please contact Garry Fox on (02) 6686 1727.

Yours faithfully

GJ Fox

GARRY FOX
Project Manager

Appendix 20

Land Owners Consent Lot 2 and Champange Drive

8th February, 2007

The Minister
NSW Department of Planning
GPO Box 9
SYDNEY NSW 2001

Dear Sir

As the registered proprietors of Lot 2 DP 1000385 we hereby authorise Villa World Limited and Greenview Developments for carry out applications to the NSW Department of Planning for development approval and development permits in relation to this lot.

William Hewitt Sullivan

Robert Thomas Ian Sullivan

Witness (Signature)

Witness (Name – please print)

TWEED SHIRE COUNCIL

Please Quote Council Ref: GR3/12/6 Pt 4; DA02/0837; DW1505795

[eltr]

Your Ref No: 06072.070321

For Enquiries Please Contact: Mrs Nela Turnbull

Telephone Direct (02) 6670 2574

L30B10

RECEIVED
07 MAY 2007
BY:

2 May 2007

PMM Sydney Pty Ltd
GPO Box 4401
SYDNEY NSW 2001

Dear Sirs

Fraser Drive, Tweed Heads South

Council refers to your letter of 21 March 2007, and apologises for the delay in our reply, due largely to Council ascertaining its position regarding your request.

At its meeting held on 6 November 2002, Council resolved to approve the closure of part of Champagne Drive in exchange for the dedication of road widening of Fraser Drive, being a ten metre strip along the eastern boundary of Lot 9 in DP 1039569.

It is to be noted that Council's approval for the road closure is subject to the road widening being effected.

We note that the proposal you have forwarded to Council seeking Council's consent as landowner provides the road widening as required, together with the inclusion of the area of Champagne Drive proposed to be closed. In this regard, Council provides its consent as landowner, as the current owner in fee simple of that part of Champagne Drive shown in plan 20934-5c, to the lodgement of the application for subdivision of Lot 9 in DP 1039569.

It is suggested that the plan of road closure be prepared as a matter of urgency to enable the title for the closed road to be issued, and then the title can be transferred to the landowner.

Yours faithfully

Mike Rayner
General Manager

CIVIC AND CULTURAL CENTRE, MURWILLUMBAH
PO BOX 816, MURWILLUMBAH NSW 2484
TELEPHONE: (02)6670 2400 FAX: (02)6670 2429

PLEASE ADDRESS ALL COMMUNICATIONS TO THE GENERAL MANAGER
ABN 90 178 732 496
www.tweed.nsw.gov.au