MOVEMENT NETWORK INFRASTRUCTURE MASTER PLAN

PROPOSED RESIDENTIAL SUBDIVISION

230 MOUNTAIN RIDGE ROAD, SOUTH MACLEAN

AMENDED IN RED
By: Eamon McDermot
Date: 3 May 2018
Queensland Government

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL
Approval no: DEV2017/887
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FOR

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1. INTRODUCTION

1.1 BACKGROUND

Bitzios Consulting (Bitzios) has been commissioned by Mountain Ridge Pty Ltd to prepare the Movement Network Infrastructure Master Plan (Movement IMP) and Access and Movement Strategy for the proposed subdivision located at 230 Mountain Ridge Road in South MacLean.

The subject site exists within the Greater Flagstone Priority Development Area (PDA) for which Economic Development Queensland (EDQ) is the Assessment Manager. The site also resides within the Logan City Council (Council) Local Government Area (LGA).

The location of the subject site is shown indicatively in Figure 1.1.

SOURCE: Google Maps

Figure 1.1: Location of Subject Site

1.2 DEVELOPMENT DETAILS

The proposed development includes the following transport-related aspects:

- subdivision of existing lots to form 650 residential allotments;
- internal road network servicing all lots including a Trunk Connector within the site;
- connection to the existing road network at Mountain Ridge Road, and ultimately Rose Almond Street (in the interim, the Rose Almond Street connection will be restricted e.g. bollards);
- access at Mountain Ridge Road via a priority controlled T-intersection; and
- external connection provisions to potential future developments to the east and west of the site.

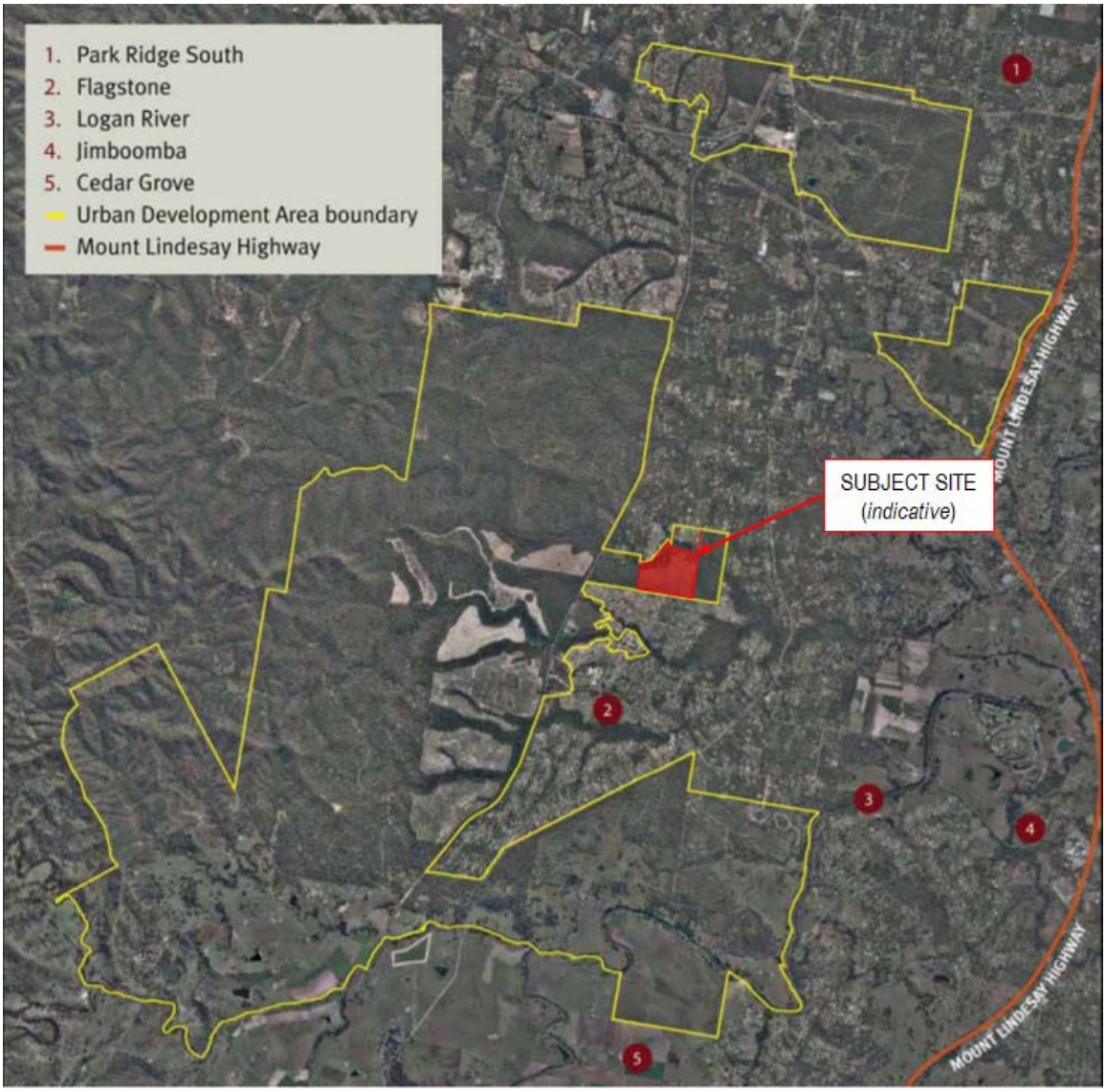
Site plans are provided in Appendix A, while Figure 1.2 depicts the proposed layout

Figure 1.2: Proposed Development Layout

2. PLANNING CONTEXT

2.1 GREATER FLAGSTONE PRIORITY DEVELOPMENT AREA (PDA)

The subject site is located within the Greater Flagstone PDA, which has been defined as a priority growth zone in the State Governments' *South-East Queensland Regional Plan 2009-2031*. Figure 2.1 shows the location of the subject site within the Greater Flagstone PDA.



SOURCE: Greater Flagstone PDA Development Scheme

Figure 2.1: Location of Subject Site within Greater Flagstone PDA

The Greater Flagstone PDA was declared on 8th October 2010 and is located west of Jimboomba within the southern part of Logan City Council (LCC) LGA. The PDA is made up of three (3) separate land areas totalling 7,188Ha. It is projected to experience significant growth in employment and industry, and estimated to accommodate approximately 50,000 dwellings and up to 120,000 residents. The development authority (Assessment Manager) for the PDA is EDQ.

The larger of the PDA land areas is bordered by the Brisbane-Sydney rail line (which is predominantly a freight line) located west of the subject site, while the Mt Lindesay Highway is located further to the east.

2.1.1 Development Considerations

Given that the subject site is within the Greater Flagstone PDA it falls under the *Greater Flagstone PDA Development Scheme*. This Development Scheme is a key consideration for the development of the Access and Movement Strategy of the proposed development. The following sections detail the key outcomes of the Development Scheme, and subsequent expected provisions and strategies.

Land Use Plan – Movement Network

The development contributes to:

- an effective, efficient and integrated movement network that provides a high level of safety and accessibility, maintains residential amenity and promotes the use of public and active transport particularly for local trips;
- a major road network that provides effective links between centres and the neighbourhoods they serve, and to the external road network, and accommodates a range of users including cars, service vehicles, pedestrians, cyclists and public transport;
- a road network that has a functional hierarchy, facilitates longer travel movements, provides multiple access routes to and through neighbourhoods and minimises traffic impacts on residential areas;
- the provision of a public transport network that is readily accessible to the community (90% of all dwellings should be within 400m of a potential public transport service), and provides effective links to centres, rail stations and external destinations; and
- a comprehensive active transport (walking and cycling) network based around major active transport spines, supplemented with local links and a safe permeable street network within neighbourhoods. The active transport network provides safe and direct links to key destinations including centres, railway stations, parks and schools.

Infrastructure Plan – Transport and Network Infrastructure

Table 2.1 lists the Transport and Network Infrastructure requirements as per the *Development Scheme.*

Table 2.1: Transport and Network Infrastructure

Infrastructure	Description of Works	When Required
Roads	Internal and trunk roads will be required to service the development as agreed with the relevant entity.	To be constructed at the time the development is being undertaken and delivered before improvements are demanded by additional loading from developments within the UDA.
Public Transport[1]	Development will contribute to an interim public transport service for up to 5 years or until the fare box income exceeds 30% of running costs, whichever is sooner. This service is to provide a minimum of half hourly services in peak time and hourly services at other times form 6:00am to 9:00pm on weekdays and 8:00 to 5:00pm on weekends.	On the completion of the 200th lot for the UDA or portion of the UDA.
Active Transport	Active transport infrastructure required to service the development.	To be constructed at the time development is being undertaken.
Other Networks	Network infrastructure improvements will be undertaken in conjunction with the relevant responsible authority.	Delivered before improvements are demanded by additional loading from developments within the UDA.

[1] Note, in relation to public transport, it is anticipated that TransLink will be the bus service provider for the areas as an extension to their existing and future planned networks for the surrounding area.

2.1.2 Connecting SEQ 2031 – An Integrated Regional Transport Plan for South East Qld

Connecting SEQ 2031 establishes a long-term plan to develop a sustainable transport system in South-East Queensland. The plan adopts an integrated approach that considers land use planning and the various modes of transport. Connecting SEQ 2031 has been developed as the guiding transport planning and policy document to support the desired regional outcomes of the *SEQ Regional Plan 2009–2031.*

In accordance with Connecting SEQ, Greater Flagstone will include UrbanLink, ExpressLink services and improved active transport infrastructure.

UrbanLink Services

Flagstone will include UrbanLink services providing connectivity between Yarrabilba (east) and Springfield (west). Connecting SEQ 2031 identifies high frequency UrbanLink bus services on strategic corridors across the region as a key part of improving bus travel.

The 'turn up and go' UrbanLink bus network will provide:

- service frequencies of 15 minutes or better off-peak, 10 minutes or better during the peak period;
- high frequency, all day (6 am–9 pm), seven days per week;
- quality shelters and information;
- simplified high frequency network map with no need for a timetable; and
- a doubling of the proportion of residents within walking distance of 'turn up and go' services by 2031.

ExpressLink

ExpressLink services will also operate from Flagstone to Brisbane. The outer sections of the greater Brisbane metropolitan rail network will be operated as ExpressLink services. These services will use existing trains and will start at the end points of the greater Brisbane rail network, which, in 2031, are expected to include Flagstone (via Salisbury).

The ExpressLink network will operate much the same as express services operate today, running all stops to a change point (where UrbanLink services terminate), then stopping only at major transfer locations and activity centres. Passengers wanting to access other destinations will be able to transfer to an UrbanLink rail service or bus services or other ExpressLink stopping points.

The ExpressLink services will:

- provide fast, express running services (competitive or faster than car) between outer suburbs and inner Brisbane;
- be easier for passengers to understand with the same stopping patterns on all services;
- allows for transfers at key stations to access multiple destinations; and
- encourage people to travel off-peak.

Active and Sustainable Transport

Specific active transport infrastructure improvements are not included in Connecting SEQ 2031, although infrastructure improvements are to be focused within new growth communities such as Flagstone. To be effective, active transport infrastructure investment must be:

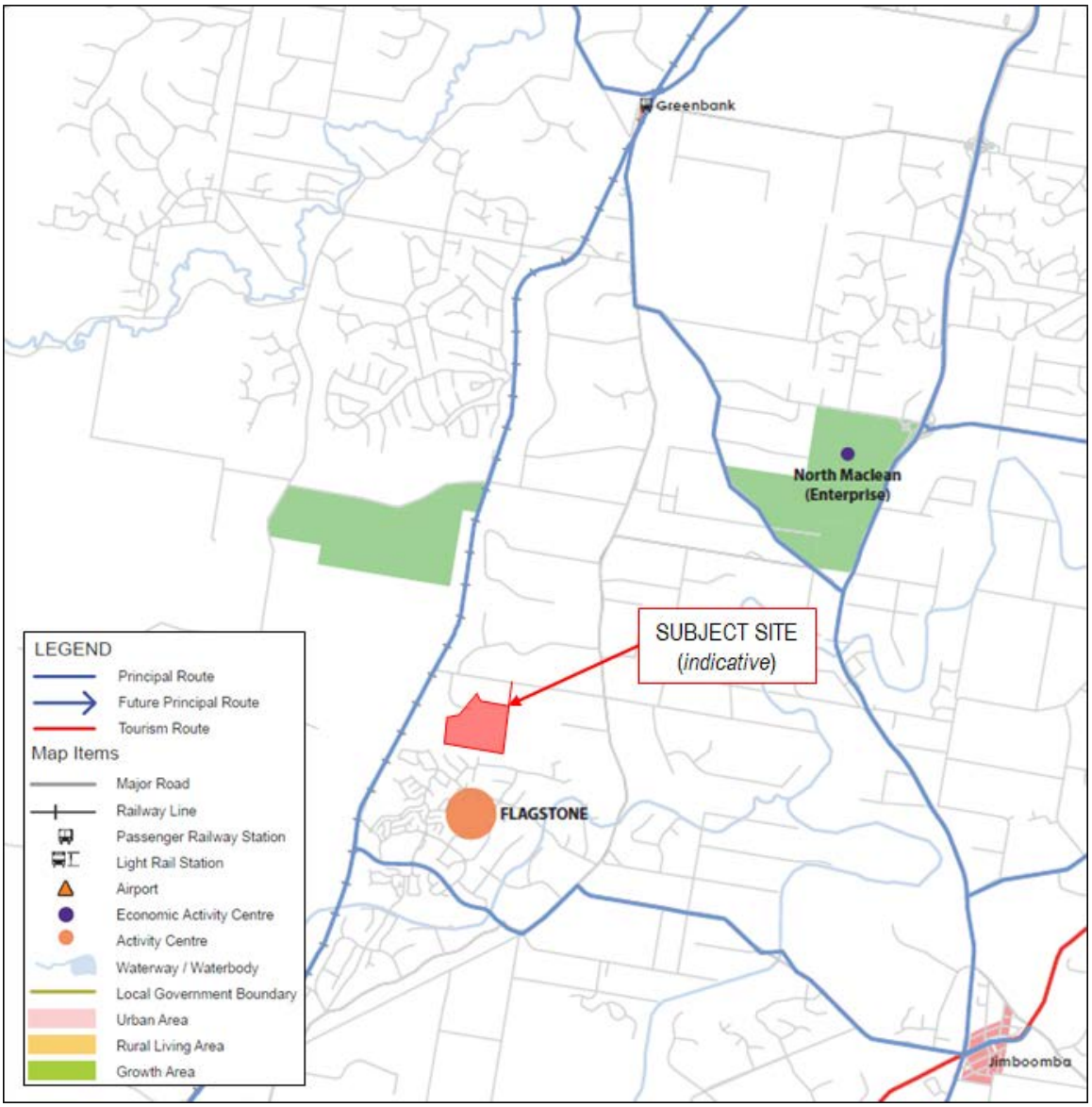
- connected – infrastructure investment in active transport needs to be targeted to fill the missing gaps in networks;
- coordinated – networks extend across local government boundaries and planning and delivery of networks needs to respond to this; and
- 'fit for purpose' – active transport infrastructure needs to be designed and delivered to meet the needs of most existing or potential users of the infrastructure.

Priority projects for completing a safe, direct and connected active transport network include:

- Complete 5 – involves the planning, development and upgrade of networks within this 5km catchment, and any centre master planning exercise should take account of this catchment;
- Educated Ways – which will focus on improvements to active transport networks around schools and universities; and
- Connect To – which plans to develop and upgrade walking and cycling routes that connect to major public transport stops and stations.

In addition to the above, the *SEQ Principal Cycle Network Plan* (SEQ PCNP) identifies a Future Principle Route through Flagstone, connecting to Jimboomba (east) and Greenbank (north).

An extract from the SEQ PCNP is provided in Figure 2.2.



SOURCE: SEQ Principal Cycle Network Plan

Figure 2.2: Extract: SEQ Principal Cycle Network Plan – Flagstone

3. TRANSPORT CONTEXT

3.1 STRATEGIC TRANSPORT GOALS

Connecting SEQ 2031 sets the following targets for Logan City Council:

- reduced trips taken by car from 85.8% to 73%;
- increase share of public transport trips from 5.5% to 10%;
- increase share of walking trips from 8.1% to 10%; and
- increase share of cycling trips from 0.6% to 7%.

As stated above, the Development Scheme includes a number of key transport, movement and infrastructure considerations and criteria to meet these strategic transport goals.

Furthermore, the Development Scheme includes the below 'Stretch targets' and goals as part of its Implementation Strategy:

- achieve a 20% share of all trips as active transport (walking and cycling) trips; and
- have sustainable transport with zero emission private vehicles, active travel and public transport that is safe and equitable for all members of the community.

3.2 EXISTING ROAD NETWORK

The existing road network surrounding the subject site is currently limited to rural standard roads, due to the largely rural residential nature of the area. Further, internal roads do not currently exist through the subject site as the land is largely greenfield.

The subject site connects to Mountain Ridge Road (Council-controlled), which is a rural standard road providing access to Teviot Road, which is the nearest arterial standard road to the subject site. Teviot Road provides a north-south arterial connection between Browns Plains and South MacLean.

Mountain Ridge Road itself currently reaches from the Brisbane-Sydney rail line in the west (PDA boundary) to Teviot Road, however no connection west of the rail line currently exists (*see Section 3.3 for further details*).

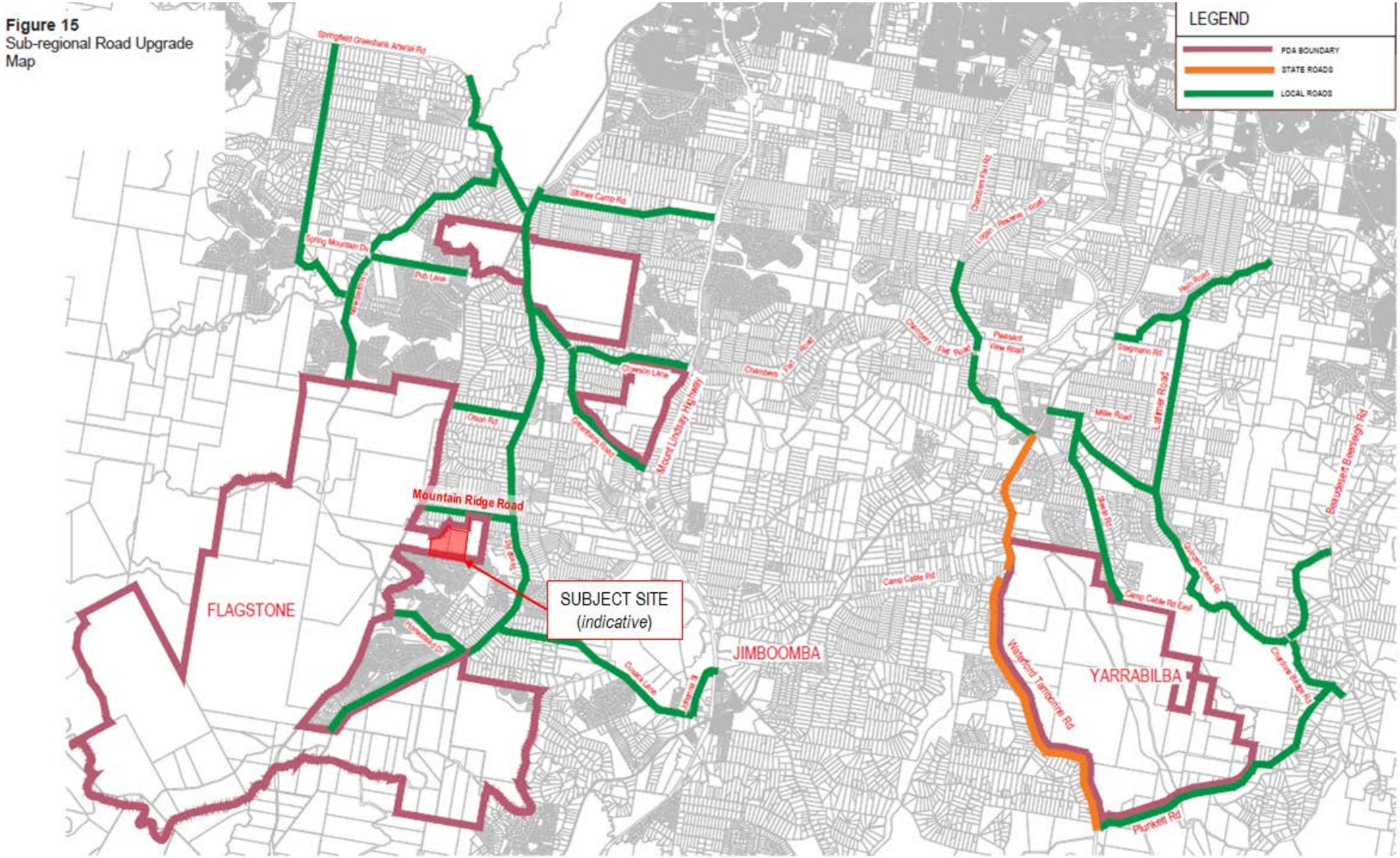
Currently Scott Lane, Stoney Camp Road and Cusack Lane provide connections to the east and to Mount Lindesay Highway.

3.3 FUTURE ROAD NETWORK

The Development Scheme identifies a number of potential Local and Sub-Regional Road infrastructure upgrades to be undertaken, however no timeframes for implementation are provided (although it is understood that several modelling exercises are currently underway by EDQ to determine the likely form and timing of the upgrades – this modelling was not available at the time of preparing this Movement IMP, however model outputs have since been provided that have been used to inform this analysis).

The future road network upgrade that is most relevant to the subject site is the Mountain Ridge Road upgrade (Flagstone PDA (eastern boundary) to Teviot Road). EDQ's Sub-Regional Road Upgrade Map identifies Mountain Ridge Road as a local 'Sub-Regional Road'.

An extract from the Sub-Regional Road Upgrade Map is provided in Figure 3.1 which shows the subject site in relation to sub-regional road upgrades.

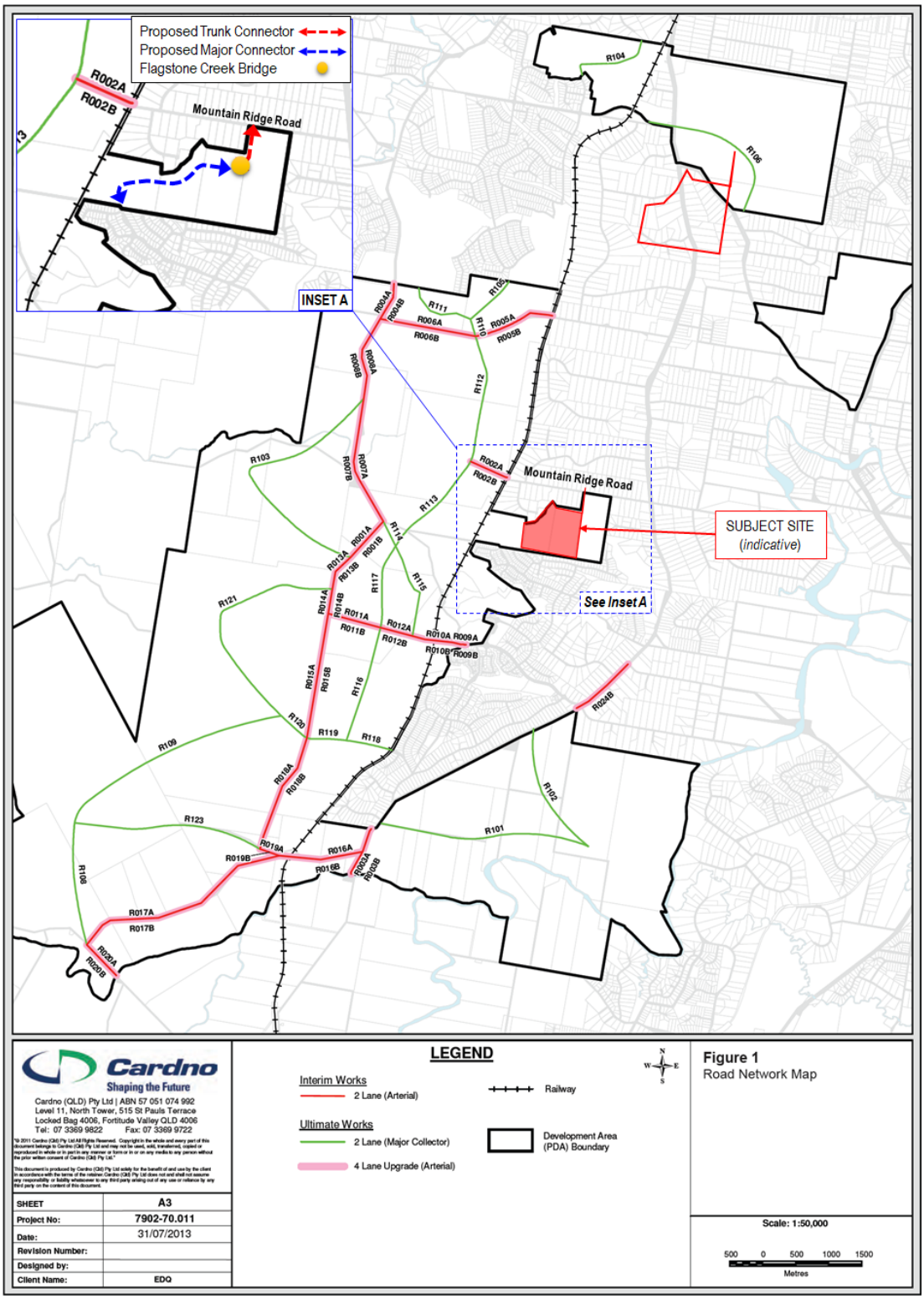


SOURCE: Infrastructure Funding Framework, Sub-Regional Infrastructure, Sub-Regional Road Upgrade Map

Figure 3.1: Extract: Figure 15 – Sub-Regional Road Upgrade Map

Additionally, the Infrastructure Charges Offset Plan (ICOP) for the Greater Flagstone PDA identifies the infrastructure charges and items that may be offset against these charges. The subsequent ICOP Maps include a number of potential upgrades to the existing network, however no time frames are provided.

As shown in Figure 3.2, a connection to Mountain Ridge Road west of the rail line is shown with interim (two-lane arterial) and ultimate (four-lane arterial) upgrades identified (R002A & R002B).



SOURCE: Greater Flagstone Infrastructure Charging Offset Plan (ICOP) Maps – Road Network Maps (edited by Bitzios)

Figure 3.2: Greater Flagstone PDA Road Network Map

However, based on ultimate design volume outputs from the *Greater Flagstone Strategic Transport Model* (GFSTM) and recent discussions/decisions between EDQ and Council, Mountain Ridge Road will ultimately remain as a two-lane road, and the previously envisaged four-lane upgrade is no longer triggered. As such, Mountain Ridge Road will exist as a two-lane arterial road for both interim and ultimate scenarios.

3.4 EXISTING PUBLIC AND ACTIVE TRANSPORT

There is currently minimal to no bus services for the Greater Flagstone PDA (with the exception of school routes) due to the current low passenger demand and lack of sufficient development density.

The only nearby bus service is route 540 running north-south along Mount Lindesay Highway at hourly frequencies between Beaudesert and Browns Plains. It connects key existing facilities outside the PDA, including; the Greenbank RSL Park 'n' Ride, the Park Ridge Park 'n' Ride, and Browns Plains Bus Station.

It is worth noting however, that bus stops currently exist on Teviot Road either side of the Mountain Ridge Road intersection (see Figure 3.3). These were recently upgraded and while they may be largely serviced by school routes currently, it is likely that these stops will be appropriate to service future bus routes.

SOURCE: Google Maps

Figure 3.3: Existing Bus Stops – Teviot Road

Furthermore, pedestrian and cyclist facilities are also limited in the Greater Flagstone PDA in the vicinity of the subject site due to the zoning and population density of the area (i.e. rural residential).

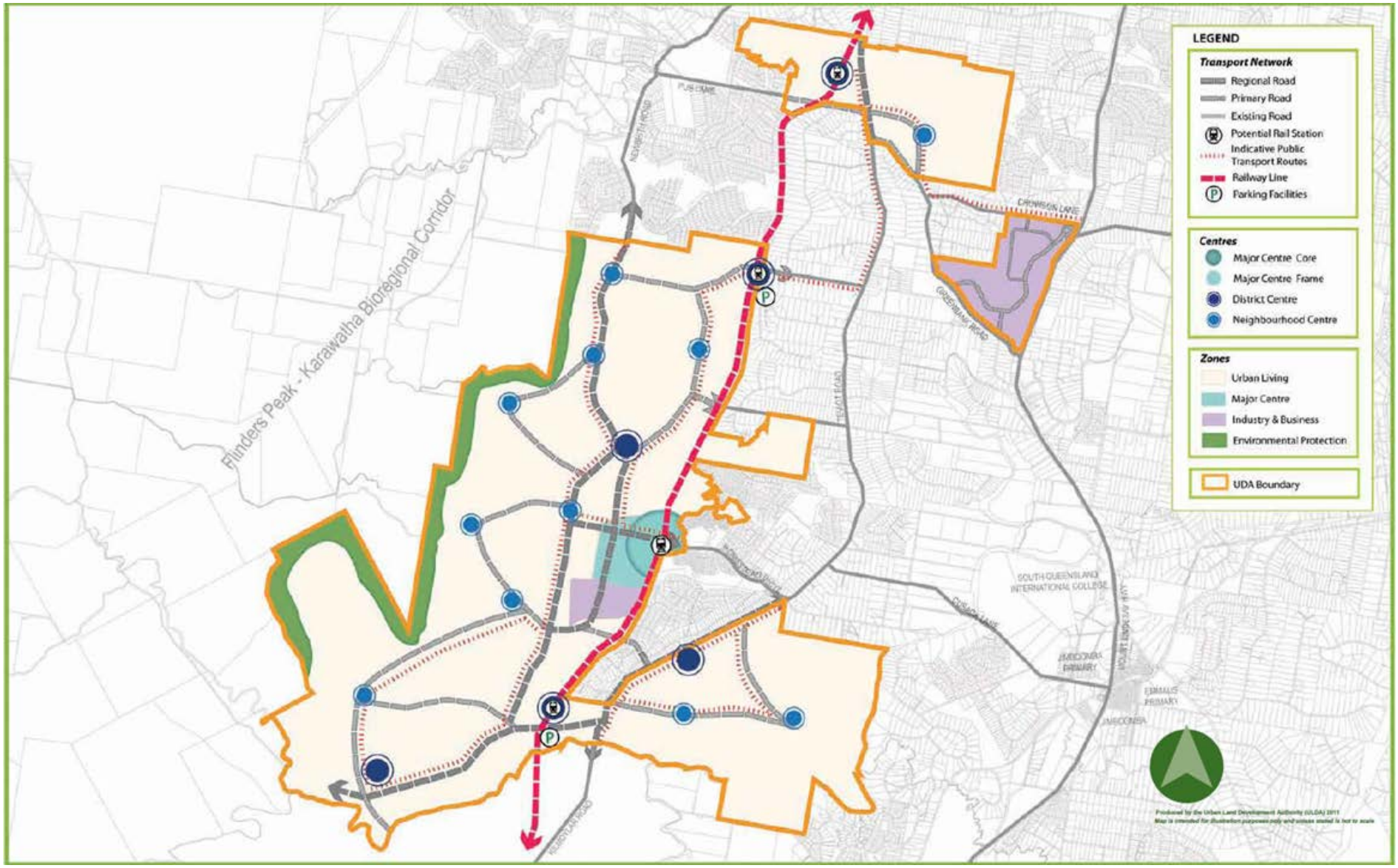
3.5 FUTURE PUBLIC AND ACTIVE TRANSPORT

The PDA Development Scheme provides a snapshot of indicative public transport routes and connections throughout the PDA, including future planned rail stations along the existing Brisbane-Sydney rail line (*see further information below on the Salisbury to Beaudesert Passenger Rail*). Figure 3.4 overleaf shows an extract from the development scheme showing the indicative centres and transport network.

There are several key public transport projects / strategies / investigations associated with the Greater Flagstone PDA that aim to build accessible public passenger transport networks for the expected growth in the region. Some of these include (but not limited to):

- the *Salisbury to Beaudesert Passenger Rail* (which includes 11 new rail stations – including Flagstone Central, dual passenger lines and freight lines, and associated infrastructure);
- the Mount Lindesay / Beaudesert Strategic Transport Network Investigation (which investigated long-term (to 2056) passenger and freight transport links identifying key north-south and east-west corridors connecting centres); and
- the Department of Transport and Main Roads (TMR) *Greater Flagstone and Ripley Valley PDA Passenger Transport Infrastructure Investment Program* (PTIIP) (which identifies key bus routes to service the Greater Flagstone PDA out to 2031).

Importantly, the key future public transport (bus) routes in the vicinity of the subject site that have been identified through these studies indicate north-south routes via Teviot Road and/or New Beith Road, and east-west routes via Homestead Drive, Cusack Lane and Olson Road.



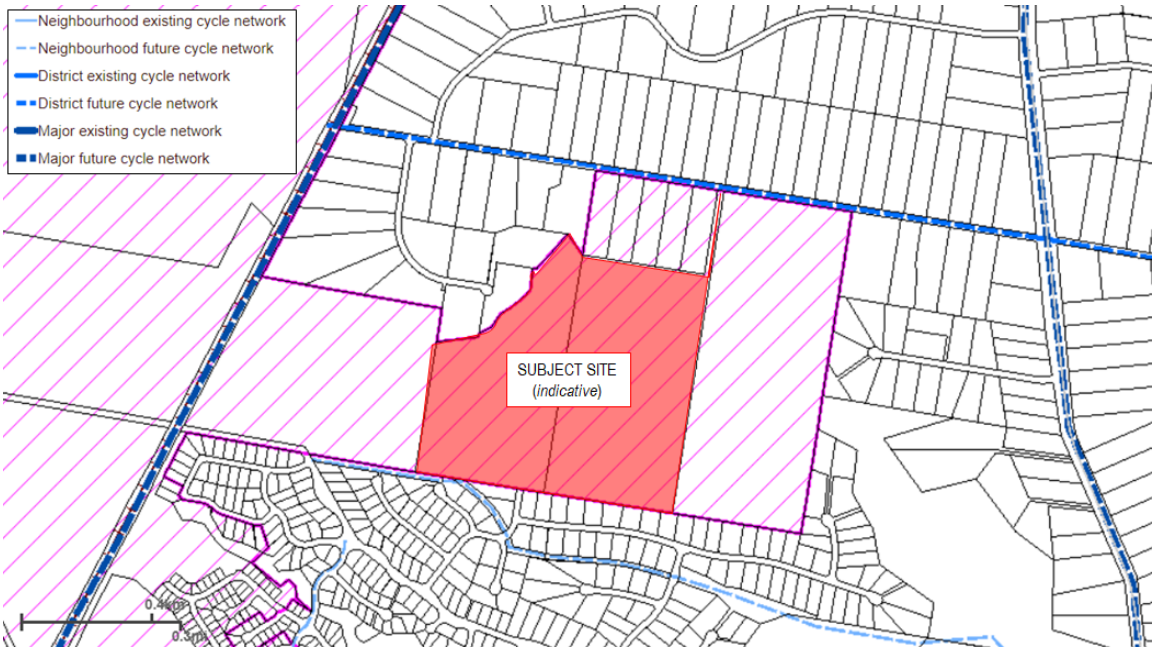
SOURCE: Greater Flagstone PDA Development Scheme

Figure 3.4: Extract: Map 3 – Centres and Transport Network

Future active transport provisions are identified in the SEQ PCNP as previously discussed, with a future Principal Cycle Route following the alignment of the Brisbane-Sydney rail line, Homestead Drive, Cusack Lane, and Greenbank Road (in the vicinity of the subject site).

Furthermore, Council has identified Mountain Ridge Road as a 'District Future Cycle Network', connecting with 'Major Future Cycle Network' on Teviot Road and within the Brisbane-Sydney rail line corridor. Additionally, a 'Neighbourhood Future Cycle Network' is identified south of the subject site generally parallel to Silver Wattle Drive.

Figure 3.5 shows Council's future cycle network in the vicinity of the subject site as described above.



SOURCE: Logan City Council Interactive Mapping

Figure 3.5: Logan City Council Cycle Network Mapping

4. EXISTING CONDITIONS

4.1 SUBJECT SITE

The site is located at 230 Mountain Ridge Road, South MacLean (formally described as Lot 6 / RP193185 & Lot 9 / SP203507) and has frontage to Mountain Ridge Road and Rose Almond Street. The site currently contains two (2) rural residential dwellings and is largely vacant / greenfield. Surrounding sites are generally large, rural residential lots.

As previously stated, the site is located within the Greater Flagstone PDA.

4.2 ROAD HIERARCHY

Table 4.1 presents the road hierarchy of key roads within proximity to the subject site. Note, the road hierarchies shown are as identified in Council's Planning Scheme Policy 5 (Infrastructure).

Table 4.1: Road Hierarchy

Road Name	Jurisdiction	Road Hierarchy	Number of Lanes	Posted Speed[1]	Additional Comments
Mountain Ridge Road	Council	Rural Arterial Single Carriageway	2	60km/h	*Orientated in an approximate east to west direction provides access to subject site. Forms a priority-controlled intersection with Teviot Road.*
Teviot Road	Council	Rural Arterial Dual Carriageway	2	80km/h	*Orientated in an approximate north to south direction, provides an arterial link between Browns Plains and South MacLean.*
Rose Almond Street	Council	Urban Access Road	2	50km/h	*Orientated in an approximate north to south direction access to subject site and residential property access.*

[1] Where a posted speed limit is not provided the road is subject to the default urban speed limit of 50 km/h

While the road hierarchy in the table above was sourced from Council's Planning Scheme Policy 5, it is noted that the existing layout and form of Mountain Ridge Road and Teviot Road differ from the road hierarchy designation. The following outlines the existing road function (based on existing pavement width, corridor width and posted speed limit) as per Table 3.4.4.2.1 of Council's Planning Scheme:

- Mountain Ridge Road: Rural Access (RA); and
- Teviot Road: Rural Collector (RC).

4.3 STUDY INTERSECTIONS

The key intersections considered in this assessment include:

- Intersection 1: Mountain Ridge Road / Teviot Road intersection; and
- Intersection 2: Mountain Ridge Road / Site Access intersection.

It is understood that Teviot Road has been flagged for future upgrade to a four-lane urban standard arterial road. The timing of this upgrade is currently unknown but is expected to be completed beyond 2031 (subject to further testing).

4.4 BACKGROUND TRAFFIC VOLUMES

Peak period traffic surveys were undertaken at Intersection 1 by *Traffic Data and Control* (TDC) on Wednesday 9th August 2017 in order to establish existing background traffic demands. The following peak hour periods were recorded:

- AM Peak Period: 6:15 to 7:15am; and
- PM Peak Period: 5:00 to 6:00pm.

A copy of the traffic survey data is provided at Appendix B.

Detailed traffic analysis is shown in Section 5.3.

5. EXTERNAL MOVEMENT NETWORK

5.1 TRAFFIC VOLUMES

Development Timeframe

The expected development timeframes for the subject site are outlined below:

- 2018: Construction of Stage 1 begins;
- 2019: First year of residential traffic generation;
- 2024: Final Stage of construction completed; and
- 2025: Residential traffic generation includes all proposed lots.

Design Horizons

As previously noted, the GFSTM was not available for use at the time of preparing the original application material. Regardless, all the relevant traffic modelling / testing and assumptions have been updated to reflect the GFSTM data which has since been provided by EDQ. Specifically, this report considers the following design horizons / scenarios:

- Interim (2031) Scenario; and
- Ultimate Scenario[1]

[1] *It is understood the Ultimate GFSTM is based on 2051 strategic horizon, however for modelling purposes, this is simply referred to as "Ultimate".*

Existing Background Volumes

As per the background traffic surveys (see Appendix B) the following existing traffic volumes were recorded on Mountain Ridge Road:

- AM Peak: 25 veh/h (two way); and
- PM peak: 30 veh/h (two way).

Based on this, using the *'average peak hour volumes represent 10% of daily traffic volumes'* rule of thumb, the average daily traffic on Mountain Ridge Road is estimated at 275 vehicles per day (veh/d).

Development Traffic Generation

Traffic generation rates for the proposed development have been advised from EDQ based on surrounding recent developments within the region. The daily traffic generation rate of 6.75 veh/d was advised by EDQ as a typical rate for the Greater Flagstone PDA and is therefore considered applicable to the proposed development.

Table 5.1 shows the rates and subsequent traffic generation estimate for the subject site.

Table 5.1: Development Traffic Generation

Land Use	Quantity	Daily Rate (veh/d)	Daily Trips	Peak Hour Rate[1] (veh/h)	Peak Hour Trips
Residential Lots	650	6.75	4,388	0.675	439

[1] *Peak hour trip generation rate assumed to be 10% of daily trip generation rate.*

It is noted that the site will be developed in stages, with approximately two (2) stages (i.e. approximately 90-100 lots) being constructed per year.

Hence, Table 5.2 presents the traffic generation estimate for each year of development.

Table 5.2: Traffic Generation by Year

Year	Lots Constructed	Total Lots Constructed	Daily Rate (veh/day)	Daily Trips	Peak Hour Rate (veh/hr)	Peak Hour Trips
2019	93	93	6.75	628	0.675	63
2020	106	199		1343		134
2021	100	299		2018		202
2022	97	396		2673		267
2023	106	502		3389		339
2024	119	621		4192		419
2025	29	650		4388		439

As shown above, the total daily trip generation for the subject site is calculated as 4,388veh/d with a peak hour generation of 439veh/h.

Traffic Distribution

Table 5.3 provides a summary of the adopted directional splits based on industry standards.

Table 5.3: Traffic Distribution

Land Use	AM Peak Hour		PM Peak Hour		Daily	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
Residential Lots	20%	80%	70%	30%	50%	50%

Network Distribution

All relevant traffic modelling / testing and assumptions (including distributions) applied reflect the GFSTM data which has been provided by EDQ, with exception only to the modelled 2031 distributions (see below).

The traffic volumes provided by EDQ for interim (2031) and ultimate scenarios is included at Appendix C. Specifically, the following relevant assumptions have been adopted:

- in 2031 (interim), there is no connection to the residential catchment to the south, nor is there any possible connection to the future Flagstone Town Centre in the interim as follows:
  - the Neighbourhood Connector (major) does not connect to Silverwood Drive in 2031; and
  - Rose Almond Street is restricted (e.g. bollards) until the Silverwood Drive connection is achieved.
- considering the above (which has been discussed and agreed with EDQ), there will be no distribution of 2031 trips to the south, and all development traffic will be via Mountain Ridge Road;
- ultimately, the Neighbourhood Connector (major) and Rose Almond Street will connect through, hence the outputs / distributions provided by EDQ from the GFSTM have been adopted for the ultimate scenario.

Table 5.4 shows the adopted network distribution assumptions associated with each scenario.

Table 5.4: Network Distribution

Scenario	Design Year	Network Distribution			
		East – via Mountain Ridge Road	West – via Mountain Ridge Road	South – via Rose Almond Street / Silverwood Drive	Total
1	2031	95%	5%	0%	100%
2	Ultimate	*As per VLC traffic volumes / distributions provided by EDQ (see Appendix C)*			

It is noted that a nominal split (5%) has been assumed to / from Mountain Ridge Road (west) towards Pennine Drive and Paula Road for completeness in 2031. This split is considered appropriate considering this is not expected to be a key route for development traffic.

The ultimate VLC distribution assumptions and intersection traffic volumes from the GFSTM have been adopted for ultimate testing. However, the 2031 volumes have been manually adjusted (reassigned) to the network (i.e. Teviot Road) as it is understood that these 2031 GFSTM outputs included the Rose Almond Street connection, which is no longer envisaged in 2031.

Future Design Traffic Volumes

The ultimate design traffic volumes utilised for testing have been adopted based on the GFSTM intersection volumes supplied by EDQ, as these are assumed representative of ultimate conditions.

The interim (2031) design traffic volumes supplied from the GFSTM were adjusted, as it is understood that these outputs included the Rose Almond Street connection which is no longer occurring in the interim. Hence the volumes were adjusted and manually reassigned to the network (i.e. Teviot Road) as agreed with EDQ. In addition to this, the intersection volumes were determined for "with" and "without" development (subject site) traffic to determine the baseline intersection configuration required regardless of the development.

The design scenario traffic volumes, including reassigned volumes, were based on the GFSTM intersection outputs and are presented at Appendix D.

5.2 MOUNTAIN RIDGE ROAD UPGRADE

The applicant had previously agreed with EDQ during the prelodgement process to include this section of the IMP addressing the upgrade timing of Mountain Ridge Road. It was previously agreed that the timing for the upgrade would be dealt with via a development condition. It was discussed that the applicant would prepare a Road Safety Audit, Road Pavement Assessment and Environmental Capacity assessment which, when combined, would be used to determine a trigger for interim upgrade of Mountain Ridge Road.

However, it has since been agreed with EDQ and the applicant that the upgrade of Mountain Ridge Road will occur with the first stages of development i.e. prior to survey plan endorsement for the first lot. It should be noted however, that based on the GFSTM model volumes and recent discussions / decisions between EDQ and Council, Mountain Ridge Road will ultimately remain as a two-lane road, and the previously envisaged four-lane upgrade no longer applies. This will occur within the existing 20m reserve as outlined in the Internal Movement Network, Road Hierarchy and Typical Cross Sections (*see Sections 6.4 and 6.6*).

Regardless of the above, the findings of the Road Safety Audit and Road Pavement Assessment have been included herein for completeness.

5.2.1 Road Safety Audit

An Existing Conditions Road Safety Audit (RSA) was conducted by Bitzios Consulting for the section of Mountain Ridge Road between the intersections of Teviot Road and Pennine Drive.

It is noted that the RSA was independently undertaken by a separate department / office of Bitzios Consulting to ensure there were no conflicts of interest between the development assessment team and the RSA team. The RSA report is included at Appendix E.

The following key outcomes of the RSA are noted in relation to the proposed development:

- one (1) item raised (Item 8) was located along Mountain Ridge Road to the east of the proposed development access (i.e. between site access and Teviot Road). This item related to an unprotected ditch / box culvert located within the clear zone; and
- eight (8) items raised (Items 9-16) covered the full length of Mountain Ridge Road, including:
  - inadequate provision of footpaths, bus bays, line markings, speed signage and street lighting;
  - hazards within the clear zone including unprotected culverts, ditches, timber power poles and substandard headwalls; and
  - uneven, damaged and substandard width of existing pavement.

Based on the above, it is evident that the existing layout of Mountain Ridge Road is substandard in a number of areas.

5.2.2 Road Pavement Assessment

A Pavement Structural Assessment was conducted by *Oscorp Engineering* for the section of Mountain Ridge Road between Teviot Road and No 29301 with a total length of approximately 1.0km.

The following key outcomes of the assessment were noted:

- at the time of inspection, the pavement is performing in a satisfactory condition with no evidence of pavement failures;
- the existing pavement is in a structurally sound condition and is envisaged to continue to perform in a satisfactory condition for the combination of background traffic and future development traffic (includes construction traffic);
- based on the visual inspection and current pavement condition, the existing bitumen spray seal surfacing is performing in a satisfactory condition;
- given the age and condition of the spray seal surfacing, it is most likely that it will continue to perform in a satisfactory condition for the next three years subject to routine preventative and reactive maintenance being undertaken;
- this section of Mountain Ridge Road has adequate cross fall drainage, with limited table drains, however shoulders and vegetation are reasonably maintained and will continue to perform reasonably well subject to adequate preventative maintenance being undertaken;
- pavement failures are minimum, however due to multiple widenings, the pavement is exhibiting minor cross fall variations combined with localised depressions along the interface of original pavement and widening areas; and
- localised areas of high deflections and weak subgrade were present; however, no pavement failures were noticed along these areas.

Based on the above, the existing pavement is in a satisfactory performing condition for existing background traffic and it is very likely that the pavement will continue to perform well for the next three years subject to the following:

- undertaking adequate preventative / reactive maintenance and as required;
- maintain and improve effective surface drainage;
- undertake six monthly visual inspections by a duly qualified RPEQ Engineer; and
- undertake annual FWD testing to monitor pavement deflection deterioration.

The complete Pavement Structural Assessment report is provided in Appendix F.

5.3 MOUNTAIN RIDGE ROAD DESIGN CRITERIA

As previously discussed, Mountain Ridge Road is no longer required for an ultimate upgrade to a four-lane corridor and will only trigger an upgrade to a two-lane sub-arterial (no interim upgrade required). This was determined based on the projected (ultimate) daily traffic volumes extracted from the GFSTM (approximately 12,000veh/d).

Hence, the guidelines referenced for the design of the Mountain Ridge Road upgrade are listed below:

- Austroads Guide to Road Design;
- Complete Streets; and
- EDQ Guidelines and Infrastructure Documents.

The key criteria utilised in the design of the Mountain Ridge Road upgrade included:

- Posted Speed: 70km/h;
- Design Speed: 80km/h;
- Kerb Type: Barrier Kerb;
- Kerb Return Radius: 8m;
- Maximum Gradient: 8%.

The above criteria are included in the Road Hierarchy and Typical Sections plans provided in Appendix G.

5.4 MOUNTAIN RIDGE ROAD TYPICAL CROSS-SECTION

Table 5.5 presents the key parameters of each Mountain Ridge Road layout, while typical cross-sections are provided in Appendix F.

Table 5.5: Mountain Ridge Road Typical Cross-Sections

Cross Section	Road Reserve	Pavement Width	No. of Lanes	Median Divided	Parking	Footpath	Cycle Provisions
Existing Layout	20.0m	~6.0-7.0m	2	No	No	No	No
Ultimate Layout	20.0m	8.8m	2	No	No	1.5m wide path (both sides)	Yes

A snapshot of the above typical cross-sections are shown below and further provided in Appendix G.

Existing Mountain Ridge Road Layout

The existing Mountain Ridge Road typical section is shown below in Figure 5.1.

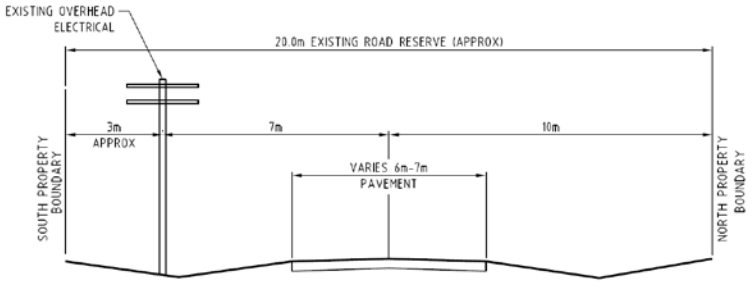


Figure 5.1: Existing Mountain Ridge Road Typical Section (Approximate)

Key points include:

- approximate 6.0-7.0m wide pavement and 20.0m wide road reserve;
- includes existing overhead electrical services (including wooden power poles) located approximately 4.0m from edge of pavement on southern side; and
- includes approximate 7.0m wide verges on each side of the road.

Ultimate Mountain Ridge Road Layout (2-lanes)

The agreed ultimate Mountain Ridge Road typical section is shown in Figure 5.2.

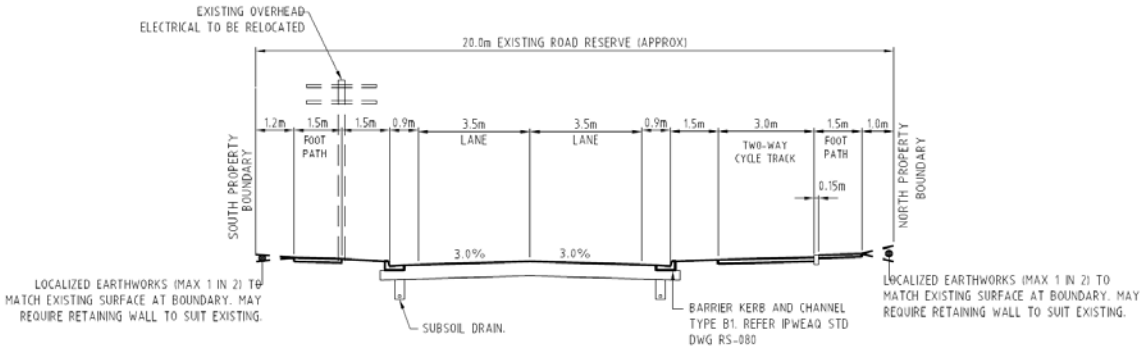


Figure 5.2: Mountain Ridge Road Typical Cross-section – Ultimate (2-lanes)

Key points include:

- layout has been agreed with EDQ and generally in accordance with Draft EDQ Guidelines/documents;
- 8.8m wide pavement (including 3.5m lanes and 0.9m shoulders) within the existing 20m road reserve;
- includes a 7.0m northern verge and a 4.2m southern verge (existing electrical to be relocated);
- includes 1.5m footpath (both sides) and a 3.0m two-way cycle track

It should be noted that this typical section has the potential to result in greater impacts to surrounding properties, likely requiring additional earthworks to match the surface levels at the property boundary, however this is subject to detailed design.

5.5 PROPOSED INTERSECTION LAYOUTS

5.5.1 Turn Warrants Assessment

A turn warrants assessment of the proposed site access intersection with Mountain Ridge Road (i.e. Intersection 2) has been conducted in accordance with the procedures set out within the Department of Transport and Main Roads (TMR) *Road Planning and Design Manual (RPDM), Supplement to Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections*.

The following scenarios were tested in the AM and PM peak hour periods:

- Scenario 1: Interim (2031); and
- Scenario 2: Ultimate.

Table 5.6 presents the key parameters related to the turn warrants assessment.

Table 5.6: Turn Warrants Assessment

Scenario	Peak Period	Left Turn Warrants Volumes			Right Turn Warrants Volumes		
		Q_L	Q_M	Req.	Q_R	Q_M	Req
1 (Interim, 2031)	AM	84	13	BAL	4	100	BAR
	PM	293	2	BAL	15	308	BAR
2 (Ultimate)	AM	110	280	AUL(s)	85	617	CHR(s)
	PM	478	206	AUL(s)	159	963	CHR

Figure 5.3 and Figure 5.4 depict the left and right turn warrants plots (respectively) for the above scenarios.

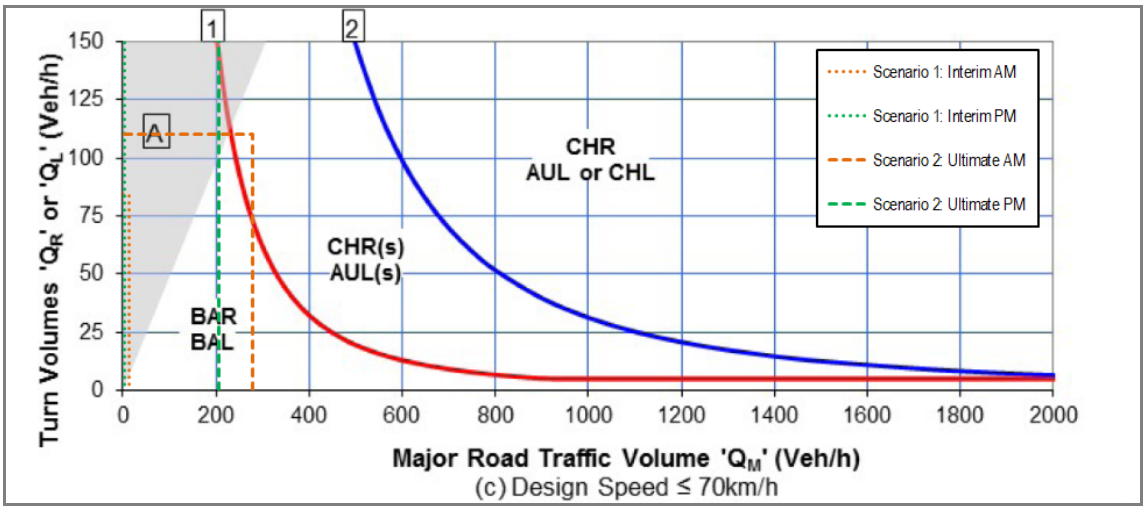


Figure 5.3: Left Turn – Turn Warrants Plot

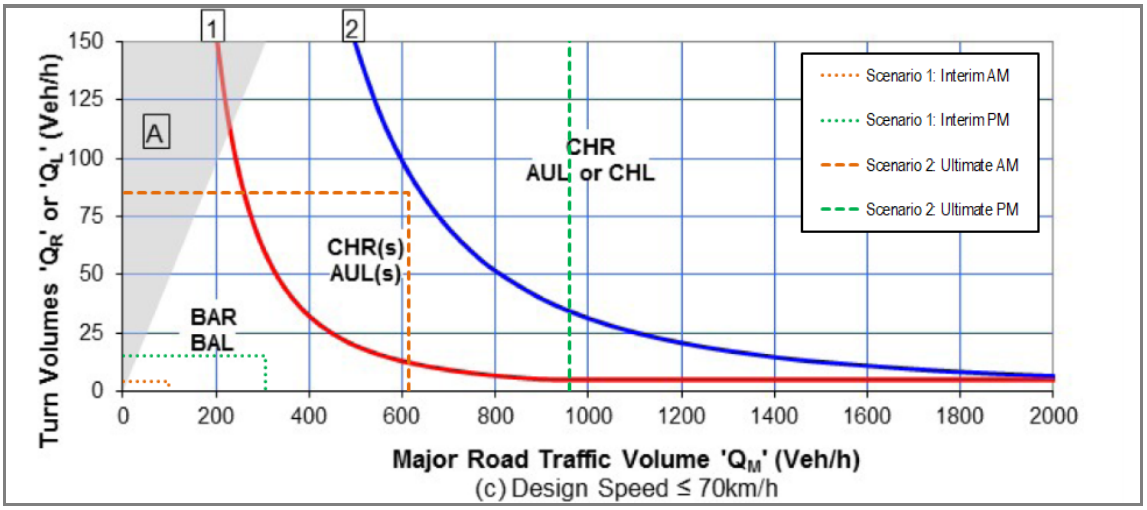


Figure 5.4: Right Turn – Turn Warrants Plot

The results of the turn warrants assessment indicate that:

- in the Interim, a Basic Left (BAL) & Basic Right (BAR) treatment is sufficient for site access (no dedicated turn treatments are required due to the low opposing volumes); and
- ultimately, short auxiliary left (AUL(s)) & channelised right (CHR) treatments are required for access.

It is important to note that given the existing (interim) neighbouring lot boundary constraints, a typical urban (residential street) intersection remains sufficient without requiring truncations / land dedications from neighbouring lots. Ultimately, the site access warrants dedicated turn treatments, however this is on the basis of the surrounding lots developing and additional throughput in the region, and is not triggered by the development itself. It is therefore assumed that under the ultimate scenario the appropriate truncations / land dedications will be resumed as part of any application over those sites.

5.5.2 Intersection Analysis

The following intersections were modelled using SIDRA 7.0 to determine the impacts of the additional development generated impacts on the existing road network:

- Intersection 1: Mountain Ridge Road / Teviot Road intersection; and
- Intersection 2: Mountain Ridge Road / Site Access intersection.

The intersections were modelled during the AM and PM peak hour periods under background (i.e. no development) and design (i.e. with development) scenarios during 2017 (current year), 2025 (assumed base year) and 2035 (10-year design horizon).

Intersection 1: Mountain Ridge Road / Teviot Road

Ultimate Scenario

The GFSTM volumes for the Ultimate scenario were adopted (as per Appendix C). As stated previously, it is understood that Teviot Road has been flagged for future upgrade to a four-lane urban standard arterial road. The timing of this upgrade is currently unknown but is expected to be completed in the Ultimate scenario. Furthermore, given the level of traffic predicted by the GFSTM, the four-way intersection will require signals due to the significant north/south volumes on Teviot Road.

Given the above, the layout determined / tested in SIDRA for the ultimate scenario is shown in Figure 5.5.

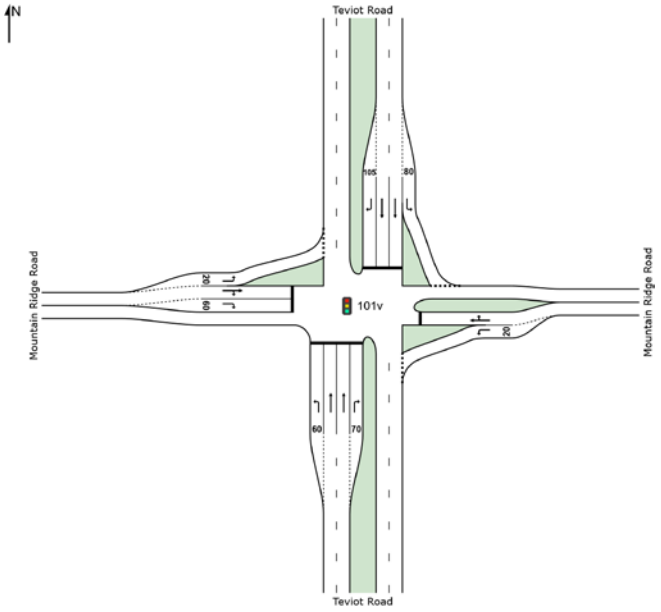


Figure 5.5: Intersection 1: Ultimate Layout Tested

The results of the testing are summarised in Table 5.7 below, with detailed results (including signal phasing summaries) provided in Appendix H.

Table 5.7: Intersection 1: Ultimate Scenario SIDRA Results Summary

Scenario	Peak Period	Degree of Saturation (DOS)	Average Delay (s)	Level of Service (LOS)	95th Percentile Queue Length (m)
Ultimate Scenario	AM Peak	0.897	35.1	LOS D	241.0
Ultimate Scenario	PM Peak	0.851	29.3	LOS C	198.3

Green shading indicates the intersection operating below the practical operating capacity for a signalised intersection (DOS < 0.90)

As shown above, the ultimate intersection configuration is sufficient to support the ultimate traffic volume predictions. The ultimate configuration includes the following key aspects:

- four-lanes on Teviot Road (understood to be planned for the future);
- extension of the southbound right turn pocket from 80m to 105m (25m extension) to accommodate right turn pocket queues (AM Peak); and
- an additional dedicated right turn pocket from Mountain Ridge Road (back-of-queue for this right turn was found to be approximately 36m long, see Appendix H).

These changes are not expected to be attributed to the subject site, rather due to several factors increasing traffic in the area, such as:

- background growth over the ultimate design horizon;
- increased north/south trips along Teviot Road;
- connection of Mountain Ridge Road to the west over the rail line to Flagstone City and other areas.

Given the above, the recommended ultimate intersection configuration for Intersection 1 is shown in Figure 5.5, however will require further detailed assessment in the future.

2031 Interim Scenario

As discussed, the 2031 volumes supplied from the GFSTM were adjusted, as it is understood that these outputs included the Rose Almond Street connection which is no longer occurring in the interim. Hence the volumes were adjusted and manually reassigned to the network (i.e. Teviot Road) as agreed with EDQ.

In addition to this, the intersection configuration was tested with and without the subject site traffic to determine the *baseline* intersection configuration required regardless of the development. The design traffic volumes, including reassigned volumes, were based on the GFSTM intersection outputs (*see Appendix D)*.

Initially, the intersection was tested under the existing priority controlled (stop-sign) arrangement which showed significant delays and failure of the intersection. Therefore, a signalised layout was tested in SIDRA for the interim (2031) scenario. Each layout tested is shown in Figure 5.6 below.

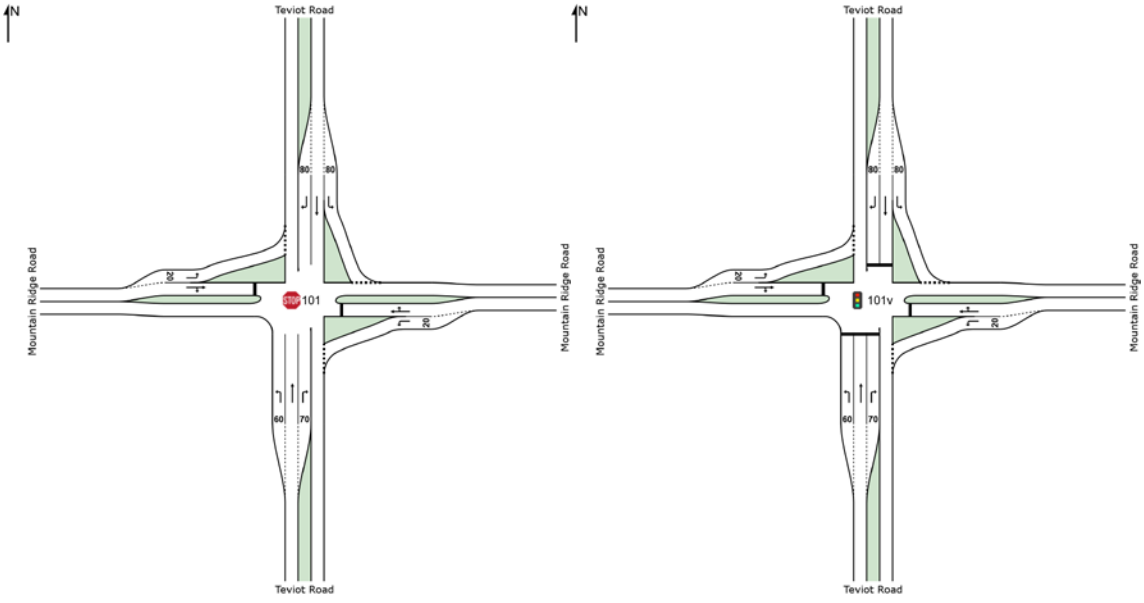


Figure 5.6: Intersection 1: Interim Layouts Tested (Existing (Priority) & Signal Control)

The results of the testing are summarised in Table 5.8 below, with detailed results (including signal phasing summaries) provided in Appendix I.

Table 5.8: Intersection 1: Interim (2031) Scenario SIDRA Results Summary

Scenario	Intersection Configuration	Peak Period	Degree of Saturation (DOS)	Average Delay (s)	Level of Service (LOS)	95th Percentile Queue Length (m)
Without Development	Existing	AM Peak	2.098	52.4	N/A	237.4
		PM Peak	2.641	44.5	N/A	187.1
	Signalised	AM Peak	0.898	17.2	LOS B	503.6
		PM Peak	0.978	42.8	LOS D	885.5
With Development	Existing	AM Peak	2.666	483.7	N/A	1,711.5
		PM Peak	5.000	114.4	N/A	291.1
	Signalised	AM Peak	0.903	29.5	LOS C	527.3
		PM Peak	1.110	164.3	LOS F	1,790.2

Green shading indicates the intersection operating below the practical operating capacity for a signalised intersection (DOS < 0.90)
Orange shading indicates the intersection operating above practical operating capacity, but below theoretical capacity (0.90 < DOS < 1.00)
Red shading indicates the intersection operating above theoretical capacity (DOS > 1.00)

As shown in the table above, the following is noted:

- the existing intersection configuration (stop-sign controlled) fails in 2031 and is not suitable;
- in testing the signalised arrangement, it was found that:
  - performance is significantly improved from the existing configuration;
  - however, the intersection is essentially saturated, regardless of the development;
  - the addition of development traffic showed relatively minor increases in key performance measures (i.e. DOS increase of 0.005 (AM) and 0.132 (PM)).

The above findings suggest that the intersection requires signalisation by 2031 regardless of the development, and that Teviot Road likely requires an upgrade to four-lanes regardless of the development.

Therefore, additional testing was undertaken to assess this assertion as detailed below. The additional layout tested for the interim (2031) scenario, four-lane configuration is shown in Figure 5.7 below.

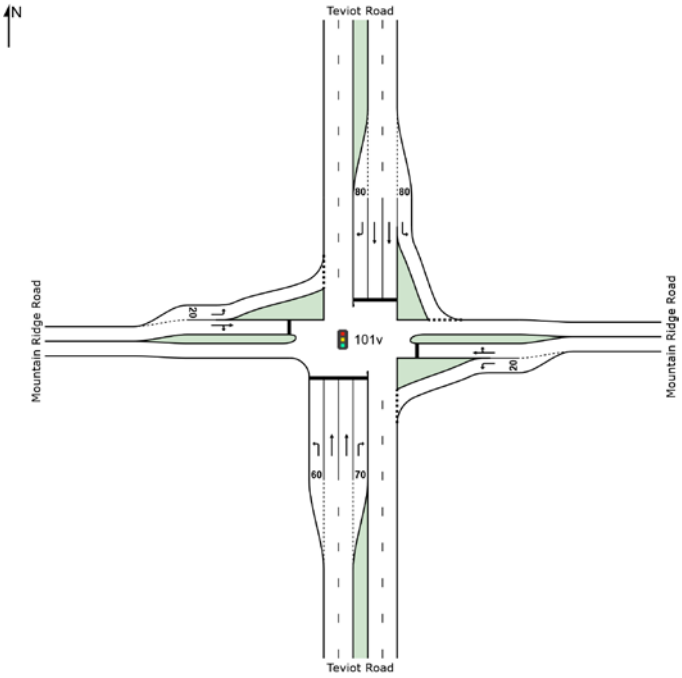


Figure 5.7: Intersection 1: Interim Layout Tested (Signal Control, 4-lanes)

The results of the additional testing are summarised in Table 5.9 below, with detailed results (including signal phasing summaries) provided in Appendix I.

Table 5.9: Intersection 1: Interim (2031) Scenario SIDRA Results Summary - Additional Testing

Scenario	Intersection Configuration	Peak Period	Degree of Saturation (DOS)	Average Delay (s)	Level of Service (LOS)	95th Percentile Queue Length (m)
Without Development	Signalised	AM Peak	0.813	22.5	LOS C	153.1
		PM Peak	0.879	27.0	LOS C	193.0
With Development	Signalised	AM Peak	0.814	22.2	LOS C	153.1
		PM Peak	0.802	23.6	LOS C	168.2

Green shading indicates the intersection operating below the practical operating capacity for a signalised intersection (DOS < 0.90)

As shown above, the signalised, four-lane configuration results in appropriate operations at the intersection under all scenarios, with development traffic having a negligible impact on performance.

Intersection 1 Summary

In summary, it is clear that the ultimate intersection configuration will require additional capacity to cater for the projected traffic volumes given the additional traffic expected from growth in the region and connecting Mountain Ridge Road west of the rail line to Flagstone City. This is likely to include:

- four-lanes on Teviot Road (understood to be planned for the future);
- extension of the southbound right turn pocket; and
- an additional dedicated right turn pocket from Mountain Ridge Road.

While the timing of the ultimate scenario is currently unknown, the ultimate intersection configuration will require further detailed assessment in the future including coordination between EDQ and Council.

Regarding the interim (2031) intersection configuration, baseline testing showed that the intersection configuration requires signalisation and four-lanes on Teviot Road to perform adequately, regardless of the development. Furthermore, testing of the 2031 intersection with the development showed that this arrangement remains suitable, and mitigation measures are not required of this development.

Intersection 2: Mountain Ridge Road / Site Access

Ultimate Scenario

The GFSTM volumes for the Ultimate scenario were adopted for testing. Given Mountain Ridge Road is no longer flagged for a four-lane upgrade, the following priority-controlled intersection layout was tested.

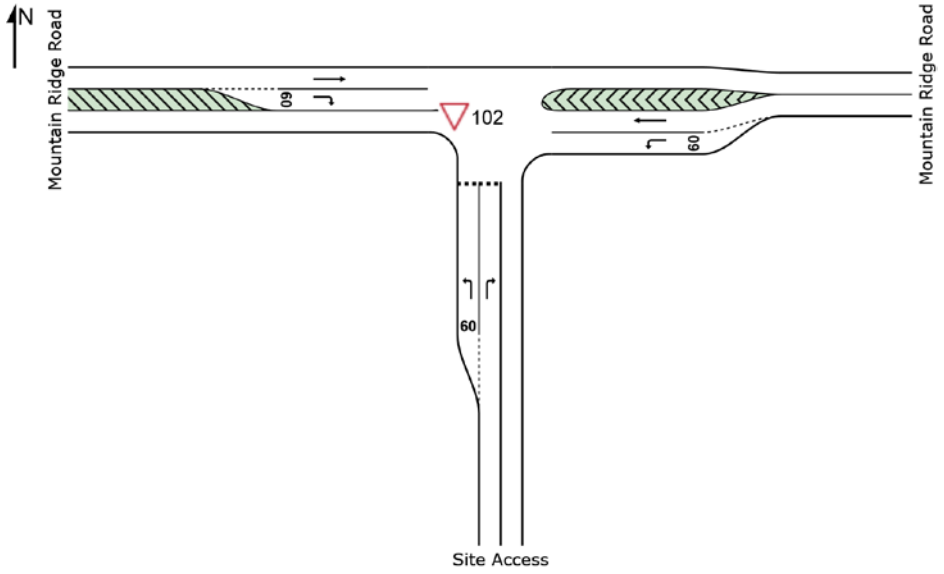


Figure 5.8: Intersection 2: Ultimate Layout Tested

The results of the testing is summarised in Table 5.10 below, with detailed results provided in Appendix J.

Table 5.10: Intersection 2: Ultimate Scenario SIDRA Results Summary

Scenario	Peak Period	Degree of Saturation (DOS)	Average Delay (s)	Level of Service (LOS)	95th Percentile Queue Length (m)
Ultimate Scenario	AM Peak	0.505	5.3	N/A	22.3
Ultimate Scenario	PM Peak	0.261	4.6	N/A	7.2

Green shading indicates the intersection operating below the practical operating capacity for a signalised intersection (DOS < 0.90)

As shown above, the proposed priority-controlled T-intersection is suitable to accommodate ultimate volume predictions with the following specific configuration:

- AUL(s) and CHR dedicated turn treatments on Mountain Ridge Road; and
- two (2) approach lanes (full length right turn lane and short left turn lane) for the site access approach.

It is reiterated that the timing of the ultimate intersection requirements will be subject to future growth and full development of the surrounding lots. It is therefore assumed that under the ultimate scenario the appropriate truncations / land dedications will be resumed as part of any application over those lots.

2031 Interim Scenario

As discussed above, the 2031 volumes supplied from the GFSTM were adjusted, as these outputs included the Rose Almond Street connection which is no longer occurring in the interim. Hence the volumes were adjusted and manually reassigned to the network (i.e. Teviot Road) as agreed with EDQ (*see Appendix C*).

The 2031 interim layout tested is shown below in Figure 5.9.

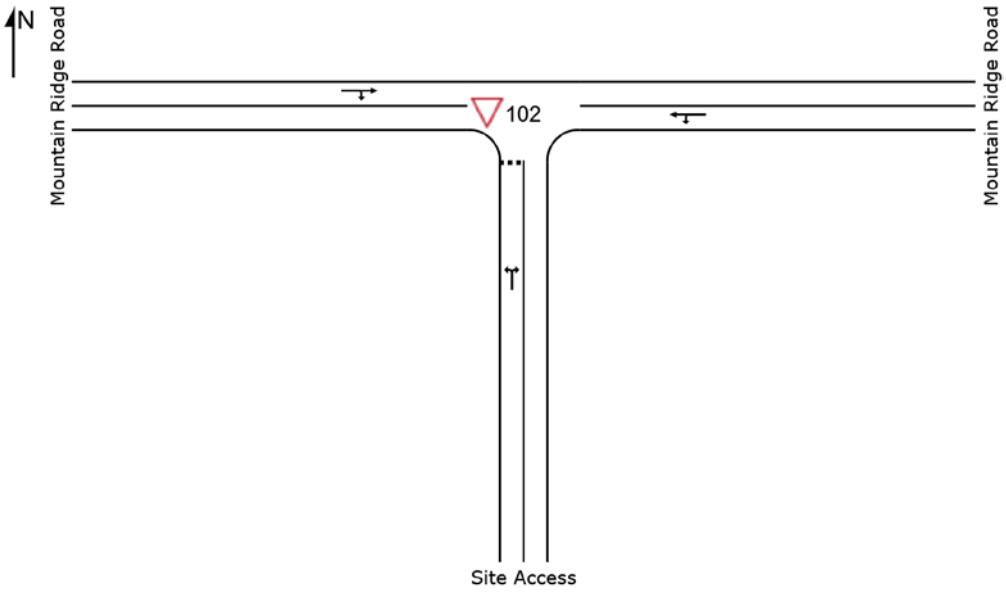


Figure 5.9: Intersection 2: Interim Layout Tested

The results of the testing is summarised in Table 5.11 below, with detailed results provided in Appendix J.

Table 5.11: Intersection 2: Interim (2031) Scenario SIDRA Results Summary

Scenario	Peak Period	Degree of Saturation (DOS)	Average Delay (s)	Level of Service (LOS)	95th Percentile Queue Length (m)
Interim Scenario	AM Peak	0.184	5.4	N/A	3.7
Interim Scenario	PM Peak	0.161	5.5	N/A	1.3

Green shading indicates the intersection operating below the practical operating capacity for a signalised intersection (DOS < 0.90)

As shown above, the proposed priority-controlled T-intersection is suitable to accommodate interim volume predictions with the following specific configuration:

- BAL and BAR treatments on Mountain Ridge Road; and
- a single approach lane for the site access approach.

Intersection 2 Summary

In summary, the Site Access intersection configuration requires the following for each scenario:

- Ultimate:
  - AUL(s) and CHR dedicated turn treatments on Mountain Ridge Road; and
  - two (2) approach lanes (full length right turn and short left turn lane) for the site access approach.
- Interim (2031):
  - BAL and BAR treatments on Mountain Ridge Road; and
  - a single approach lane for the site access approach.

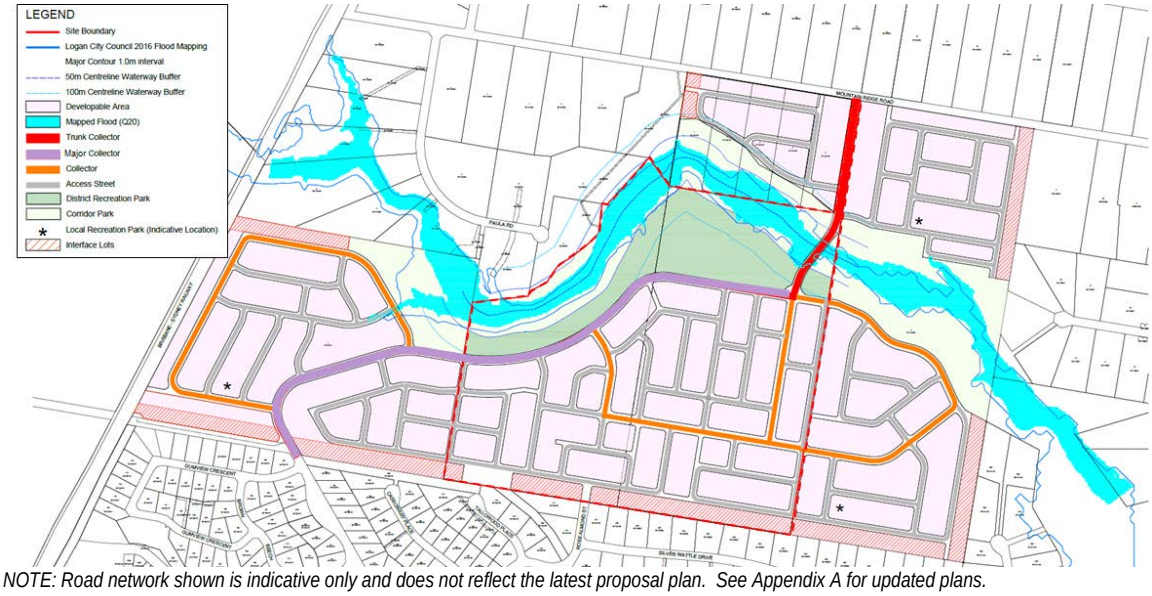
The above intersection arrangements are suitable to accommodate all predicted development traffic and external traffic in interim and ultimate years. It is important to note that given the existing (interim) neighbouring lot boundary constraints, a typical urban (residential street) intersection remains sufficient without requiring truncations / land dedications from neighbouring lots.

Detailed functional layouts of the intersection arrangements can be prepared upon final agreement of the typical cross-sections for Mountain Ridge Road and the internal road network (see Section 6).

6. INTERNAL MOVEMENT NETWORK

6.1 PRELIMINARY NEIGHBOURHOOD CONTEXT PLAN

Figure 6.1 below presents a preliminary neighbourhood context plan incorporating the subject site and the neighbouring properties. The plan shows "indicative" road network layouts for the adjacent properties and their connectivity with the subject site's proposed network, including the overarching road hierarchy.



NOTE: Road network shown is indicative only and does not reflect the latest proposal plan. See Appendix A for updated plans.

Figure 6.1: Preliminary Neighbourhood Context Plan

6.2 UNIDENTIFIED TRUNK INFRASTRUCTURE

This section of the report has been redacted as it is not approved.

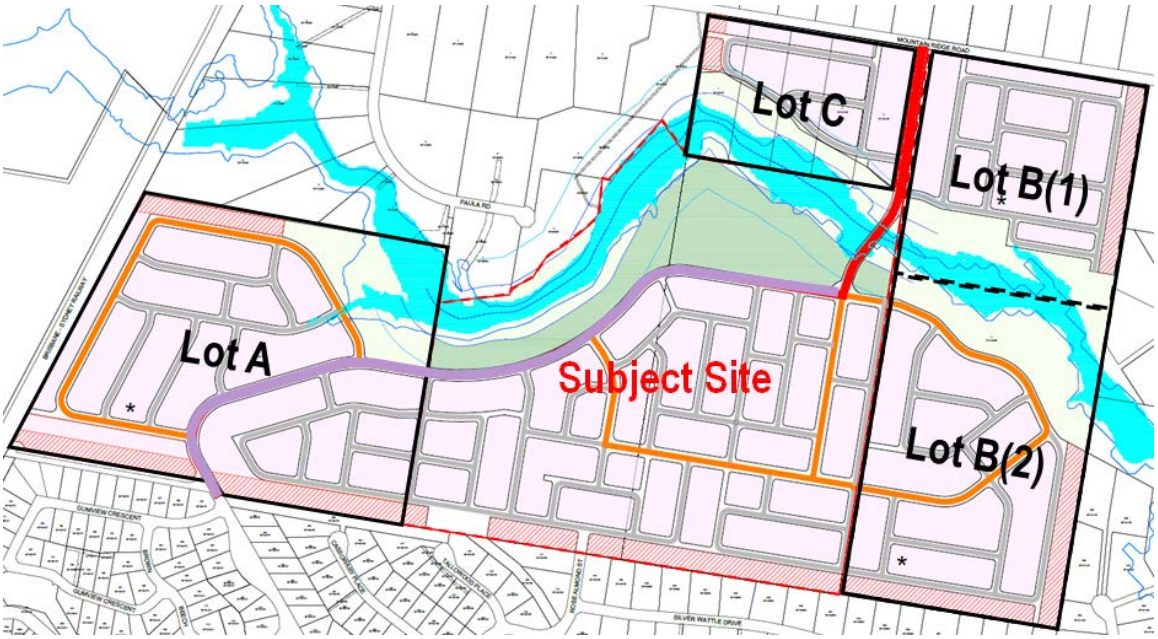
AMENDED IN RED
By: Eamon McDermot
Date: 1 May 2018

Queensland Government

6.3 TRAFFIC DEMAND AND CATCHMENT ANALYSIS

6.3.1 Surrounding Allotments

To determine the traffic demand utilising the trunk connector, the surrounding allotments have also been considered as shown in Figure 6.2.



NOTE: Road network shown is indicative only and does not reflect the latest proposal plan. See Appendix A for updated plans.

Figure 6.2: Surrounding Allotments

Table 6.1 below presents the surrounding allotment details.

Table 6.1: Surrounding Allotment Details

Lot	Bitzios Designation	Lot Area (ha)	Estimated Residential Lots
Lot 1 on RP45241	Lot A	28.23	480
Lot 3 on RP133386	Lot B(1)	27.75	192
	Lot B(2)		278
Lots 1-5 on RP193185	Lot C	6.47	111
	TOTAL	62.45	1,061

NOTE: Lot areas shown are developable land only and do not include local park areas.

Key elements of the entire study catchment area are further summarised below:

- total yields include approximately 1,711 residential lots (subject site plus surrounding allotments);
- access is via the proposed Trunk Connector and Neighbourhood Connector (major) between Mountain Ridge Road and Silverwood Drive; and
- access to / from the external road network is expected to be predominately via Mountain Ridge Road to its intersection with Teviot Road, with proportions of trips heading south and west (over rail line).

At this stage the timing, sequencing and planning of the surrounding allotments is unknown. Regardless, Table 6.2 below presents the details of the total catchment area (including the subject site).

Table 6.2: Catchment Details

Catchment Area	Lot Area (ha)	Estimated Residential Lots	% of Total Catchment
Surrounding Allotments (Lot A, B & C)	62.45	1,061	62%
Subject Site	38.35	650	38%
TOTAL	100.80	1,711	100%

NOTE: Lot areas shown are developable land only and do not include local park areas.

As shown the subject site includes approximately 38% of the study catchment area directly serviced by the Trunk and Major Connector, and the Flagstone Creek bridge.

6.3.2 Development Traffic Demands

The modelling completed by EDQ was based on a previous estimation of lots in the surrounding catchment area, specifically for Lot B(1) and B(2) noted above. The dwelling rate provided in Table 6.1 above has since been agreed between the applicant EDQ and has therefore been used in determining catchment traffic demands and relative apportionment of trips.

The table below has been reproduced and updated from advice provided by EDQ in relation to traffic demands and apportionment, informed by the GFSTM modelling and to include external (through) trips.

Table 6.3: Adjusted Study Catchment Traffic Demands

Site	GFSTM Volume	% of Total	Previous Dwellings	Agreed Dwellings	Adjustment Factor	Adjusted Volume	Adjusted Apportionment
Northern access point (via Mountain Ridge Road)							
Subject site	2,613	27.04%	650	650	1.00	2,613	27.04%
Lot A	1,378	14.26%	480	424	0.88	1,217	12.60%
Lot B (1)	981	10.15%	195	192	0.98	966	9.99%
Lot B (2)	1,361	14.08%	334	278	0.83	1,133	11.72%
Lot C	560	5.79%	111	97	0.87	489	5.06%
External	2,771	28.67%	-	-	-	3,246	33.59%
Total	9,664	100%	1,770	1,641		9,664	100%
Flagstone Creek Bridge							
Subject site	2,644	30.86%	650	650	1.00	2,644	30.86%
Lot A	1,360	15.87%	480	424	0.88	1,201	14.02%
Lot B (1)	276	3.22%	195	192	0.98	272	3.17%
Lot B (2)	1,357	15.84%	334	278	0.83	1,129	13.18%
Lot C	159	1.86%	111	97	0.87	139	1.62%
External	2,771	32.35%	-	-	-	3,181	37.14%
Total	8,567	100%	1,770	1,641		8,567	100%
Southern Access Point (via Silverwood Drive)							
Subject site	1,001	21.88%	650	650	1.00	1,001	21.88%
Lot A	1,480	32.34%	480	424	0.88	1,307	28.57%
Lot B (1)	165	3.61%	195	192	0.98	162	3.55%
Lot B (2)	6	0.13%	334	278	0.83	5	0.11%
Lot C	95	2.08%	111	97	0.87	83	1.81%
External	1,829	39.97%	-	-	-	2,017	44.08%
Total	4,576	100%	1,770	1,641		4,576	100%

As shown above, the Flagstone Creek Bridge and entry road (Trunk Connector) are expected to carry in the order of 8,500-10,000veh/h (>7,500veh/h for a Trunk Connector). The southern access point (and Neighbourhood Connector (major) adjacent the park) is expected to carry in the order of 4,500-5,000veh/d.

Based on the adjusted apportionment of demands, the subject site is expected to contribute approximately 31% of the catchment traffic demands to the Flagstone Creek Bridge, and 27% of traffic demands to the entry road (north of the bridge).

On this basis, the trunk connector road and bridge will provide service and benefit to the entire catchment with the resulting traffic volumes warranting a higher order road hierarchy than would be required to service the subject site alone.

6.4 SUBJECT SITE ROAD HIERARCHY

Figure 6.3 presents the agreed internal road hierarchy plan for the subject site.

Figure 6.3: Proposed Development Road Hierarchy

The following key points are noted:

- includes a north-south Trunk Connector to Mountain Ridge Road (entry road) including the bridge crossing of Flagstone Creek;
- includes an east-west Neighbourhood Connector (major) along the district recreation park frontage;
- includes a Neighbourhood Connector (minor) linking the Trunk and Neighbourhood Connectors;
- majority of lot access is via Access Streets;
- includes Access Street connection to Rose Almond Street in the south (restricted in interim); and
- includes Access Roads along the east and west boundary of the site for residential access.

6.5 INTERNAL ROAD NETWORK DESIGN CRITERIA

The guidelines referenced for the design of the internal road network are listed below:

- Austroads Guide to Road Design;
- Complete Streets; and
- EDQ Guidelines and Infrastructure Documents.

The key criteria utilised in the design of the internal road network included:

- Trunk Connector (entry road):
  - Posted Speed: 60km/h;
  - Design Speed: 70km/h;
  - Kerb Type: Barrier Kerb;
  - Kerb Return Radius: 8m;
  - Maximum Gradient: 8%.
- Neighbourhood Connector (major):
  - Posted Speed: 60km/h;
  - Design Speed: 70km/h;
  - Kerb Type: Barrier Kerb;
  - Kerb Return Radius: 8m;
  - Maximum Gradient: 8%.
- Neighbourhood Connector (minor):
  - Posted Speed: 50km/h;
  - Design Speed: 60km/h;
  - Kerb Type: Barrier Kerb;
  - Kerb Return Radius: 8m;
  - Maximum Gradient: 16%.
- Access Street:
  - Posted Speed: 50km/h;
  - Design Speed: 60km/h;
  - Kerb Type: Mountable Kerb;
  - Kerb Return Radius: 8m;
  - Maximum Gradient: 16%.
- Access Road:
  - Posted Speed: 50km/h;
  - Design Speed: 60km/h;
  - Kerb Type: Mountable Kerb;
  - Kerb Return Radius: 8m;
  - Maximum Gradient: 16%.

The above criteria are included in the Road Hierarchy and Typical Sections plans provided in Appendix G.

6.6 TYPICAL CROSS SECTIONS

Based on the above, Table 6.4 presents the key parameters of each road typology.

Table 6.4: Road Hierarchy

Road Hierarchy	Road Reserve	Pavement Width	No. of Lanes	Parking	Footpath	Cycle Provisions
Trunk Connector	20.0m	7m	2	No	1.5m wide (both sides)	3.0m two-way cycle track
Trunk Connector (Bridge Section)	17.15m	10.0m	2	No	2.1m wide (one side)	3.2m two-way cycle track
Neighbourhood Connector (major)[1]	22.5m	11.2m	2	2.3m wide lanes (both sides)	1.5m wide (both sides)	3.0m two-way cycle track
Neighbourhood Connector (minor)	21.0m	11.2m	2	2.3m indented (both sides)	1.5m + 2.5m (both sides)	On-road / 2.5m shared path
Access Street	16.0m	7.5m	2	Kerbside	1.5m wide (one side)	On-road
Access Road[2]	15.5m	7.5m	2	Kerbside	1.5m wide (one side)	On-road

[1] Overall width is 22.5m, with 5.5m included within district recreation park.
[2] Interim road reserve is 12m with 6m pavement, ultimate road reserve is 15.5m (future widening by others).

Detailed hierarchy and cross-section plans are included in Appendix G and are further discussed below.

6.7 INTERNAL NETWORK ANALYSIS

The following key points are noted for the proposed development's internal road network:

- main access for the site is via Mountain Ridge Road, and the provision of a Trunk Connector from Mountain Ridge Road to the residential area is considered suitable;
- the Neighbourhood Connector (minor) provides catchment-wide connectivity to adjacent lots and access streets, providing a link to the Trunk and Major Connector (i.e. from entry road to rec park);
- provision of the Neighbourhood Connector (major) along the frontage of the recreation park provides efficient access to / from nearby lots, and allows for future connectivity to adjacent properties;
- intersections are generally designed as priority-controlled T-intersections, with 'modified' T-intersection arrangements in the majority of locations as speed control measures;
- four-way intersections have been minimised and designed to accommodate roundabout control;
- the internal layout is well resolved, limits potential rat-running, minimises road connections to the Neighbourhood Connector (major) and generally in accordance with the EDQ Draft Guideline No. 6.

Importantly, no 'uncontrolled' four-way intersections or long 'dead-end' streets are proposed allowing sufficient connectivity. Furthermore, provision has been made for connectivity to future adjacent lots with 'east-west' connections via the Trunk Connector and Neighbourhood Connector roads, and direct 'easy-access' to / from Rose Almond Street (once connected) is limited.

6.8 PARKING ANALYSIS

An on-street parking plan has been completed in accordance with EDQ's *Practice Note 11: Parking Analysis Plans*. The parking plan shows all dedicated and possible on-street car parking spaces based on the road function, pavement width and other features which may restrict parking, such as indicative driveway locations. The below presents the key parking-related information for the site.

- Number of Lots / Dwellings: 650;
- Required Rate of Provision: 0.75 on-street spaces per 3 bed + house;
- Required (critical) on-street parking: 488 spaces; and
- Proposed on-street parking: 622 spaces.

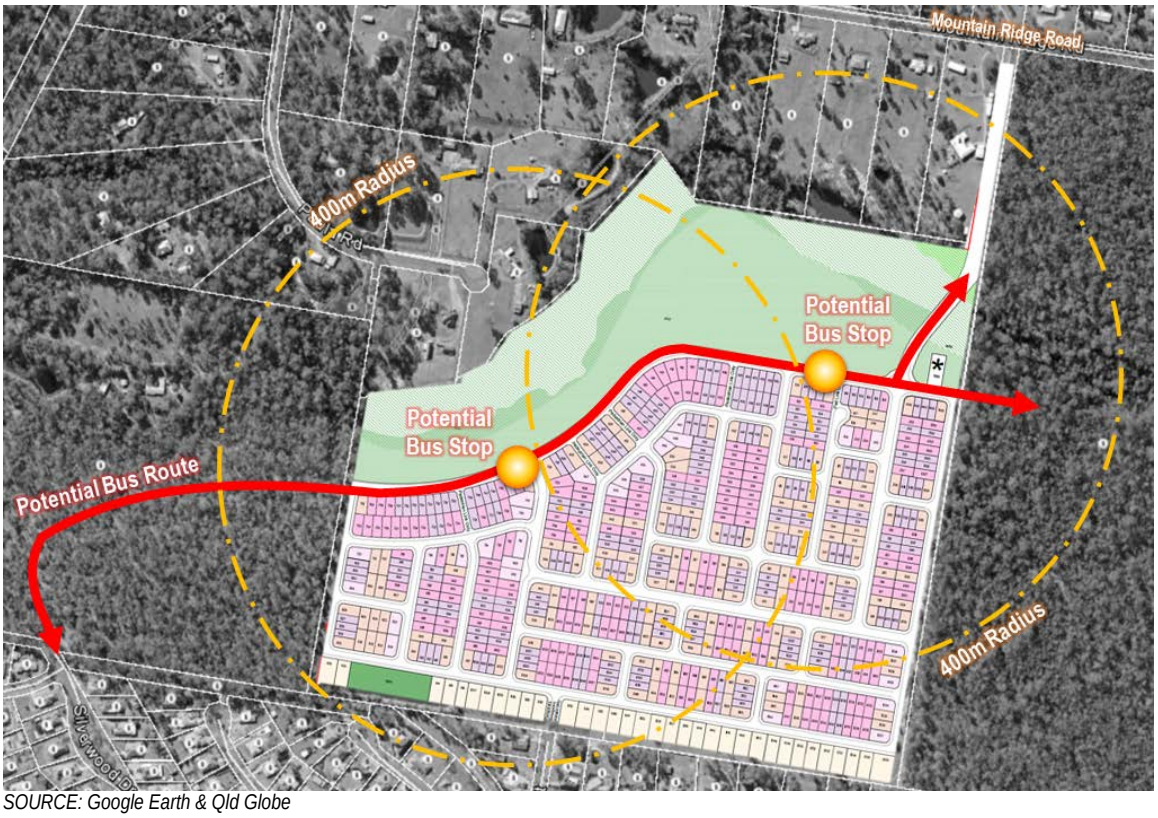
As shown above, the proposed development allows for the provision of approximately 622 on-street parking spaces, which exceeds the minimum requirements for the rate of provision. Parking has been allowed for on both sides of Trunk Connector and Neighbourhood Connector Roads, one side of 7.5m wide access streets, while no parking is allowed for on the access roads.

A Parking Analysis Plan has been developed and is included in Appendix L.

6.9 PUBLIC TRANSPORT NETWORK

As discussed in Section 3.5, it is understood that no current / future planning is in-place that indicates any public transport (bus) routes along Mountain Ridge Road, through the subject site, or within the immediately adjacent neighbouring properties (existing or future). Therefore, it is not considered warranted to incorporate any detailed public transport planning or design within the subject site.

However, the internal movement network does not preclude a bus route and/or associated stops from being accommodated in the future, should current / future planning change. That is; if the adjacent properties were developed in the future to allow a bus route to traverse the site, say; via Silverwood Drive travelling along the Trunk Connector, stops could potential be provided along the District Rec Park at 400m spacings. This is shown indicatively below in Figure 6.4 which overlays a potential bus route connecting from Silverwood Drive via the Trunk Connector, potential bus stop locations at 400m spacings, and 400m radius walkable catchment overlays.



SOURCE: Google Earth & Qld Globe

Figure 6.4: Potential Public Transport Coverage

Based on the above, approximately 92% of all dwellings would be within 400m of a potential public transport service in accordance with the requirements of the Development Scheme. Importantly, it is not considered warranted to incorporate detailed public transport planning or design for the subject site given the current planning for bus routes within the PDA, yet a service is not precluded by the subject site design.

6.10 ACTIVE TRANSPORT NETWORK

Cycling Provisions

As detailed in Section 6.6, two-way cycle tracks are to be provided along Mountain Ridge Road, the proposed Trunk Connector road, and along the Neighbourhood Connector (major).

All other internal roads are considered suitable to accommodate on-road cycling (i.e. no dedicated cycle lanes) given the low posted speeds (50km/h) and built-up, urban environment. However, it is noted that the Neighbourhood Connector (minor) accommodates a 2.5m shared path on one side suitable for cycling.

Figure 6.5 shows the cycling provisions associated with the subject site.

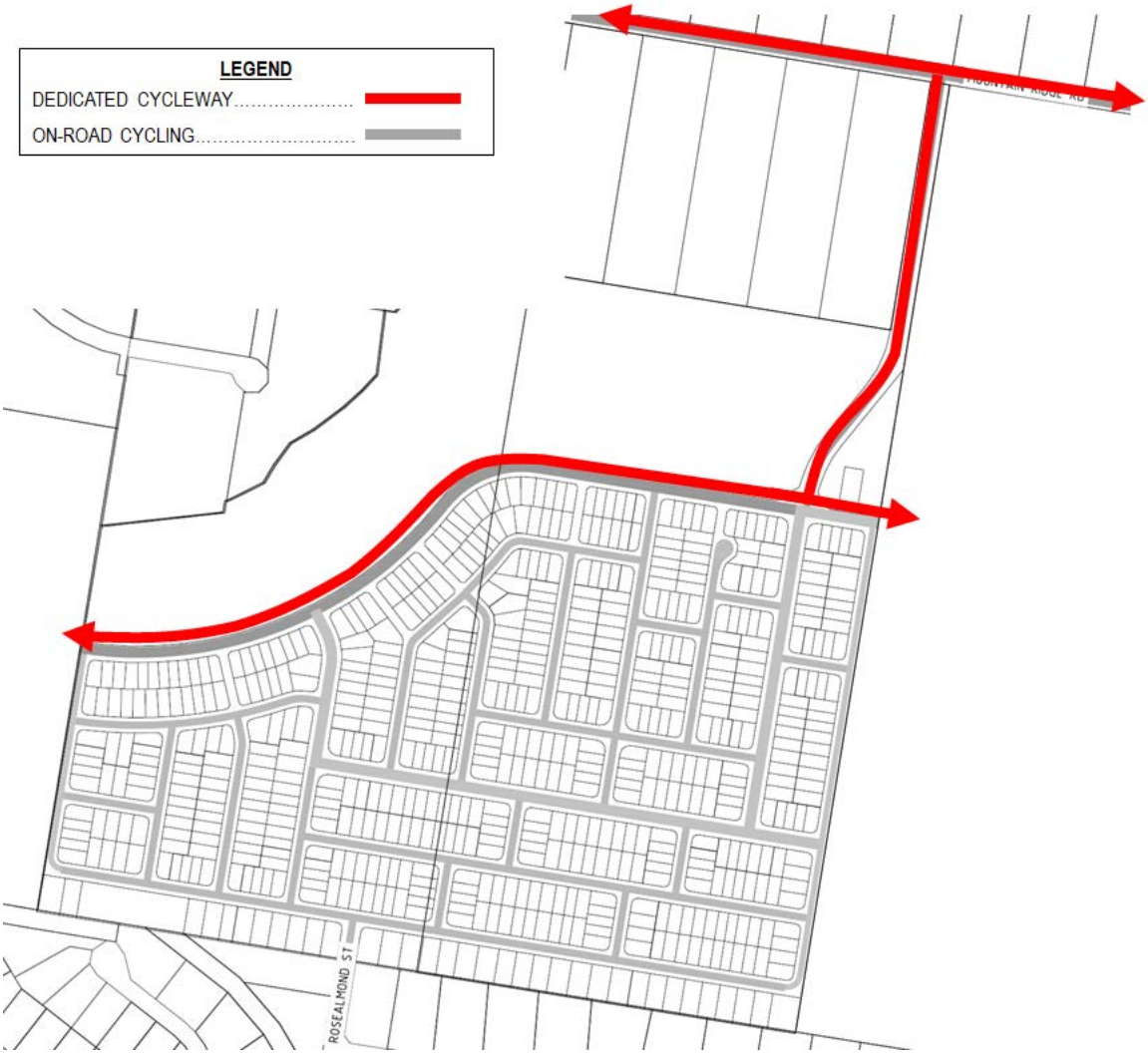


Figure 6.5: Active Transport Network: Cycling Provisions

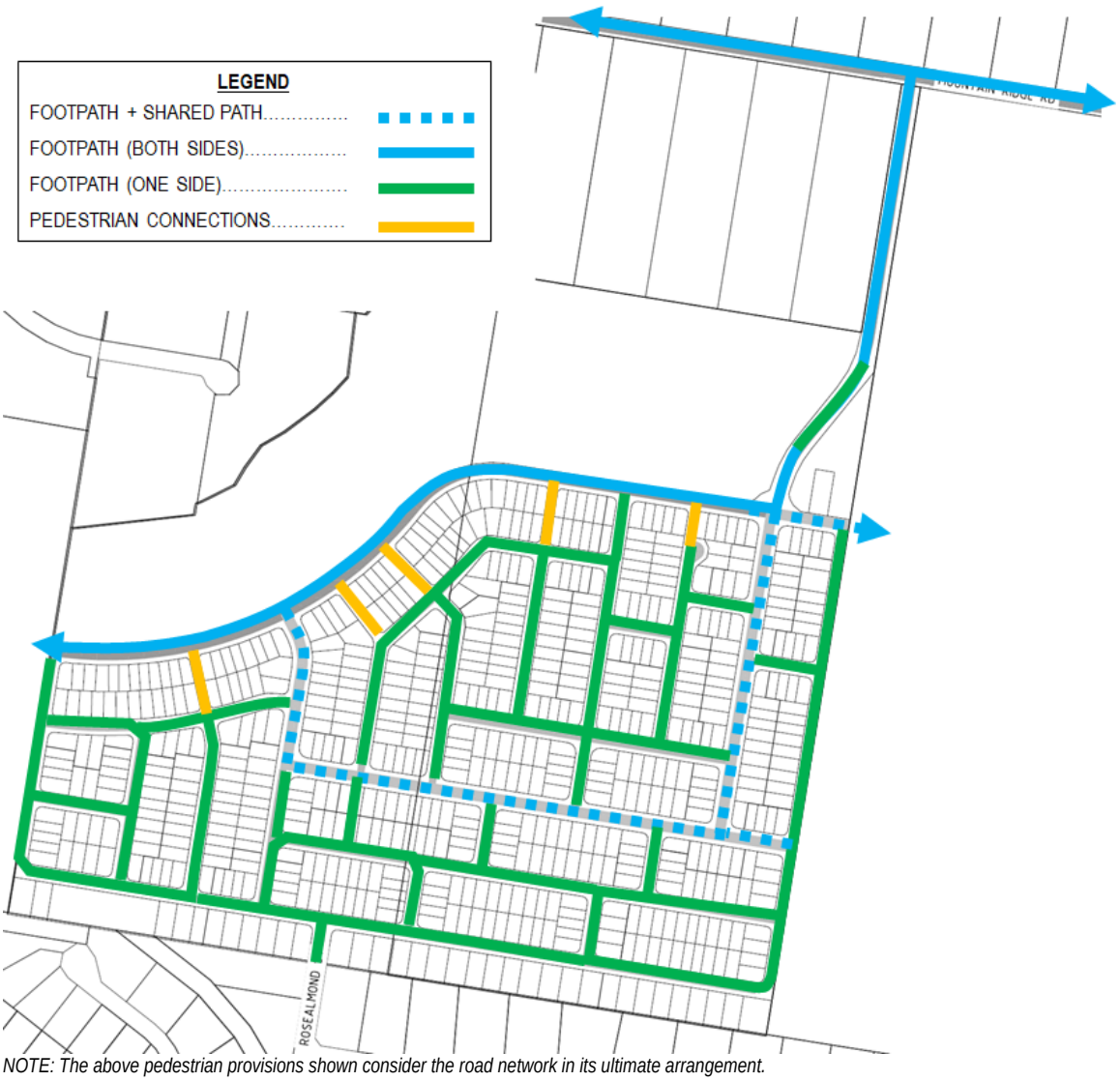
Based on the above, the proposed cycling provisions are considered appropriate and generally in accordance with the relevant requirements.

Pedestrian Provisions

As detailed in Section 6.6, pedestrian footpaths have been provided throughout the internal road network. Footpaths are ultimately provided on both sides of Mountain Ridge Road and the proposed Trunk Connector and Neighbourhood Connector roads.

Further, footpaths are ultimately provided on one side of all Access Streets and Access Roads, including the bridge section of the Trunk Connector (entry road) which accommodates a single footpath adjacent the separated cycle track.

Figure 6.6 shows the pedestrian provisions associated with the subject site in its *ultimate form*.



NOTE: The above pedestrian provisions shown consider the road network in its ultimate arrangement.

Figure 6.6: Active Transport Network: Pedestrian Provisions

Based on the above, the proposed pedestrian provisions are considered appropriate and generally in accordance with the relevant requirements.

7. SUMMARY AND CONCLUSIONS

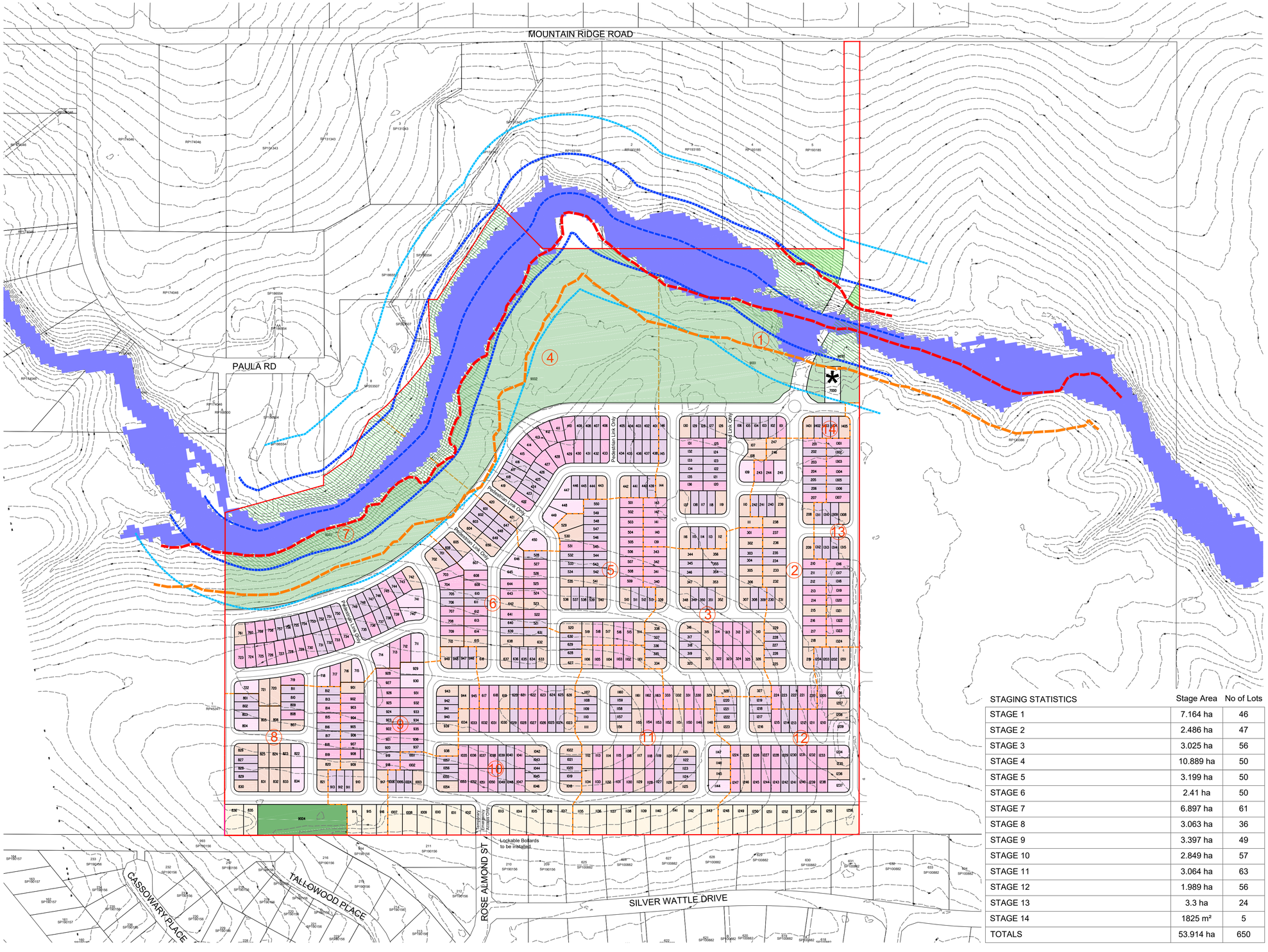
The key findings for the site at 230 Mountain Ridge Road, South MacLean are summarised below:

- the proposal includes an internal road network connecting to Mountain Ridge Road via a priority-controlled access intersection, with considerations for interim and ultimate configurations;
- the current strategic transport goals are outlined in several key documents, including (but not limited to); *Connecting SEQ 2031* and the *Greater Flagstone PDA Development Scheme* which target reduced vehicle trips and increase public and active transport mode share;
- the existing road network surrounding the site is currently limited to rural standard roads due the largely rural residential nature of the area, and internal roads do not currently exist through the site;
- relevant future road network upgrades are outlined in the Development Scheme and ICOP mapping, however a recent decision with EDQ and Council has resulted in only a two-lane arterial arrangement required ultimately for Mountain Ridge Road (opposed to a four-lane upgrade);
- the existing public and active transport provision surrounding the site are minimal due to the lack of sufficient development density and current low passenger demand;
- future planning does not identify any key public transport facilities on Mountain Ridge Road or the site, while Council planning identifies Mountain Ridge Road as a 'District Future Cycle Network';
- traffic counts were undertaken at the Teviot Road / Mountain Ridge Road intersection which identified existing daily traffic volumes to be very low (approximately 275veh/d);
- the proposed development does not trigger the need or warrant the upgrade of Mountain Ridge Road to a four-lane (ultimate) configuration;
- a turn warrants assessment was undertaken for the site access intersection with Mountain Ridge Road which identified BAL / BAR turn treatments under the interim (2031) arrangement, while AUL(s) and CHR turn treatments are warranted under the ultimate scenario (subject to design);
- SIDRA Intersection analysis was undertaken for the site access intersection for interim (2031) and ultimate scenarios which identified a priority T-intersection was sufficient to accommodate development traffic given the above turn treatments;
- SIDRA Intersection analysis was undertaken for the Teviot Road / Mountain Ridge intersection for interim (2031) and ultimate scenarios which identified:
  - the interim (2031) scenario requires signals and four-lanes on Teviot Road by 2031 regardless of the development; and
  - ultimately additional capacity is required to support projected volumes in the form of four-lanes on Teviot Road, extended southbound right turn pocket, and additional right turn pocket from Mountain Ridge Road given the growth in the surrounding area;
- a preliminary (indicative) context area plan was developed which includes a Trunk Connector road and bridge connection over Flagstone Creek which are classified as *Unidentified Trunk Infrastructure*, hence are considered eligible for an offset based on the demand on the infrastructure in excess of that required to service the development;
- Based on the adjusted apportionment of demands, the subject site is expected to contribute approximately 31% of the catchment traffic demands to the Flagstone Creek Bridge, and 27% of traffic demands to the entry road (north of the bridge).
- a traffic demand and catchment analysis informed by the GFSTM and EDQ advice identified the subject site is expected to contribute approximately 31% of the catchment traffic demands to the Flagstone Creek Bridge, and 27% of traffic demands to the entry road (north of the bridge).
- the road hierarchies and typical cross-sections have been prepared generally in accordance with the relevant EDQ Guidelines and are considered appropriate with the internal layout being well resolved, and laergely discussed / agreed with EDQ;
- a parking analysis plan was prepared which showed the development to provide approximately 622 on-street parking spaces, in excess of the minimum rate of provision (488 spaces);
- it is not considered warranted to incorporate detailed public transport planning or design for the subject site given the current planning for bus routes within the PDA, yet a service is not precluded by the internal design with approximately 92% of all dwellings able to be within 400m of a potential public transport service (in accordance with the requirements of the Development Scheme); and
- the proposed active transport provisions include two-way cycle track provisions, on-road (shared) cycling ability, and appropriate pedestrian facilities generally in accordance with the relevant requirements.

APPENDIX A

SITE PLANS

STAGING PLAN - OVERALL



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LEGEND

- Site Boundary
- Logan City Council 2016 Flood Mapping
- Minor Contour 0.25m Interval
- Major Contour 1.0m interval
- Flagstone Creek Centreline
- 50m Centreline Waterway Buffer
- 100m Centreline Waterway Buffer
- Aprrox High Bank - Derived from Slope analysis utilising lidar data
- 50m High Bank Offset
- 1 in 5 ARI
- Pump Station
- Riparian Zone - 7.6 ha
- Linear Park - 2260 m²
- District Park - 9.403 ha
- Staging No.
- Staging Boundary

- Gross density (53.91 ha) = 12.3 dwellings per hectare
- Net density (38.35 ha) = 17.0 dwellings per hectare (excluding District Park/Linear Open Space)

STAGING STATISTICS	Stage Area	No of Lots
STAGE 1	7.164 ha	46
STAGE 2	2.486 ha	47
STAGE 3	3.025 ha	56
STAGE 4	10.889 ha	50
STAGE 5	3.199 ha	50
STAGE 6	2.41 ha	50
STAGE 7	6.897 ha	61
STAGE 8	3.063 ha	36
STAGE 9	3.397 ha	49
STAGE 10	2.849 ha	57
STAGE 11	3.064 ha	63
STAGE 12	1.989 ha	56
STAGE 13	3.3 ha	24
STAGE 14	1825 m²	5
TOTALS	53.914 ha	650

DEVELOPMENT STATISTICS

Development Area	53.914 ha	
Total Length of New Roads	7018 m	
Total Area of New Roads	12.90 ha	23.9%
Villa (10.5m -12.49m frontage)	237	36.5%
Premium Villa (12.5m - 13.99m frontage)	197	30.3%
Courtyard (14m - 15.99m frontage)	155	23.9%
Premium Courtyard (16m + frontage)	27	4.1%
Interface Lots	34	5.2%
Total Residential Allotments	650	100%
Average Lot Size	390 m²	
Total Open Space	15.653 ha	29.0%
Stormwater / Detention Basin	4455 m²	0.8%

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:2500 @A3 1:5000 - LENGTHS ARE IN METRES

20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300

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STAGING PLAN - STAGE 1

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LEGEND

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- Minor Contour 0.25m Interval
- Major Contour 1.0m interval
- 50m Centreline Waterway Buffer
- 100m Centreline Waterway Buffer
- Aprrox High Bank - Derived from Slope analysis utilising lidar data
- 50m High Bank Offset
- 1 in 5 ARI
- Pump Station
- Riparian Zone - 7.6 ha
- Linear Park - 2260 m²
- District Park - 9.403 ha
- ① Staging No.
- Staging Boundary

STAGING STATISTICS - STAGE 1

Stage Area	8.251 ha	
Length of New Roads	1115 m	
Area of New Roads	2.121ha	25.7%
Villa (10.5m - 12.99m frontage)	24	52.2%
Premium Villa (12.5m - 13.99m frontage)	10	21.7%
Courtyard (14m - 15.99m frontage)	11	23.9%
Premium Courtyard (16m + frontage)	1	2.2%
Total Residential Allotments	46	100%
Average Lot Size	345 m²	
Pump Station (Lot 7000)	928 m²	
Open Space (Lots 9000 & 9001)	4.452 ha	53.8%

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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STAGING PLAN - STAGE 2

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- Logan City Council 2016 Flood Mapping
- Minor Contour 0.25m Interval
- Major Contour 1.0m interval
- (1) Staging No.
- Staging Boundary

NOTE: DIMENSIONS HAVE BEEN ROUNDED DOWN TO THE NEAREST 0.1m

STAGING STATISTICS - STAGE 2

Stage Area	2.577 ha	
Length of New Roads	435m	
Area of New Roads	8865 m²	33.1%
Villa (10.5m - 12.99m frontage)	16	34.0%
Premium Villa (12.5m - 13.99m frontage)	15	31.9%
Courtyard (14m - 15.99m frontage)	15	31.9%
Premium Courtyard (16m + frontage)	1	2.2%
Total Residential Allotments	47	100%
Average Lot Size	360 m²	

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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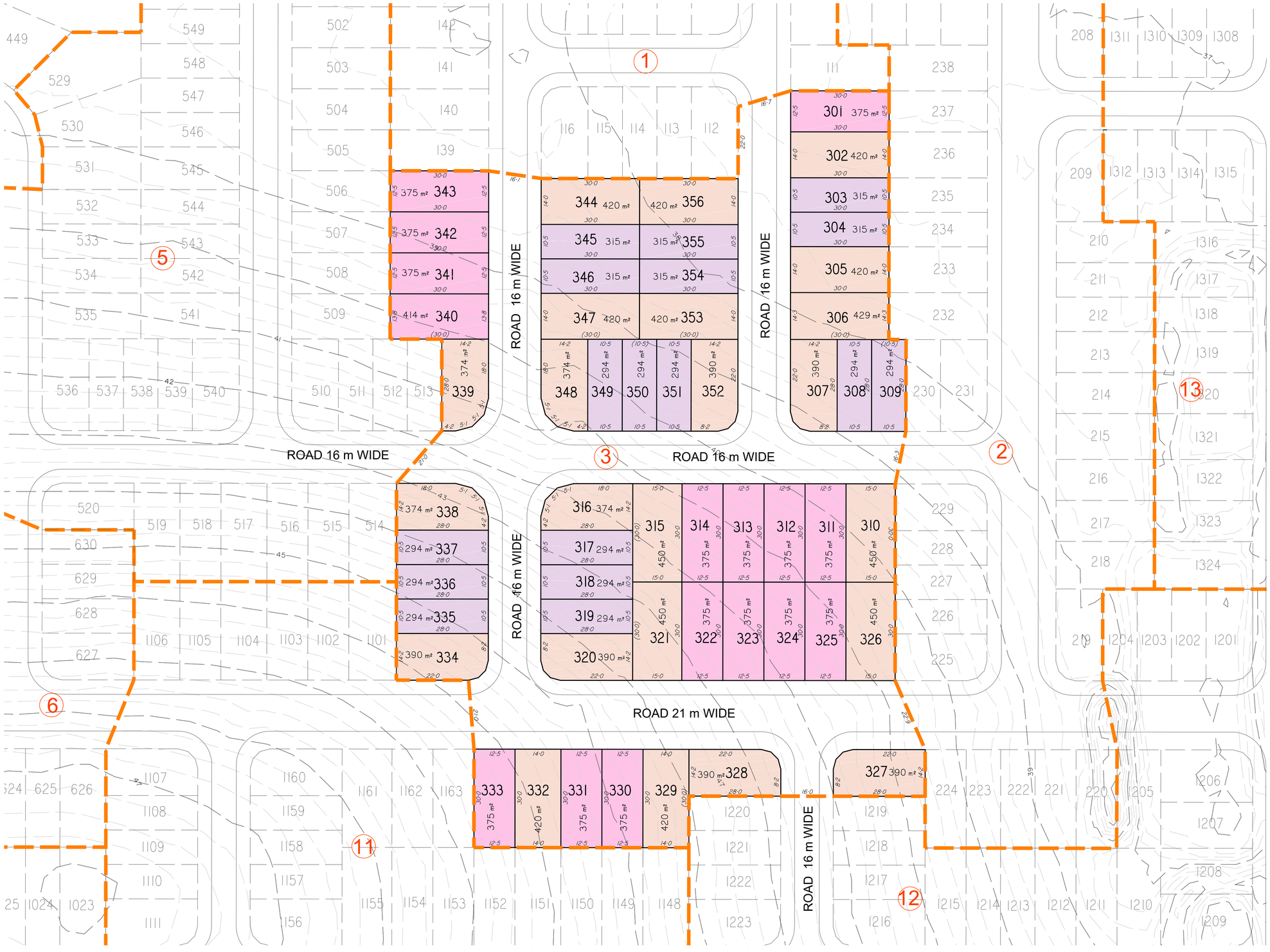
STAGING PLAN - STAGE 3



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- Major Contour 1.0m interval
- (1) Staging No.
- Staging Boundary

NOTE: DIMENSIONS HAVE BEEN ROUNDED DOWN TO THE NEAREST 0.1m

STAGING STATISTICS - STAGE 3

Stage Area	3.026 ha	
Length of New Roads	530 m	
Area of New Roads	9675m²	32.0%
Villa (10.5m - 12.99m frontage)	17	30.3%
Premium Villa (12.5m - 13.99m frontage)	16	28.6%
Courtyard (14m - 15.99m frontage)	23	41.1%
Total Residential Allotments	56	100%
Average Lot Size	368 m²	

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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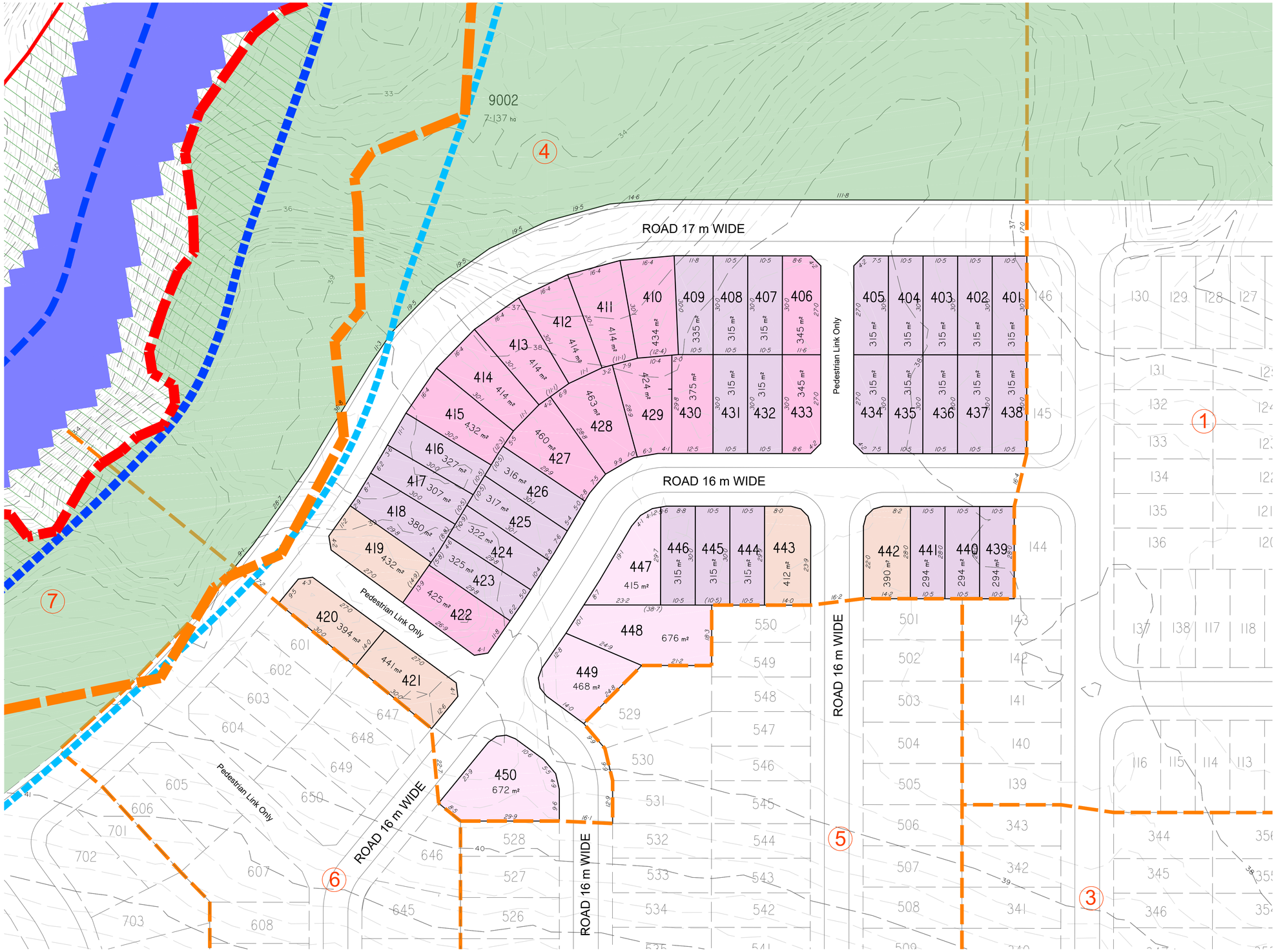
STAGING PLAN - STAGE 4



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- Major Contour 1.0m interval
- 50m Centreline Waterway Buffer
- 100m Centreline Waterway Buffer
- Aprrox High Bank - Derived from Slope analysis utilising lidar data
- 50m High Bank Offset
- 1 in 5 ARI
- Riparian Zone - 7.6 ha
- Linear Park - 2260 m²
- ① Staging No.
- Staging Boundary

STAGING STATISTICS - STAGE 4

Stage Area	10.078 ha	
Length of New Roads	580 m	
Area of New Roads	1.088 ha	10.8%
Villa (10.5m - 12.99m frontage)	28	56.0%
Premium Villa (12.5m - 13.99m frontage)	13	26.0%
Courtyard (14m - 15.99m frontage)	5	10.0%
Premium Courtyard (16m + frontage)	4	8.0%
Total Residential Allotments	50	100%
Average Lot Size	371 m²	
Open Space	7.137 ha	70.8%

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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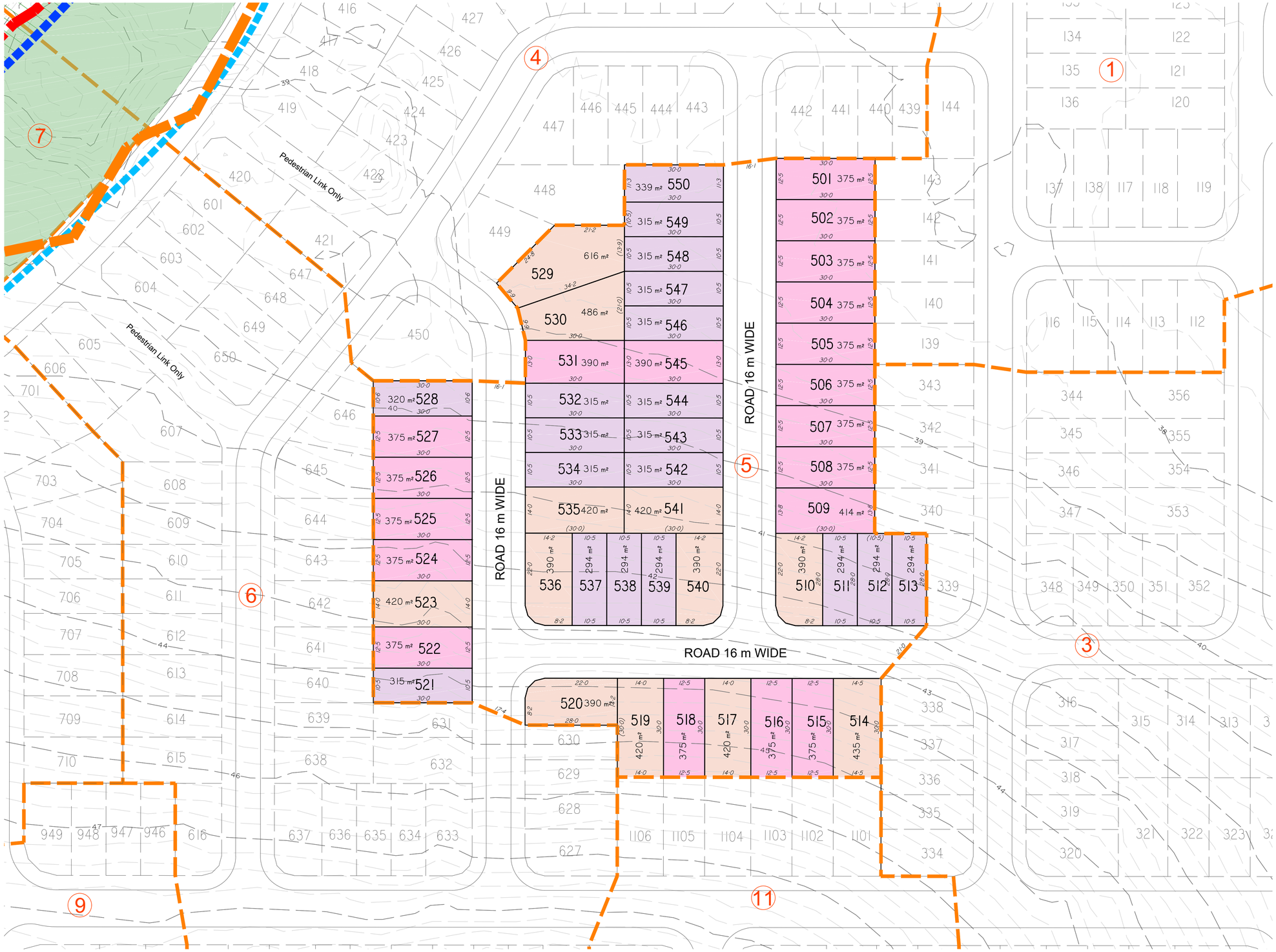
STAGING PLAN - STAGE 5



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- Major Contour 1m Interval
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- 100m Centreline Waterway Buffer
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- 50m High Bank Offset
- 1 in 5 ARI
- Riparian Zone - 7.6 ha
- Linear Park - 2260 m²
- District Park - 9.403 ha
- ① Staging No.
- Staging Boundary

STAGING STATISTICS - STAGE 5

Stage Area	2.403 ha	
Length of New Roads	355m	
Area of New Roads	5750 m²	23.9%
Villa (10.5m - 12.99m frontage)	19	38.0%
Premium Villa (12.5m - 13.99m frontage)	19	38.0%
Courtyard (14m - 15.99m frontage)	12	24.0%
Total Residential Allotments	50	100%
Average Lot Size	366 m²	

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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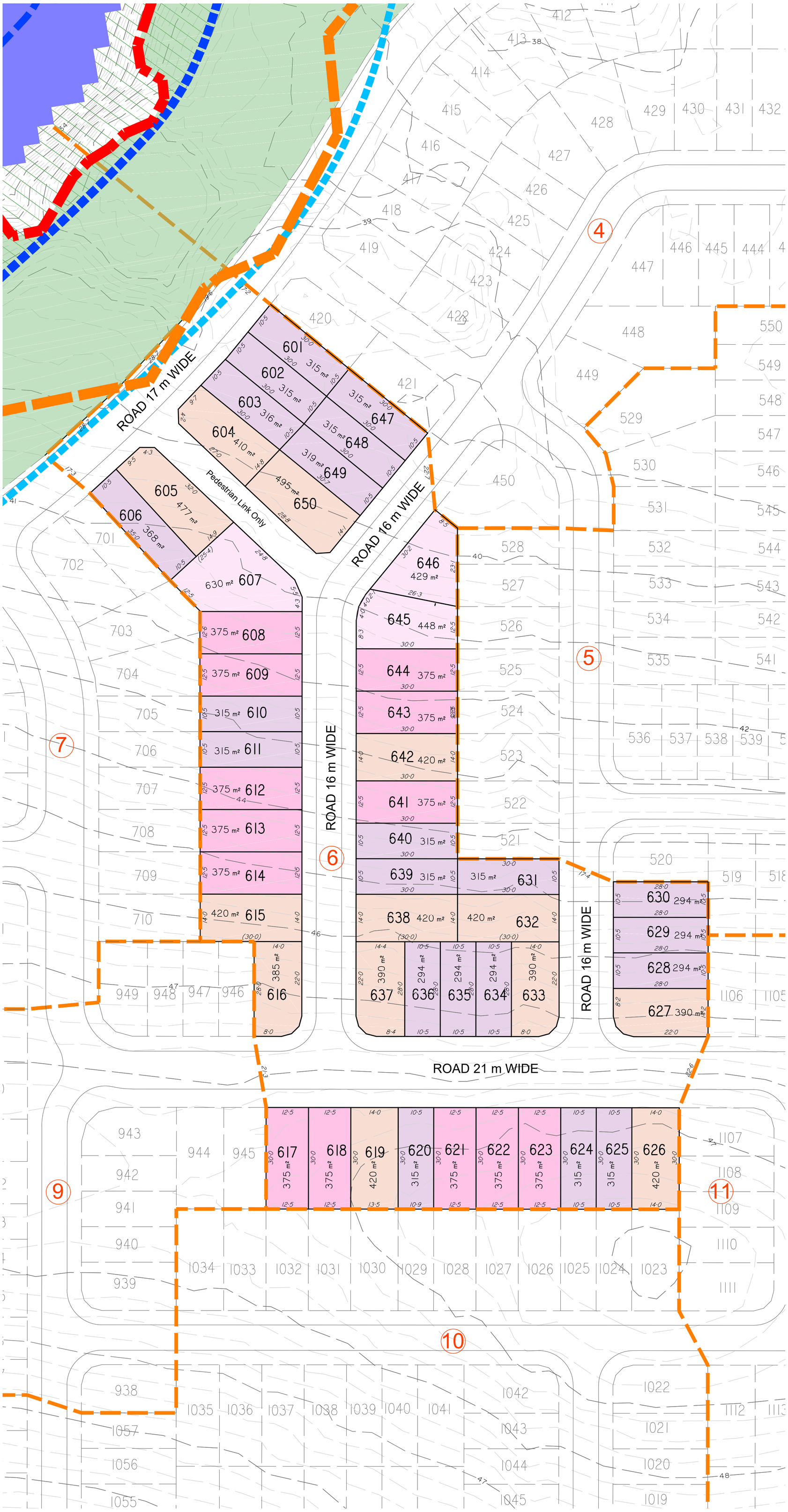
MOUNTAIN RIDGE ROAD, SOUTH MACLEAN • 13/03/2018 • 7344 P 19 PP F

STAGING PLAN - STAGE 6



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LEGEND

- Site Boundary
- Logan City Council 2016 Flood Mapping
- Minor Contour 0.25m Interval
- Major Contour 1.0m interval
- 50m Centreline Waterway Buffer
- 100m Centreline Waterway Buffer
- Aprrox High Bank - Derived from Slope analysis utilising lidar data
- 50m High Bank Offset
- 1 in 5 ARI
- Riparian Zone - 7.6 ha
- Linear Park - 2260 m²
- District Park - 9.403 ha
- ① Staging No.
- Staging Boundary

STAGING STATISTICS - STAGE 6

Stage Area	2.671 ha	
Length of New Roads	430m	
Area of New Roads	8325 m²	24.6%
Villa (10.5m - 12.99m frontage)	21	42.0%
Premium Villa (12.5m - 13.99m frontage)	13	26.0%
Courtyard (14m - 15.99m frontage)	13	260%
Premium Courtyard (16m + frontage)	3	6.0%
Total Residential Allotments	50	100%
Average Lot Size	368 m²	

RP DESCRIPTION — LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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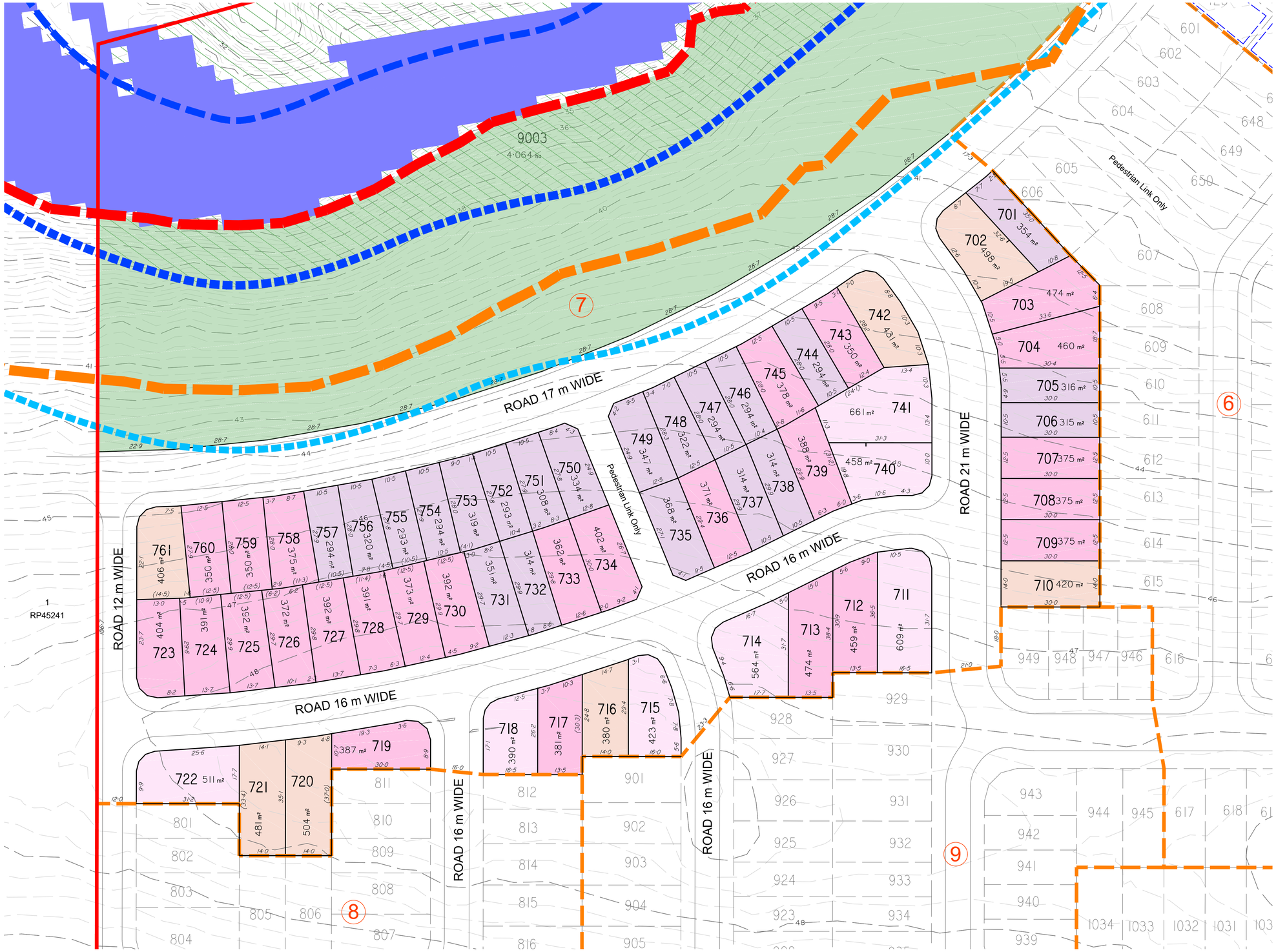
STAGING PLAN - STAGE 7



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- 50m Centreline Waterway Buffer
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- Aprrox High Bank - Derived from Slope analysis utilising lidar data
- 50m High Bank Offset
- 1 in 5 ARI
- Riparian Zone - 7.6 ha
- Linear Park - 2260 m²
- District Park - 9.403 ha
- ① Staging No.
- Staging Boundary

STAGING STATISTICS - STAGE 7

Stage Area	7.863 ha	
Length of New Roads	585 m	
Area of New Roads	1.474 ha	18.7%
Villa (10.5m - 12.99m frontage)	21	34.4%
Premium Villa (12.5m - 13.99m frontage)	26	42.6%
Courtyard (14m - 15.99m frontage)	7	11.5%
Premium Courtyard (16m + frontage)	7	11.5%
Total Residential Allotments	61	100%
Average Lot Size	381 m²	
Open Space	4.064 ha	51.7%

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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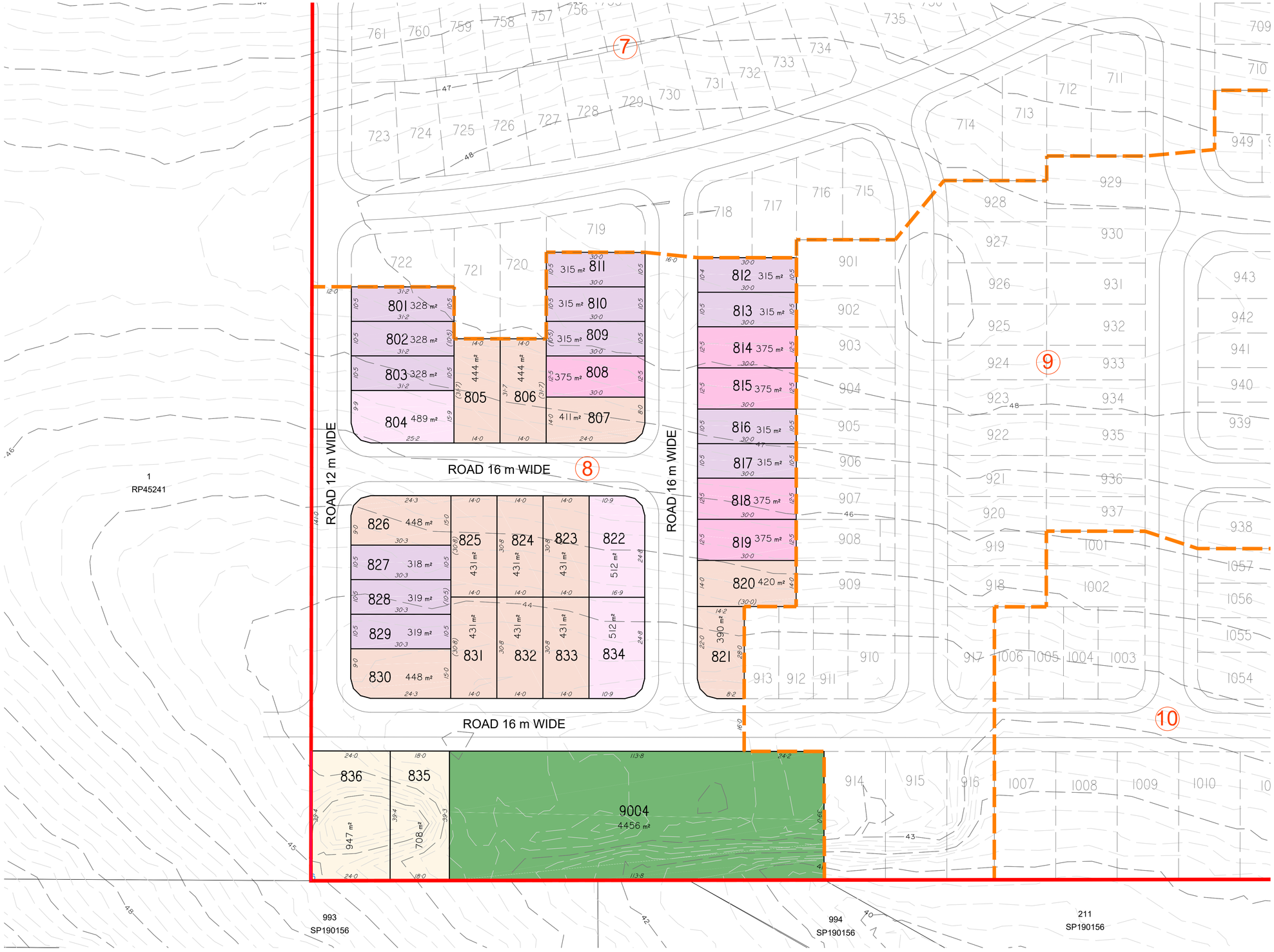
STAGING PLAN - STAGE 8



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- Staging Boundary

NOTE: DIMENSIONS HAVE BEEN ROUNDED DOWN TO THE NEAREST 0.1m

STAGING STATISTICS - STAGE 8

Stage Area	2.649 ha	
Length of New Roads	480 m	
Area of New Roads	7250 m²	27.4%
Villa (10.5m - 12.99m frontage)	13	36.1%
Premium Villa (12.5m - 13.99m frontage)	5	13.9%
Courtyard (14m - 15.99m frontage)	13	36.1%
Premium Courtyard (16m + frontage)	3	8.3%
Interface Lots	2	5.6%
Total Residential Allotments	36	100%
Average Lot Size	411 m²	
Stormwater / Detention Basin	4456 m²	16.8%

RP DESCRIPTION — LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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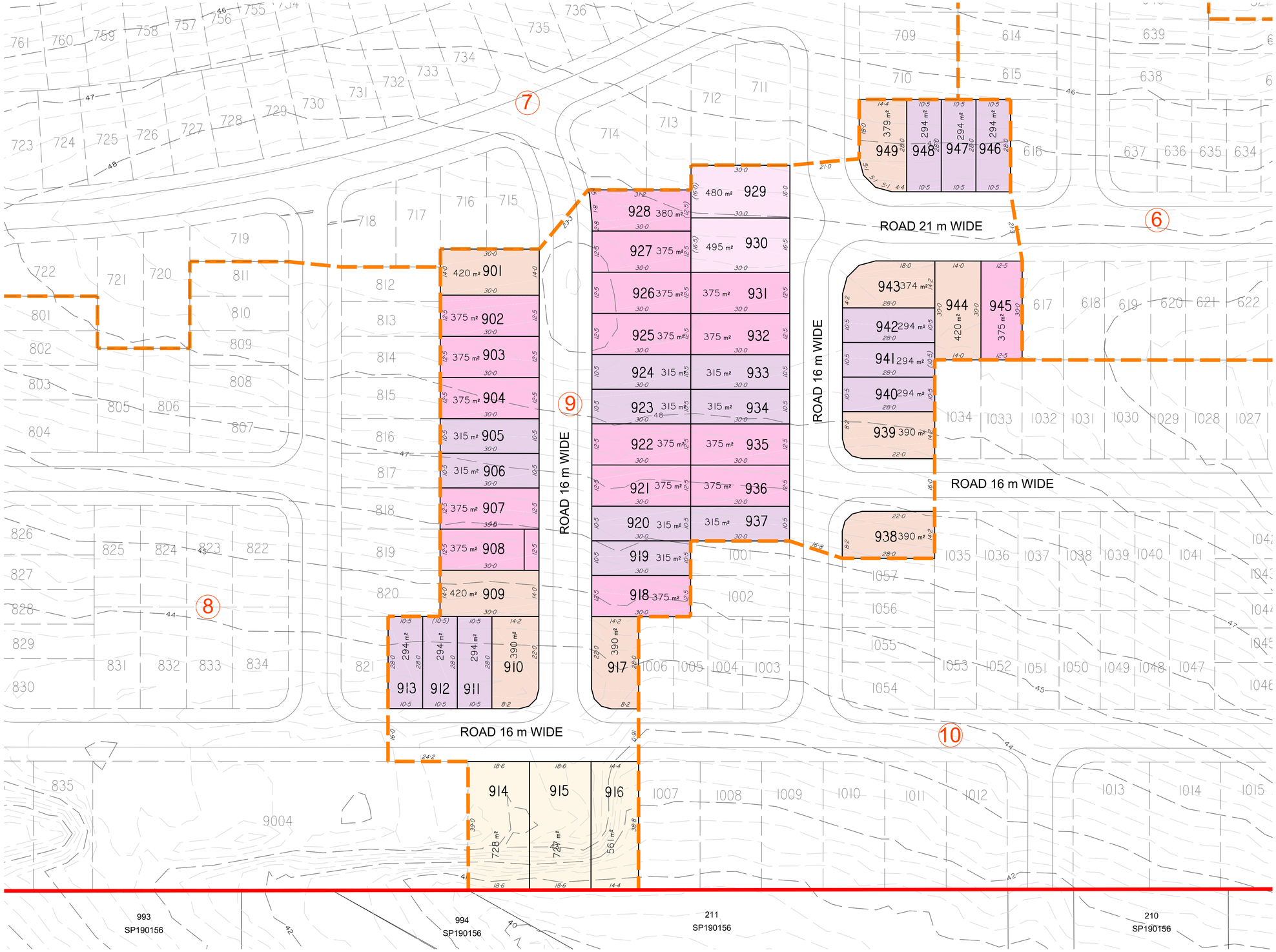
STAGING PLAN - STAGE 9



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STAGING STATISTICS - STAGE 9

Stage Area	2.559 ha	
Length of New Roads	420m	
Area of New Roads	7165 m²	28.0%
Villa (10.5m - 12.99m frontage)	18	36.7%
Premium Villa (12.5m - 13.99m frontage)	17	34.7%
Courtyard (14m - 15.99m frontage)	9	18.4%
Premium Courtyard (16m + frontage)	2	4.1%
Interface Lots	3	6.1%
Total Residential Allotments	49	100%
Average Lot Size	376 m²	

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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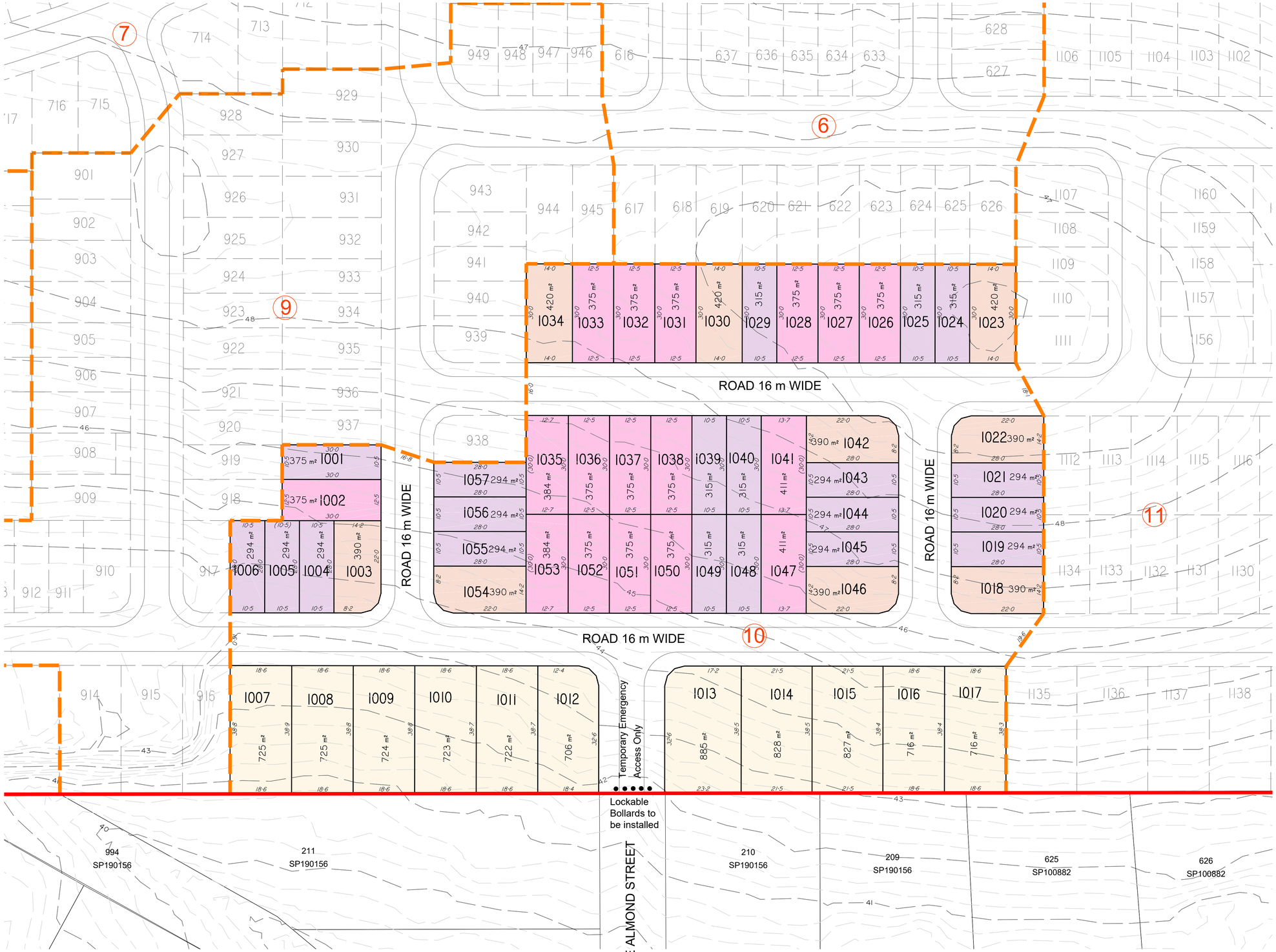
STAGING PLAN - STAGE 10



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- Staging Boundary

NOTE: DIMENSIONS HAVE BEEN ROUNDED DOWN TO THE NEAREST 0.1m

STAGING STATISTICS - STAGE 10

Stage Area	3.329 ha	
Length of New Roads	540 m	
Area of New Roads	8875 m²	26.7%
Villa (10.5m - 12.99m frontage)	20	35.1%
Premium Villa (12.5m - 13.99m frontage)	17	29.8%
Courtyard (14m - 15.99m frontage)	9	15.8%
Interface Lots	11	19.3%
Total Residential Allotments	57	100%
Average Lot Size	428 m²	

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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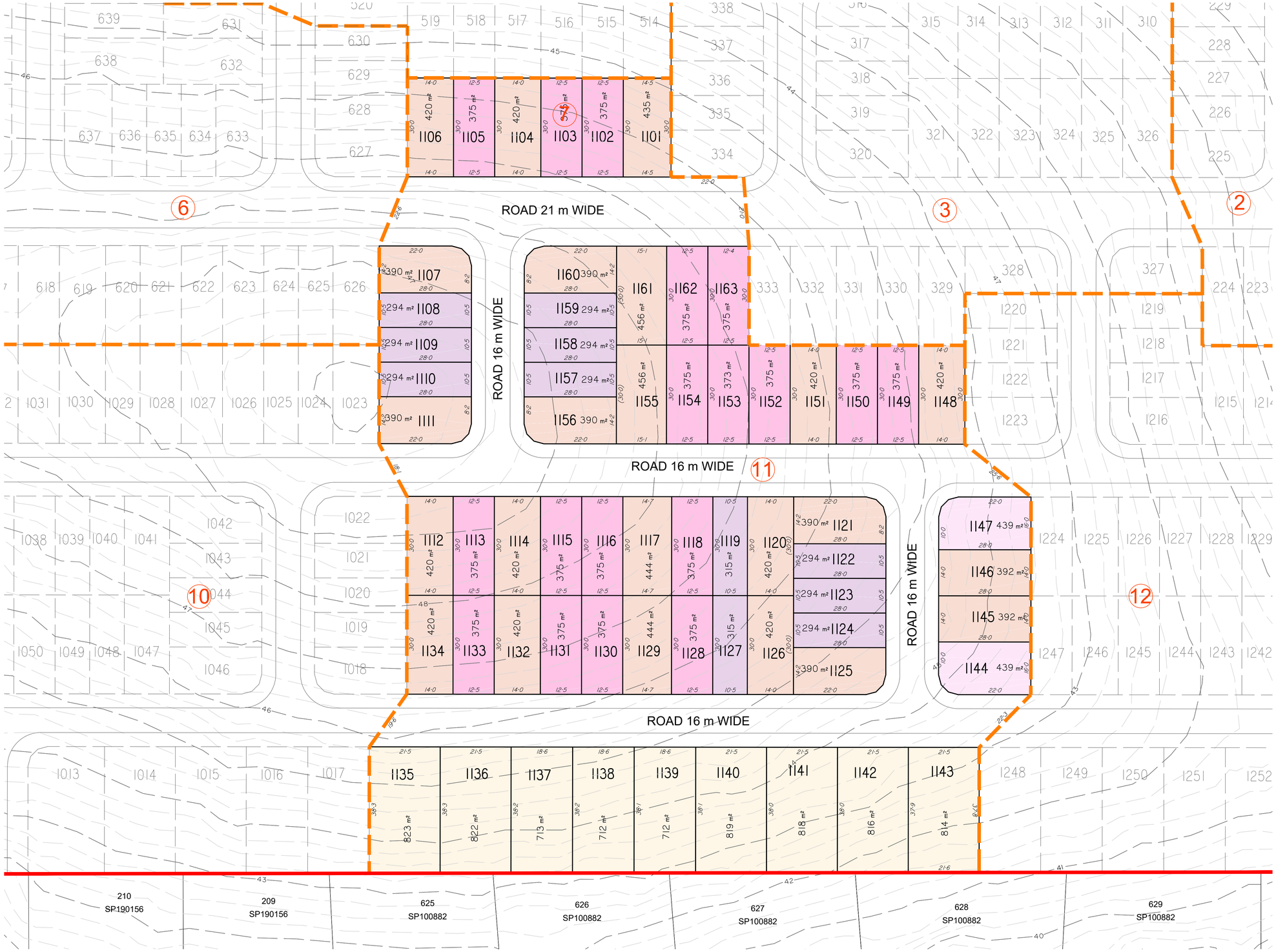
STAGING PLAN - STAGE 11



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- (1) Staging No.
- Staging Boundary

NOTE: DIMENSIONS HAVE BEEN ROUNDED DOWN TO THE NEAREST 0.1m

STAGING STATISTICS - STAGE 11

Stage Area	3.768 ha	
Length of New Roads	595 m	
Area of New Roads	1.017 ha	27.0%
Villa (10.5m - 12.99m frontage)	11	17.5%
Premium Villa (12.5m - 13.99m frontage)	18	28.6%
Courtyard (14m - 15.99m frontage)	23	36.5%
Premium Courtyard (16m + frontage)	2	3.1%
Interface Lots	9	14.3%
Total Residential Allotments	63	100%
Average Lot Size	437 m²	

RP DESCRIPTION — LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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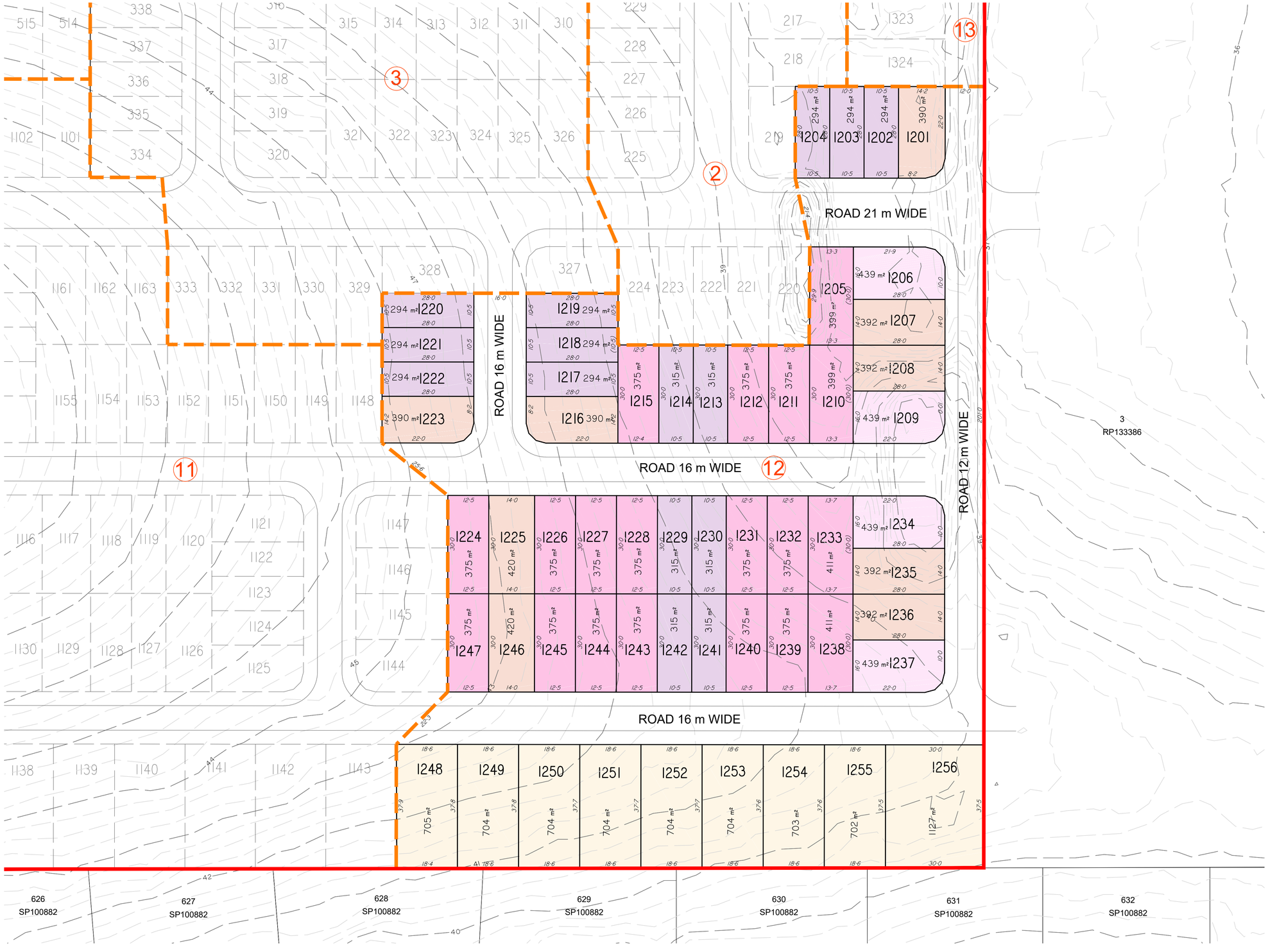
STAGING PLAN - STAGE 12



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STAGING STATISTICS - STAGE 12

Stage Area	3.313 ha	
Length of New Roads	615 m	
Area of New Roads	9245 m²	25.5%
Villa (10.5m - 12.99m frontage)	15	26.8%
Premium Villa (12.5m - 13.99m frontage)	19	33.9%
Courtyard (14m - 15.99m frontage)	9	16.1%
Premium Courtyard (16m + frontage)	4	7.1%
Interface Lots	9	16.1%
Total Residential Allotments	56	100%
Average Lot Size	427 m²	

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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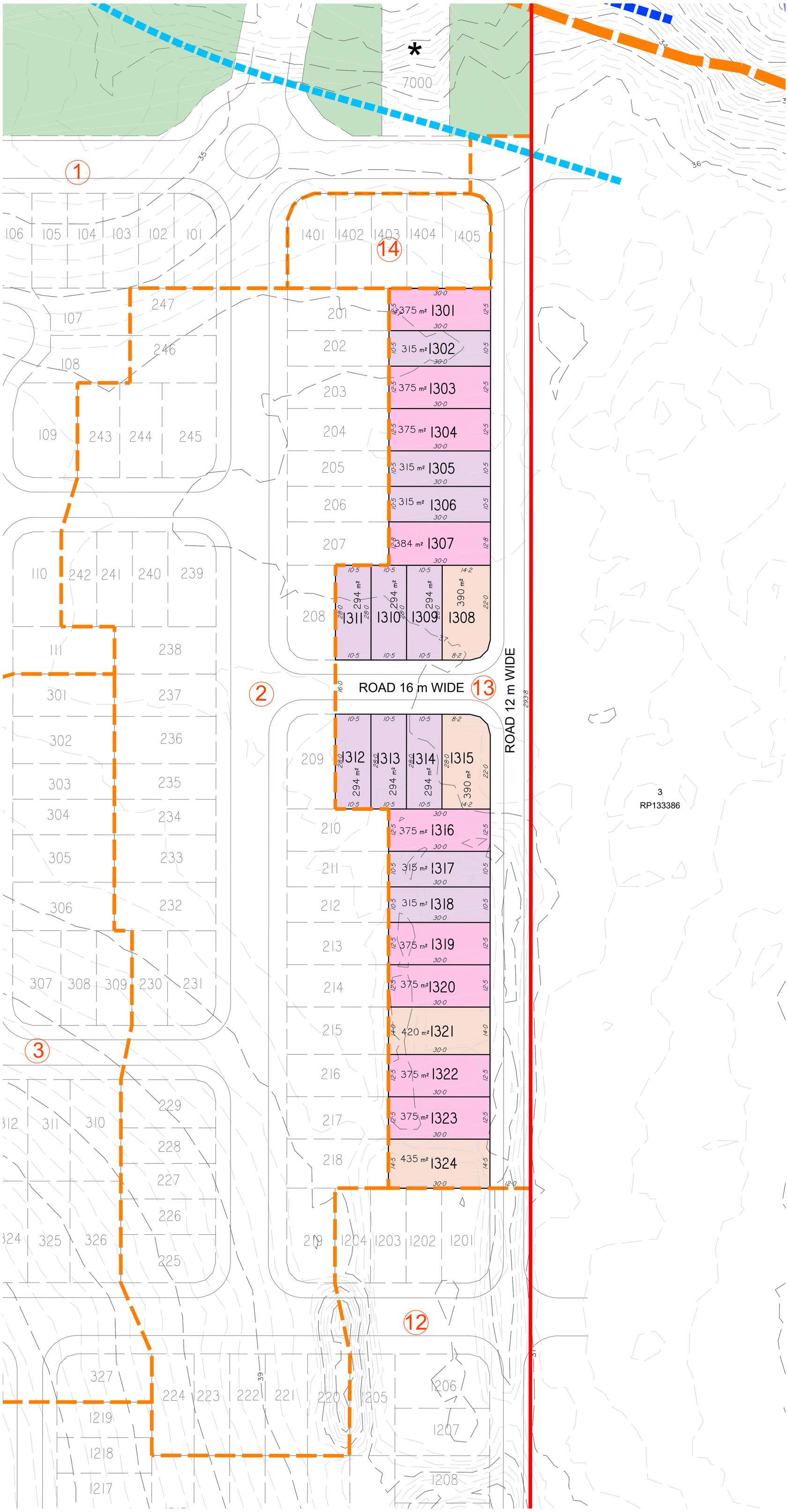
STAGING PLAN - STAGE 13



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- 100m Centreline Waterway Buffer
- Aprrox High Bank - Derived from Slope analysis utilising lidar data
- 50m High Bank Offset
- 1 in 5 ARI
- * Pump Station
- Riparian Zone - 7.6 ha
- Linear Park - 2260 m²
- District Park - 9.403 ha
- ① Staging No.
- Staging Boundary

STAGING STATISTICS - STAGE 13

Stage Area	1.264 ha	
Length of New Roads	340 m	
Area of New Roads	4285 m²	33.9%
Villa (10.5m - 12.99m frontage)	11	45.8%
Premium Villa (12.5m - 13.99m frontage)	9	37.5%
Courtyard (14m - 15.99m frontage)	4	16.7%
Total Residential Allotments	24	100%
Average Lot Size	348 m²	

RP DESCRIPTION — LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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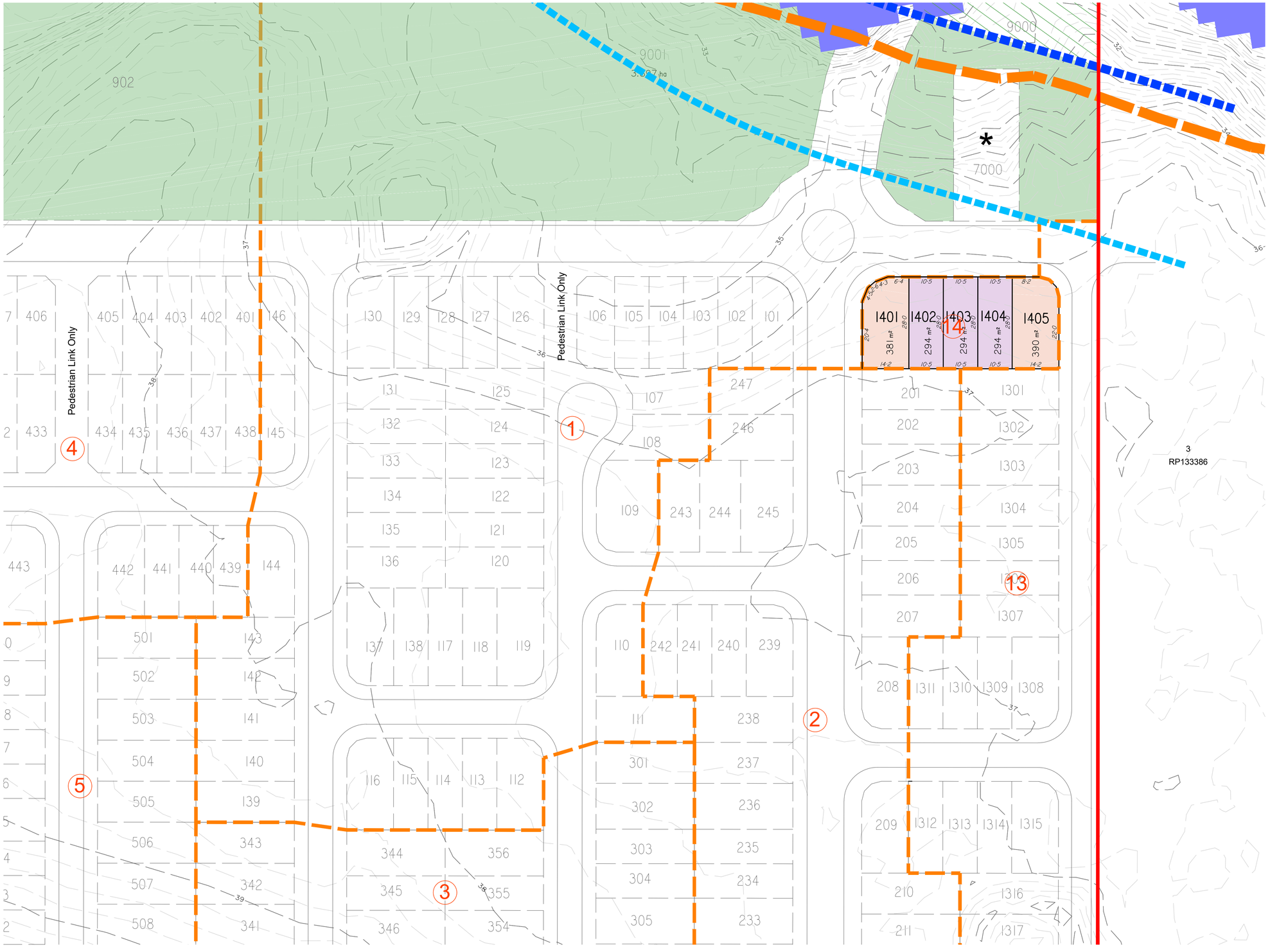
STAGING PLAN - STAGE 14



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- 100m Centreline Waterway Buffer
- Aprrox High Bank - Derived from Slope analysis utilising lidar data
- 50m High Bank Offset
- 1 in 5 ARI
- * Pump Station
- Riparian Zone - 7.6 ha
- Linear Park - 2260 m²
- District Park - 9.403 ha
- ① Staging No.
- Staging Boundary

STAGING STATISTICS - STAGE 14

Stage Area	1653 m²	
Villa (10.5m - 12.99m frontage)	3	60.0%
Courtyard (14m - 15.99m frontage)	2	40.0%
Total Residential Allotments	5	100%
Average Lot Size	331m²	

RP DESCRIPTION LOT 6 on RP193185 & LOT 9 on SP203507

SCALE @A1 1:600 @A3 1:1200 - LENGTHS ARE IN METRES

10 0 10 20 30 40 50 60 70

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APPENDIX B

TRAFFIC SURVEY DATA

TDC
Traffic Data & Control

SURVEY INFORMATION

Site ID:	1			
Location:	Teviot Rd & Mountain Ridge Rd, South Maclean			
Date:	9	/ Aug	/ 2017	
Time Period 1:	06:00	to	09:00	
Time Period 2:	15:00	to	18:00	

	Primary Classes:	Secondary Classes:
1	Light Vehicles	Pedestrians
2	Trucks	None
3	Bicycles on Road	
4	None	
5	None	

Weather Conditions 1: Fine **Weather Conditions 2:** Fine

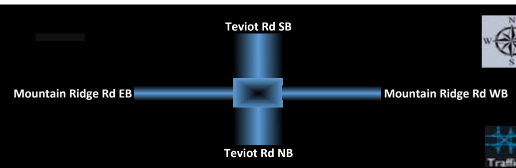
Intersection Legs:	**North**	Teviot Rd SB
	East	Mountain Ridge Rd WB
	South	Teviot Rd NB
	West	Mountain Ridge Rd EB

Output time interval: 15 mins

MAP

Site ID: 1
Location: Teviot Rd & Mountain Ridge Rd, South Maclean
Date: 9-Aug-2017
Period 1 Time: 6:00 AM to 9:00 AM
Weather: Fine

Period 1 Peak Hour: 6:15 AM to 7:15 AM



TOTALS AND PEAKS

Teviot Rd SB

Time Starting	Left Light Vehicles	Left Trucks	Left Bicycles on Road	Through Light Vehicles	Through Trucks	Through Bicycles on Road	Right Light Vehicles	Right Trucks	Right Bicycles on Road	U-turn Light Vehicles	U-turn Trucks	U-turn Bicycles on Road	Cross 1 Pedestrians
Period 1 Total	16	2	0	470	75	0	6	0	0	1	0	0	0
Period 1 Peak Hr	2	0	0	115	38	0	3	0	0	0	0	0	0
06:00	0	0	0	36	3	0	0	0	0	0	0	0	0
06:15	0	0	0	36	4	0	1	0	0	0	0	0	0
06:30	0	0	0	24	10	0	0	0	0	0	0	0	0
06:45	2	0	0	23	17	0	1	0	0	0	0	0	0
07:00	0	0	0	32	7	0	1	0	0	0	0	0	0
07:15	0	0	0	25	8	0	0	0	0	0	0	0	0
07:30	0	0	0	46	4	0	0	0	0	0	0	0	0
07:45	7	1	0	46	3	0	0	0	0	0	0	0	0
08:00	3	1	0	35	5	0	0	0	0	0	0	0	0
08:15	1	0	0	67	5	0	2	0	0	1	0	0	0
08:30	1	0	0	53	7	0	0	0	0	0	0	0	0
08:45	2	0	0	47	2	0	1	0	0	0	0	0	0

Mountain Ridge Rd WB

Time Starting	Left Light Vehicles	Left Trucks	Left Bicycles on Road	Through Light Vehicles	Through Trucks	Through Bicycles on Road	Right Light Vehicles	Right Trucks	Right Bicycles on Road	U-turn Light Vehicles	U-turn Trucks	U-turn Bicycles on Road	Cross 1 Pedestrians
Period 1 Total	27	7	0	0	0	0	71	1	0	0	0	0	0
Period 1 Peak Hr	6	4	0	0	0	0	28	1	0	0	0	0	0
06:00	0	1	0	0	0	0	5	0	0	0	0	0	0
06:15	1	1	0	0	0	0	7	1	0	0	0	0	0
06:30	1	2	0	0	0	0	6	0	0	0	0	0	0
06:45	2	0	0	0	0	0	9	0	0	0	0	0	0
07:00	2	1	0	0	0	0	6	0	0	0	0	0	0
07:15	0	0	0	0	0	0	6	0	0	0	0	0	0
07:30	2	0	0	0	0	0	8	0	0	0	0	0	0
07:45	5	0	0	0	0	0	3	0	0	0	0	0	0
08:00	2	1	0	0	0	0	4	0	0	0	0	0	0
08:15	6	1	0	0	0	0	3	0	0	0	0	0	0
08:30	3	0	0	0	0	0	8	0	0	0	0	0	0
08:45	3	0	0	0	0	0	6	0	0	0	0	0	0

Teviot Rd NB

Time Starting	Left Light Vehicles	Left Trucks	Left Bicycles on Road	Through Light Vehicles	Through Trucks	Through Bicycles on Road	Right Light Vehicles	Right Trucks	Right Bicycles on Road	U-turn Light Vehicles	U-turn Trucks	U-turn Bicycles on Road	Cross 1 Pedestrians
Period 1 Total	8	0	0	1197	62	1	15	3	0	0	0	0	0
Period 1 Peak Hr	0	0	0	477	25	0	4	1	0	0	0	0	0
06:00	0	0	0	101	4	0	1	1	0	0	0	0	0
06:15	0	0	0	110	12	0	2	0	0	0	0	0	0
06:30	0	0	0	121	5	0	0	0	0	0	0	0	0
06:45	0	0	0	127	3	0	1	0	0	0	0	0	0
07:00	0	0	0	119	5	0	1	1	0	0	0	0	0
07:15	1	0	0	103	2	0	1	0	0	0	0	0	0
07:30	2	0	0	121	1	1	0	0	0	0	0	0	0
07:45	0	0	0	101	10	0	2	0	0	0	0	0	0
08:00	1	0	0	90	2	0	1	0	0	0	0	0	0
08:15	0	0	0	85	7	0	1	1	0	0	0	0	0
08:30	3	0	0	58	3	0	2	0	0	0	0	0	0
08:45	1	0	0	61	8	0	3	0	0	0	0	0	0

Mountain Ridge Rd EB

Time Starting	Left Light Vehicles	Left Trucks	Left Bicycles on Road	Through Light Vehicles	Through Trucks	Through Bicycles on Road	Right Light Vehicles	Right Trucks	Right Bicycles on Road	U-turn Light Vehicles	U-turn Trucks	U-turn Bicycles on Road	Cross 1 Pedestrians
Period 1 Total	35	2	0	0	0	0	19	3	0	0	0	0	0
Period 1 Peak Hr	17	0	0	0	0	0	4	1	0	0	0	0	0
06:00	6	1	0	0	0	0	1	0	0	0	0	0	0
06:15	5	0	0	0	0	0	1	1	0	0	0	0	0
06:30	3	0	0	0	0	0	2	0	0	0	0	0	0
06:45	6	0	0	0	0	0	0	0	0	0	0	0	0
07:00	3	0	0	0	0	0	1	0	0	0	0	0	0
07:15	0	1	0	0	0	0	1	1	0	0	0	0	0
07:30	4	0	0	0	0	0	3	0	0	0	0	0	0
07:45	1	0	0	0	0	0	0	0	0	0	0	0	0
08:00	2	0	0	0	0	0	4	1	0	0	0	0	0
08:15	2	0	0	0	0	0	4	0	0	0	0	0	0
08:30	3	0	0	0	0	0	1	0	0	0	0	0	0
08:45	0	0	0	0	0	0	1	0	0	0	0	0	0

Totals

Time Starting	GRAND TOTAL TOTALS	Teviot Rd SB TOTAL All Classes	Mountain Ridge Rd WB TOTAL All Classes	Teviot Rd NB TOTAL All Classes	Mountain Ridge Rd EB TOTAL All Classes
Period 1 Total	2021	570	106	1286	59
Period 1 Peak Hr	726	158	39	507	22
06:00	**160**	39	6	107	8
06:15	**182**	41	10	124	7
06:30	**174**	34	9	126	5
06:45	**191**	43	11	131	6
07:00	**179**	40	9	126	4
07:15	**149**	33	6	107	3
07:30	**192**	50	10	125	7
07:45	**179**	57	8	113	1
08:00	**152**	44	7	94	7
08:15	**186**	76	10	94	6
08:30	**142**	61	11	66	4
08:45	**135**	52	9	73	1

Site ID: 1

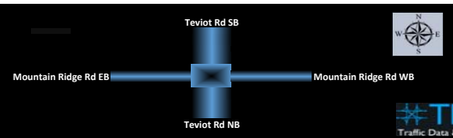
Location: Teviot Rd & Mountain Ridge Rd, South Maclean

Date: 9-Aug-2017

Period 2 Time: 3:00 PM to 6:00 PM

Weather: Fine

Period 2 Peak Hour: 5:00 PM to 6:00 PM



TDC Traffic Data & Control

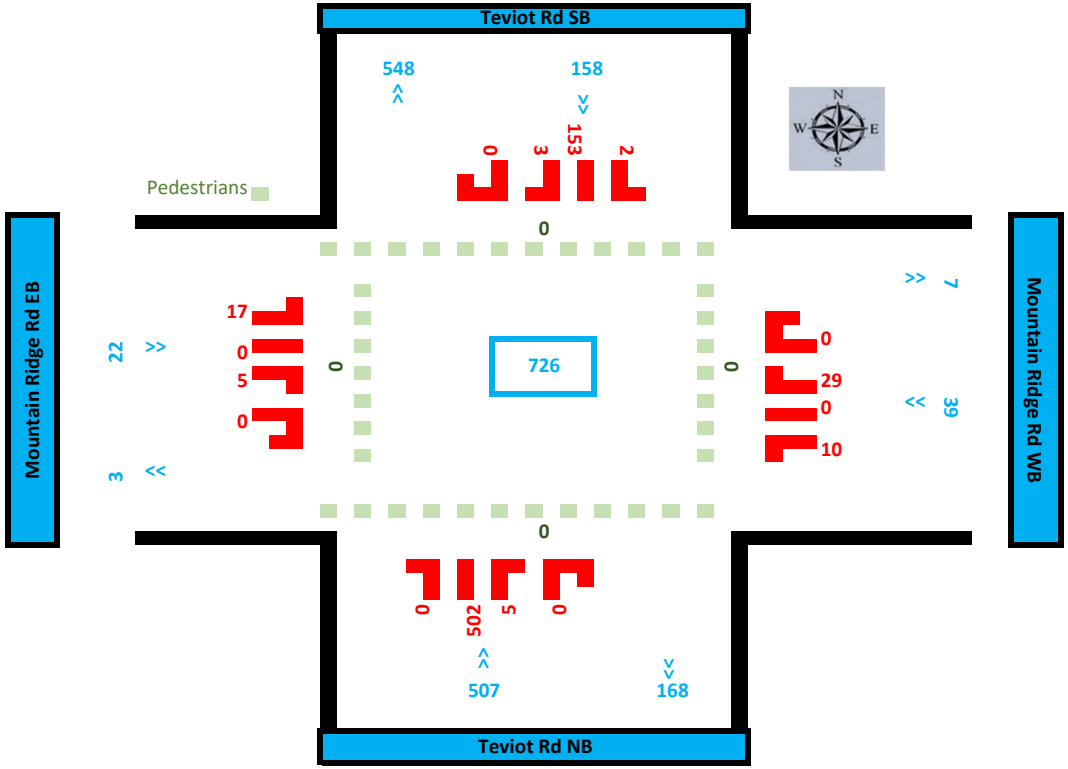
TOTALS AND PEAKS

	Teviot Rd SB Left Light Vehicles	Teviot Rd SB Left Trucks	Teviot Rd SB Left Bicycles on Road	Teviot Rd SB Through Light Vehicles	Teviot Rd SB Through Trucks	Teviot Rd SB Through Bicycles on Road	Teviot Rd SB Right Light Vehicles	Teviot Rd SB Right Trucks	Teviot Rd SB Right Bicycles on Road	Teviot Rd SB U-turn Light Vehicles	Teviot Rd SB U-turn Trucks	Teviot Rd SB U-turn Bicycles on Road	Teviot Rd SB Cross 1 Pedestrians	Mountain Ridge Rd WB Left Light Vehicles	Mountain Ridge Rd WB Left Trucks	Mountain Ridge Rd WB Left Bicycles on Road	Mountain Ridge Rd WB Through Light Vehicles	Mountain Ridge Rd WB Through Trucks	Mountain Ridge Rd WB Through Bicycles on Road	Mountain Ridge Rd WB Right Light Vehicles	Mountain Ridge Rd WB Right Trucks	Mountain Ridge Rd WB Right Bicycles on Road	Mountain Ridge Rd WB U-turn Light Vehicles	Mountain Ridge Rd WB U-turn Trucks	Mountain Ridge Rd WB U-turn Bicycles on Road	Mountain Ridge Rd WB Cross 1 Pedestrians	Teviot Rd NB Left Light Vehicles	Teviot Rd NB Left Trucks	Teviot Rd NB Left Bicycles on Road	Teviot Rd NB Through Light Vehicles	Teviot Rd NB Through Trucks	Teviot Rd NB Through Bicycles on Road	Teviot Rd NB Right Light Vehicles	Teviot Rd NB Right Trucks	Teviot Rd NB Right Bicycles on Road	Teviot Rd NB U-turn Light Vehicles	Teviot Rd NB U-turn Trucks	Teviot Rd NB U-turn Bicycles on Road	Teviot Rd NB Cross 1 Pedestrians	Mountain Ridge Rd EB Left Light Vehicles	Mountain Ridge Rd EB Left Trucks	Mountain Ridge Rd EB Left Bicycles on Road	Mountain Ridge Rd EB Through Light Vehicles	Mountain Ridge Rd EB Through Trucks	Mountain Ridge Rd EB Through Bicycles on Road	Mountain Ridge Rd EB Right Light Vehicles	Mountain Ridge Rd EB Right Trucks	Mountain Ridge Rd EB Right Bicycles on Road	Mountain Ridge Rd EB U-turn Light Vehicles	Mountain Ridge Rd EB U-turn Trucks	Mountain Ridge Rd EB U-turn Bicycles on Road	Mountain Ridge Rd EB Cross 1 Pedestrians	GRAND TOTAL
Time Starting																																																	
Period 2 Total	71	2	0	1472	81	1	33	2	0	0	0	0	0	16	4	0	0	1	0	31	2	0	0	0	0	0	26	2	0	578	31	0	31	7	0	0	0	0	0	12	1	0	1	0	0	8	0	0	0	0	0	2413
Period 2 Peak Hr	35	0	0	569	27	1	11	0	0	0	0	0	0	9	1	0	0	0	0	13	0	0	0	0	0	0	8	0	0	165	5	0	11	1	0	0	0	0	0	6	1	0	1	0	0	3	0	0	0	0	0	867

Time Starting	Teviot Rd SB Left Light Vehicles	Teviot Rd SB Left Trucks	Teviot Rd SB Left Bicycles on Road	Teviot Rd SB Through Light Vehicles	Teviot Rd SB Through Trucks	Teviot Rd SB Through Bicycles on Road	Teviot Rd SB Right Light Vehicles	Teviot Rd SB Right Trucks	Teviot Rd SB Right Bicycles on Road	Teviot Rd SB U-turn Light Vehicles	Teviot Rd SB U-turn Trucks	Teviot Rd SB U-turn Bicycles on Road	Teviot Rd SB Cross 1 Pedestrians	Mountain Ridge Rd WB Left Light Vehicles	Mountain Ridge Rd WB Left Trucks	Mountain Ridge Rd WB Left Bicycles on Road	Mountain Ridge Rd WB Through Light Vehicles	Mountain Ridge Rd WB Through Trucks	Mountain Ridge Rd WB Through Bicycles on Road	Mountain Ridge Rd WB Right Light Vehicles	Mountain Ridge Rd WB Right Trucks	Mountain Ridge Rd WB Right Bicycles on Road	Mountain Ridge Rd WB U-turn Light Vehicles	Mountain Ridge Rd WB U-turn Trucks	Mountain Ridge Rd WB U-turn Bicycles on Road	Mountain Ridge Rd WB Cross 1 Pedestrians	Teviot Rd NB Left Light Vehicles	Teviot Rd NB Left Trucks	Teviot Rd NB Left Bicycles on Road	Teviot Rd NB Through Light Vehicles	Teviot Rd NB Through Trucks	Teviot Rd NB Through Bicycles on Road	Teviot Rd NB Right Light Vehicles	Teviot Rd NB Right Trucks	Teviot Rd NB Right Bicycles on Road	Teviot Rd NB U-turn Light Vehicles	Teviot Rd NB U-turn Trucks	Teviot Rd NB U-turn Bicycles on Road	Teviot Rd NB Cross 1 Pedestrians	Mountain Ridge Rd EB Left Light Vehicles	Mountain Ridge Rd EB Left Trucks	Mountain Ridge Rd EB Left Bicycles on Road	Mountain Ridge Rd EB Through Light Vehicles	Mountain Ridge Rd EB Through Trucks	Mountain Ridge Rd EB Through Bicycles on Road	Mountain Ridge Rd EB Right Light Vehicles	Mountain Ridge Rd EB Right Trucks	Mountain Ridge Rd EB Right Bicycles on Road	Mountain Ridge Rd EB U-turn Light Vehicles	Mountain Ridge Rd EB U-turn Trucks	Mountain Ridge Rd EB U-turn Bicycles on Road	Mountain Ridge Rd EB Cross 1 Pedestrians	GRAND TOTALS	Teviot Rd SB TOTAL All Classes	Mountain Ridge Rd WB TOTAL All Classes	Teviot Rd NB TOTAL All Classes	Mountain Ridge Rd EB TOTAL All Classes
15:00	5	0	0	81	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	53	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**154**	94	2	57	1
15:15	1	0	0	89	4	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	85	4	0	4	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	**198**	96	2	96	4
15:30	6	0	0	109	4	0	3	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	5	0	0	42	7	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**184**	122	2	60	0
15:45	4	0	0	124	3	0	3	0	0	0	0	0	0	1	0	0	0	1	0	4	1	0	0	0	0	0	1	0	0	55	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**202**	134	7	61	0
16:00	3	0	0	118	10	0	3	0	0	0	0	0	0	1	1	0	0	0	0	5	0	0	0	0	0	0	2	0	0	48	3	0	7	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	**203**	134	7	60	2
16:15	8	1	0	122	13	0	3	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	1	0	38	2	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**196**	147	2	46	1
16:30	7	0	0	127	8	0	5	2	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	4	1	0	46	2	0	1	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	**209**	149	3	54	3
16:45	2	1	0	133	5	0	2	0	0	0	0	0	0	1	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	46	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**200**	143	6	51	0
17:00	4	0	0	127	7	0	1	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	42	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**191**	139	3	48	1
17:15	8	0	0	142	10	0	5	0	0	0	0	0	0	3	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	41	2	0	5	1	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	0	0	**223**	165	6	49	3
17:30	10	0	0	129	6	1	3	0	0	0	0	0	0	4	0	0	0	0	0	5	0	0	0	0	0	0	3	0	0	52	1	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	**220**	149	9	59	3
17:45	13	0	0	171	4	0	2	0	0	0	0	0	0	1	0	0	0	0	0	4	0	0	0	0	0	0	2	0	0	30	1	0	1	0	0	0	0	0	0	2	1	0	0	0	0	1	0	0	0	0	0	**233**	190	5	34	4

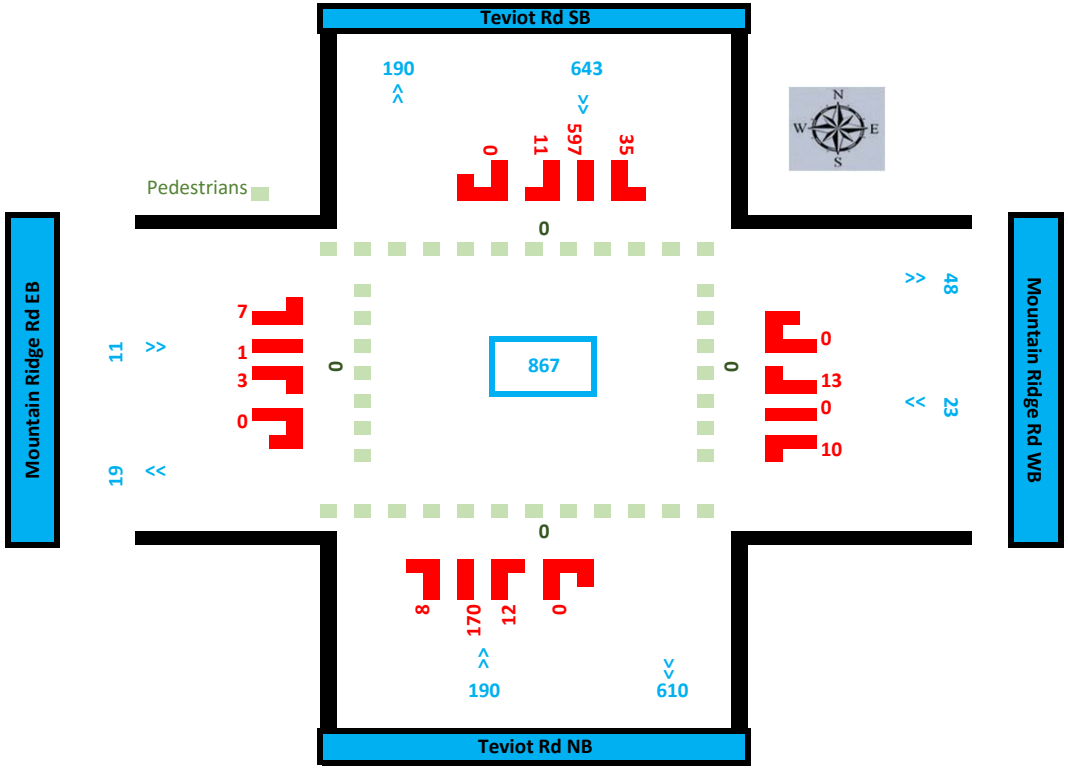
Turning Movement Count Summary

Site ID:	1
Location:	Teviot Rd & Mountain Ridge Rd, South Maclean
Date:	9-Aug-2017
Surveyed Time:	6:00 AM to 9:00 AM
Weather:	Fine
Data for hour starting:	6:15 AM to 7:15 AM
Vehicle Class:	ALL VEHICLES



Turning Movement Count Summary

Site ID:	1
Location:	Teviot Rd & Mountain Ridge Rd, South Maclean
Date:	9-Aug-2017
Surveyed Time:	3:00 PM to 6:00 PM
Weather:	Fine
Data for hour starting:	5:00 PM to 6:00 PM
Vehicle Class:	ALL VEHICLES



APPENDIX C

GFSTM TURNING VOLUMES

5. Intersection Turning Volumes

This section provides forecast turning movements for the Access Road / Mountain Ridge Road and Teviot Road / Mountain Ridge Road intersections. These turning movements have been requested to inform SIDRA analysis and intersection design as part of the IMP.

NB: A number of north bound trips using Teviot Road are loaded onto Mountain Ridge Road west of the Access Road because of limited capacity on Mountain Ridge Road in the 2031 network. These trips use Mountain Ridge Road and then Pennine Drive to access Teviot Road. As a result, it would be appropriate for the SIDRA analyst to adjust the 2031 turning movements to account for this. Interestingly, this analysis shows that capacity constraints on Mountain Ridge Road between the development site and Teviot Road will lead to poor levels of service. An upgrade to Mountain Ridge Road between the Access Road and Teviot Road would be required irrespective of the Rose Almond Street connection being provided.

5.1 2031 Turning Movements

Figure 5 to Figure 8 detail the 1 hr AM and PM turning movements from the 2031 forecasts.

Figure 5: AM 1hr - Mountain Ridge Road / Access Road

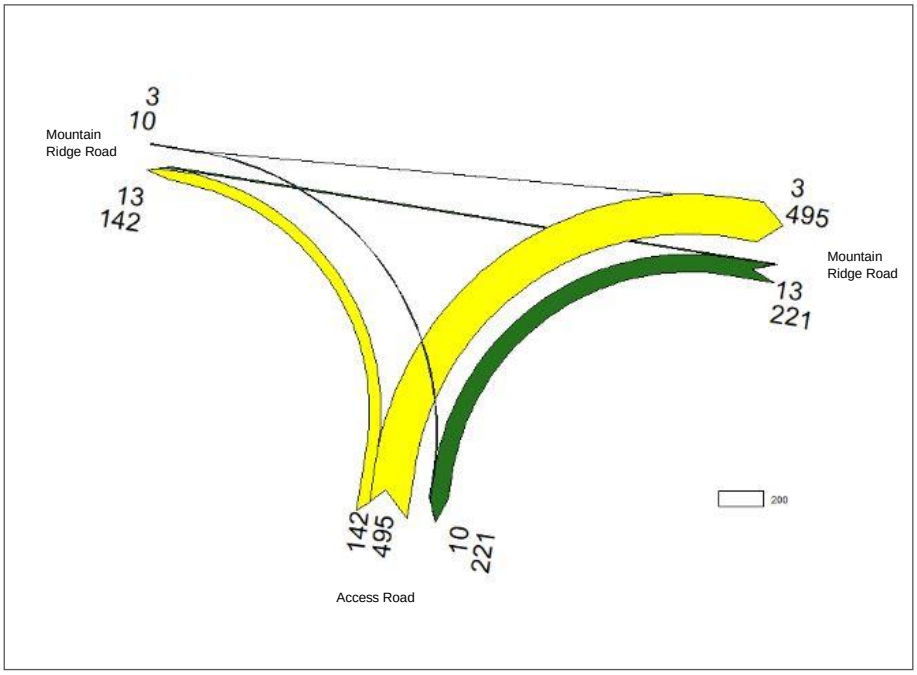


Figure 6: PM 1hr - Mountain Ridge Road / Access Road

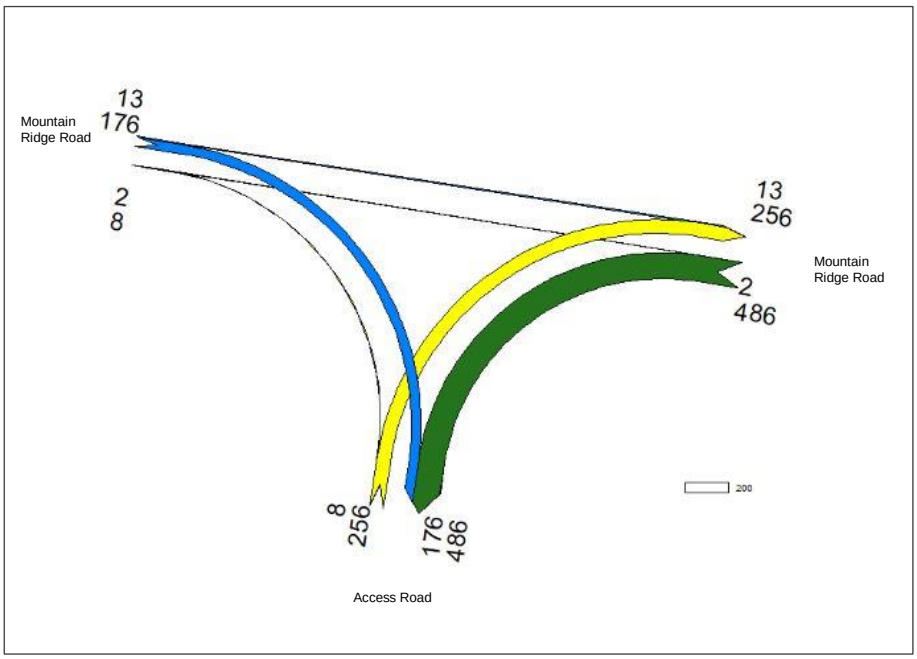


Figure 7: AM 1hr - Mountain Ridge Road / Teviot Road

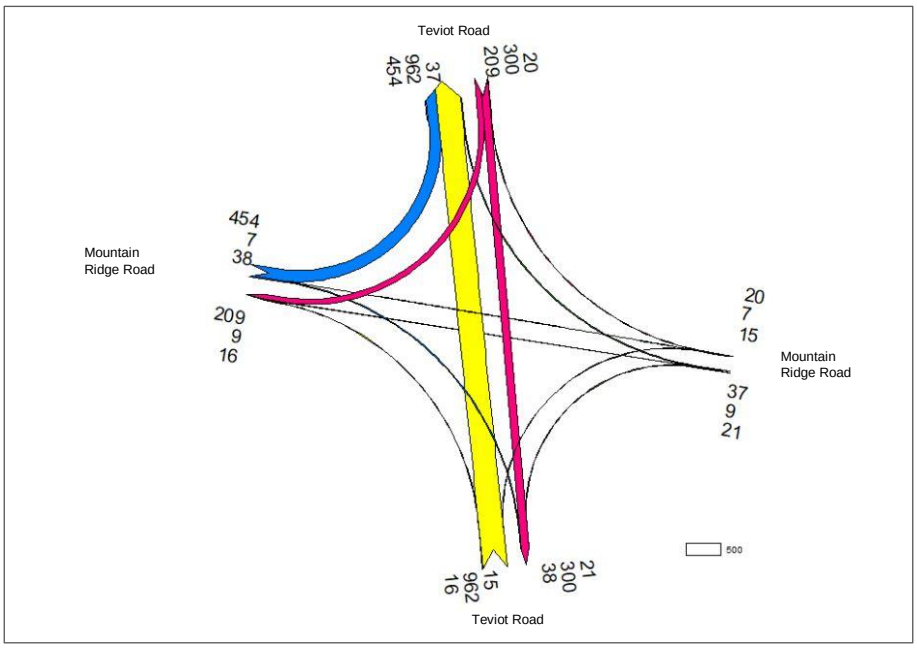
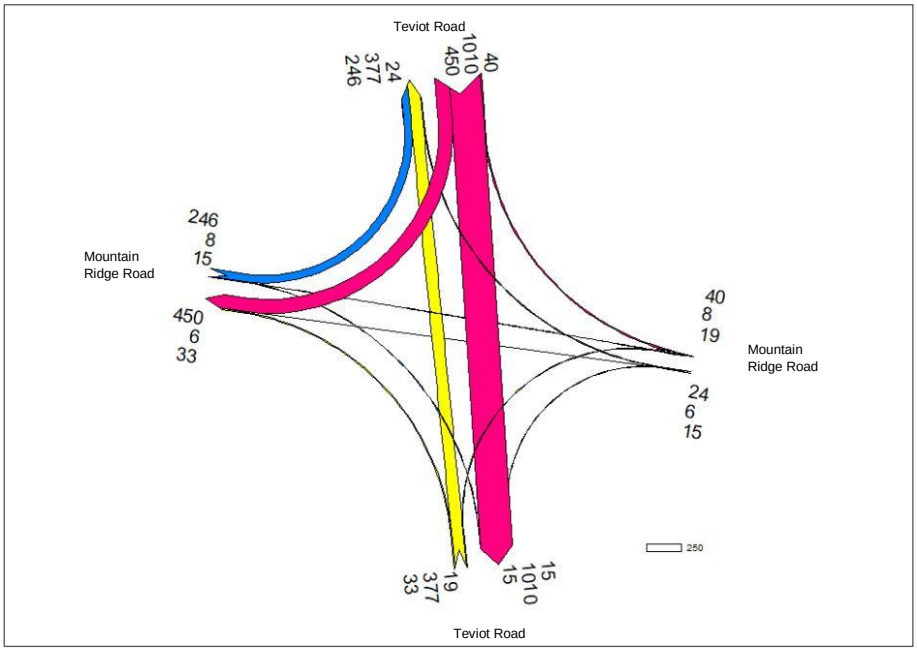


Figure 8: PM 1hr - Mountain Ridge Road / Teviot Road



5.2 Ultimate Turning Movements

Figure 9 to Figure 12 detail the 1 hr AM and PM turning movements taken from the ultimate year forecasts.

Figure 9: AM 1hr - Mountain Ridge Road / Access Road

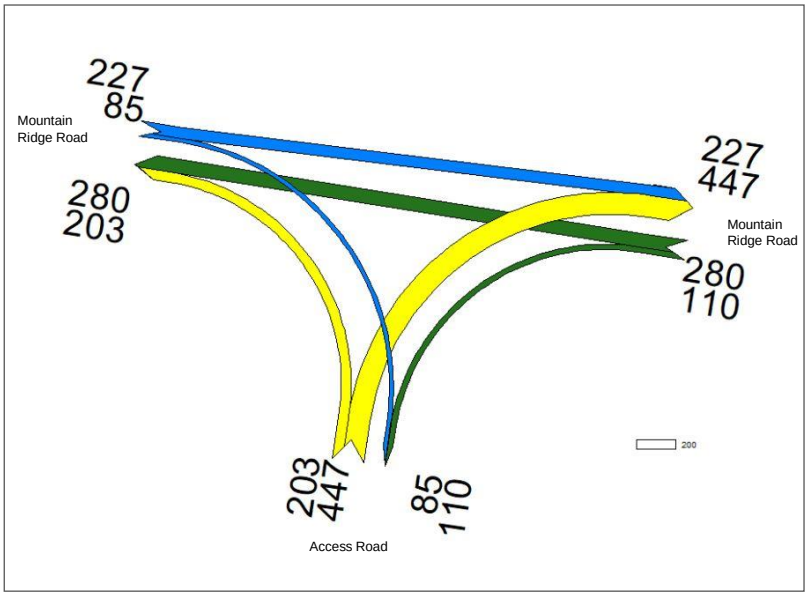


Figure 10: PM 1hr - Mountain Ridge Road / Access Road

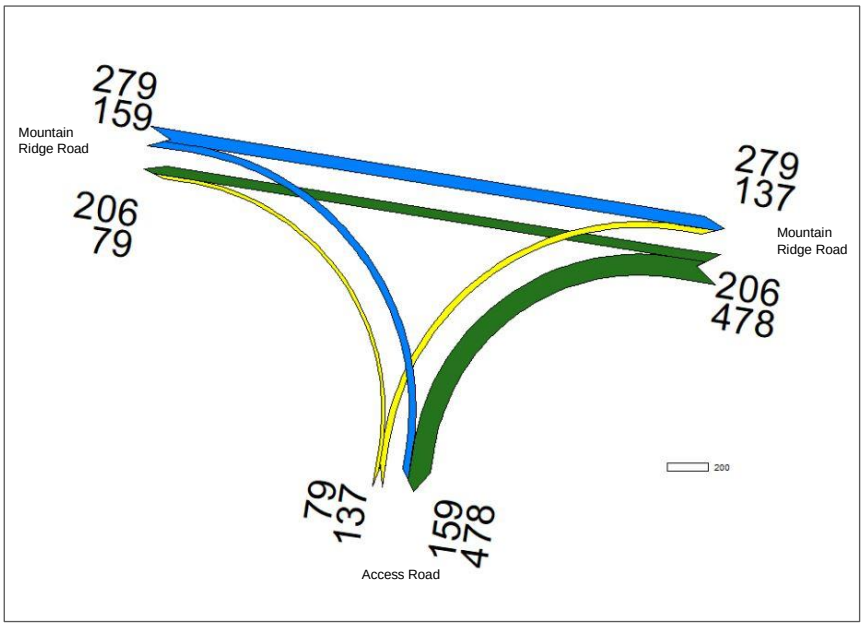


Figure 11: AM 1 hr - Mountain Ridge Road / Teviot Road

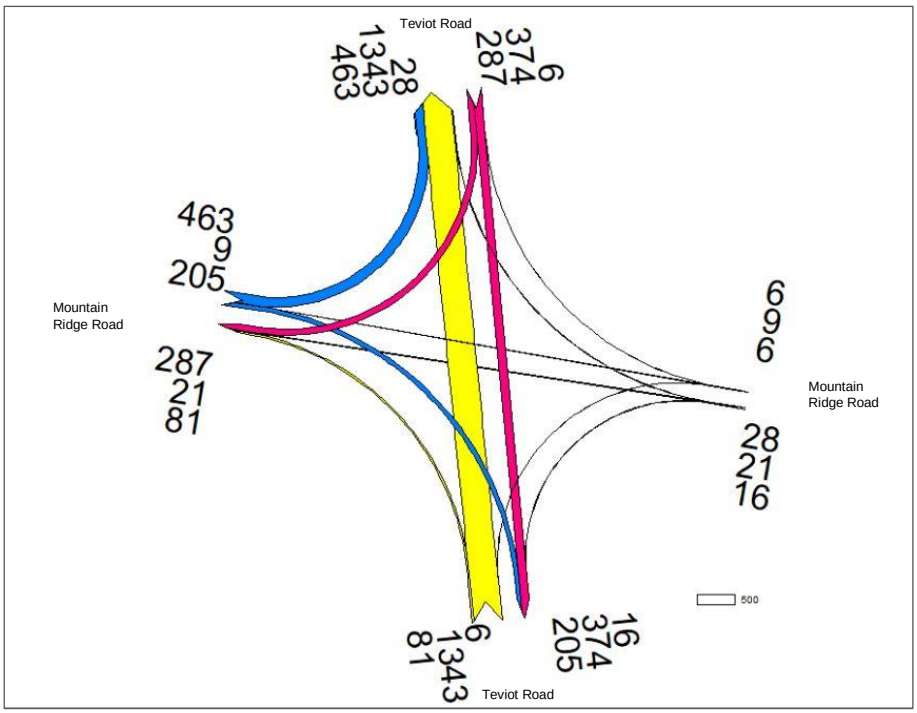
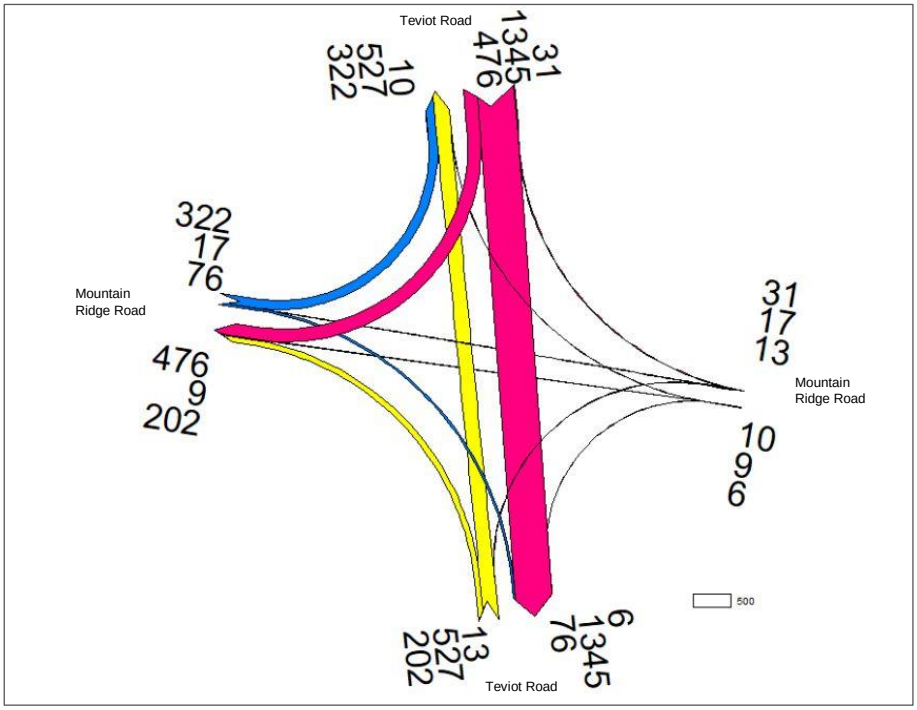


Figure 12: PM 1 hr - Mountain Ridge Road / Teviot Road

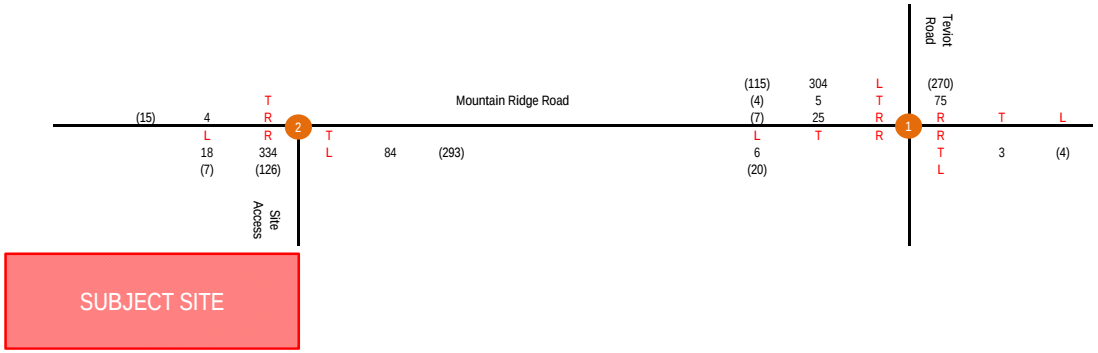


APPENDIX D

DESIGN SCENARIO VOLUMES

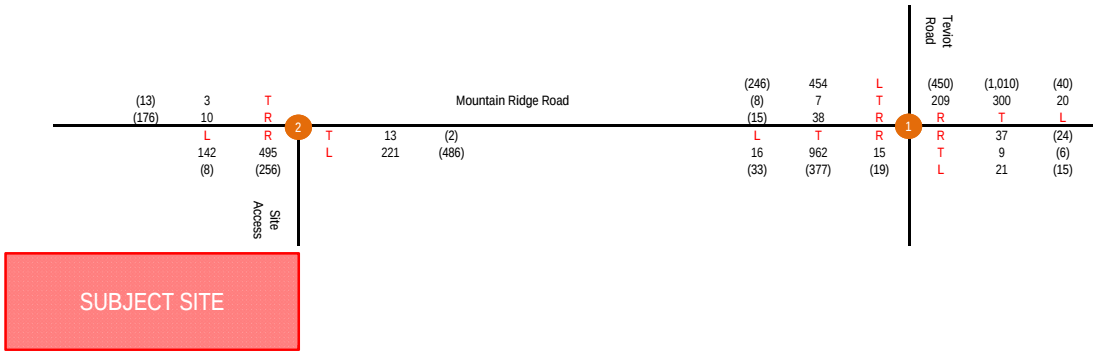
DEVELOPMENT GENERATION & TRAFFIC VOLUMES

DEVELOPMENT VOLUMES ONLY



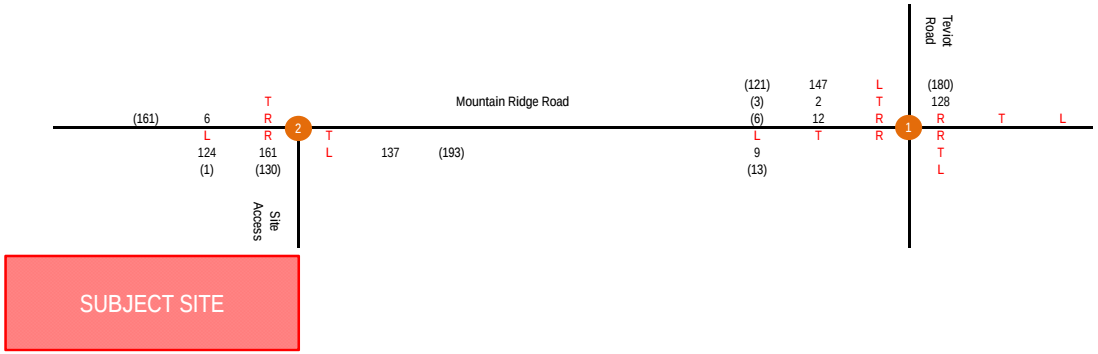
SUBJECT SITE

2031 GREATER FLAGSTONE STRATEGIC TRANSPORT MODEL (GFSTM) VOLUMES



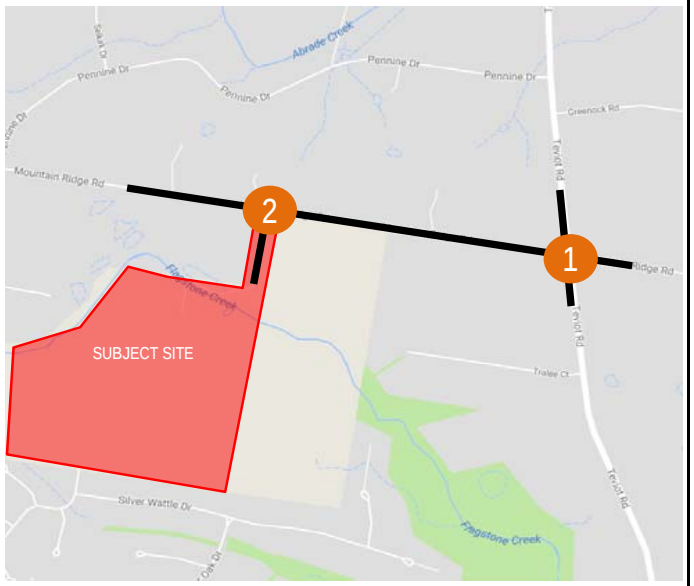
SUBJECT SITE

2031 ROSE ALMOND VOLUMES ONLY - FOR REASSIGNMENT



SUBJECT SITE

LOCALITY PLAN



SCENARIO: DEVELOPMENT GENERATION

	DEV VOLS		2031 GFSTM VOLS		2031 ROSE ALMOND	
	#1	#2	#1	#2	#1	#2
AM	418	440	2088	884	298	428
PM	(420)	(441)	(2,243)	(941)	(323)	(485)
TOTAL	838	881	4331	1825	621	913
TOTAL	1719		6156		1534	

DETAILS

Date of Traffic Surveys	21/03/2017	Background Year	2017
AM Peak	6:15-7:15am	Interim Year	2031
PM Peak	5:00-6:00pm	Ultimate Year	*Ultimate*

DOCUMENT CONTROL

Job Number:	P2895	Job Name:	Mountain Ridge Road, South Maclean
Prepared By:	Mark Davidson	Prepared Date:	22/03/2018
Reviewed By:	Luke Darragh	Reviewed Date:	22/03/2018
File Path:	C:\Users\Luke\Documents\Bitzios Consulting\P2895 MRR\Technical Work\		

LEGEND

##	AM Peak Period: 6:15-7:15am	T	Through Turn Movement
(##)	PM Peak Period: 5:00-6:00pm	R	Right Turn Movement
L	Left Turn Movement	1	Intersection ID

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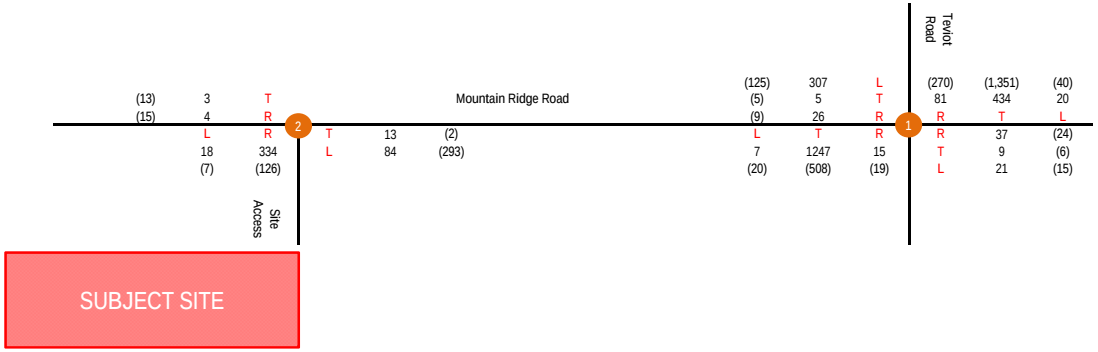
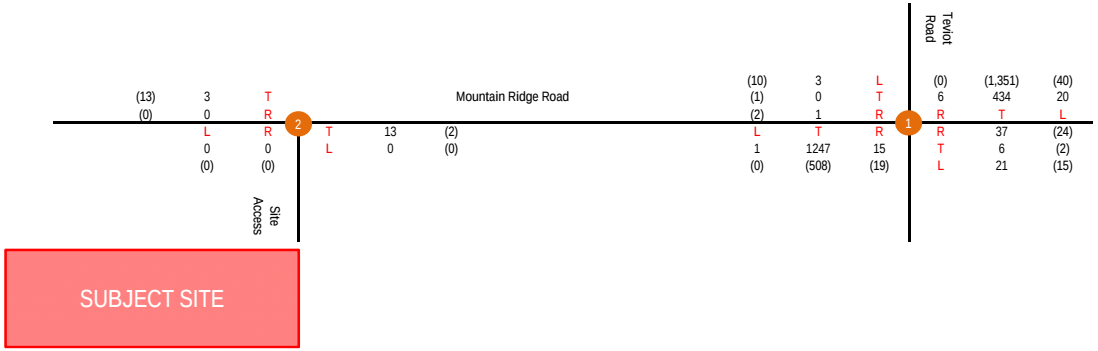
TRAFFIC DESIGN VOLUMES

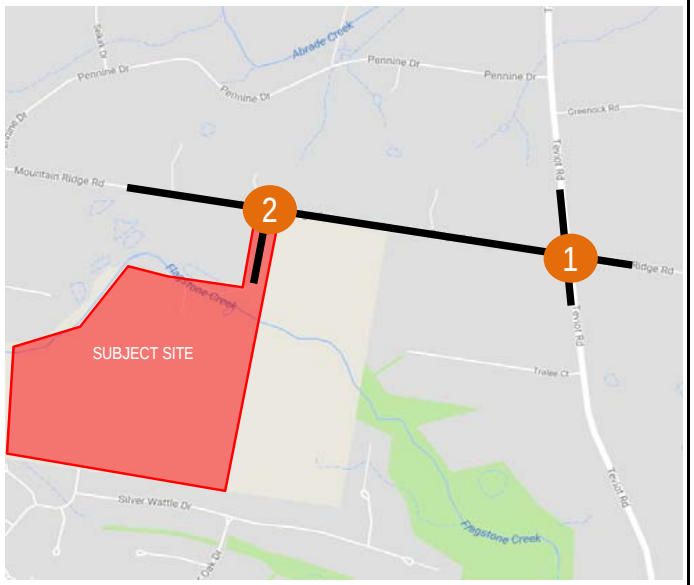
2031 VOLUMES (REASSIGNED) WITH DEVELOPMENT



2031 VOLUMES (REASSIGNED) WITHOUT DEVELOPMENT



LOCALITY PLAN



SCENARIO: DEVELOPMENT GENERATION

	2031 WITH DEV		2031 WITHOUT DEV			
	#1	#2	#1	#2		
AM	2209	456	1791	16		
PM	(2,392)	(456)	(1,972)	(15)		
TOTAL	4601	912	3763	31		
TOTAL	5513		3794			

DETAILS

Date of Traffic Surveys	21/03/2017	Background Year	2017
AM Peak	6:15-7:15am	Interim Year	2031
PM Peak	5:00-6:00pm	Ultimate Year	*Ultimate*

DOCUMENT CONTROL

Job Number:	P2895	**Job Name:**	Mountain Ridge Road, South Maclean
Prepared By:	Mark Davidson	Prepared Date:	22/03/2018
Reviewed By:	Luke Darragh	Reviewed Date:	22/03/2018
File Path:	C:\Users\Luke\Documents\Bitzios Consulting\P2895 MRR\Technical Work\		

LEGEND

##	AM Peak Period: 6:15-7:15am	T	Through Turn Movement
(##)	PM Peak Period: 5:00-6:00pm	R	Right Turn Movement
L	Left Turn Movement	1	Intersection ID

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APPENDIX E

ROAD SAFETY AUDIT – MOUNTAIN RIDGE ROAD

MOUNTAIN RIDGE ROAD

EXISTING CONDITIONS ROAD SAFETY AUDIT

FOR

MOUNTAIN RIDGE ROAD PTY LTD

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Project No: P2895 Version No: 001 Issue date: 25th August 2017

DOCUMENT CONTROL SHEET

Issue History

Report File Name	Prepared by	Reviewed by	Issued by	Date	Issued to
P2895.001R Mountain Ridge Rd Existing Conditions RSA Report	P. Bollavaram	S. Brooke	P. Bollavaram	25/08/2017	Matthew McLaren, sent via: mattmc@urbansolutions.net.au

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Tables

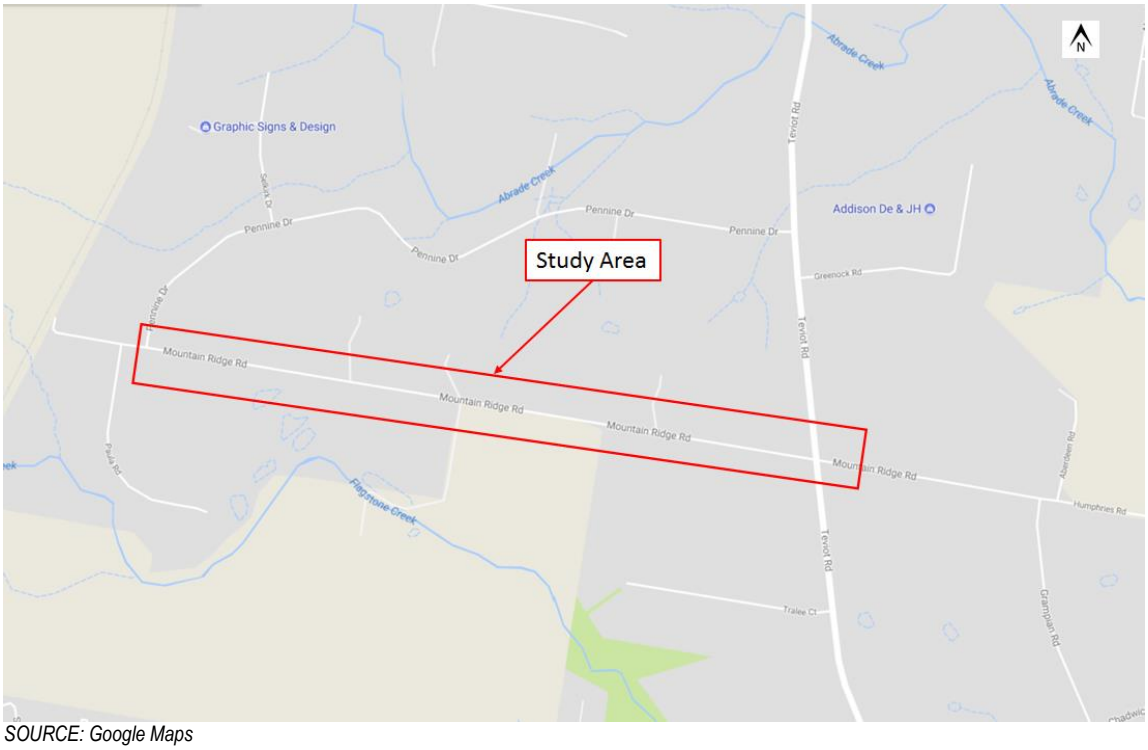
Figures

1. INTRODUCTION

1.1 BACKGROUND

Bitzios Consulting Pty Ltd (Bitzios) has been commissioned by Mountain Ridge Road Pty Ltd to undertake an Existing Conditions Road Safety Audit (RSA) for the section of Mountain Ridge Road between the intersections of Teviot Road / Mountain Ridge Road and Pennine Drive / Mountain Ridge Road.

The length of the study area is approximately 1.9km for which an overview is shown in Figure 1.1.



SOURCE: Google Maps

Figure 1.1: Study Area

1.2 SCOPE

The scope of work has involved the following:

- undertaking a day-time (light conditions) and night-time (dark conditions) site inspection;
- an existing conditions road safety review of Mountain Ridge Road between the intersections of Teviot Road / Mountain Ridge Road (Ch 0.00km) and Pennine Drive / Mountain Ridge Road (Ch. 1.91km);
- tabling a schedule of audit findings (issues) which presented a safety risk within the study area; and
- summarising the findings in a concise existing conditions RSA report.

The RSA was undertaken in accordance with the procedures set out within the *Austroads Guide to Road Safety – Part 6 Road Safety Audit* for existing roads, and the *RMS Guide to Road Safety Practices*. The audit involved undertaking an existing conditions RSA (as per the *Austroads Road Safety Audit Checklist 6*) for the study area highlighted in Figure 1.1.

1.3 LIMITATIONS FOR INTERPRETATION OF AUDIT RESULTS

Actions have been suggested for each of the issues primarily as a guide for the personnel responsible for selecting and implementing remedial measures. It is not intended to imply that the suggested actions are the only possible actions.

Furthermore, while the audit considers a range of items that were reviewed as part of the audit process, only the issues identified as presenting a safety risk have been raised and commented upon within this report.

2. ROAD SAFETY AUDIT PROCESS

2.1 DEFINITIONS

The *Austroads Guide to Road Safety* (2009) defines a road safety audit as:

"a formal examination of a future road or traffic project or an existing road, in which an independent, qualified team reports on the project's crash risk potential and safety performance."

The essential elements of this definition are that it is:

- a formal process and not an informal check;
- an independent process;
- carried out by someone with appropriate experience and training; and
- restricted to road safety issues.

The objectives of a road safety audit are:

- to identify potential safety problems for road users and others affected by a road project; and
- to ensure that measures to eliminate or reduce the problems are considered fully.

The benefits of conducting road safety audits are that the:

- likelihood of accidents on the road network can be reduced; and
- severity of accidents can be reduced.

The aim of the road safety audit is:

"to identify any existing safety deficiencies of design, layout and road furniture which are not consistent with the road's function or use. There should be consistency of standards such that the road users' perception of local conditions assists safe behaviour."

2.2 METHODOLOGY

The road safety audit was carried out as per the procedures set out in the *Austroads Guide to Road Safety* and in accordance with the *Austroads Road Safety Audit Checklist 6: Existing Roads: Road Safety Audit.* The minimum activities stipulated for an *Existing Road,* road safety audit include:

- assess the road and road related areas by inspecting the site during day and night conditions; and
- record all road safety deficiencies.

Items audited as part of the RSA included (but not limited to) the following:

- road geometry;
- road alignment (horizontal and vertical) and cross-section;
- sight distances;
- signs and pavement markings;
- roadside objects and hazards; and
- available crash history along the study area.

2.3 AUDIT TEAM

The road safety audit was carried out by an audit team comprising:

- Praveen Bollavaram – Senior Road Safety Auditor (Lead Auditor); and
- Steve Brooke – Senior Road Safety Auditor (Team Member).

2.4 INCEPTION MEETING

There was no formal inception meeting to pre-start the road safety review.

2.5 INFORMATION SOURCES

Data sources for the road safety audit included:

- aerial photography and ground level photography by *Google Maps* and *Google Earth*;
- crash data obtained from the Department of Transport and Main Roads (TMR) (2012-2016);
- RMS Guidelines for Road Safety Practices; and
- Austroads Road Safety Audit Publication.

2.6 SITE INSPECTION

Both day and night time site inspections were carried out as part of the existing conditions RSA. The site inspection was undertaken on Tuesday 8th August 2017 between 3pm-7pm to gain an appreciation of the existing conditions and terrain, and to identify deficiencies along the study area that need to be addressed. The weather conditions on the day were fine with good visibility.

2.7 AUDIT HISTORY

The audit team was not aware of any previous audit that had been undertaken for the study area.

2.8 TRAFFIC VOLUMES

Traffic surveys were undertaken by Traffic Data & Control (TDC) on 9th August 2017 at the Teviot Road / Mountain Ridge Road intersection. The AM and PM peak 1-hour traffic volumes on Mountain Ridge Road are 25veh/h and 30veh/h respectively (average of approximately 27.5veh/h).

This equates to an estimated daily traffic volume on Mountain Ridge Road of approximately 275veh/d (considering peak hour volumes representing 10% of daily volumes as per typical industry practice).

2.9 CRASH HISTORY

Crash data obtained for a five year period (i.e. 2012 to 2016) for the study area – including the intersection of Teviot Road / Mountain Ridge Road intersection – was provided by TMR.

During this period, a single crash was recorded (DCA 202) at Teviot Road / Mountain Ridge Road intersection which involved vehicles from opposite approaches (Thru-Right). The intersection has since been upgraded (circa. early 2017) which included; dedicated turn pockets on Teviot Road and slip lanes from the side streets (separating through movements and providing better protection for turning traffic), and indented bus stop provisions either side of the intersection on Teviot Road.

Figure 2.1 shows an aerial image of the upgraded intersection layout.

SOURCE: Nearmap

Figure 2.1: Teviot Road / Mountain Ridge Road Upgraded Intersection

3. KEY AUDIT FINDINGS

The following section summarises the safety issues identified during the audit of the existing road section and presents the suggested remedial measures to address the identified issues. The key audit findings are outlined below, followed by a table of specific issues (Table 3.1).

The key safety issues identified are summarised as follows:

- loose gravel on road surface;
- absence of line marking and uneven road surface;
- a number of hazards within the clear zone (ditches / power poles / culverts); and
- insufficient shoulder / road width at a number of locations along Mountain Ridge Road.

3.1 CLEAR ZONE REQUIREMENTS

The posted speed limit on Mountain Ridge Road is 60km/h (i.e. a design speed of 70km/h) and TMR's *Road Planning and Design Manual* (RPDM) specifies a clear zone distance requirement of 2m for average daily traffic (ADT) under 750 veh/d, as shown in Figure 3.1 below.

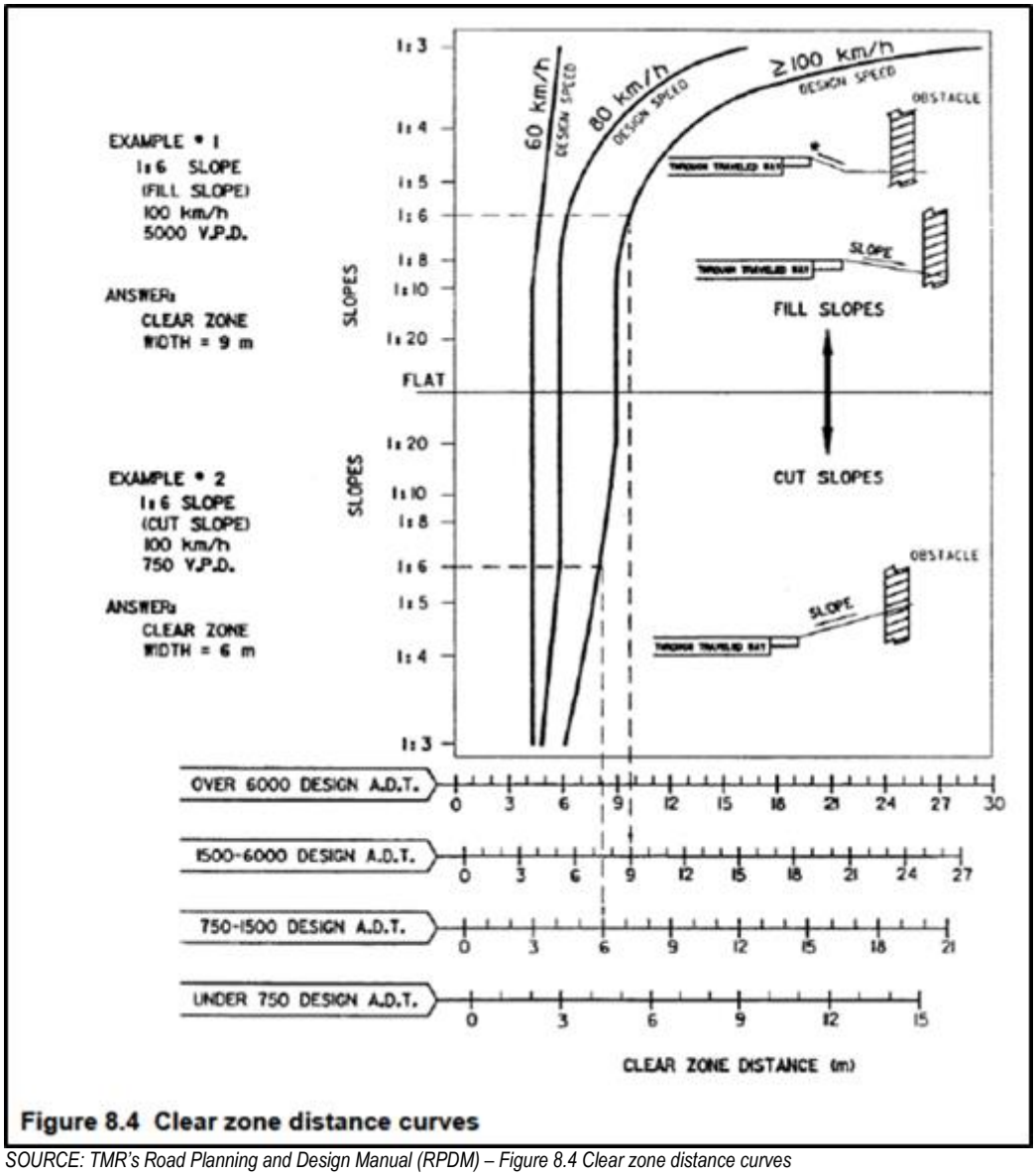


Figure 8.4 Clear zone distance curves

SOURCE: TMR's Road Planning and Design Manual (RPDM) – Figure 8.4 Clear zone distance curves

Figure 3.1: Clear Zone Requirements

3.2 AUDIT FINDINGS

Table 3.1 details the key safety issues identified during the audit of the existing road section, together with suggested treatments. The locations of these issues are shown in Figure 3.2 to Figure 3.5.

The below figures should be referenced when reviewing Table 3.1.

SOURCE: Google Earth and Qld Globe

Figure 3.2: Issues Location Reference (1 of 4)

SOURCE: Google Earth and Qld Globe

Figure 3.3: Issues Location Reference (2 of 4)

SOURCE: Google Earth and Qld Globe

Figure 3.4: Issues Location Reference (3 of 4)

SOURCE: Google Earth and Qld Globe

Figure 3.5: Issues Location Reference (4 of 4)

Table 3.1: Road Safety Audit Findings and Suggested Treatments

Item	Locality / Chainage	Issues	Site Illustration	Recommendation
1	1,845	The '60km/h' speed restriction signage is faded.		Replace the faded sign.
2	1,845	Uneven road surface which can be a hazard for motorbike drivers to veer off the road. It appears that newly added road section (approximately 1.2m to 1.6m) on either side does not tie in neatly with the existing road.		Ensure the road surface is smooth to improve safety and driveability.

Item	Locality / Chainage	Issues	Site Illustration	Recommendation
3	1,754	A power pole is located within the clear zone on Mountain Ridge Road.		Install a hazard marker in the short term and consider relocating the pole from its current location to improve safety in the future should traffic volumes increase.
4	1,754	Uneven / damaged road surface on Mountain Ridge Road.		Repair the damaged road section to improve safety.

Item	Locality / Chainage	Issues	Site Illustration	Recommendation
5	1,692	A power pole is located within the clear zone on Mountain Ridge Road.		Install a hazard marker in the short term and consider relocating the pole from its current location to improve safety in the future should traffic volumes increase.
6	1,692	Uneven / undulating road surface on Mountain Ridge Road can be a potential hazard for motorbike drivers to veer off the road.		Consider providing a smooth road surface along this section of Mountain Ridge Road to improve safety and driveability.

Item	Locality / Chainage	Issues	Site Illustration	Recommendation
7	1,556	Unprotected ditch / box culvert is located within the clear zone.		A guide post exists, however consider providing additional protection i.e. guardrail / barrier as a long-term treatment to protect errant vehicles that may leave the road.
8	900	Unprotected ditch / box culvert is located within the clear zone.		A guide post exists, however consider providing additional protection i.e. guardrail / barrier as a long-term treatment to protect errant vehicles that may leave the road.

Item	Locality / Chainage	Issues	Site Illustration	Recommendation
9	0.0 - 1.91km	Absence of dedicated footpaths for pedestrians. Pedestrians were observed walking on the road / shoulders which is considered unsafe.		Consider providing a dedicated footpath for pedestrian safety on Mountain Ridge Road.
10	0.0 - 1.91km	Absence of dedicated bus bays for school buses on Mountain Ridge Road. Cars travelling behind the school bus will be required to either stop behind the bus, or alternatively attempt to pass (overtake) the stopped vehicle.		Consider providing a dedicated bus stopping bay to improve safety.

Item	Locality / Chainage	Issues	Site Illustration	Recommendation
11	0.0 - 1.91km	Numerous timber power poles are located within the clear zone.		Install a hazard marker in the short term and consider relocating the pole from its current location to improve safety in the future should traffic volumes increase.
12	0.0 - 1.91km	Absence of any line markings (i.e. edge line, centre line etc) on Mountain Ridge Road within the study area.		It is recommended to install edge lines due to the presence of hazards within the clear zone along this section of Mountain Ridge Road.
13	0.0 - 1.91km	Absence of speed restriction signage in the study area to reinforce the speed limit, as vehicles were observed travelling in excess of the speed limit. A "60" speed restriction sign currently exists in the westbound direction immediately west of Teviot Road / Mountain Ridge Road intersection, and east of Pennine Drive / Mountain Ridge Road intersection in the eastbound direction.	n/a	Consider installing additional speed restriction signage to reinforce the existing speed limit along the corridor in accordance with the *Manual of Uniform Traffic Control Devices* (MUTCD).

<table>
<tr><th>Item</th><th>Locality / Chainage</th><th>Issues</th><th>Site Illustration</th><th>Recommendation</th></tr>
<tr><td>14</td><td>0.0 - 1.91km</td><td>No street lighting was observed on Mountain Ridge Road within the study area.</td><td>n/a</td><td>Consider providing street lighting along this section.</td></tr>
<tr><td>15</td><td>0.0 - 1.91km</td><td>Road width varies between 5.8m–6.1m along Mountain Ridge Road which is less than the minimum width requirement of 6.2m as specified in Table 4.5 of the Austroads Guide to Road Design Part 3 (Single Carriageway Rural Road Widths). The AADT on Mountain Ridge Road based on 2017 traffic surveys is 275veh/d (i.e. between 150-500veh/d.</td><td>Table 4.5: Single carriageway rural road widths (m)
<table><tr><th rowspan="2">Element</th><th colspan="5">Design AADT</th></tr><tr><th>1 – 150</th><th>150 – 500</th><th>500 – 1,000</th><th>1,000 – 3,000</th><th>> 3,000</th></tr><tr><td>Traffic lanes(1)</td><td>3.7
(1 x 3.7)</td><td>6.2
(2 x 3.1)</td><td>6.2 – 7.0
(2 x 3.1/3.5)</td><td>7.0
(2 x 3.5)</td><td>7.0
(2 x 3.5)</td></tr><tr><td>Total shoulder</td><td>2.5</td><td>1.5</td><td>1.5</td><td>2.0</td><td>2.5</td></tr><tr><td>Minimum shoulder seal (2),(3),(4),(5),(6)</td><td>0</td><td>0.5</td><td>0.5</td><td>1.0</td><td>1.5</td></tr><tr><td>Total carriageway</td><td>8.7</td><td>9.2</td><td>9.2 – 10.0</td><td>11.0</td><td>12.0</td></tr></table></td><td>Consider providing a 6.2m wide road, with a minimum of 0.5m wide sealed shoulder in accordance with the Austroads Guide to Road Design Part 3.</td></tr>
<tr><td>16</td><td>0.0 - 1.91km</td><td>A number of unprotected culverts / ditches and substandard head walls are located within the clear zone on Mountain Ridge Road.</td><td>n/a</td><td>Upgrade the substandard headwalls to sloping type headwalls to improve safety. Consider installing guardrail as a long-term solution.</td></tr>
</table>

4. CONCLUSION

This audit has recognised the potential safety issues for road users and others and has suggested improvements to eliminate or reduce these issues. Through the introduction of the recommendation outlined in this report, the possibility of crashes should reduce but this is also dependent on the awareness of the road user in their environment.

Praveen Bollavaram, Level 3 Road Safety Auditor (Lead Auditor)

Steve Brooke, Level 2 Senior Road Safety Auditor (Team member)

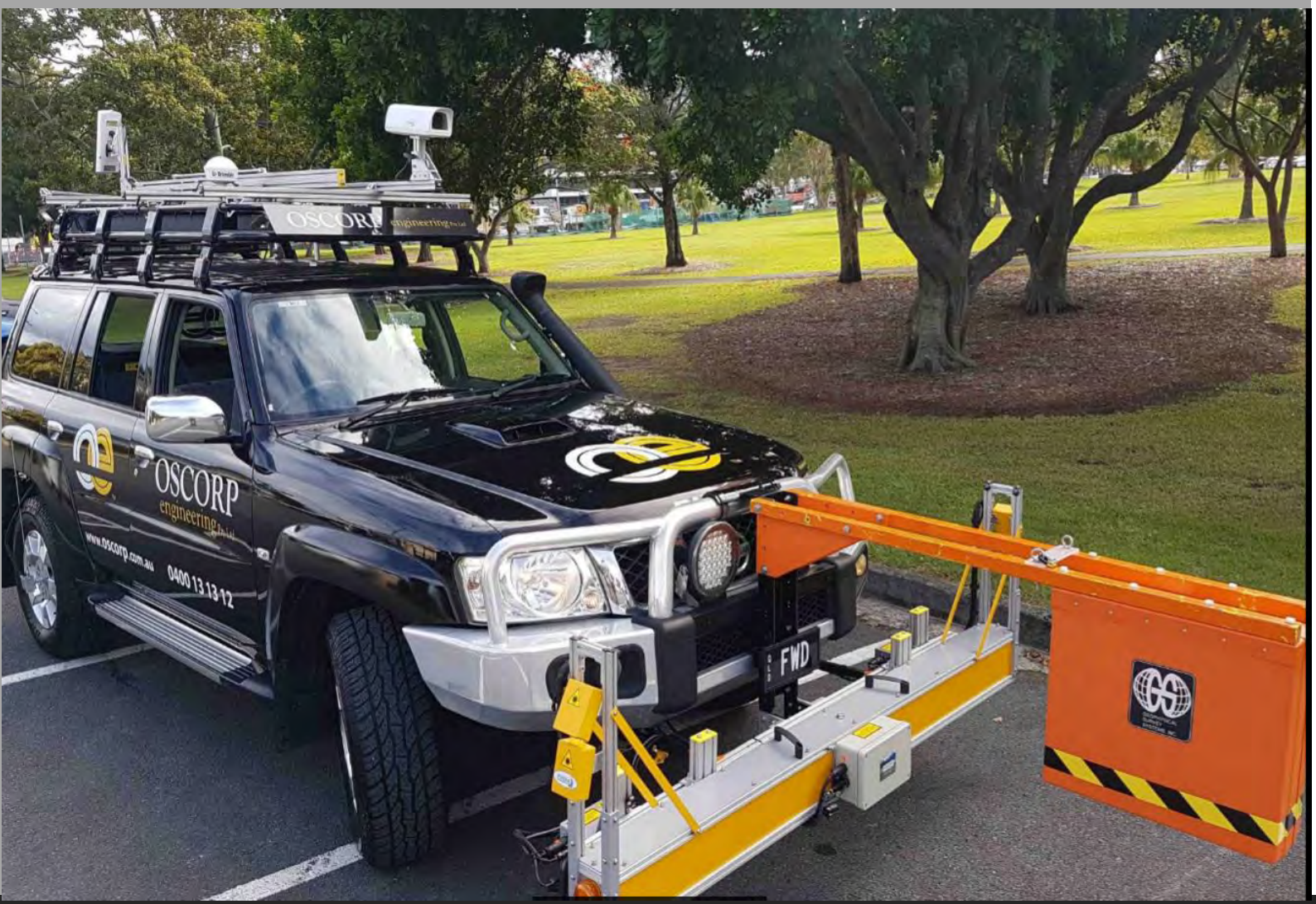
APPENDIX F

PAVEMENT STRUCTURAL ASSESSMENT REPORT

Mountain Ridge Road – South MacLean
Teviot Road – No. 29301

Pavement Structural Assessment

Prepared for: Mountain Ridge Road Pty Ltd
[September 2017] (Oscorp Ref: MUS01-17)



DOCUMENT/REPORT CONTROL FORM

Project Name:	Mountain Ridge Road, South Mclean
Project Number:	Visual Pavement Inspection
Revision Number:	MUSO1-7

Revision History

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
01	15/09/2017	O. Mood		

Issue Register

Distribution List	Date Issued	Number of Copies
Mountain Ridge Road Pty Ltd	20/09/2017	1
Oscorp Project File	20/09/2017	1

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The client should be made aware that soil conditions can change dramatically over short distances and therefore even careful exploration programmes may not locate all variations. The soil profile may therefore vary from the bore logs on occasion. If the soil conditions encountered during construction vary from those referred to in this report, then Oscorp should be immediately contacted and asked to review the impact on the proposed design solution.

The findings contained in this report refer solely to pavement structural evaluation and attention is drawn to the need to verify the design assumptions contained in this report in the detailed pavement design and construction phases to ensure the design intent has been satisfied with regard to RPEQ sign off of pavement related works. Particular attention is drawn to verifying the subgrade CBR, complying with material specifications and achieving the specified construction standards (e.g. compaction levels) in all pavement and earthworks layers.

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Abbreviations and Acronyms

Abbreviation	Description
AADT	Annual Average Daily Traffic
AC	Asphaltic Concrete (Dense Graded Asphalt)
AGTP	Austroads Guide to Pavement Technology
ALD	Average Least Dimension
ARMIS	Automated Reporting Management Information System
CBR	California Bearing Ratio
CGF	Cumulative Growth Factor
CL	Centre Line
DCP	Dynamic Cone Penetrometer
DESA	Design Equivalent Standard Axles
DF	Directional Factor
DTL	Design Traffic Loading
ESA	Equivalent Standard Axle
%HV	Percentage of Heavy Vehicles
HVAG	Heavy Vehicle Axle Groups
HVOS	Heavy Vehicle Operating Speed
LDF	Lane Distribution Factor
MRTS	Main Roads Technical Specification
N_{HVAG}	Average Number of Heavy Vehicle Axle Groups
OWP	Outer Wheel Path
PDM	DTMR's Pavement Design Manual (2012)
PDS	DTMR's Pavement Design Supplement (2013)
PRM	Pavement Rehabilitation Manual
PI	Plasticity Index
RPEQ	Registered Professional Engineer Queensland
SAR	Standard Axle Repetitions
TARS	Traffic And Reporting System
DTMR	Department of Transport & Main Roads
WIM	Weigh in Motion
WMAPT	Weighted Mean Annual Pavement Temperature

1 EXECUTIVE SUMMARY

Mountain Ridge Pty Ltd commissioned Oscorp Engineering Pty Ltd (Oscorp) to undertake detailed pavement structural investigation, testing and assessment for the subject section of Mountain Ridge Road, South Maclean between Teviot Road and No 29301 with a total length of approximately 1.0Km. The scope of the works is in accordance with the Client requested scope of works and any associated variations

Mountain Ridge Road is currently a rural residential road in South Maclean and provides access to large rural catchment area. The road has a relatively mild to flat longitudinal grade and is located in a relatively high ground area.

The pavement investigation components include:

- Visual pavement condition assessment
- FWD deflection testing of inner and outer wheel paths at 20m intervals with a 40 kN plate load
- Statistical analysis of FWD deflections
- Ground Penetration Radar testing (GPR)
- Field intrusive pavement investigation including the drilling of six boreholes to 1.2 m target depth below surface level, logging of existing pavement profile, sampling of pavement and subgrade materials for laboratory testing and DCP tests through fill and subgrade materials beneath existing pavement layers (to be agreed with the Client)
- From visual condition assessment, FWD deflection analysis output, pavement logs, DCP test results and laboratory test results, the structural pavement condition are evaluated
- Traffic Modelling in terms the determination of the number Equivalent Standard Axles (ESA's), FWD deflection testing, statistical analysis and back calculation of layer moduli
- Geotechnical and field intrusive pavement investigation

Design parameters have been selected with due consideration to the past and existing pavement performance, DTMR Pavement Design & Rehabilitation Manuals as well as Austroads Pavement Design and Rehabilitation Guidelines (in that order of preference).

Following the assessments of pavement condition, background and development traffic modelling, Non-destructive pavement testing (GPR and FWD), Geotechnical testing and Pavement modelling, it is evident that the exiting pavement is in a satisfactory performing condition for existing background traffic and it is very likely that the pavement will continue to perform well for the next three years subject to the following.

- Undertaking adequate preventative/reactive maintenance and as required
- Maintain and improve effective surface drainage
- Undertake six monthly visual inspections by a duly qualified RPEQ Engineer
- Undertake annual FWD testing to monitor pavement deflection deterioration

As part of ongoing monitoring, Oscorp Engineering suggests the following way forward.

- Continue to use this section of Mountain Ridge Road during incremental future development stages
- Undertake six monthly visual inspection programs by a duly qualified RPEQ pavement Engineer
- Monitor and undertake adequate preventative/reactive maintenance and as required
- Maintain/improve effective surface drainage
- Undertake annual FWD testing to monitor pavement deflections

2 STANDARDS, GUIDLIENES & PROVIDED INFORMATION

The following design manuals and guidelines have been referenced in this report:

- Department of Transport and Main Roads: Pavement Design Supplement – Supplement to Austroads Guide to Pavement Technology: Structural Design, 2013
- Department of Transport and Main Roads: Pavement Rehabilitation Manual, 2012
- Austroads: Guide to Pavement Technology – Part 2: Pavement Structural Design, 2012
- Brisbane City Council Pavement Rehabilitation Manual 2011

Any variations to the above documents were clarified and agreed with Client through consultation at site meetings.

In addition to the above, the Client has provided the following information:

- Client Brief
- Scope variations
- Various email correspondence from relating to the scope of works
- Design drawings
- Traffic surveys

2.1 Design Documentation

The scope is limited to the information available at the date this report was compiled. This package consists of the following design documentation:

- This report
- Appendix A - Design Traffic Loading Calculations
- Appendix B - FWD Test Report
- Appendix C - GPR Testing
- Appendix D- Geotechnical Investigations

2.2 Reference Documents

This design report should be read in conjunction with the reference documents detailed below:

- supplied concept drawings
- Project Specifications
- Oscorp Engineering Pty Ltd Visual Assessment Report, Rev 1 date 10th August 2017

Any variations to the above documents were clarified and agreed with the Client representative.

2.3 Design Performance Criteria

The performance criteria and technical details proposed for the production of the final pavement and rehabilitation designs are detailed in Table 2.1 below:

Table 2.1 – Design Parameters for Calculation of Pavement Design Traffic

Design Parameter	Value/Reference	
Design Life	20-year design life (Client Scope)	
AADT's and Direction Factors	SMEC PMS LDG	
% HV and Growth		
Lane Distribution	1.0	AGPT Part 2: Structural Pavement Design (2012)
NHVAG/HV	2.5	AGPT Part 2: Structural Pavement Design (2008)
ESA/NHVAG	0.9	

Table 2.2- Asphalt Material Properties at 32 °C Proposed for Detailed Design

Pavement Layer		V_B (%)	Poisson's Ratio	Modulus (MPa)	Performance Exponent (k)
Multigrade Asphalt	AC14H (MG)	11	0.4	3468	17,800

Table 2.3 - All Other Material Properties Adopted for Detailed Design

Pavement Layer	Shear Stress (f)	Modulus (MPa)	Poisson's Ratio	Elastic Model	Sub-layering Scheme
Cementitious Improved Layer	155.56	210	0.35	Anisotropic	Austroads 2004
Cement Modified Base (CMB)/CTB Post Cracking	444	600	0.35	Anisotropic	Austroads 2004
High Standard Gravel (HSG)	370	500	0.35	Anisotropic	Austroads 2004
Unbound Granular DTMR 2.1	260	350	0.35	Anisotropic	Austroads 2004
Unbound Granular DTMR 2.4	111	150	0.35	Anisotropic	Austroads 2004
Subgrade	As per soil tests	As per soil tests	0.45	Anisotropic	-

2.4 Assumptions

This report refers specifically to the designs in accordance with the agreed approach and DTMR current engineering standards and construction practices.

The common assumptions used throughout the design process are summarised in Table 2.4. Where assumptions are made that vary to those given, these are stated within the design notes.

Table 2.4 - Risks, Assumptions and Unknowns

Variable	Design Assumption
Heavy Vehicle Operating Speed for Pavement Design Purposes	Intersections: 10 km/hr Through Lanes: 30 km/hr
Design Reliability Factor	90% (DTMR PDS 2013)
Design Construction Tolerance	+ 20mm where Cement Modified Base (CMB)/Granular pavement are the critical layers
WMAPT	32^{o}C
SAR_A/ESA	1.1
SAR_{SUB}/ESA	1.6
Subgrade CBR	Derived from either geotechnical investigations or back calculation of layers moduli using DAPS back calculation software

3 BACKGROUND AND SCOPE

3.1 Background

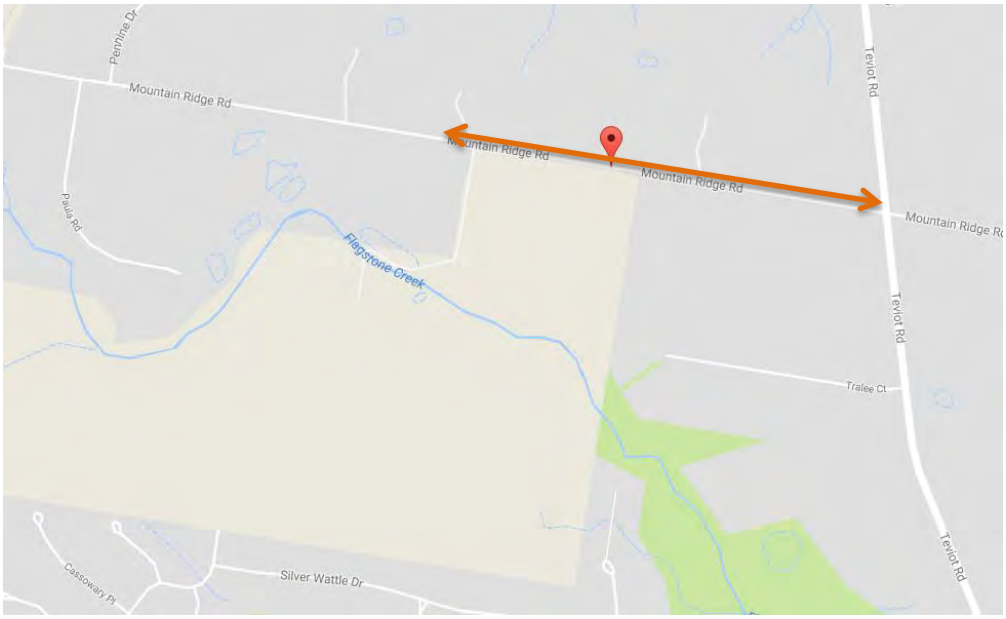
Mountain Ridge Pty Ltd commissioned Oscorp Engineering Pty Ltd (Oscorp) to undertake detailed structural pavement investigation testing and assessment for the subject section of Mountain Ridge Road in South Maclean. The scope of the works is in accordance with the Client Brief and any associated contract variations

This report is intended to assist in making an informed decision on the pavement structural capacity and residual life in accordance with the Client requirements, with due recognition of the contract brief assumptions made during investigations and identified risks associated with those assumptions. A selection of proposed pavement treatment option is presented where appropriate.

This report is for the structural pavement investigation, testing and assessment for the subject section of Mountain Ridge Road between Teviot Road and No 29301 with a total length of approximately 1.0Km. Mountain Ridge Road (refer figure 3.1) is currently a rural residential road in South Maclean and provides access to large rural catchment area. The road has a relatively mild to flat longitudinal grade and is located in a relatively high ground area.

Visually the pavement appears to consist of unbound granular base with a thin spray seal surfacing. The pavement along the subject section of the road appears to be recently widened along both sides of the road. At the time of inspection, the pavement is maintaining its shape and serviceability with minimal surface failures and no pavement failures.

Figure 3.1 – Mountain Ridge Road, South Maclean locality map



It is assumed that this road section was initially built to a local standard, incorporating practices considered reasonable at the time, which may not meet current standards.

3.2 Scope

Oscorp has been commissioned to undertake a pavement testing, investigation and structural assessment design to determine the existing pavement structural condition and residual life for the nominated 1Km section of Mountain Ridge Road. When providing this technical advice, due consideration has been given to the nature of the road section, its current and future functional classes and traffic hierarchies.

The pavement investigation field and laboratory components undertaken include:

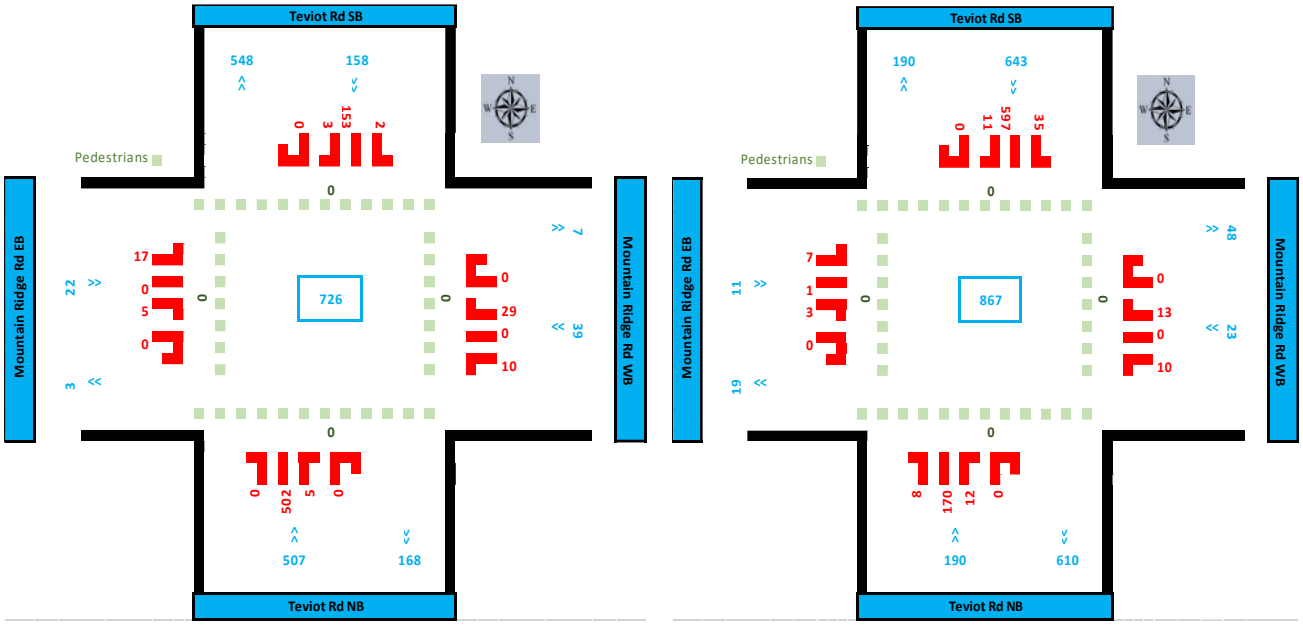
- Visual pavement condition assessment of this section of Mountain Ridge Road to identify prevailing distress types, distress degree of severity and extent. The identification of the most probable causes of distress and the overall drainage condition of the pavement were important components of the visual pavement condition assessment
- FWD deflections undertaken on both inner and outer wheel paths of each lane at 10m intervals with a 40 kN plate load
- Statistical analysis of FWD deflections, delineation of pavement homogeneous sections, selection of representative deflection bowls and selection of borehole locations (as agreed with CoGC)
- Ground Penetration Radar testing (GPR) and Back calculation of layer moduli
- Field intrusive pavement investigation including the drilling of boreholes to 1.0 m target depth below surface level, logging of existing pavement profile, sampling of pavement and subgrade materials for laboratory testing and DCP tests through fill and subgrade materials beneath existing pavement layers
- From visual condition assessment, FWD deflection analysis output, pavement logs, DCP test results and laboratory test results, sections the existing pavement structural capacity and residual life is estimated.

4 DEVELOPMENT TRAFFIC MODELLING

Traffic counts were undertaken by Traffic Data and Control Pty Ltd on 9th August 2017 at the intersection of Teviot and Mountain Ridge Roads as per Figure 4.1 below and between the peak hours of 06:00-09:00AM and 15:00-18:00PM.

Figure 4.1 –Mountain Ridge Road traffic survey

Figure 4.2 –Mountain Ridge Peak Hours Traffic Surveys



4.1 Calculated Design Traffic Loading

A summary of the variables adopted and the design traffic loading is detailed in Table 4.1. Appendix A includes the complete design traffic calculations for the abovementioned sections of pavement associated with this project.

Table 4.1- 10-Years Design Traffic Loading Variables

Variable	Nominated Value	Source
AADT 2017 AADT in 2027	275 4388	Estimated Background traffic Estimated Develepment Traffic
Design Reliability	90%	DTMR PDS
Growth Rate	Incremental and as per development traffic projections e.g. Table 4.2	
N_{HVAG}	2.8	AGPT – Part 2: Pavement Structural Design (2009)
% Heavy Vehicles	Incremental and as per development traffic projections e.g. Table 4.2	
10 Years Design Traffic Loading	1.67 x 10^6 ESA's and as per Table 4.2 traffic projection and modelling	

Table 4.2- 10-Years Design Traffic Life

Year	Background AADT	Development Year	Stage	Lots	Constructed Lots	AADT Per Lot	Development AADT	Construction AADT		AADT					ESA's per Annum
								LV	HV	BG LV (%)	LV (Vol)	BG HV (%)	HV (Vol)	TOTAL	
2017	275	0	0	0	0	6.75	0		0	96.4%	265	3.6%	10	275	11,242
2018	282	1	2	107	107	6.75	0	321	64	96.4%	593	3.6%	74	667	83,191
2019	289	2	4	93	200	6.75	722	279	56	96.4%	1253	3.6%	93	1346	104,551
2020	296	3	6	90	290	6.75	1350	270	54	96.4%	1856	3.6%	114	1970	128,159
2021	304	4	8	90	380	6.75	1958	270	54	96.4%	2450	3.6%	136	2586	152,891
2022	311	5	10	90	470	6.75	2565	270	54	96.4%	3041	3.6%	159	3200	178,748
2023	319	6	12	90	560	6.75	3173	270	54	96.4%	3635	3.6%	181	3816	203,480
2024	327	7	14	90	650	6.75	3780	270	54	96.4%	4228	3.6%	203	4431	228,213
2025	335	8	16	0	650	6.75	4388			96.4%	4551	3.6%	172	4723	193,362
2026	343	9	18	0	650	6.75	4388			96.4%	4559	3.6%	172	4731	193,362
2027	352	10	20	0	650	6.75	4388			96.4%	4568	3.6%	172	4740	193,362
														10 Years Total ESA's	1.67E+06

AADT Av. Annual Daily Traffic
LV Light Vehicles
HV Heavy Vehicles
BG Background
ESA Equivalent Standard Axels
Note, ESA/HVAG =1.1, NHVAG 2.8 for rural roads

It is recommended to adopt a traffic design of 1.67x106 ESA's for pavement structural modelling.

5 HISTORICAL DATA

5.1 Logan City Council

At the time of writing this report and for the subject section of Mountain Ridge Road, no pavement construction data was available from Logan City Council (LCC). However, a recent discussion with a LCC road asset engineer asset indicated that this section of Mountain Ridge Road is performing in satisfactory condition under existing traffic conditions and the subgrade is relatively strong in dry conditions and weak in wet conditions.

It was highlighted and confirmed by LCC that the road was widened along both sides to a depth of approximately 200mm. The materials used in the widening process was bitumen emulsion stabilised recycled gravel at a rate of 1.0% which was sprayed and bladed onsite.

The feedback from the construction team indicated that a rock subgrade was encountered on site in many locations especially near the western job end limit (e.g. near the development western boundary).

5.2 Visual Pavement Assessment

Oscorp Engineers carried out a visual site inspection to assess the overall pavement condition.

This section of Mountain Ridge Road is currently a minor rural residential road with one lane in each direction.

This section of Mountain Ridge Road is currently characterised by a 2-coat spray seal and unbound granular construction. Visually, the road pavement appears to be widened along both sides to provide minimum/safe road formation (refer to Figures 2 and 3).

Figure 5.1- Typical Pavement Profile, looking towards Teviot Road

Figure 5.2 - Typical Pavement Profile, note the widening along both sides, looking towards Teviot Road

From site inspection, this section of Mountain Ridge Road has adequate cross fall drainage, with limited efficient table drains, however shoulders and vegetation are reasonably maintained and will continue to perform reasonably well with adequate preventive maintenance. This is typical for a rural standard road and is in keeping with acceptable design standards for the function of the road.

Pavement failures are minimum, however the

The condition of the pavement along the subject sections of Mountain Ridge Road was based on a visual assessment carried out by Oscorp Engineers is described below.

- Visually, the original exiting pavement age appears to be over 12 years old
- Pavement widenings along both sides of the road are estimated to be 2 years old
- The existing spray seal surface is approaching the end of its functional life in some parts
- There is no evidence of pavement failures whilst surface failures are minimal
- Due to the widenings along both sides of the road, the pavement is exhibiting minor cross fall variations combined with localised depressions along the interface of original pavement and widening areas.

Based solely on visual inspection, the pavement is performing adequately with no pavement structural defects. The existing localised surface distresses are thought to be due to a combination of reasons including:

- Age hardening of the existing surfacing
- Inadequate maintenance
- Moisture ingress through various mechanisms

6 PAVEMENT INVESTIGATION

6.1 Evaluation of Pavement Strength

6.1.1 Falling Weight Deflectometer (FWD) Testing

FWD testing was undertaken by Oscorp on Mountain Ridge Road in August 2017. The results of FWD testing are presented in **Appendix B**. FWD testing was undertaken as per the following:

- FWD drop spacing 10m
- FWD drop load of 40 KN
- North and Southbound Inner and outer wheel paths

6.1.2 Surface Deflection

The surface deflection of a flexible pavement under an applied load is a good indicator of its structural condition.

The FWD testing was performed with a target load of 40kN being applied to the pavement, which represents a contact stress of approximately 566kPa.

6.1.3 Homogeneous Sections

FWD deflection analysis was undertaken to identify homogeneous pavement performing sections for each road section that was tested. This task was completed for variables including maximum deflections, curvature functions and deflection ratios.

6.1.4 Deflection Correction Factors

6.1.4.1 Moisture Correction

If possible, deflection testing should be undertaken when the subgrade is in its weakest condition. In this case, deflection testing was undertaken during August 2017 and hence a moisture correction factor does not need to be applied to the measured deflections to "simulate" the weakest condition and therefore is not warranted.

6.1.4.2 Temperature Adjustment

Variations in temperature can cause significant changes in the stiffness of flexible pavements containing asphalt and the measured pavement deflection.

The average working temperature is referred to as the Weighted Mean Annual Pavement Temperature (WMAPT). With reference to Section 4, the adopted WMAPT value was 32ºC.

The deflection test results [Maximum Deflection (Do) and the Curvature Function, (CF)] are multiplied by adjustment factors to correct for the difference between the measured field temperatures and the WMAPT for the Gold Coast region. The representative adjustment factors are determined using DTMR Pavement Rehabilitation Manual Figure 2.18 for the maximum deflection and Figure 2.19 for the curvature function as per. In this instance, as the existing surfacing is spray seal, temperature adjustments are not considered warranted.

6.1.5 FWD Deflection Summary Results

In the analysis of FWD test results, particular deflection parameters provide useful technical information as follows:

6.1.5.1 Maximum Deflection

The maximum deflection gives an indication of the overall pavement performance and is influenced by the pavement thickness and is closely related to the vertical compressive strain at subgrade level.

6.1.5.2 Curvature Function

The shape (curvature) of the deflection bowl may be used to estimate the likelihood of fatigue cracking of an asphalt layer. The Curvature Function is mainly influenced by the base course stiffness and it is closely related to strain in the asphalt. High values of the curvature function may indicate a pavement lacking stiffness, a very thin pavement, a pavement with a cracked stabilised base or a pavement with a cracked asphalt surface. Low values of the curvature function indicate a stiff pavement.

6.1.5.3 Deflection Ratio:

May be used to differentiate sections of road on the basis of the pavement being bound, unbound or excessively weak.

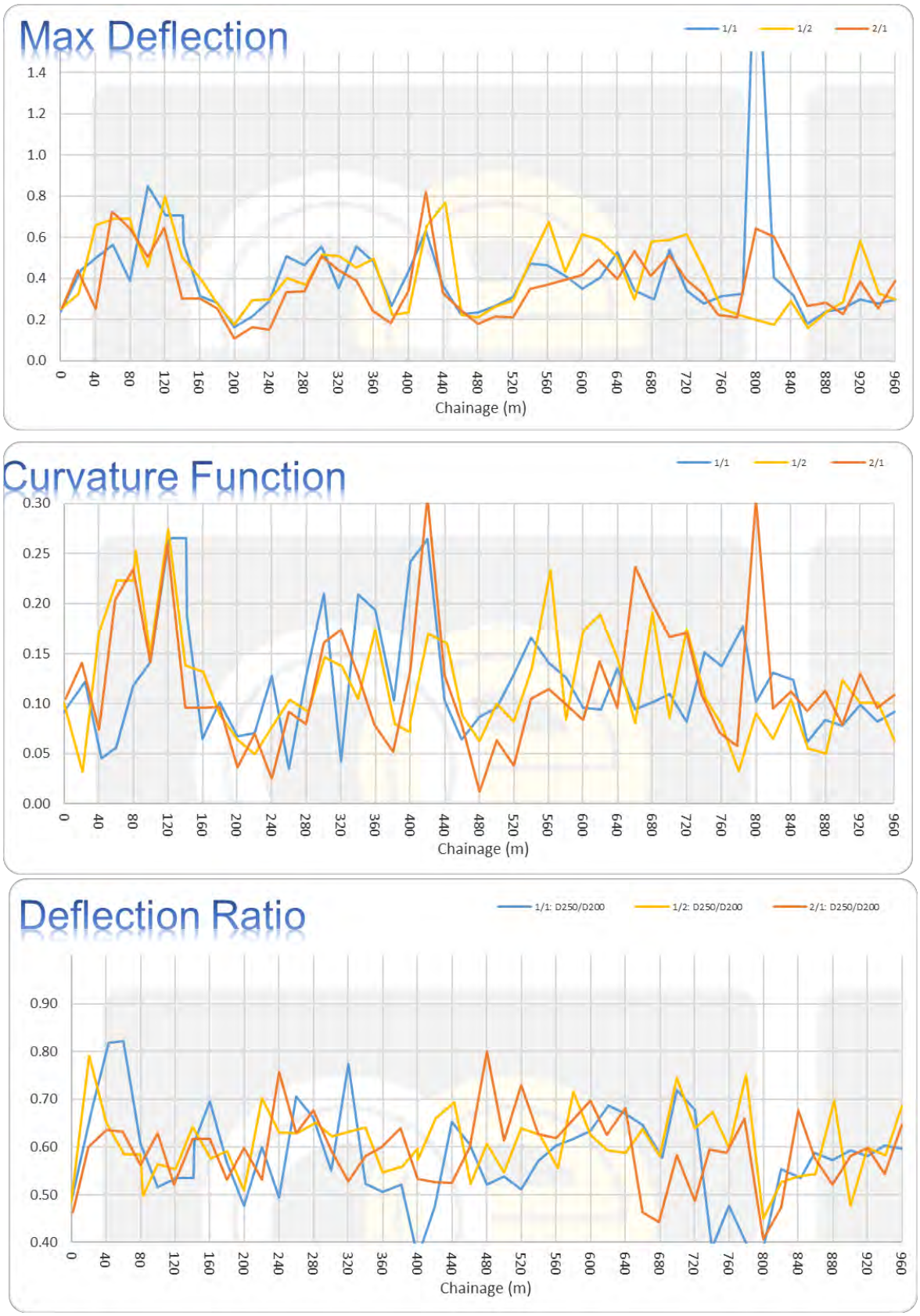
A deflection ratio of:

- Greater than 0.8 would indicate a bound or rigid pavement;
- Between 0.6 and 0.7 would be expected for a good quality unbound pavement
- Less than 0.6 would indicate the possible existence of poor quality or moisture sensitive pavement gravel.

The statistical analysis summary of the FWD results and graphical plots for each of the lanes tested (showing the maximum deflection, deflection ratio, and curvature function and subgrade response) are provided in Appendix C.

Details of each sub-section, and some general observations based on the measured deflections, curvatures and deflection ratios for each of the road and lanes tested are summarised by the figures and comment below the figures.

Figure 6.1: FWD Deflection Results



6.1.5.4 FWD Analysis

FWD results indicate that the pavement is homogenous and sectionalising is not required. Table 6.1 represent FWD deflection statistical analysis for all wheel paths.

Table 6.1 – FWD Results for all wheelpaths

Client:	**Mountain Ridge Road Pty Ltd**			Tested by:	Oscorp		CBR% Normalised Load (KN):	40						
Street:	**Mountain Ridge Road - South Mclean**			Date Tested:	00/01/1900		FWD Normalised Loads(KN):	40						
Temprature:	Pavement temp. range during testing: ºC to: 0 ºC			Chainage 0m to 960m			Plate:	300mm Dia						
				Normalised Deflection Bowl (mm)									Max Defln	Curvature D0-D200	Ratio	Subgrade CBR
Run	Chge (m)	Load (KN)	Sur (Cº)	D0	D200	D300	D450	D600	D900	D1200	D1500	D-200			D250/D0	%
Mean (μ)				0.368	0.254	0.188	0.125	0.084	0.046	0.027	0.019	0.274	0.377	0.113	0.600	17.158
Standard Deviation (s)				0.133	0.101	0.078	0.052	0.035	0.020	0.014	0.010	0.126	0.140	0.052	0.086	4.005
CVAR(%)				36.1	39.9	41.2	41.3	41.2	43.4	49.5	50.7	46.1	37.2	46.1	14.3	23.3
Characteristic Value (f=40)				0.538	0.384	0.288	0.191	0.128	0.071	0.045	0.031	0.435	0.56	0.11	0.49	12.03

The pavement is showing representative rebound maximum deflection (Do) of 0.538. The Mean Deflection Ratios are 0.60 which indicates average granular pavement exists. Generally, the Curvature Functions (Do-D200) are below the tolerable limits, for both 10 and 20-year design traffic volumes. Note, as the existing surfacing is a spray seal, the application of curvature function analysis is not appropriate in this instance.

6.1.6 FWD Assessment

Assessment of the deflection results identified the following key points:

- Generally, the homogenous deflection results indicate the likely existence of uniform pavement types with localised weak areas mainly along the outer wheel paths where moisture ingress is very likely.
- Discrete areas, mainly along the outer wheelpaths of the through lanes and intersections, recording high deflections and curvature functions.
- Deflection ratio's indicating average quality pavement with localised areas of weak gravel base

Assessment of the FWD results and field performance indicate that the existing pavement is performing adequately and deflection results are below tolerable limits.

Note for the calculated 10-year traffic volume of 1.67 x10^6 ESA's, According to Austroads Guide, the tolerable deflection is approximately 1.05mm.

6.2 Ground penetrating radar

6.2.1 Introduction

The Ground Penetrating Radar (GPR) is a non-destructive and non-invasive geophysical technique for rapidly imaging the shallow subsurface of a structure and producing high- resolution colour sections for analysis in real time.

In principle, the GPR technique is normally operated in the reflection mode with high frequency impulses of electromagnetic energy transmitted into the ground. Typically, 100,000 impulses per second are transmitted downwards into the subsurface from an antenna placed close to the surface.

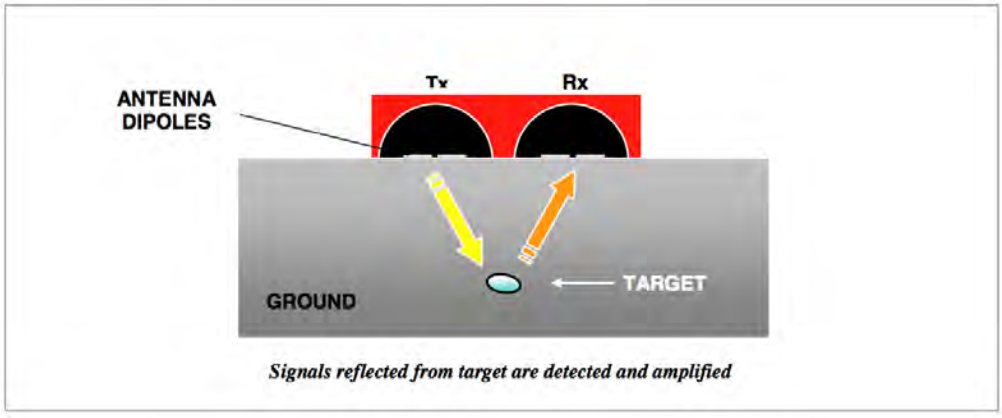
These impulses are of very short duration (each pulse has a rise time of typically 1-5 nanoseconds) and contain a wide spectrum of frequencies, typically in the range between 100 MHz and 1 GHz. A 900 MHz Antenna was used for the sub-surface imaging along Mountain Ridge Road.

The transmitted radar signal propagates through the subsurface as a function of the subsurface material's electrical properties, which are in turn dependent on its physical and chemical properties. Reflection of radar energy occurs at boundaries between differing stratigraphic layers or inclusions that have contrasting electrical properties. Conversely, no reflections occur from a homogenous material where there are no internal reflectors. The receiving antenna placed adjacent to the transmitter detects the reflections. The depth to the target is proportional to the time (in nanoseconds) taken for the signal to travel from the transmitting antenna at the surface to the target and back to the receiver.

In principle, the GPR technique is normally operated in the reflection mode (like an echosounder), except that high frequency impulses of electromagnetic energy are transmitted rather than sound waves. These impulses are of very short duration (each pulse has a rise time of 1 – 5 nanoseconds) and contain a wide spectrum of frequencies, typically between 100 MHz and 1 GHz. The energy levels transmitted are very low (only milliwatts of average power), which is only a fraction of the power used by a mobile phone.

Signals are reflected back from interfaces (Figure 6.2) in the ground where there is a contrast in the dielectric properties between two adjacent layers. The target depth is proportional to the time taken for the signal to travel down and back from a given layer. An optical encoder wheel is used to measure horizontal distance as the antenna is pulled across the ground surface.

Figure 6.2: How the GPR and Antennas works



6.2.2 Data Collection

This investigation used Ground Penetrating Radar air coupled antennae operating in the frequency range 900MHz to 2GHz to scan and produce longitudinal profiles. Oscorp assembled the equipment on site. The antennas were mounted to an onsite vehicle and connected to Trimble Differential Global Positioning System (DGPS) and utilised an optical odometer system for position/ navigation information. The coordinates at the start and end of each lane were recorded using DGPS. The position along each profile was recorded in both meterage and navigation GGA string at 5 points per second. An example of a vehicle setup is shown below.

Figure 6.3: Image of GPR Vehicle Setup – Note the two antennas

The pavement was scanned using Geophysical Survey Systems Inc. (GSSI) 2 GHz air-coupled and 900MHz ground-coupled antennas set to scan to 400mm and 900mm deep respectively. The antennae were used to determine the longitudinal layer profiles and are selected to provide the best combination of depth of penetration and resolution. The 2GHz antenna has a minimum layer thickness for resolution of 10 mm in ideal conditions. However, depth resolution can be as small as 6mm once a layer is resolved.

The chainage starting point was based on the section segment information provided by the CoGC. The reference chainage was measured in the prescribed direction provided by the client.

6.2.3 Accuracy

The radio wave velocity for the pavement will be assumed to be 120mm/ns (typical for asphalt concrete or chip seal materials) for depth measurements. We would expect depth error in the order of +/- or 10% with calibration of the quoted depth for bound layers and +/- 20% with for unbound layers mainly because of variation in moisture content and the generally low amplitude interface reflection between base layers and sub-base or formation.

The radar antenna locations were adjusted by an offset from the Trimble DGPS Navigation position. It is expected that the chainage error will be no more than +/- 5m in 1000m.

6.2.4 Data Processing

The raw radar data (*.dzt) files collected from the pavement are downloaded, processed and analysed using Reflex® for Windows processing software (Version 7.2.3) developed by Sandmeier Software. Processing was carried out as follows:

- Correct Maximum Phase to set zero depth at the surface interface.
- Background Removal Filter to remove multiples of the surface reflection.
- Applying colour palette to provide the best contrast of signal amplitudes and phases.
- Calibrate signal velocity to provide layer depth information.

The Radar signals reflected from the interior of a structure contain various types of information. Not all of this is of engineering value and much relates to the electrical properties of the materials profiled. The purpose of

the analysis is therefore to identify the information contained within the signals that relate directly to the engineering requirements specified in the objectives. Consideration is given to the nature and cause of the signals recorded by the radar. The fundamental measurement parameters used are as follows:

- The signal travel time which, combined with the calibration of signal velocity, determines the depth of the target;
- The signal amplitude and phase, which defines the boundaries between different materials and their relative properties;
- The signal continuity, which shows the general dimension and shape of the target to be determined.

Note, that ground-penetrating radar relies on the variation in dielectric constant of the material between layers to generate a reflection. The more similar the materials are, the smaller is the reflected signal and the harder it is to detect the boundary.

6.2.5 Presentation of Results and Reporting

The quality of the radar data recorded on site was generally observed to be good, showing a high signal to noise ratio. Minor processing of the data was necessary to further enhance the signal.

The majority of the collected GPR profiles show a distinctive high amplitude reflective layer at an approximate within the asphalt surfacing layers.

A ground penetrating radar survey was also undertaken and calibrated using pavement sampling findings. These results show variations in pavement thicknesses and were used in our assessment undertaken. The results of the analysis to date are presented in the pavement profile drawings e.g. Radargrams in Appendix C.

7 GEOTECHNICAL INVESTIGATION

A geotechnical pavement investigation was undertaken by Oscorp to further develop an understanding of the existing pavement composition, configuration and subgrade material and to assist in determining suitable rehabilitation treatments and consideration into design subgrade CBRs analysis. A total of 6 test pits were undertaken as per Table 7.1. The pavement profile from the boreholes was used in the calibration of the GPR results.

Oscorp engaged Protest Geotechnical Pty Ltd to undertake geotechnical field investigations and testing. Field geotechnical investigation was completed on August 2017 and included the drilling of six (6) boreholes at locations identified as representative of site conditions.

Table 7.1 – Borehole Locations

BH	Ch	Direction	Location
1	100	WB	Centre
2	300	WB	Southern Widening
3	500	WB	Northern Widening
4	650	WB	Centre
5	800	WB	Southern Widening
6	950	WB	Northern Widening

7.1 Laboratory Testing

7.1.1 Laboratory Testing Schedule

Following completion of logging and on-site testing, granular and subgrade bulk samples were uniquely labelled, stored, and subsequently scheduled for laboratory geotechnical testing at Protest Geotechnical Pty Ltd NATA accredited laboratory. Granular and subgrade samples were subjected to a suite of laboratory testing undertaken in accordance with relevant Australian Standards to enable geotechnical characteristics to be defined for the encountered materials. The laboratory testing schedule is summarised in the table below.

Table 7.2 – Subgrade Laboratory Testing Schedule

Test	Test Method
CBR, 4 Day Soak Single Point	AS1289.6.1.1
Atterberg Limits and Linear Shrinkage Limit	AS1289.3.1.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1, AS 1289.3.3.1
Particle Size Distribution (PSD)	AS1289.3.6.1
Moisture Content	AS1289.2.1.1

7.2 Pavement Profiles

A summary of each borehole is illustrated in Table 7.3 below:

Table 7.3– Borelog Summary

Summary of Laboratory Soil Testing as of - 20/09/2017																				
BH	Ch.	Direction	Location	Start of Layer (m)	End of Layer (m)	Classification	Particle Size Distribution			Atterberg Limits				CALIFORNIA BEARING RATIO						
							Gravel > 2.3mm	Sand 2.3mm to 0.075mm	Fines < 0.075mm	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liner Shrinkage (%)	Maximum Dry Density Std (t/m^3)	Optimum Moisture Content (%)	Field Moisture Content (%)	Swell (%)	Insitu CBR* (%)	Soaked CBR (%)
PTJ17/289 Mountain Ridge Road, South Mclean																				
1	100	East Bound	Centre	0.00	0.02	Two Coat Seal														
				0.02	0.20	Sandy Gravel with Silt (GW) Light Brown	78	16	6	22	13	9	4.5	2.22	7.9	3.5	0.5	-	35.0
				0.20	1.20	Silty Clayey Sandy Gravel (GW) Red/Brown	49	30	21	30	19	11	5	1.71	17.1	15	3.5	22	10.0
2	300	East Bound	Southern Widening	0.00	0.02	Two Coat Seal														
				0.02	0.20	Sandy Gravel with Silt (GW) Brown	74	20	6	20	15	5	3.5	2.24	8.1	3.5	0	-	18.0
				0.20	1.20	Silty Clayey Gravelly Sand (SW) Red/Brown	26	54	20	22	15	7	3	2	10	6	1	27	50.0
3	500	West Bound	Northern Widening	0.00	0.02	Two Coat Seal														
				0.02	0.30	Sandy Gravel with Silt (GW) Light Brown	53	37	10	24	20	4	1.5	2.19	6.8	3.5	0	-	20.0
				0.30	1.20	Gravelly Silty/Clayey Sand (SW) Brown	16	65	19	19	14	5	2.5	2.06	7.8	6	0	15	25.0
4	650	East Bound	Centre	0.00	0.02	Two Coat Seal														
				0.02	0.20	Sandy Gravel with Silt (GW) Light Brown	51	38	11	30	15	15	7						
				0.20	1.20	Silty Clayey Sandy Gravel(SW) Brown	43	40	17	28	18	10	5.5						
5	800	West Bound	Southern Widening	0.00	0.02	Two Coat Seal														
				0.02	0.30	Silty Sandy Gravel (GW) Light Brown	46	41	13	26	18	8	5	2.18	7.1	2.5	0	-	35.0
				0.30	1.20	Silty/Clayey Sand with Gravel (SW) Light Brown	9	73	18	19	16	3	0.5						
6	950	West Bound	Northern Widening	0.00	0.02	Two Coat Seal														
				0.02	0.30	Sandy Gravel with Silt (GW) Light Brown	52	40	8	22	15	7	3.5						
				0.30	0.60	Sand with Clay/Silt and Gravel (SW) Light Brown	6	87	7	16	14	2	0						
				0.60		SANDSTONE													

As illustrated in Table 7.3, and from geotechnical investigation, the base gravel varied in thickness and quality. The test pits characterised as Sandy Gravel with Silt. For detailed report, refer to Appendix C.

Some notes regarding the pavement investigation are detailed below:

- Bituminous spray seal is 20mm thick
- Gravel base thicknesses were over between 200mm and 300mm
- Gravel soaked CBR's varied between 18 and 35% were recorded
- The subgrade consisted Silty/Clayey Sand.
- High subgrade swell of 3.5% was noted at one location e.g. in Borehole 1 which indicates that the subgrade is highly reactive and is very sensitive to seasonal moisture variations.

From soil test results, the total thicknesses of existing pavement varied between 200 and 300mm over reasonably strong subgrade support with soaked CBR's of greater than 10.0% which will be adopted for pavement design purposes. The exiting gravel base appears to be of a mid to low quality for upper base materials.

8 CONCLUSIONS FROM EVALUATIONS

This section of Mountain Ridge Road is currently a minor rural residential road with one lane in each direction with a 2-coat bituminous spray seal surfacing and unbound granular construction. The road pavement appears to be widened along both sides to provide minimum/safe road formation.

Based on the visual inspection and current pavement condition, the existing bitumen spray seal surfacing is performing in a satisfactory condition. Given the age and condition of the spray seal surfacing, it is most likely that it will continue to perform in a satisfactory condition for the next three years subject to routine preventative and reactive maintenance being undertaken.

At the time of our inspection, the pavement is performing in a satisfactory condition with no evidence of pavement failures.

From site inspection, this section of Mountain Ridge Road has adequate cross fall drainage, with limited table drains, however shoulders and vegetation are reasonably maintained and will continue to perform reasonably well subject to adequate preventive maintenance being undertaken.

Pavement failures are minimum, however the due to multiple widenings, the pavement is exhibiting minor cross fall variations combined with localised depressions along the interface of original pavement and widening areas.

Traffic counts were undertaken by Traffic Data and Control Pty Ltd on 9th August 2017 at the intersection of Teviot and Mountain Ridge Roads. Pavement design traffic modelling estimated the total pavement traffic design traffic volume between 2017 and 2027 is 1.67x10^{6} ESA'S which is used for pavement design modelling.

Assessment of the FWD results indicates the following.

- The exiting pavement is in a current structural sound condition and is envisaged to continue to perform in a satisfactory condition for the combination of background traffic and future development traffic (includes construction traffic).
- Localised areas of high deflections and weak subgrade were present; however, no pavement failures were noticed along these areas.
- The existing pavement is considered to be homogeneous along the widenings and the original centre pavement. The pavement is exhibiting homogenous deflections with the representative rebound deflection of 0.538mm which is well below the development traffic (1.67x10^{6} ESA'S) tolerable deflection limit of 1.05mm.
- Indicative subgrade CBR values where predominantly higher than 10.0%, which indicates sound subgrade support.
- Back calculation of layer moduli indicates sound pavement support conditions and generally the existing pavement gravel strength is over 350MPa and the subgrade strength is over 10.0%.

Geotechnical pavement investigations identified the following.

- Thin bituminous spray seal surfacing along the entire subject section of Mountain Ridge Road
- Existing pavement gravel depths range between 200 and 300mm for the widening and centre pavement respectively.
- The pavement gravel base does not meet current quality standards for an upper road base and has performed adequately since its construction. For the pavement gravel, provided it is kept waterproofed, it is expected to continue to perform reasonably well.
- A subgrade support CBR of 10.0% is considered to be appropriate for pavement modelling purposes
- Geotechnical investigation test results are generally in line with the Ground Penetrating Radar profiles
- High subgrade swell of 3.5% was noted at one location e.g. in Borehole 1 which indicates that the subgrade is highly reactive and is very sensitive to seasonal moisture variations.

In conclusion, following the assessments of: -

- Visual inspections
- Current road condition
- Background and development traffic modelling
- Non-destructive pavement testing (GPR and FWD)
- Geotechnical testing
- Pavement modelling

It is evident that the exiting pavement is in a satisfactory performing condition for existing background traffic and it is very likely that it will continue to perform well for the next three years subject to the following.

- Undertaking adequate preventative/reactive maintenance and as required
- Maintain and improve effective surface drainage
- Undertake six monthly visual inspections by a duly qualified RPEQ Engineer
- Undertake annual FWD testing to monitor pavement deflections

It is worth noting that due to widenings being constructed from recycled gravel as a do minimum option by Council, it would be beneficial if construction traffic stay clear of the outer edges where limited lateral support and variable moisture saturation condition could affect the overall performance of the widenings.

9 FUTURE PAVEMENT DESIGN CONSIDERATIONS

The Client attention is drawn to the possibility of salvaging/recycling the existing pavement as part of the future ultimate pavement upgrade. There are numerous economic and environmental advantages of insitu pavement recycling. It is worth noting that pavement rehabilitation/upgrade is subject to the following.

- Local Council design guidelines and requirements
- Ultimate traffic design
- Subgrade conditions at the time
- Vertical/horizontal alignments and other geometrical/drainage constraints. It is estimated that a granular overlay of approx. 250mm could be required to aid in the pavement rehabilitation process
- Suitability of existing gravel materials for insitu stabilisation
- Economy
- Pavement testing, rehabilitation and design by a competent Registered Professional Engineer Queensland (RPEQ)

10 RECOMMENDATIONS

As the pavement is in a sound structural condition and it is very likely that it will continue to perform well during incremental future development stages, Oscorp Engineering suggests the following: -

- Continue to use this section of Mountain Ridge Road during incremental future development stages
- Undertake six monthly visual inspections by a duly qualified RPEQ pavement Engineer
- Monitor and undertake adequate preventative/reactive maintenance and as required
- Maintain and improve effective surface drainage
- Undertake annual FWD testing to monitor pavement deflections
- Investigate existing pavement rehabilitation and recycling options as part of the ultimate upgrade. This could involve raising the current levels where permissible to a nominated depth e.g. say 250mm (subject to various constraints as detailed in Section 9 of this report). This could be undertaken in the detailed design phase.

11 OUTSTANDING ISSUES

No issues remain outstanding at the completion of this report.

12 REFERENCES

- Queensland Department of Transport and Main Roads, Pavement Design Supplement, 2013
- Queensland Department of Transport and Main Roads, Pavement Rehabilitation Manual, 2012
- Austroads Guide to Pavement Technology Part 2: Pavement Structural Design (2012)
- Queensland Department of Transport and Main Roads (DTMR) Technical Specifications:
  - MRTS05 Unbound Pavements (August 2015)
  - MRTS07B Insitu Stabilised Pavements using Cement or Cementitious Blends (October 2014)
  - MRTS07C Insitu Stabilised Pavements using Foamed Bitumen (October 2014):
  - MRTS30 Dense Graded and Open Graded Asphalt (August 2015):
  - MRTS31 Heavy Duty Asphalt (August 2013):
- Auststab Technical Note (2008): Foam Bitumen Stabilisation

13 APPENDIXES

APPENDIX A - DESIGN TRAFFIC LOADING CALCULATIONS

APPENDIX B - FWD TEST REPORT

APPENDIX C - GPR TESTING

APPENDIX D- GEOTECHNICAL INVESTIGATIONS

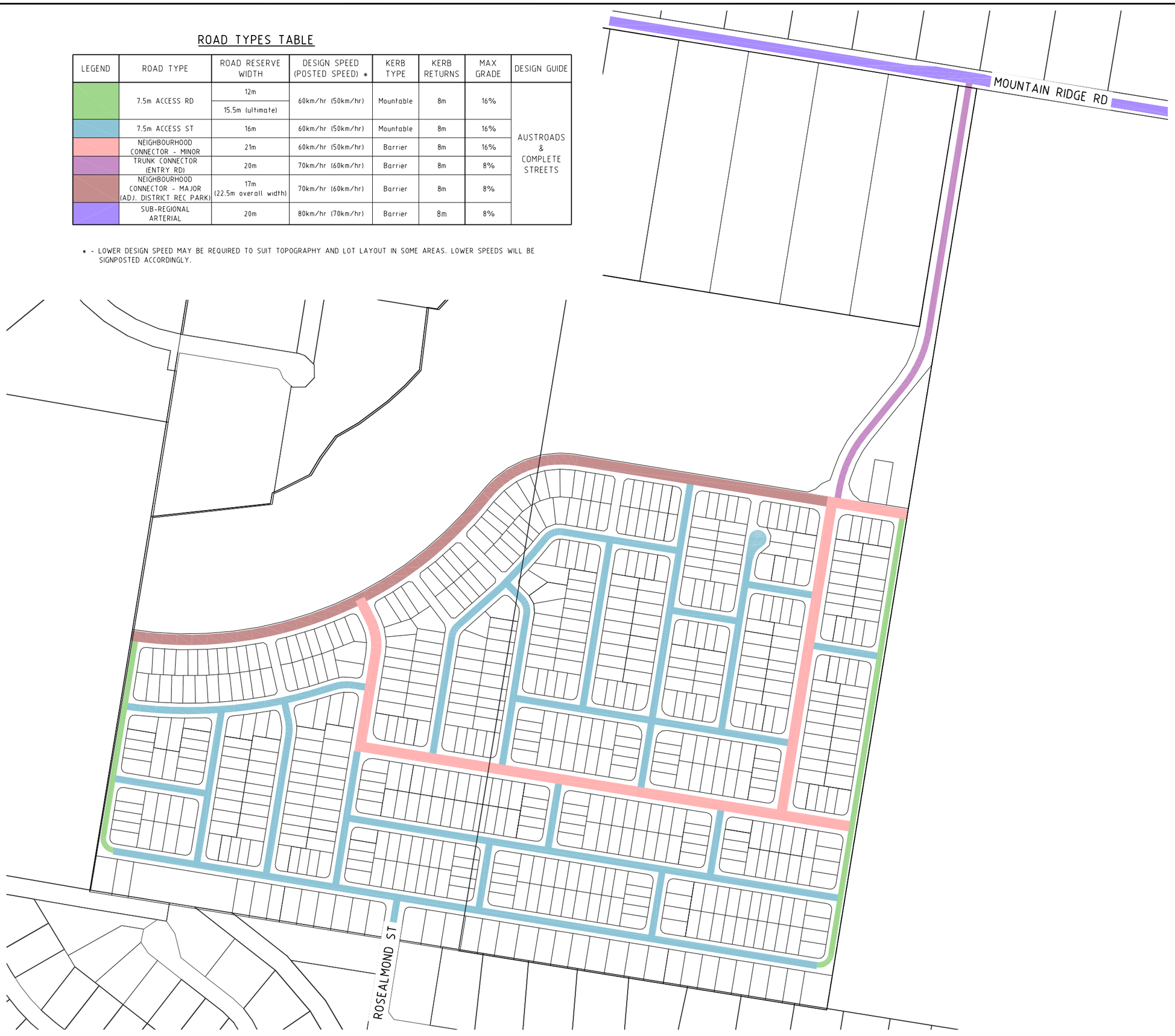
APPENDIX G

ROAD HIERARCHY AND TYPICAL CROSS-SECTIONS

ROAD TYPES TABLE

LEGEND	ROAD TYPE	ROAD RESERVE WIDTH	DESIGN SPEED (POSTED SPEED) *	KERB TYPE	KERB RETURNS	MAX GRADE	DESIGN GUIDE
	7.5m ACCESS RD	12m 15.5m (ultimate)	60km/hr (50km/hr)	Mountable	8m	16%	AUSTROADS & COMPLETE STREETS
	7.5m ACCESS ST	16m	60km/hr (50km/hr)	Mountable	8m	16%	
	NEIGHBOURHOOD CONNECTOR - MINOR	21m	60km/hr (50km/hr)	Barrier	8m	16%	
	TRUNK CONNECTOR (ENTRY RD)	20m	70km/hr (60km/hr)	Barrier	8m	8%	
	NEIGHBOURHOOD CONNECTOR - MAJOR (ADJ. DISTRICT REC PARK)	17m (22.5m overall width)	70km/hr (60km/hr)	Barrier	8m	8%	
	SUB-REGIONAL ARTERIAL	20m	80km/hr (70km/hr)	Barrier	8m	8%	

* - LOWER DESIGN SPEED MAY BE REQUIRED TO SUIT TOPOGRAPHY AND LOT LAYOUT IN SOME AREAS. LOWER SPEEDS WILL BE SIGNPOSTED ACCORDINGLY.



PROJECT NAME

MOUNTAIN RIDGE

OVERALL

RP DESCRIPTION
Lot 6 RP193185
& Lot 9 SP203507

CLIENT

MOUNTAIN RIDGE ROAD PTY/LTD

NORTH

0 20 40 60 80 100m

Scale 1:2000 - A1 (1:4000 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
G	07-03-18	LAYOUT UPDATED
F	13-02-18	NEIGHBOURHOOD CONNECTOR UPDATED
E	12-02-18	TABLE AMENDED
D	15-01-18	TABLE REVISED
C	11-10-17	MEDIAN REMOVED
B	26-09-17	ROAD TYPES AMENDED
A	31-08-17	INITIAL DRAFT ISSUE

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ASSOCIATED CONSULTANTS

saunders havill group
OSCORP engineering
WATER TECHNOLOGY
BITZIOS consulting

DRAWING TITLE

ROAD HIERARCHY PLAN

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Civil Engineering
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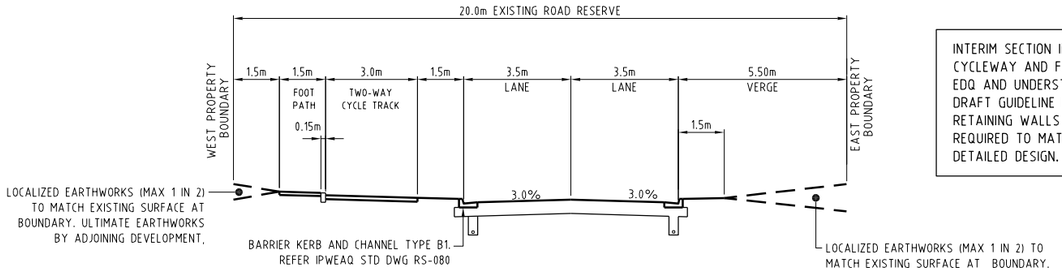
APPROVED		RPEQ	DATE 31-08-17

DRAWING NUMBER: 29301-ALL-S004

AMEND.: G

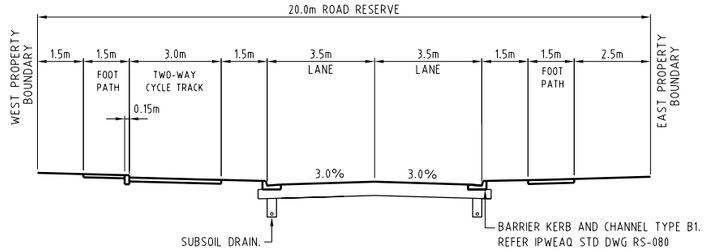


INTERIM SECTION INCORPORATES THE DEDICATED CYCLEWAY AND FOOTPATH AS REQUESTED BY EDQ AND UNDERSTOOD TO BE INCLUDED IN THE DRAFT GUIDELINE NO. 6 NOT YET RELEASED. RETAINING WALLS AND GUARDRAIL MAY BE REQUIRED TO MATCH INTO EXISTING, SUBJECT TO DETAILED DESIGN.

INTERNAL ENTRY ROAD - INTERIM

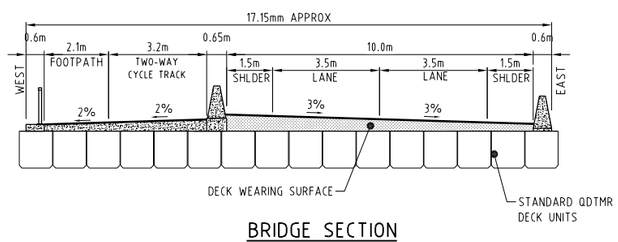
SCALE 1:100

NOTE: NO PARKING LANE HAS BEEN PROVIDED IN THESE TYPICAL SECTIONS TO MINIMISE INTERIM FOOTPRINT AND IMPACT ON ADJACENT PROPERTIES. IF A PARKING LANE IS REQUIRED ULTIMATELY, CONSIDERATION OF THE LOCATION/PROVISION OF KERB AND CHANNEL & DRAINAGE IN THE INTERIM. FUTURE DETAILED DESIGN WILL DETERMINE THE APPROPRIATE INTERIM CROSS-SECTION IN CONSULTATION WITH EDQ. ULTIMATE CROSS-SECTION TO BE PROVIDED BY OTHERS WHEN ADJOINING PROPERTIES ARE DEVELOPED.



INTERNAL ENTRY ROAD - ULTIMATE

SCALE 1:100



BRIDGE SECTION

SCALE: 1:100

NOTE: DIMENSIONS ARE SUBJECT TO STRUCTURAL DESIGN

PROJECT NAME

MOUNTAIN RIDGE

OVERALL

RP DESCRIPTION
Lot 6 RP193185
& Lot 9 SP203507

CLIENT

MOUNTAIN RIDGE ROAD PTY/LTD

0 1 2 3 4 5m
Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
CONSTRUCTION		

PRE	DATE	AMENDMENT
F	12-01-18	DETAILS AMENDED
E	10-10-17	MINOR AMENEDMENTS
D	26-09-17	SECTIONS AMENDED
C	06/09/17	INTERNAL ENTRY ROAD AMENDED
B	29/08/17	EDQ COMMENTS INCORPORATED
A	10-08-17	INITAL ISSUE

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ASSOCIATED CONSULTANTS

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OSCORP engineering
WATER TECHNOLOGY
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DRAWING TITLE

ENTRY ROAD
TYPICAL SECTIONS

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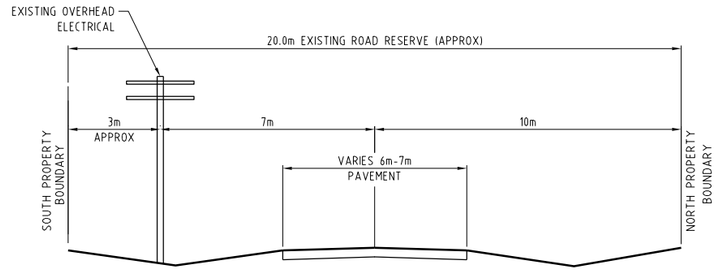
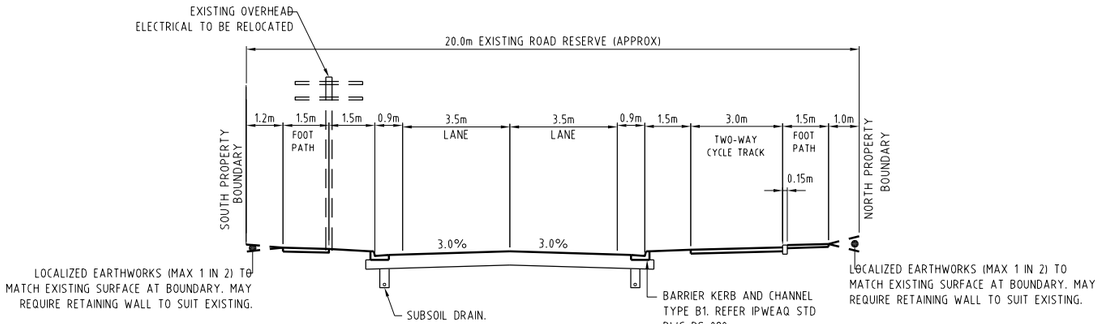


EXISTING MOUNTAIN RIDGE ROAD (APPROXIMATE)

SCALE 1:100



MOUNTAIN RIDGE ROAD (ULTIMATE = 2 LANES)

SCALE 1:100

NOTE: NO DETAILED DESIGN HAS BEEN PREPARED FOR THESE TYPICAL SECTIONS. IT IS LIKELY THAT EARTHWORKS WILL EXTEND INTO ADJACENT PROPERTIES TO ACCOMMODATE THESE SECTIONS. IF THIS IS NOT POSSIBLE SMALL RETAINING WALLS MAY BE REQUIRED.

PROJECT NAME

MOUNTAIN RIDGE

OVERALL

RP DESCRIPTION
Lot 6 RP193185
& Lot 9 SP203507

CLIENT

MOUNTAIN RIDGE ROAD PTY/LTD

0 1 2 3 4 5m
Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
CONSTRUCTION		

F	08-02-18	DETAILS AMENDED
E	12-01-18	DETAILS AMENDED
D	10-10-17	MINOR AMENEDMENTS
C	26/09/17	SECTIONS UPDATED
B	29/08/17	EDQ COMMENTS INCORPORATED
A	10-08-17	INITAL ISSUE
PRE	DATE	AMENDMENT

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ASSOCIATED CONSULTANTS

saunders havill group
OSCORP engineering
WATER TECHNOLOGY
BITZIOS consulting

DRAWING TITLE

MOUNTAIN RIDGE ROAD
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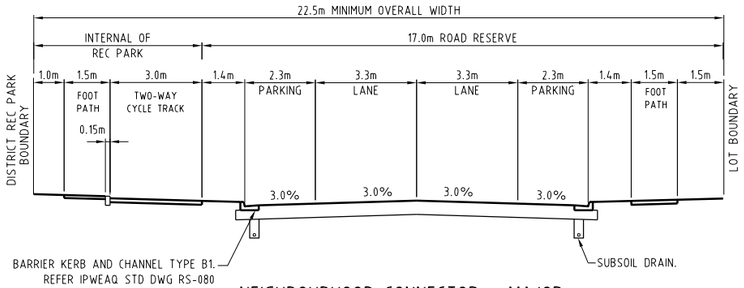
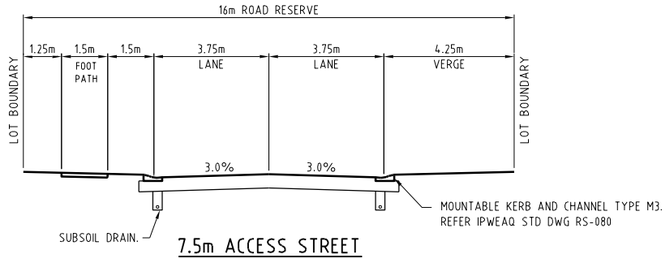


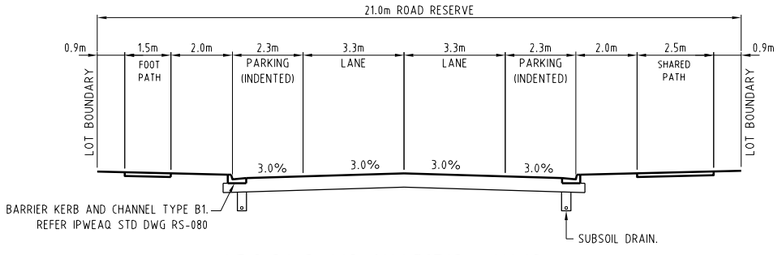
NEIGHBOURHOOD CONNECTOR - MAJOR (ADJACENT TO DISTRICT REC PARK)

SCALE 1:100



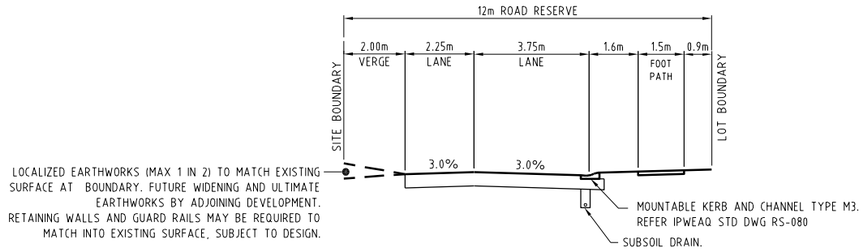
7.5m ACCESS STREET (16m ROAD RESERVE)

SCALE 1:100



NEIGHBOURHOOD CONNECTOR - MINOR (21m ROAD RESERVE)

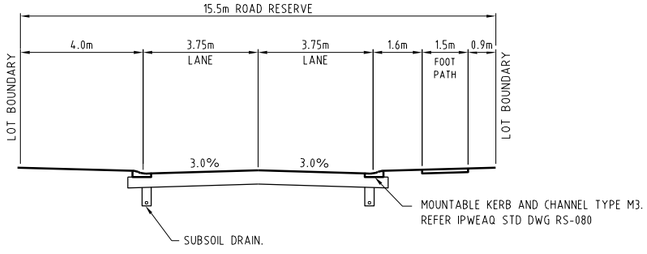
SCALE 1:100



6.0m ACCESS ROAD - INTERIM (ADJACENT TO SITE BOUNDARY, 12m ROAD RESERVE)

SCALE 1:100

NOTE: THE INTERIM CROSS-SECTION WILL BE REVIEWED AT THE DETAILED DESIGN PHASE TO ENSURE SUITABLE STORMWATER CONVEYANCE IS PROVIDED.



7.5m ACCESS ROAD - ULTIMATE (15.5m ROAD RESERVE)

SCALE 1:100

PROJECT NAME

MOUNTAIN RIDGE

OVERALL

RP DESCRIPTION
Lot 6 RP193185
& Lot 9 SP203507

CLIENT

MOUNTAIN RIDGE ROAD PTY/LTD

0 1 2 3 4 5m
Scale 1:100 - A1 (1:200 - A3)

ISSUES	DATE	
TENDER		
COUNCIL		
CONSTRUCTION		

I	07-03-18	SECTIONS UPDATED
H	13-02-18	NEIGHBOURHOOD CONNECTOR UPDATED
G	12-01-18	ACCESS ROAD AMENDED
F	16-10-17	NEIGHBOURHOOD CONNECTOR ROAD AMENDED
E	11-10-17	MEDIAN REMOVED
D	10-10-17	MINOR AMENEDMENTS
C	26-09-17	FOOTPATHS ADDED
B	12-09-17	MINOR REVISIONS
A	31-08-17	INITAL ISSUE - DRAFT
PRE	DATE	AMENDMENT

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DRAWING TITLE

TYPICAL SECTIONS INTERNAL ROADS

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APPROVED		RPEQ	DATE 29-08-17

DRAWING NUMBER: 29301-ALL-S002
AMEND.: I

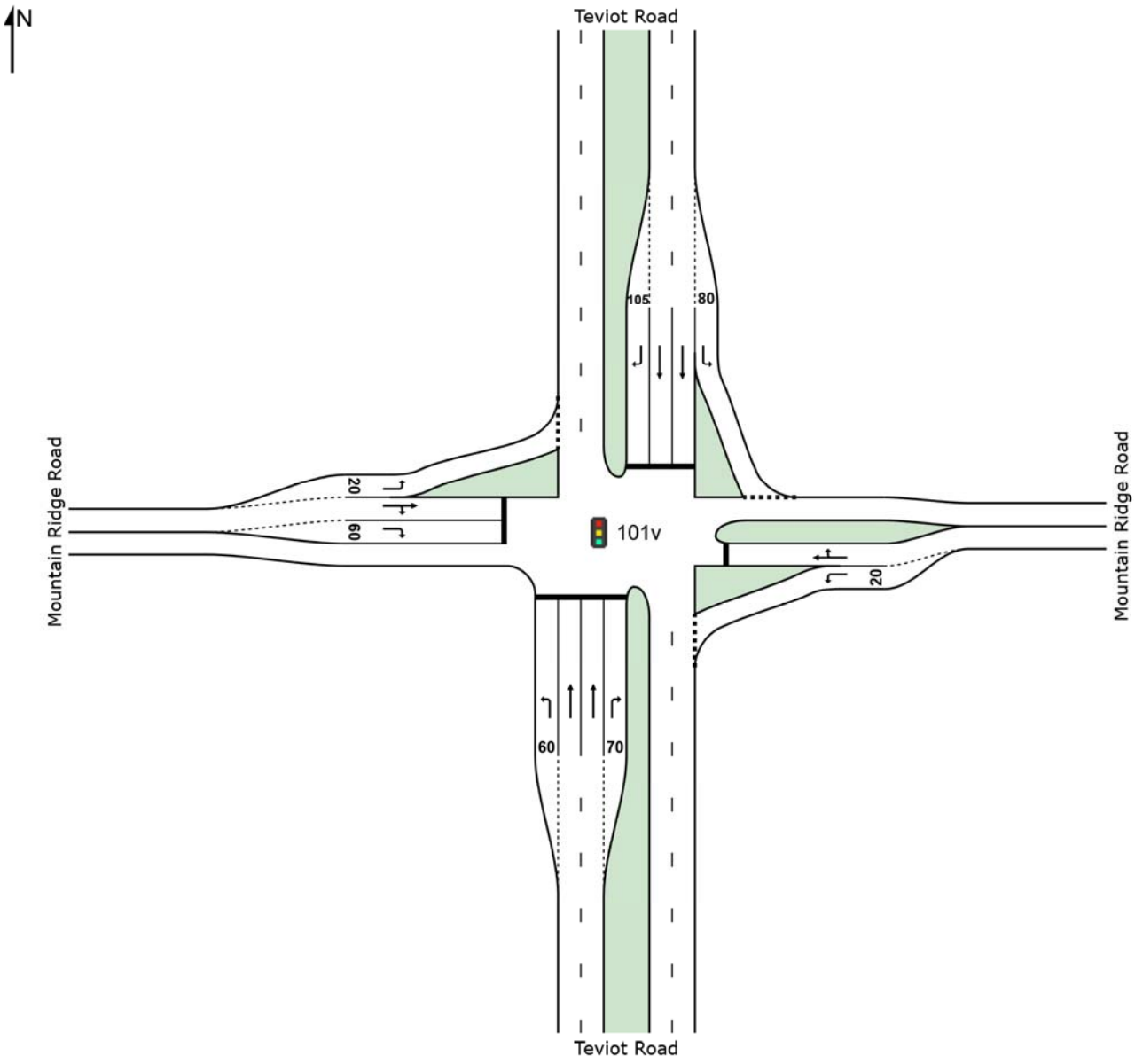
APPENDIX H

INTERSECTION 1: ULTIMATE SIDRA ANALYSIS

SITE LAYOUT

Site: 101v [Ultimate Scenario | AM Peak]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: 101v [Ultimate Scenario | AM Peak]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 85 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	81	2.0	0.094	14.4	LOS B	1.2	8.6	0.58	0.71	52.7
2	T1	1343	2.0	0.897	39.3	LOS D	33.8	241.0	0.99	1.06	43.0
3	R2	6	2.0	0.019	38.3	LOS D	0.2	1.5	0.85	0.66	39.2
Approach		1430	2.0	0.897	37.9	LOS D	33.8	241.0	0.97	1.04	43.5
East: Mountain Ridge Road											
4	L2	16	2.0	0.012	7.3	LOS A	0.1	0.8	0.26	0.59	57.1
5	T1	21	2.0	0.371	43.6	LOS D	2.1	14.9	0.99	0.74	34.0
6	R2	28	2.0	0.371	49.2	LOS D	2.1	14.9	0.99	0.74	35.3
Approach		65	2.0	0.371	37.1	LOS D	2.1	14.9	0.81	0.70	38.4
North: Teviot Road											
7	L2	6	2.0	0.004	7.8	LOS A	0.0	0.1	0.15	0.62	59.0
8	T1	374	2.0	0.243	18.2	LOS B	5.1	36.6	0.70	0.58	57.2
9	R2	287	2.0	0.888	56.2	LOS E	14.2	101.1	1.00	0.99	33.0
Approach		667	2.0	0.888	34.4	LOS C	14.2	101.1	0.83	0.76	43.5
West: Mountain Ridge Road											
10	L2	463	2.0	0.689	17.8	LOS B	12.1	86.2	0.77	0.80	49.0
11	T1	9	2.0	0.826	49.5	LOS D	5.0	35.9	1.00	0.94	31.7
12	R2	205	2.0	0.826	55.1	LOS E	5.0	35.9	1.00	0.94	32.7
Approach		677	2.0	0.826	29.6	LOS C	12.1	86.2	0.84	0.85	42.4
All Vehicles		2839	2.0	0.897	35.1	LOS D	33.8	241.0	0.90	0.92	43.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [Ultimate Scenario | AM Peak]

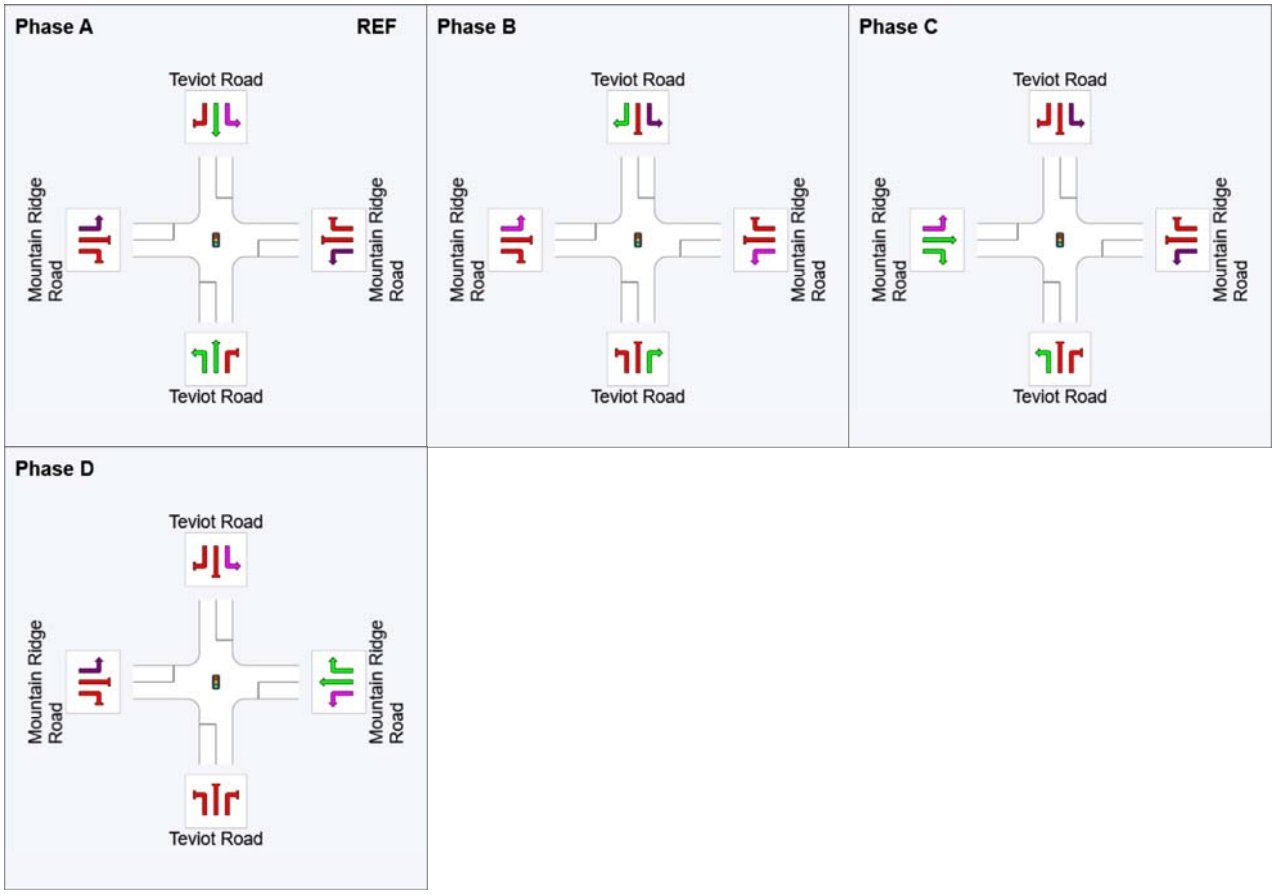
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 85 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns - Copy
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, E*
Output Phase Sequence: A, B, C, D
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	40	61	73
Green Time (sec)	34	15	6	6
Phase Time (sec)	40	21	12	12
Phase Split	47%	25%	14%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

MOVEMENT SUMMARY

Site: 101v [Ultimate Scenario | PM Peak]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	202	2.0	0.465	22.8	LOS C	4.4	31.3	0.90	0.80	47.0
2	T1	527	2.0	0.842	42.4	LOS D	11.5	82.1	1.00	0.97	41.5
3	R2	13	2.0	0.052	40.0	LOS D	0.5	3.2	0.90	0.69	38.5
Approach		742	2.0	0.842	37.0	LOS D	11.5	82.1	0.97	0.92	42.8
East: Mountain Ridge Road											
4	L2	6	2.0	0.006	12.6	LOS B	0.1	0.7	0.49	0.61	52.7
5	T1	9	2.0	0.135	39.5	LOS D	0.7	5.2	0.96	0.68	35.4
6	R2	10	2.0	0.135	45.1	LOS D	0.7	5.2	0.96	0.68	36.8
Approach		25	2.0	0.135	35.3	LOS D	0.7	5.2	0.85	0.67	39.1
North: Teviot Road											
7	L2	31	2.0	0.021	7.9	LOS A	0.1	0.8	0.17	0.64	58.9
8	T1	1345	2.0	0.851	30.0	LOS C	27.8	198.3	0.97	0.97	48.3
9	R2	476	2.0	0.832	27.7	LOS C	12.1	86.2	0.99	0.92	44.5
Approach		1852	2.0	0.851	29.0	LOS C	27.8	198.3	0.96	0.95	47.4
West: Mountain Ridge Road											
10	L2	322	2.0	0.265	8.1	LOS A	3.1	22.1	0.36	0.66	56.4
11	T1	17	2.0	0.336	40.6	LOS D	1.9	13.3	0.98	0.73	34.9
12	R2	76	2.0	0.336	46.3	LOS D	1.9	13.3	0.98	0.73	35.8
Approach		415	2.0	0.336	16.4	LOS B	3.1	22.1	0.50	0.68	49.9
All Vehicles		3034	2.0	0.851	29.3	LOS C	27.8	198.3	0.90	0.90	46.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [Ultimate Scenario | PM Peak]

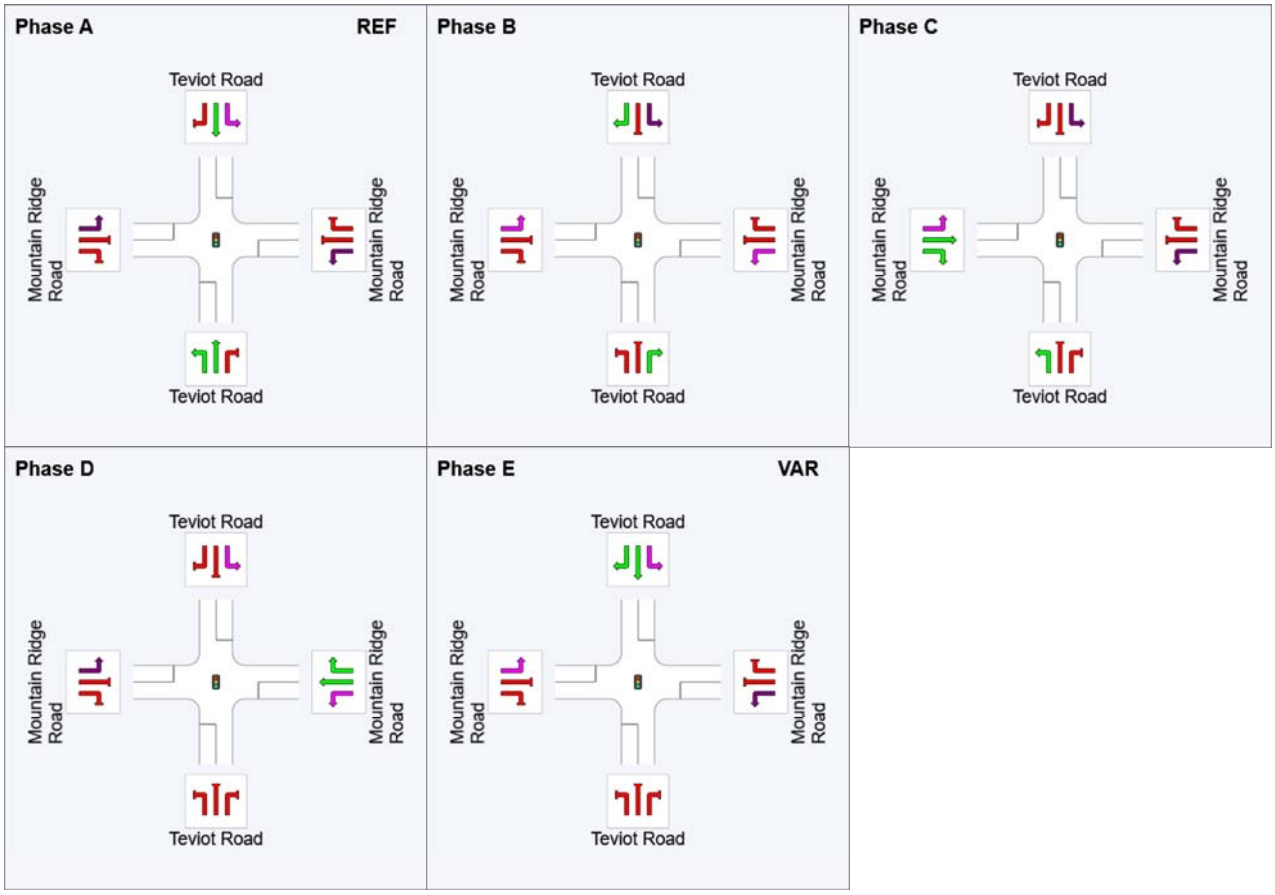
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns - Copy
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, E*
Output Phase Sequence: A, B, C, D, E*
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D	E
Phase Change Time (sec)	0	19	36	48	60
Green Time (sec)	13	11	6	6	14
Phase Time (sec)	19	17	12	12	20
Phase Split	24%	21%	15%	15%	25%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

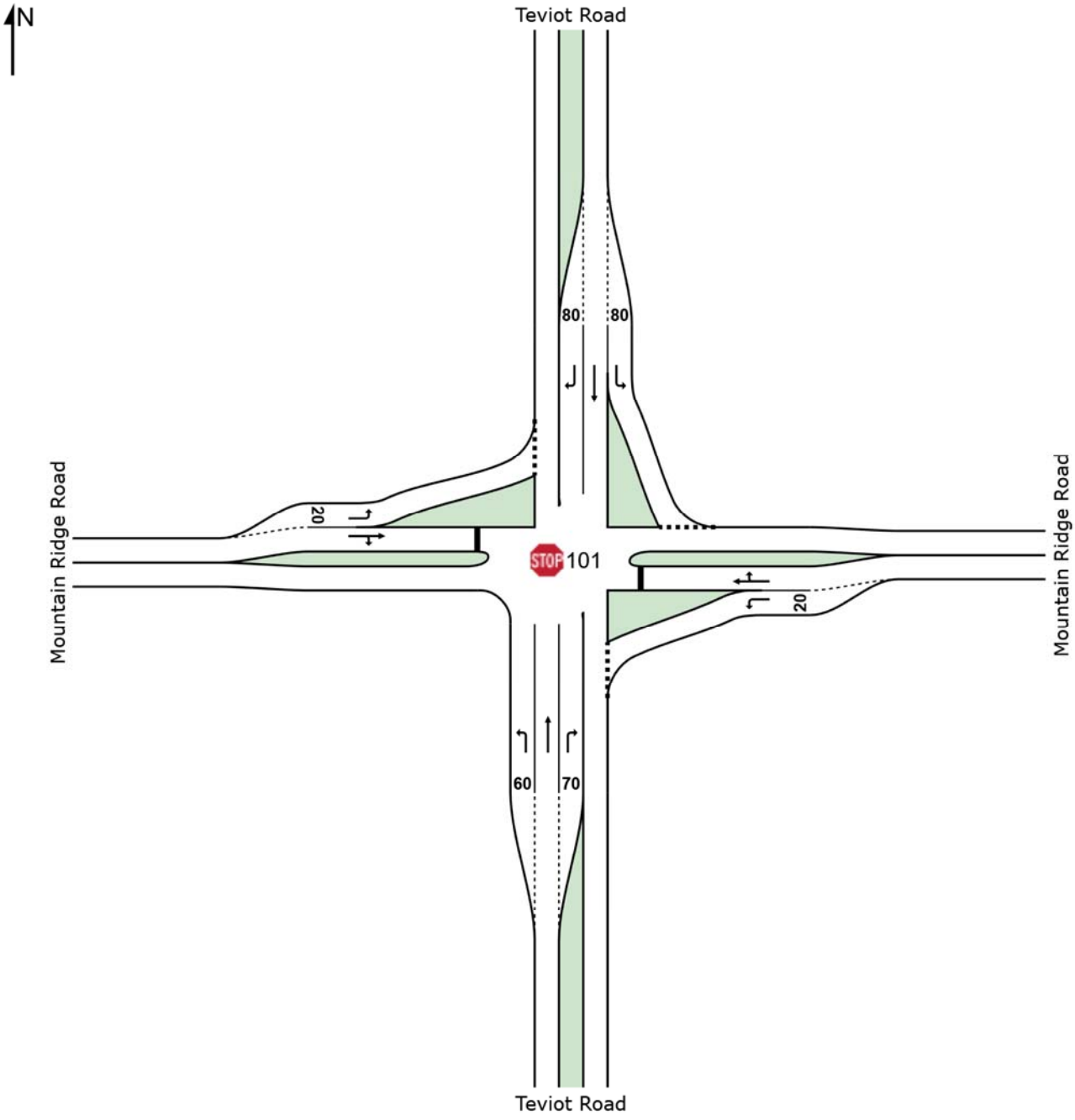
APPENDIX I

INTERSECTION 1: INTERIM SIDRA ANALYSIS

SITE LAYOUT

Site: 101 [2031 AM Peak | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Stop (Two-Way)



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MOVEMENT SUMMARY

Site: 101 [2031 AM Peak | With Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	7	2.0	0.004	7.0	LOS A	0.0	0.0	0.00	0.63	64.7
2	T1	1247	2.0	0.648	0.2	LOS A	0.0	0.0	0.00	0.00	79.5
3	R2	15	2.0	0.013	8.4	LOS A	0.1	0.4	0.46	0.63	57.2
Approach		1269	2.0	0.648	0.3	NA	0.1	0.4	0.01	0.01	79.0
East: Mountain Ridge Road											
4	L2	21	2.0	0.026	7.9	LOS A	0.1	0.6	0.46	0.64	56.6
5	T1	9	2.0	2.666	3172.5	LOS F	42.3	301.4	1.00	2.42	1.1
6	R2	37	2.0	2.666	3172.0	LOS F	42.3	301.4	1.00	2.42	1.1
Approach		67	2.0	2.666	2180.3	LOS F	42.3	301.4	0.83	1.86	1.6
North: Teviot Road											
7	L2	20	2.0	0.013	7.4	LOS A	0.0	0.4	0.07	0.58	59.3
8	T1	434	2.0	0.225	0.0	LOS A	0.0	0.0	0.00	0.00	79.9
9	R2	81	2.0	0.514	39.2	LOS E	1.8	13.0	0.94	1.04	38.7
Approach		535	2.0	0.514	6.2	LOS A	1.8	13.0	0.15	0.18	68.0
West: Mountain Ridge Road											
10	L2	307	2.0	2.555	2827.3	LOS F	240.4	1711.5	1.00	9.47	1.3
11	T1	5	2.0	1.767	1632.9	LOS F	21.2	151.3	1.00	2.02	2.1
12	R2	26	2.0	1.767	1636.3	LOS F	21.2	151.3	1.00	2.02	2.1
Approach		338	2.0	2.555	2718.0	LOS F	240.4	1711.5	1.00	8.79	1.3
All Vehicles		2209	2.0	2.666	483.7	NA	240.4	1711.5	0.22	1.45	6.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2031 PM Peak | With Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Stop (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	20	2.0	0.011	7.0	LOS A	0.0	0.0	0.00	0.63	64.7
2	T1	508	2.0	0.264	0.0	LOS A	0.0	0.0	0.00	0.00	79.9
3	R2	19	2.0	0.118	29.0	LOS D	0.4	2.5	0.92	0.97	43.3
Approach		547	2.0	0.264	1.3	NA	0.4	2.5	0.03	0.06	77.0
East: Mountain Ridge Road											
4	L2	15	2.0	0.172	44.7	LOS E	0.5	3.3	0.94	0.98	36.2
5	T1	6	2.0	5.000	7522.5	LOS F	40.9	291.1	1.00	1.66	0.5
6	R2	24	2.0	5.000	7522.8	LOS F	40.9	291.1	1.00	1.66	0.5
Approach		45	2.0	5.000	5030.1	LOS F	40.9	291.1	0.98	1.43	0.7
North: Teviot Road											
7	L2	40	2.0	0.025	7.4	LOS A	0.1	0.7	0.08	0.58	59.3
8	T1	1351	2.0	0.702	0.2	LOS A	0.0	0.0	0.00	0.00	79.3
9	R2	270	2.0	0.344	10.9	LOS B	1.7	12.4	0.60	0.89	55.2
Approach		1661	2.0	0.702	2.1	LOS A	1.7	12.4	0.10	0.16	73.5
West: Mountain Ridge Road											
10	L2	125	2.0	0.173	8.9	LOS A	0.6	4.4	0.53	0.77	55.8
11	T1	5	2.0	2.333	3016.9	LOS F	15.4	109.7	1.00	1.46	1.1
12	R2	9	2.0	2.333	2992.7	LOS F	15.4	109.7	1.00	1.46	1.1
Approach		139	2.0	2.333	310.3	LOS F	15.4	109.7	0.58	0.84	9.3
All Vehicles		2392	2.0	5.000	114.4	NA	40.9	291.1	0.13	0.20	21.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2031 AM Peak | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	1	2.0	0.001	7.0	LOS A	0.0	0.0	0.00	0.63	64.7
2	T1	1247	2.0	0.648	0.2	LOS A	0.0	0.0	0.00	0.00	79.5
3	R2	15	2.0	0.013	8.4	LOS A	0.1	0.4	0.46	0.63	57.2
Approach		1263	2.0	0.648	0.3	NA	0.1	0.4	0.01	0.01	79.1
East: Mountain Ridge Road											
4	L2	21	2.0	0.025	7.7	LOS A	0.1	0.6	0.44	0.63	56.8
5	T1	6	2.0	2.098	2157.2	LOS F	33.3	237.4	1.00	2.41	1.6
6	R2	37	2.0	2.098	2157.2	LOS F	33.3	237.4	1.00	2.41	1.6
Approach		64	2.0	2.098	1451.9	LOS F	33.3	237.4	0.82	1.83	2.3
North: Teviot Road											
7	L2	20	2.0	0.013	7.4	LOS A	0.0	0.4	0.06	0.59	59.3
8	T1	434	2.0	0.225	0.0	LOS A	0.0	0.0	0.00	0.00	79.9
9	R2	6	2.0	0.040	28.8	LOS D	0.1	0.8	0.90	0.96	43.4
Approach		460	2.0	0.225	0.7	LOS A	0.1	0.8	0.01	0.04	77.9
West: Mountain Ridge Road											
10	L2	3	2.0	0.025	32.0	LOS D	0.1	0.5	0.91	0.96	41.3
11	T1	1	2.0	0.095	149.9	LOS F	0.2	1.6	0.98	1.00	17.2
12	R2	1	2.0	0.095	153.1	LOS F	0.2	1.6	0.98	1.00	17.7
Approach		5	2.0	0.095	79.8	LOS F	0.2	1.6	0.94	0.98	26.8
All Vehicles		1792	2.0	2.098	52.4	NA	33.3	237.4	0.04	0.08	36.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2031 PM Peak | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Stop (Two-Way)

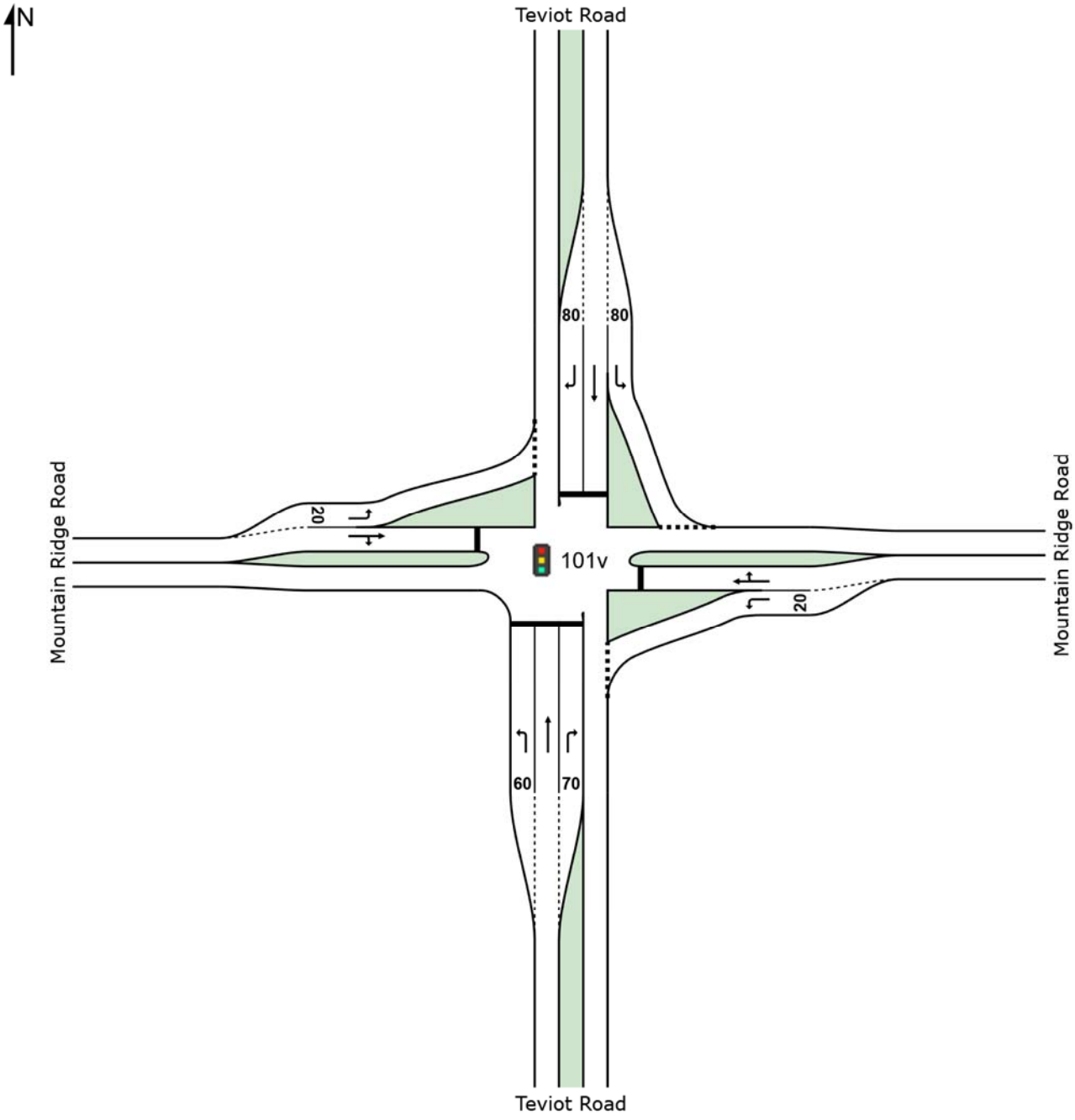
Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	1	2.0	0.001	7.0	LOS A	0.0	0.0	0.00	0.63	64.7
2	T1	508	2.0	0.264	0.0	LOS A	0.0	0.0	0.00	0.00	79.9
3	R2	19	2.0	0.118	29.0	LOS D	0.4	2.5	0.92	0.97	43.3
Approach		528	2.0	0.264	1.1	NA	0.4	2.5	0.03	0.04	77.5
East: Mountain Ridge Road											
4	L2	15	2.0	0.167	43.3	LOS E	0.4	3.2	0.94	0.98	36.7
5	T1	2	2.0	2.641	3267.5	LOS F	26.3	187.1	1.00	1.83	1.0
6	R2	24	2.0	2.641	3267.4	LOS F	26.3	187.1	1.00	1.83	1.0
Approach		41	2.0	2.641	2087.9	LOS F	26.3	187.1	0.98	1.52	1.6
North: Teviot Road											
7	L2	40	2.0	0.025	7.4	LOS A	0.1	0.7	0.07	0.58	59.3
8	T1	1351	2.0	0.702	0.2	LOS A	0.0	0.0	0.00	0.00	79.3
9	R2	1	2.0	0.001	9.3	LOS A	0.0	0.0	0.49	0.60	56.6
Approach		1392	2.0	0.702	0.4	LOS A	0.1	0.7	0.00	0.02	78.5
West: Mountain Ridge Road											
10	L2	10	2.0	0.014	8.4	LOS A	0.0	0.3	0.49	0.65	56.2
11	T1	1	2.0	0.281	344.3	LOS F	0.6	4.6	0.99	1.01	9.0
12	R2	2	2.0	0.281	346.6	LOS F	0.6	4.6	0.99	1.01	9.1
Approach		13	2.0	0.281	86.3	LOS F	0.6	4.6	0.60	0.73	25.7
All Vehicles		1974	2.0	2.641	44.5	NA	26.3	187.1	0.03	0.06	39.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101v [2031 AM Peak | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: 101v [2031 AM Peak | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 155 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	1	2.0	0.001	9.2	LOS A	0.0	0.1	0.24	0.62	57.0
2	T1	1247	2.0	0.898	17.0	LOS B	70.7	503.6	0.84	0.80	58.3
3	R2	15	2.0	0.212	89.3	LOS F	1.2	8.3	1.00	0.69	25.3
Approach		1263	2.0	0.898	17.8	LOS B	70.7	503.6	0.85	0.80	57.4
East: Mountain Ridge Road											
4	L2	21	2.0	0.016	6.9	LOS A	0.2	1.3	0.16	0.58	57.5
5	T1	6	2.0	0.603	85.2	LOS F	3.5	24.6	1.00	0.76	24.2
6	R2	37	2.0	0.603	90.8	LOS F	3.5	24.6	1.00	0.76	24.8
Approach		64	2.0	0.603	62.7	LOS E	3.5	24.6	0.73	0.70	30.5
North: Teviot Road											
7	L2	20	2.0	0.012	7.6	LOS A	0.1	0.5	0.09	0.62	59.2
8	T1	434	2.0	0.309	7.7	LOS A	11.1	79.3	0.38	0.34	68.5
9	R2	6	2.0	0.085	88.0	LOS F	0.5	3.3	0.99	0.65	25.5
Approach		460	2.0	0.309	8.7	LOS A	11.1	79.3	0.37	0.35	66.6
West: Mountain Ridge Road											
10	L2	3	2.0	0.008	31.3	LOS C	0.1	0.9	0.61	0.63	41.6
11	T1	1	2.0	0.028	79.9	LOS E	0.2	1.1	0.98	0.60	25.5
12	R2	1	2.0	0.028	85.4	LOS F	0.2	1.1	0.98	0.60	26.2
Approach		5	2.0	0.028	51.8	LOS D	0.2	1.1	0.76	0.62	33.5
All Vehicles		1792	2.0	0.898	17.2	LOS B	70.7	503.6	0.72	0.68	57.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [2031 AM Peak | Without Development (Reassigned Vols)]

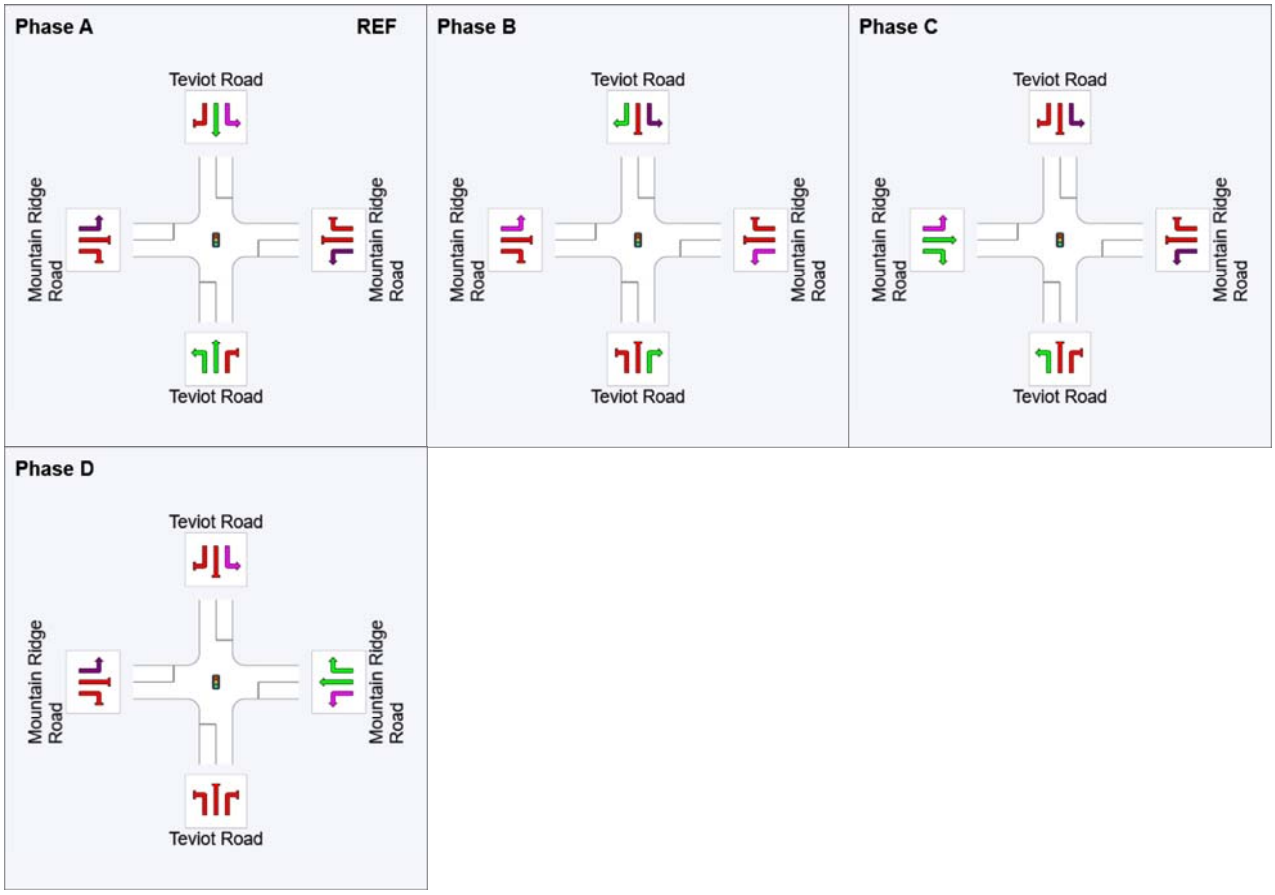
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 155 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, F1*, F2*
Output Phase Sequence: A, B, C, D
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	119	131	143
Green Time (sec)	113	6	6	6
Phase Time (sec)	119	12	12	12
Phase Split	77%	8%	8%	8%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

MOVEMENT SUMMARY

Site: 101v [2031 PM Peak | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	1	2.0	0.001	9.1	LOS A	0.0	0.1	0.23	0.62	57.0
2	T1	508	2.0	0.358	7.8	LOS A	13.7	97.7	0.39	0.35	68.3
3	R2	19	2.0	0.277	92.6	LOS F	1.5	10.9	1.00	0.70	24.7
Approach		528	2.0	0.358	10.9	LOS B	13.7	97.7	0.41	0.36	64.2
East: Mountain Ridge Road											
4	L2	15	2.0	0.028	42.4	LOS D	0.8	5.4	0.73	0.67	37.0
5	T1	2	2.0	0.377	86.4	LOS F	2.1	15.1	1.00	0.71	24.0
6	R2	24	2.0	0.377	92.0	LOS F	2.1	15.1	1.00	0.71	24.6
Approach		41	2.0	0.377	73.6	LOS E	2.1	15.1	0.90	0.70	28.0
North: Teviot Road											
7	L2	40	2.0	0.024	7.6	LOS A	0.1	1.0	0.09	0.63	59.2
8	T1	1351	2.0	0.978	55.6	LOS E	124.4	885.5	0.97	1.08	36.1
9	R2	1	2.0	0.015	89.0	LOS F	0.1	0.6	0.98	0.59	25.3
Approach		1392	2.0	0.978	54.2	LOS D	124.4	885.5	0.94	1.07	36.5
West: Mountain Ridge Road											
10	L2	10	2.0	0.011	7.5	LOS A	0.1	0.8	0.19	0.58	56.9
11	T1	1	2.0	0.043	83.1	LOS F	0.2	1.7	0.98	0.62	24.8
12	R2	2	2.0	0.043	88.7	LOS F	0.2	1.7	0.98	0.62	25.4
Approach		13	2.0	0.043	25.8	LOS C	0.2	1.7	0.37	0.59	44.2
All Vehicles		1974	2.0	0.978	42.8	LOS D	124.4	885.5	0.79	0.87	41.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [2031 PM Peak | Without Development (Reassigned Vols)]

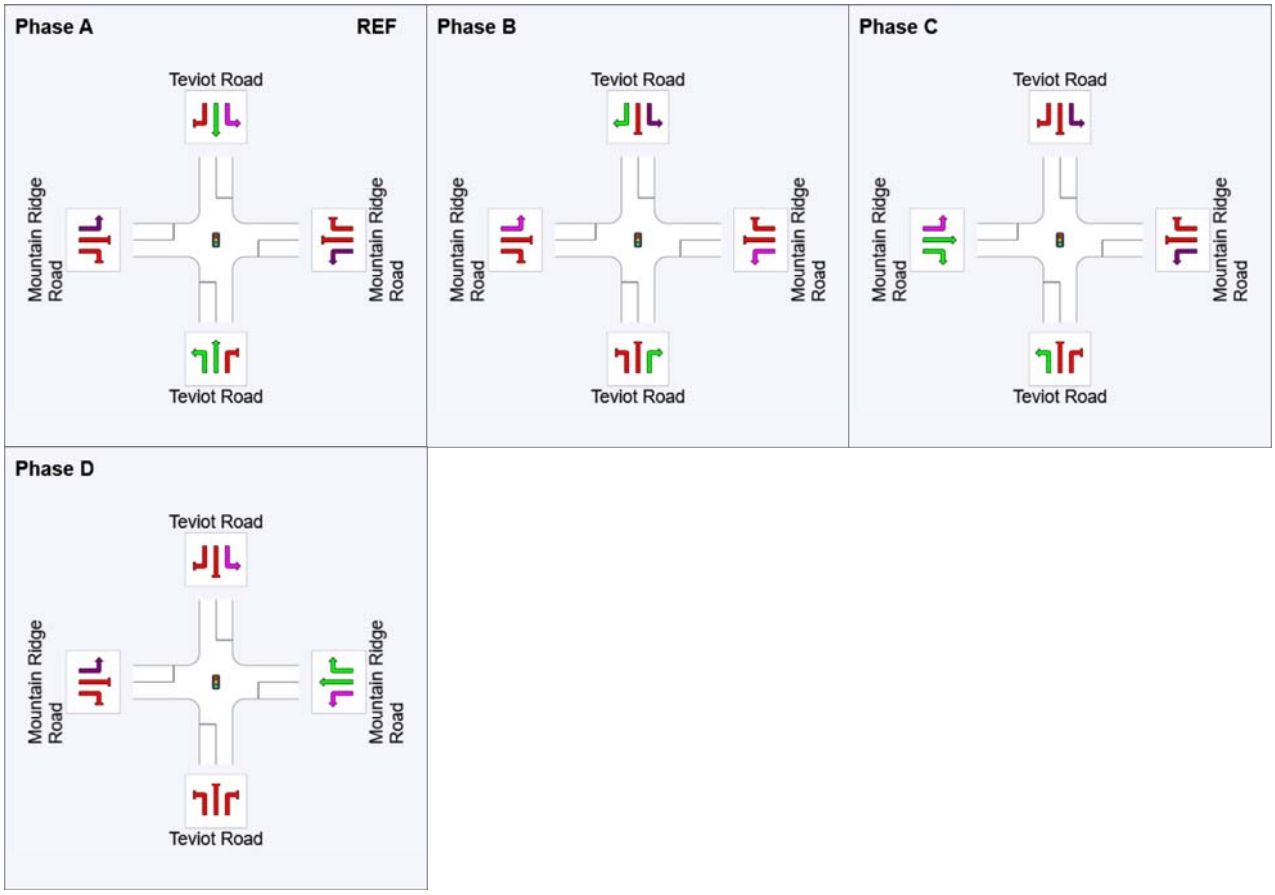
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, F1*, F2*
Output Phase Sequence: A, B, C, D
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	124	136	148
Green Time (sec)	118	6	6	6
Phase Time (sec)	124	12	12	12
Phase Split	78%	8%	8%	8%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

MOVEMENT SUMMARY

Site: 101v [2031 AM Peak | With Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	7	2.0	0.005	9.4	LOS A	0.1	0.5	0.25	0.64	56.8
2	T1	1247	2.0	0.903	18.0	LOS B	74.1	527.3	0.86	0.82	57.3
3	R2	15	2.0	0.164	88.6	LOS F	1.2	8.3	0.99	0.69	25.4
Approach		1269	2.0	0.903	18.8	LOS B	74.1	527.3	0.85	0.81	56.5
East: Mountain Ridge Road											
4	L2	21	2.0	0.016	7.2	LOS A	0.2	1.5	0.18	0.58	57.2
5	T1	9	2.0	0.664	88.8	LOS F	3.8	27.4	1.00	0.79	23.7
6	R2	37	2.0	0.664	94.3	LOS F	3.8	27.4	1.00	0.79	24.3
Approach		67	2.0	0.664	66.3	LOS E	3.8	27.4	0.74	0.72	29.6
North: Teviot Road											
7	L2	20	2.0	0.012	7.6	LOS A	0.1	0.5	0.09	0.62	59.2
8	T1	434	2.0	0.311	8.2	LOS A	11.7	83.1	0.38	0.34	67.9
9	R2	81	2.0	0.885	101.5	LOS F	7.1	50.6	1.00	0.92	23.3
Approach		535	2.0	0.885	22.3	LOS C	11.7	83.1	0.47	0.44	52.4
West: Mountain Ridge Road											
10	L2	307	2.0	0.876	71.9	LOS E	27.2	193.5	1.00	1.00	28.5
11	T1	5	2.0	0.448	86.8	LOS F	2.5	18.0	1.00	0.72	24.0
12	R2	26	2.0	0.448	92.4	LOS F	2.5	18.0	1.00	0.72	24.6
Approach		338	2.0	0.876	73.7	LOS E	27.2	193.5	1.00	0.97	28.1
All Vehicles		2209	2.0	0.903	29.5	LOS C	74.1	527.3	0.78	0.74	47.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [2031 AM Peak | With Development (Reassigned Vols)]

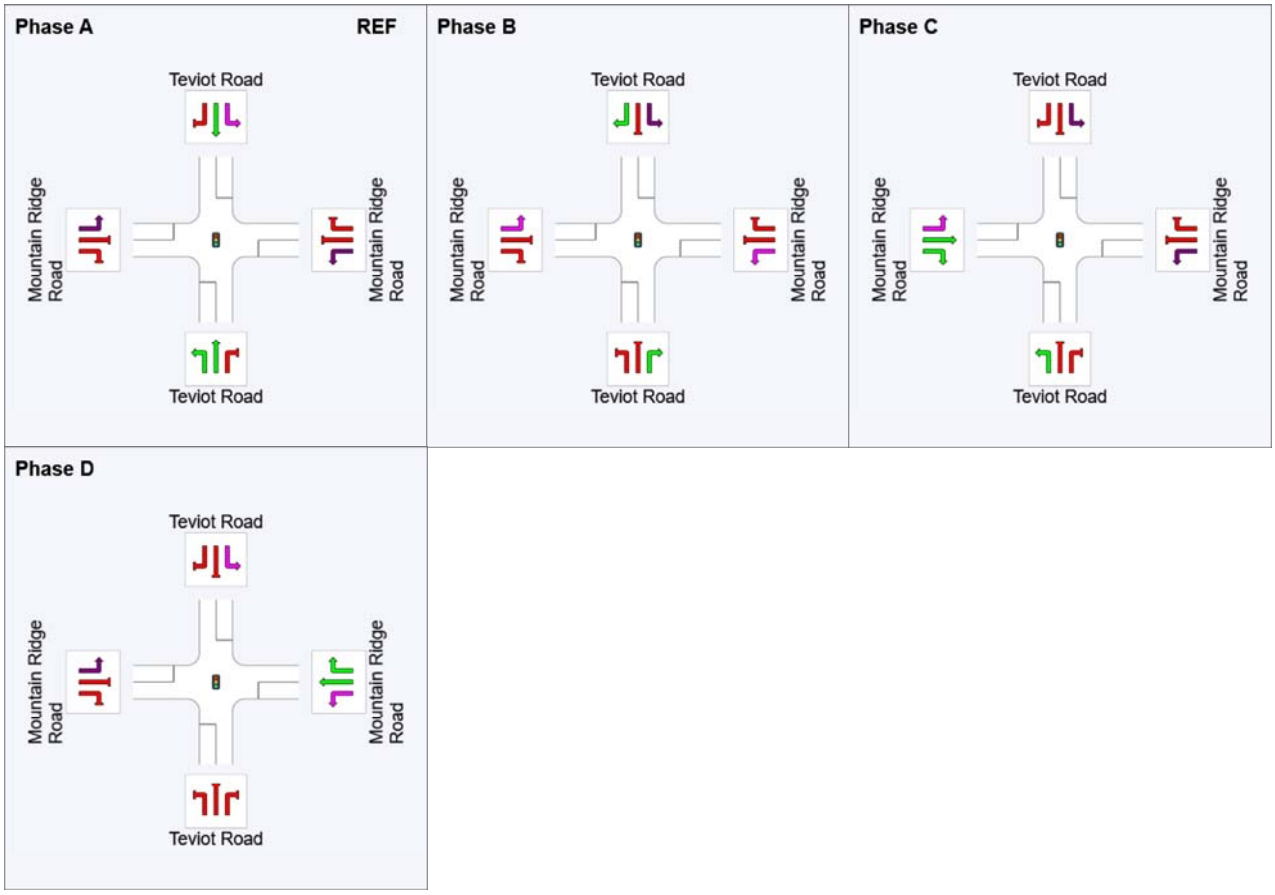
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, F1*, F2*
Output Phase Sequence: A, B, C, D
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	122	136	148
Green Time (sec)	116	8	6	6
Phase Time (sec)	122	14	12	12
Phase Split	76%	9%	8%	8%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

MOVEMENT SUMMARY

Site: 101v [2031 PM Peak | With Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	20	2.0	0.020	18.1	LOS B	0.5	3.7	0.48	0.68	50.0
2	T1	508	2.0	0.539	27.9	LOS C	26.0	185.3	0.72	0.65	49.6
3	R2	19	2.0	0.277	92.6	LOS F	1.5	10.9	1.00	0.70	24.7
Approach		547	2.0	0.539	29.8	LOS C	26.0	185.3	0.72	0.65	48.0
East: Mountain Ridge Road											
4	L2	15	2.0	0.049	58.0	LOS E	0.9	6.5	0.85	0.69	32.0
5	T1	6	2.0	0.433	86.7	LOS F	2.5	17.4	1.00	0.72	24.1
6	R2	24	2.0	0.433	92.3	LOS F	2.5	17.4	1.00	0.72	24.7
Approach		45	2.0	0.433	80.1	LOS F	2.5	17.4	0.95	0.71	26.6
North: Teviot Road											
7	L2	40	2.0	0.024	7.7	LOS A	0.2	1.1	0.09	0.63	59.2
8	T1	1351	2.0	1.110	261.7	LOS F	251.4	1790.2	1.00	1.99	11.8
9	R2	270	2.0	0.638	61.8	LOS E	14.4	102.6	0.96	0.94	31.2
Approach		1661	2.0	1.110	223.1	LOS F	251.4	1790.2	0.97	1.79	13.4
West: Mountain Ridge Road											
10	L2	125	2.0	0.122	10.4	LOS B	2.4	16.8	0.31	0.64	54.5
11	T1	5	2.0	0.200	85.1	LOS F	1.1	8.0	1.00	0.69	24.5
12	R2	9	2.0	0.200	90.6	LOS F	1.1	8.0	1.00	0.69	25.1
Approach		139	2.0	0.200	18.3	LOS B	2.4	16.8	0.38	0.64	48.7
All Vehicles		2392	2.0	1.110	164.3	LOS F	251.4	1790.2	0.88	1.44	17.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [2031 PM Peak | With Development (Reassigned Vols)]

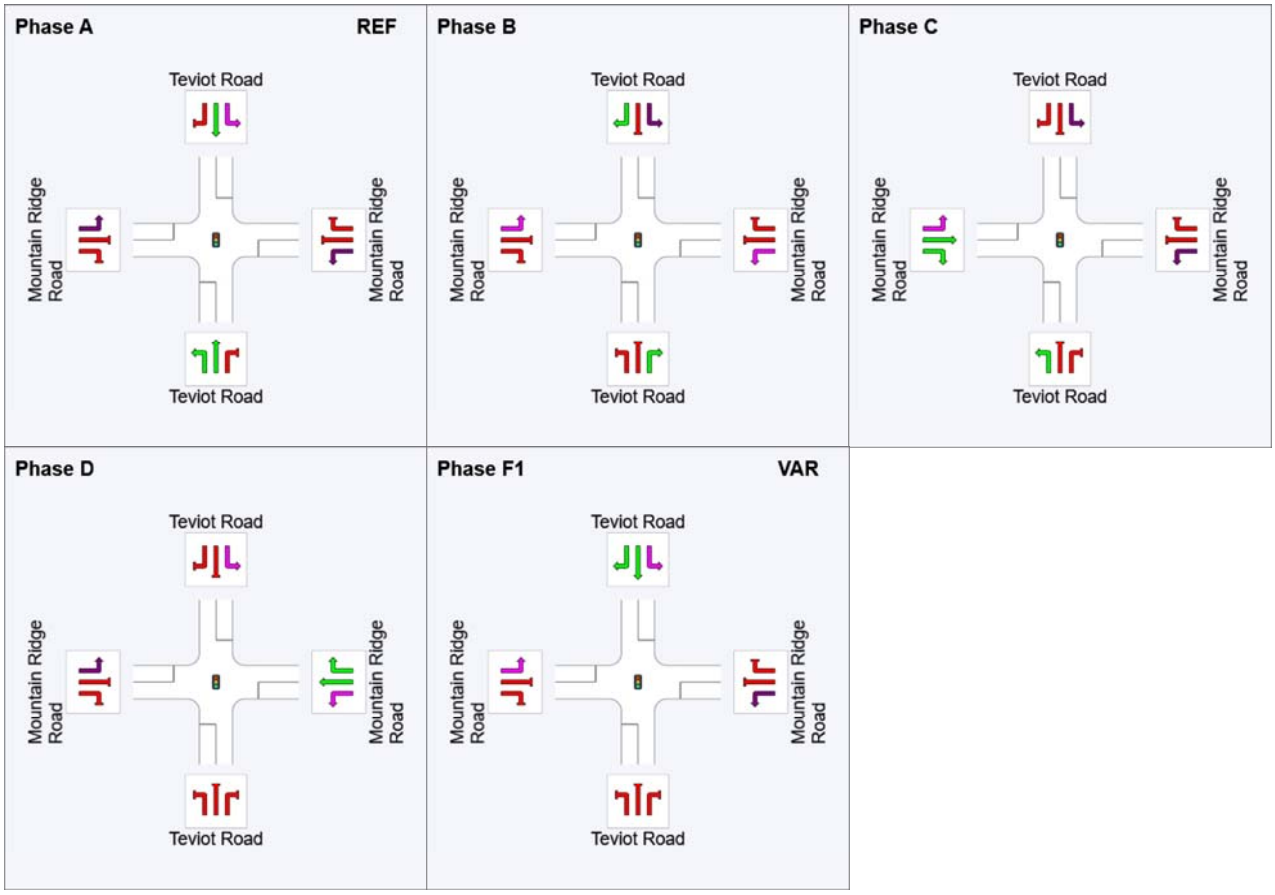
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, F1*, F2*
Output Phase Sequence: A, B, C, D, F1*
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D	F1
Phase Change Time (sec)	0	87	99	111	123
Green Time (sec)	81	6	6	6	31
Phase Time (sec)	87	12	12	12	37
Phase Split	54%	8%	8%	8%	23%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

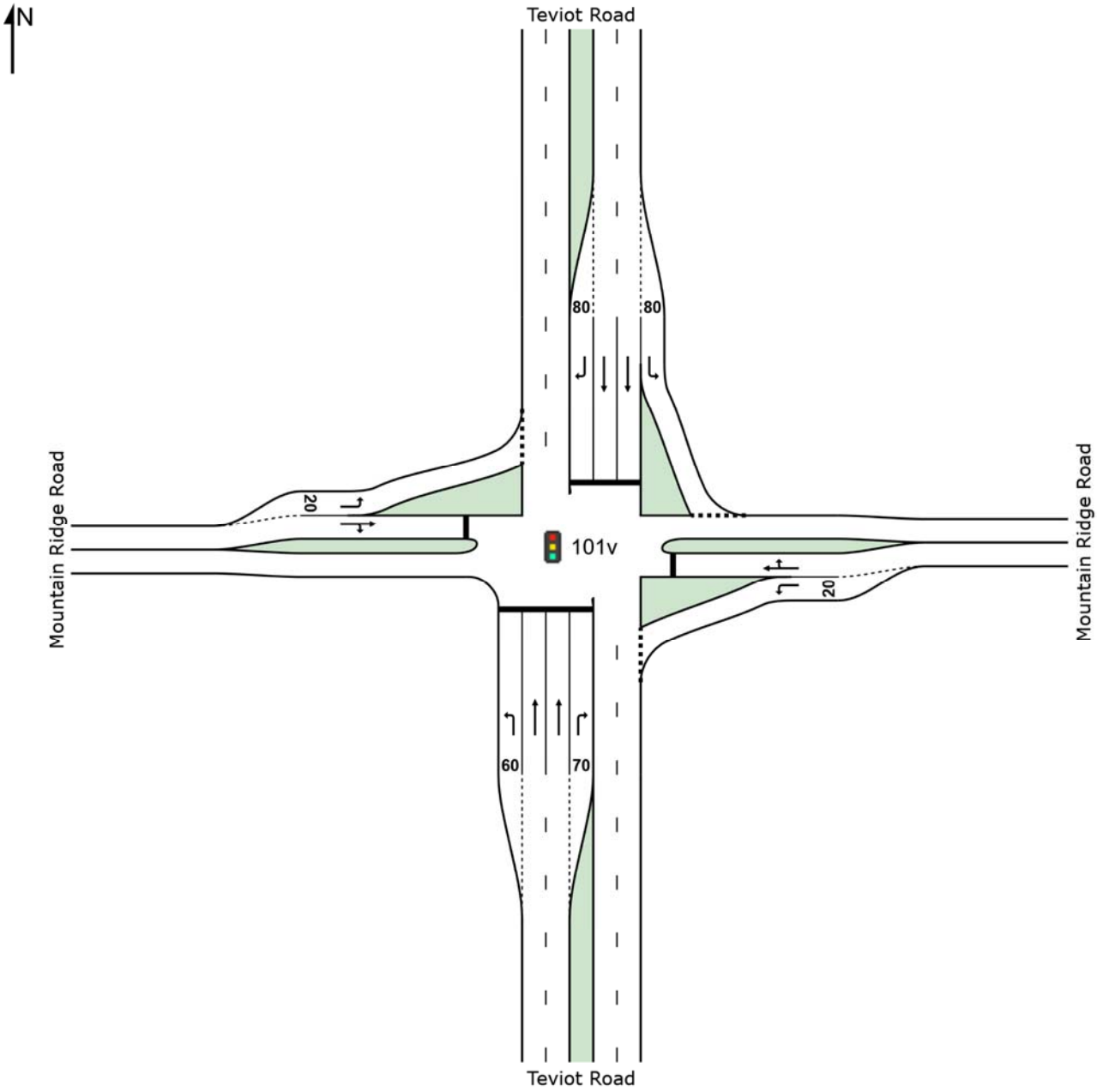


REF: Reference Phase
VAR: Variable Phase

SITE LAYOUT

Site: 101v [2031 AM Peak (4-lanes) | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated



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MOVEMENT SUMMARY

Site: 101v [2031 AM Peak (4-lanes) | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	1	2.0	0.001	12.0	LOS B	0.0	0.1	0.52	0.61	54.6
2	T1	1247	2.0	0.813	24.6	LOS C	21.5	153.1	0.95	0.92	51.9
3	R2	15	2.0	0.096	40.7	LOS D	0.5	3.6	0.95	0.69	38.2
Approach		1263	2.0	0.813	24.8	LOS C	21.5	153.1	0.95	0.92	51.7
East: Mountain Ridge Road											
4	L2	21	2.0	0.017	6.9	LOS A	0.1	0.8	0.26	0.59	57.5
5	T1	6	2.0	0.272	34.7	LOS C	1.5	10.5	0.97	0.73	36.5
6	R2	37	2.0	0.272	40.3	LOS D	1.5	10.5	0.97	0.73	38.0
Approach		64	2.0	0.272	28.8	LOS C	1.5	10.5	0.74	0.68	42.6
North: Teviot Road											
7	L2	20	2.0	0.014	7.9	LOS A	0.1	0.4	0.18	0.63	58.8
8	T1	434	2.0	0.282	15.4	LOS B	5.0	35.9	0.72	0.60	59.8
9	R2	6	2.0	0.038	40.1	LOS D	0.2	1.4	0.94	0.65	38.4
Approach		460	2.0	0.282	15.4	LOS B	5.0	35.9	0.70	0.60	59.3
West: Mountain Ridge Road											
10	L2	3	2.0	0.004	11.5	LOS B	0.0	0.3	0.48	0.60	53.6
11	T1	1	2.0	0.012	32.6	LOS C	0.1	0.5	0.93	0.59	38.0
12	R2	1	2.0	0.012	38.2	LOS D	0.1	0.5	0.93	0.59	39.6
Approach		5	2.0	0.012	21.1	LOS C	0.1	0.5	0.66	0.59	46.5
All Vehicles		1792	2.0	0.813	22.5	LOS C	21.5	153.1	0.88	0.83	53.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [2031 AM Peak (4-lanes) | Without Development (Reassigned Vols)]

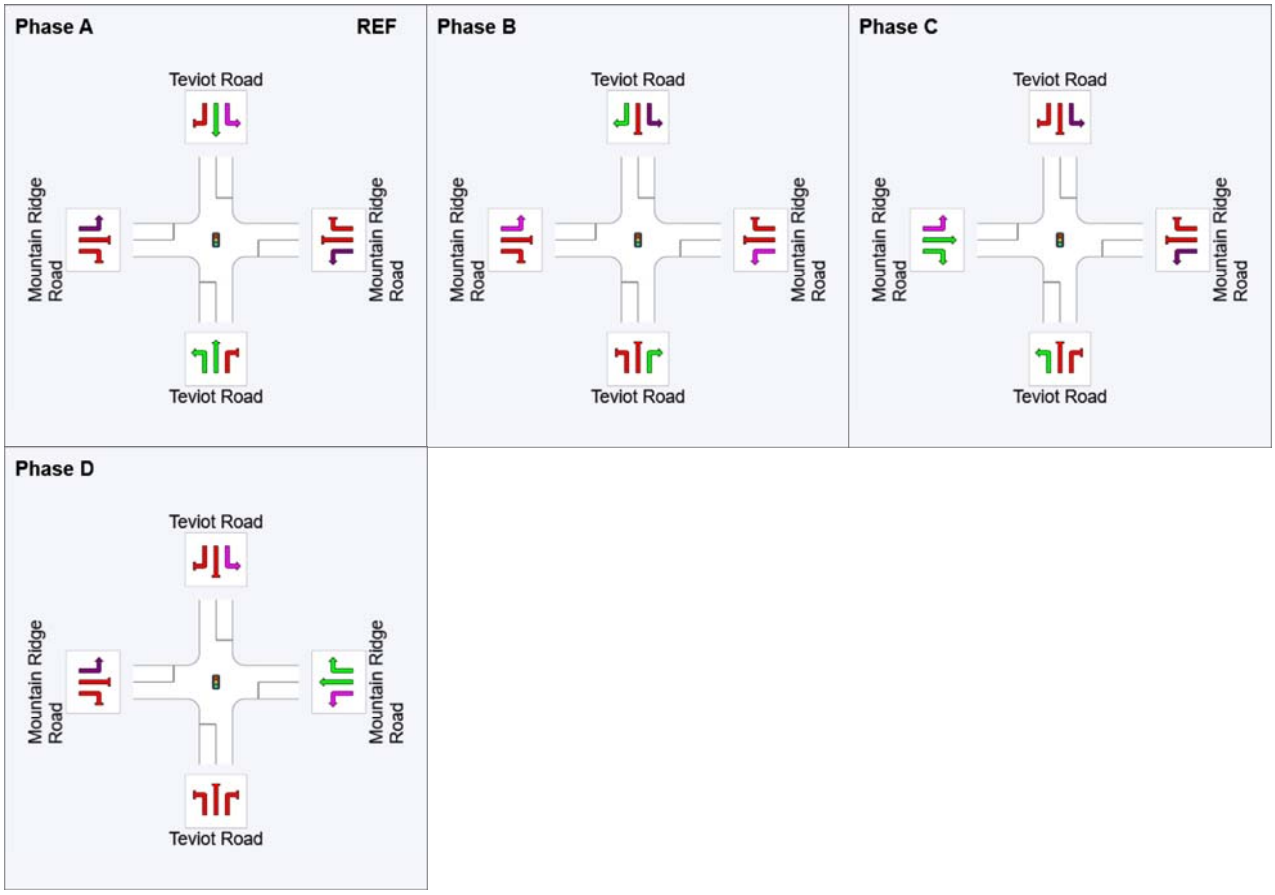
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, F1*, F2*
Output Phase Sequence: A, B, C, D
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	34	46	58
Green Time (sec)	28	6	6	6
Phase Time (sec)	34	12	12	12
Phase Split	49%	17%	17%	17%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

MOVEMENT SUMMARY

Site: 101v [2031 PM Peak (4-lanes) | Without Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	1	2.0	0.001	12.0	LOS B	0.0	0.1	0.52	0.61	54.6
2	T1	508	2.0	0.330	15.7	LOS B	6.0	43.0	0.73	0.62	59.5
3	R2	19	2.0	0.121	40.8	LOS D	0.6	4.5	0.95	0.70	38.2
Approach		528	2.0	0.330	16.6	LOS B	6.0	43.0	0.74	0.62	58.3
East: Mountain Ridge Road											
4	L2	15	2.0	0.017	12.0	LOS B	0.2	1.5	0.51	0.63	53.2
5	T1	2	2.0	0.165	34.1	LOS C	0.9	6.3	0.96	0.70	36.6
6	R2	24	2.0	0.165	39.7	LOS D	0.9	6.3	0.96	0.70	38.0
Approach		41	2.0	0.165	29.3	LOS C	0.9	6.3	0.79	0.68	42.4
North: Teviot Road											
7	L2	40	2.0	0.028	7.9	LOS A	0.1	0.9	0.18	0.64	58.8
8	T1	1351	2.0	0.879	31.7	LOS C	27.1	193.0	0.99	1.05	47.2
9	R2	1	2.0	0.006	39.4	LOS D	0.0	0.2	0.93	0.59	38.7
Approach		1392	2.0	0.879	31.0	LOS C	27.1	193.0	0.97	1.03	47.4
West: Mountain Ridge Road											
10	L2	10	2.0	0.010	7.0	LOS A	0.1	0.4	0.27	0.59	57.3
11	T1	1	2.0	0.019	32.8	LOS C	0.1	0.7	0.94	0.61	37.6
12	R2	2	2.0	0.019	38.4	LOS D	0.1	0.7	0.94	0.61	39.2
Approach		13	2.0	0.019	13.8	LOS B	0.1	0.7	0.42	0.59	51.6
All Vehicles		1974	2.0	0.879	27.0	LOS C	27.1	193.0	0.90	0.91	49.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [2031 PM Peak (4-lanes) | Without Development (Reassigned Vols)]

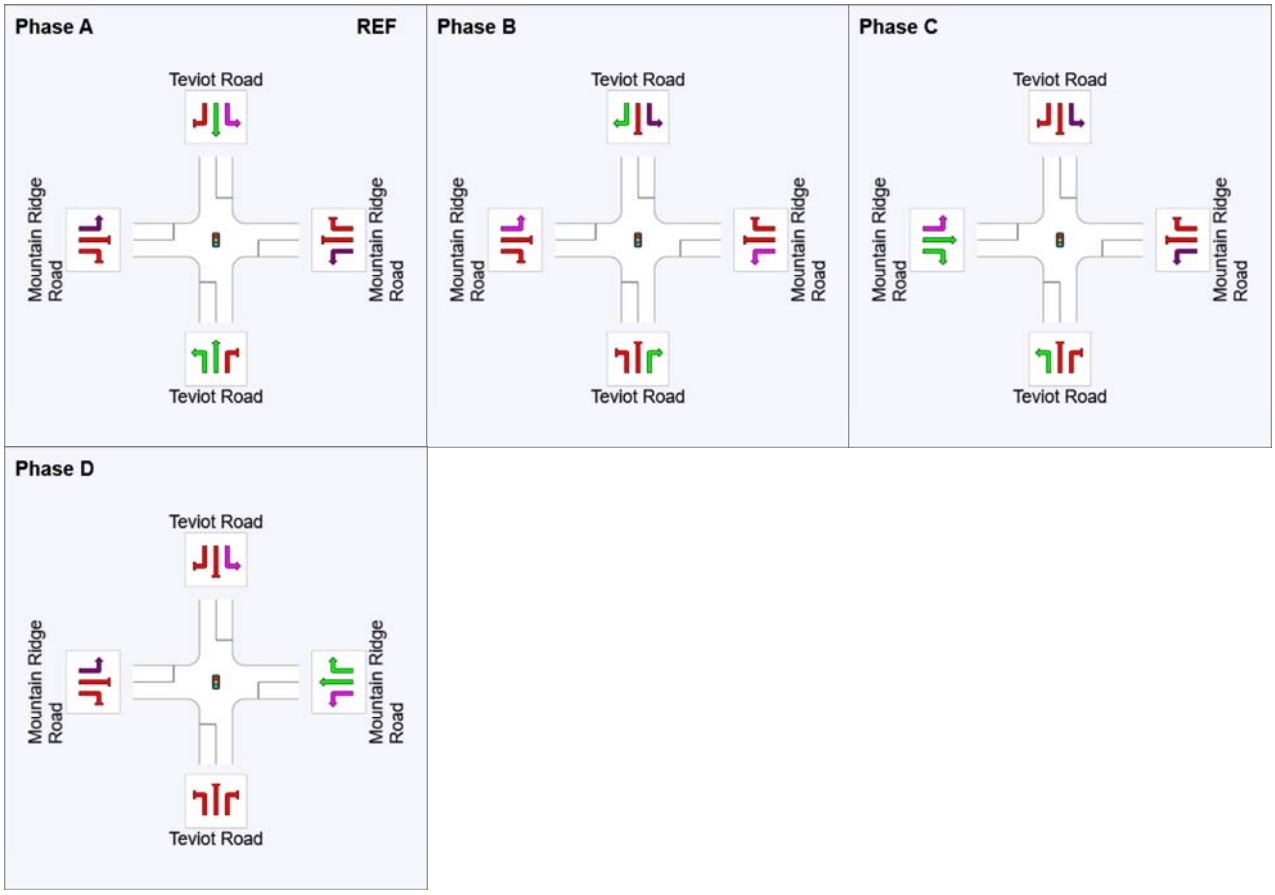
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, F1*, F2*
Output Phase Sequence: A, B, C, D
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	34	46	58
Green Time (sec)	28	6	6	6
Phase Time (sec)	34	12	12	12
Phase Split	49%	17%	17%	17%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

MOVEMENT SUMMARY

Site: 101v [2031 AM Peak (4-lanes) | With Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	7	2.0	0.008	12.1	LOS B	0.1	0.5	0.53	0.65	54.5
2	T1	1247	2.0	0.814	24.7	LOS C	21.5	153.1	0.95	0.92	51.9
3	R2	15	2.0	0.096	40.7	LOS D	0.5	3.6	0.95	0.69	38.2
Approach		1269	2.0	0.814	24.8	LOS C	21.5	153.1	0.95	0.92	51.7
East: Mountain Ridge Road											
4	L2	21	2.0	0.018	7.0	LOS A	0.1	0.9	0.27	0.60	57.3
5	T1	9	2.0	0.290	34.7	LOS C	1.6	11.3	0.97	0.73	36.6
6	R2	37	2.0	0.290	40.3	LOS D	1.6	11.3	0.97	0.73	38.1
Approach		67	2.0	0.290	29.1	LOS C	1.6	11.3	0.75	0.69	42.3
North: Teviot Road											
7	L2	20	2.0	0.014	7.9	LOS A	0.1	0.4	0.18	0.63	58.8
8	T1	434	2.0	0.282	15.4	LOS B	5.0	35.9	0.72	0.60	59.8
9	R2	81	2.0	0.516	42.8	LOS D	2.9	20.5	1.00	0.77	37.4
Approach		535	2.0	0.516	19.2	LOS B	5.0	35.9	0.74	0.62	54.8
West: Mountain Ridge Road											
10	L2	307	2.0	0.433	13.5	LOS B	5.4	38.5	0.65	0.75	52.1
11	T1	5	2.0	0.196	34.3	LOS C	1.1	7.5	0.96	0.71	36.7
12	R2	26	2.0	0.196	39.9	LOS D	1.1	7.5	0.96	0.71	38.2
Approach		338	2.0	0.433	15.8	LOS B	5.4	38.5	0.67	0.75	50.3
All Vehicles		2209	2.0	0.814	22.2	LOS C	21.5	153.1	0.85	0.81	51.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [2031 AM Peak (4-lanes) | With Development (Reassigned Vols)]

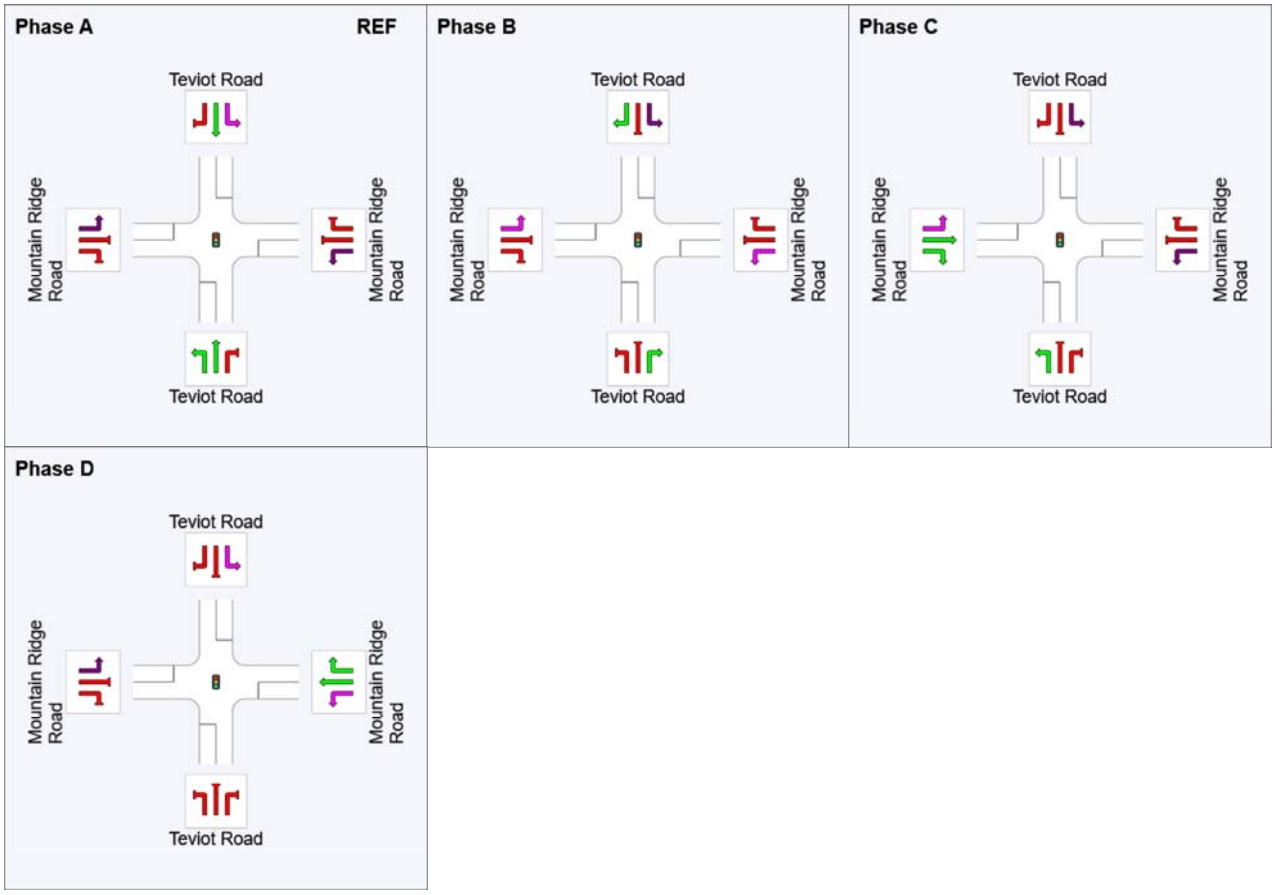
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 70 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, F1*, F2*
Output Phase Sequence: A, B, C, D
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	34	46	58
Green Time (sec)	28	6	6	6
Phase Time (sec)	34	12	12	12
Phase Split	49%	17%	17%	17%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

MOVEMENT SUMMARY

Site: 101v [2031 PM Peak (4-lanes) | With Development (Reassigned Vols)]

Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 75 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Teviot Road											
1	L2	20	2.0	0.036	18.0	LOS B	0.3	2.4	0.72	0.69	50.1
2	T1	508	2.0	0.582	28.6	LOS C	8.5	60.7	0.94	0.79	49.1
3	R2	19	2.0	0.130	43.7	LOS D	0.7	4.9	0.96	0.70	37.0
Approach		547	2.0	0.582	28.8	LOS C	8.5	60.7	0.94	0.78	48.6
East: Mountain Ridge Road											
4	L2	15	2.0	0.020	12.4	LOS B	0.2	1.6	0.50	0.63	52.9
5	T1	6	2.0	0.203	37.1	LOS D	1.1	7.8	0.97	0.71	35.7
6	R2	24	2.0	0.203	42.7	LOS D	1.1	7.8	0.97	0.71	37.2
Approach		45	2.0	0.203	31.9	LOS C	1.1	7.8	0.81	0.68	41.0
North: Teviot Road											
7	L2	40	2.0	0.027	7.9	LOS A	0.1	0.9	0.17	0.64	58.9
8	T1	1351	2.0	0.802	23.0	LOS C	23.6	168.2	0.93	0.89	53.2
9	R2	270	2.0	0.691	23.8	LOS C	5.2	36.9	0.97	0.84	46.4
Approach		1661	2.0	0.802	22.7	LOS C	23.6	168.2	0.92	0.87	52.1
West: Mountain Ridge Road											
10	L2	125	2.0	0.106	7.4	LOS A	0.9	6.5	0.30	0.63	56.9
11	T1	5	2.0	0.094	36.4	LOS D	0.5	3.6	0.95	0.67	36.3
12	R2	9	2.0	0.094	42.0	LOS D	0.5	3.6	0.95	0.67	37.8
Approach		139	2.0	0.106	10.7	LOS B	0.9	6.5	0.37	0.63	54.1
All Vehicles		2392	2.0	0.802	23.6	LOS C	23.6	168.2	0.89	0.83	51.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101v [2031 PM Peak (4-lanes) | With Development (Reassigned Vols)]

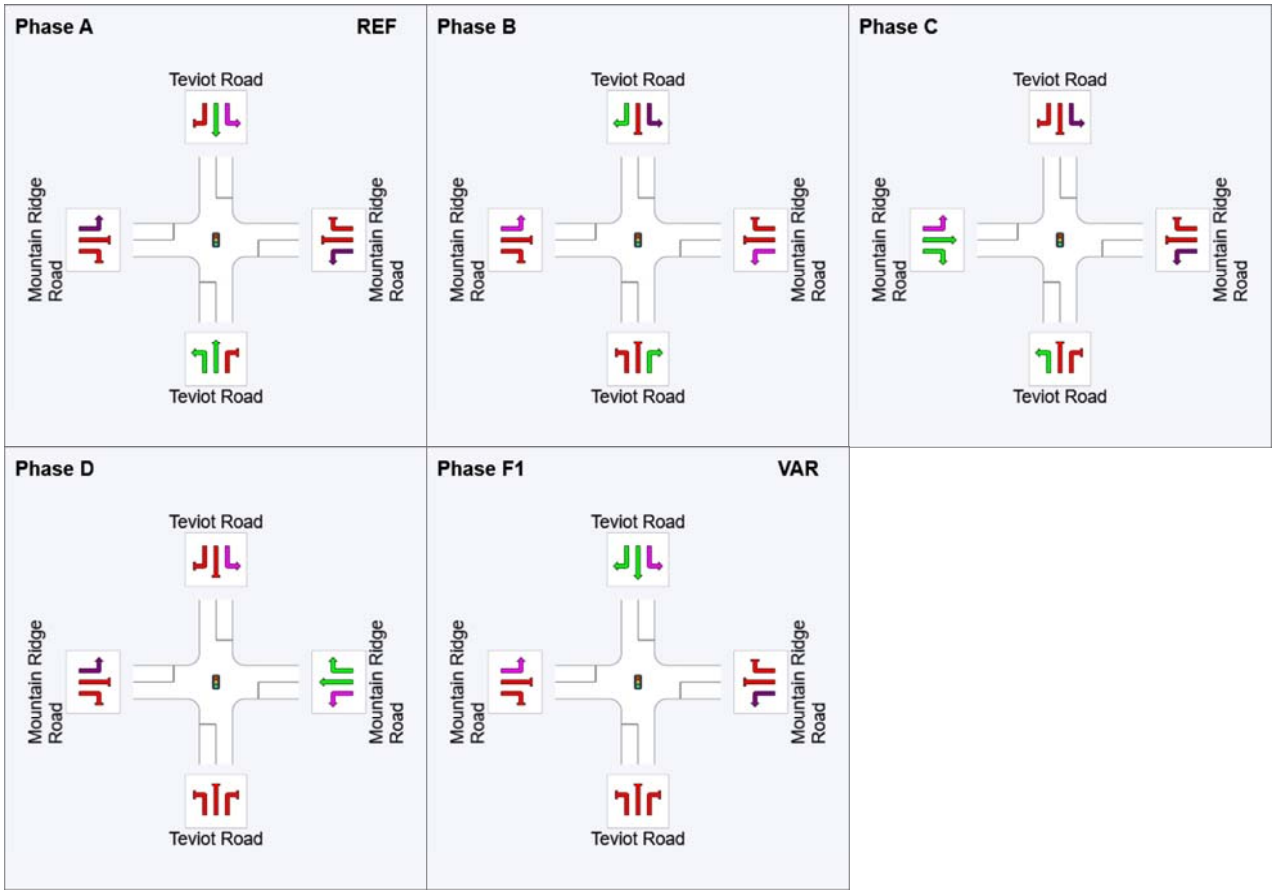
Intersection 1 | Teviot Road / Mountain Ridge Road
Signals - Fixed Time Isolated Cycle Time = 75 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Opposed Turns
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, F1*, F2*
Output Phase Sequence: A, B, C, D, F1*
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D	F1
Phase Change Time (sec)	0	23	35	47	59
Green Time (sec)	17	6	6	6	10
Phase Time (sec)	23	12	12	12	16
Phase Split	31%	16%	16%	16%	21%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

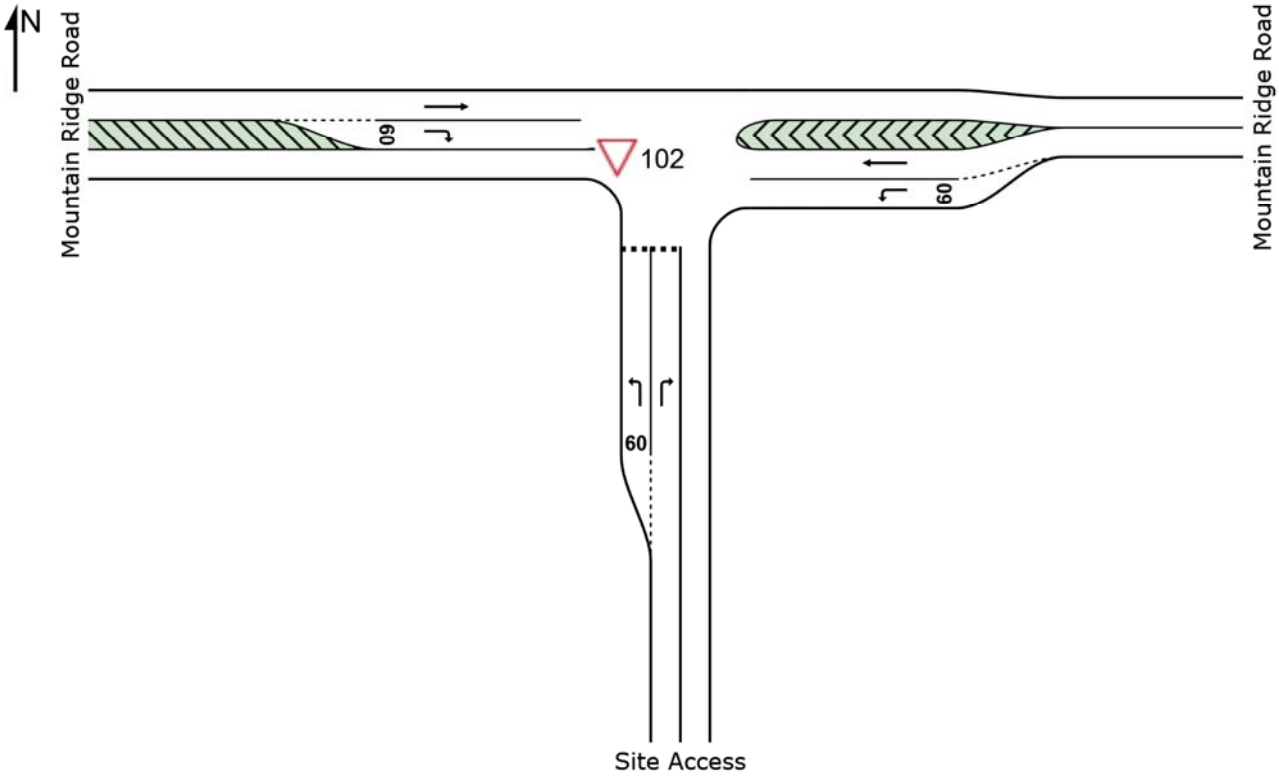
APPENDIX J

INTERSECTION 2: SIDRA ANALYSIS

SITE LAYOUT

Site: 102 [Ultimate | AM Peak]

Intersection 2 | Mountain Ridge Road / Site Access
Giveway / Yield (Two-Way)



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MOVEMENT SUMMARY

Site: 102 [Ultimate | AM Peak]

Intersection 2 | Mountain Ridge Road / Site Access
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Site Access											
1	L2	203	2.0	0.204	7.0	LOS A	0.8	5.7	0.39	0.65	52.3
3	R2	447	2.0	0.505	10.0	LOS A	3.1	22.3	0.63	0.96	50.1
Approach		650	2.0	0.505	9.0	LOS A	3.1	22.3	0.56	0.86	50.8
East: Mountain Ridge Road											
4	L2	110	2.0	0.060	5.6	LOS A	0.0	0.0	0.00	0.58	53.5
5	T1	280	2.0	0.145	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		390	2.0	0.145	1.6	NA	0.0	0.0	0.00	0.16	58.0
West: Mountain Ridge Road											
11	T1	227	2.0	0.118	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R2	85	2.0	0.089	7.4	LOS A	0.4	2.5	0.45	0.67	51.9
Approach		312	2.0	0.118	2.0	NA	0.4	2.5	0.12	0.18	57.5
All Vehicles		1352	2.0	0.505	5.3	NA	3.1	22.3	0.30	0.50	54.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 102 [Ultimate | PM Peak]

Intersection 2 | Mountain Ridge Road / Site Access
Giveway / Yield (Two-Way)

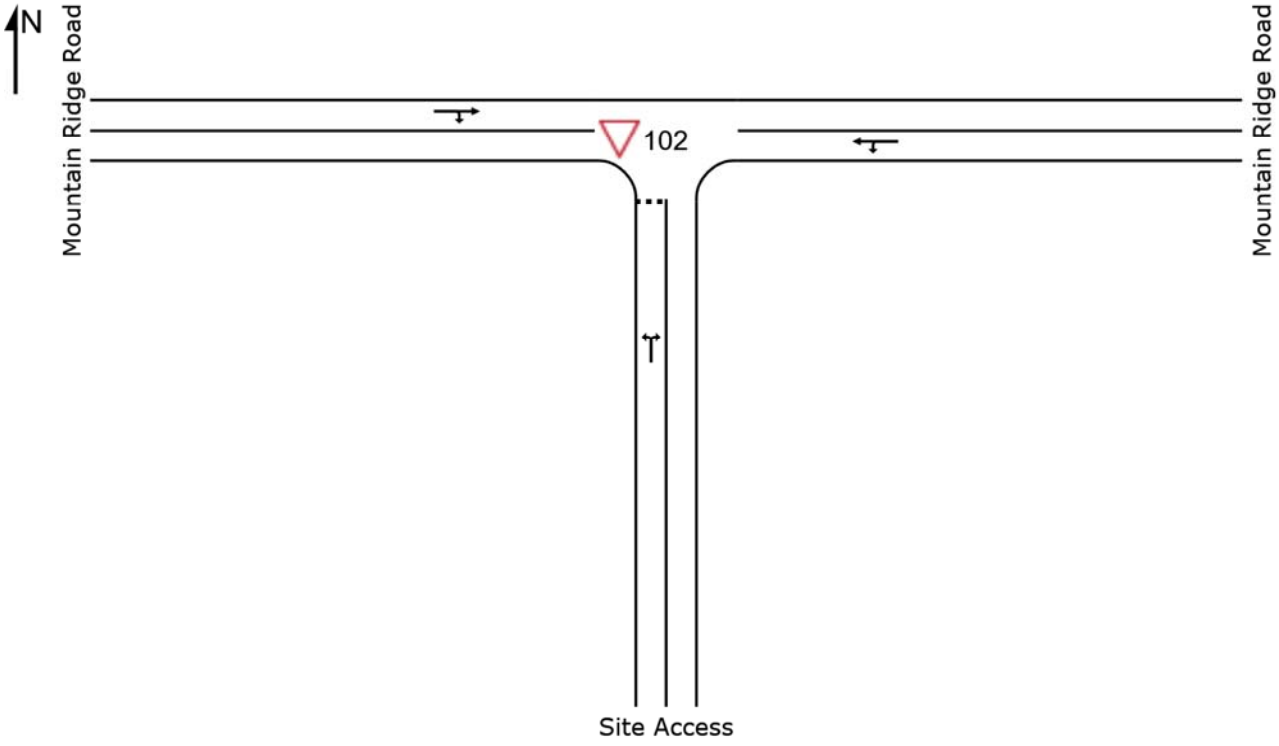
Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Site Access											
1	L2	79	2.0	0.073	6.4	LOS A	0.3	1.9	0.30	0.59	52.6
3	R2	137	2.0	0.194	9.4	LOS A	0.7	5.0	0.60	0.83	50.4
Approach		216	2.0	0.194	8.3	LOS A	0.7	5.0	0.49	0.74	51.2
East: Mountain Ridge Road											
4	L2	478	2.0	0.261	5.6	LOS A	0.0	0.0	0.00	0.58	53.5
5	T1	206	2.0	0.107	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		684	2.0	0.261	3.9	NA	0.0	0.0	0.00	0.40	55.3
West: Mountain Ridge Road											
11	T1	279	2.0	0.145	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R2	159	2.0	0.244	10.2	LOS B	1.0	7.2	0.62	0.85	49.9
Approach		438	2.0	0.244	3.7	NA	1.0	7.2	0.22	0.31	55.9
All Vehicles		1338	2.0	0.261	4.6	NA	1.0	7.2	0.15	0.43	54.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 102 [2031 | AM Peak (Reassigned Vols)]

Intersection 2 | Mountain Ridge Road / Site Access
Giveway / Yield (Two-Way)



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MOVEMENT SUMMARY

Site: 102 [2031 | AM Peak (Reassigned Vols)]

Intersection 2 | Mountain Ridge Road / Site Access
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Site Access											
1	L2	18	2.0	0.184	5.6	LOS A	0.5	3.7	0.08	0.58	53.4
3	R2	334	2.0	0.184	5.5	LOS A	0.5	3.7	0.08	0.58	52.8
Approach		352	2.0	0.184	5.5	LOS A	0.5	3.7	0.08	0.58	52.9
East: Mountain Ridge Road											
4	L2	84	2.0	0.053	5.6	LOS A	0.0	0.0	0.00	0.50	54.1
5	T1	13	2.0	0.053	0.0	LOS A	0.0	0.0	0.00	0.50	55.6
Approach		97	2.0	0.053	4.8	NA	0.0	0.0	0.00	0.50	54.3
West: Mountain Ridge Road											
11	T1	3	2.0	0.004	0.2	LOS A	0.0	0.1	0.18	0.32	56.4
12	R2	4	2.0	0.004	5.7	LOS A	0.0	0.1	0.18	0.32	54.3
Approach		7	2.0	0.004	3.4	NA	0.0	0.1	0.18	0.32	55.2
All Vehicles		456	2.0	0.184	5.4	NA	0.5	3.7	0.06	0.56	53.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 102 [2031 | PM Peak (Reassigned Vols)]

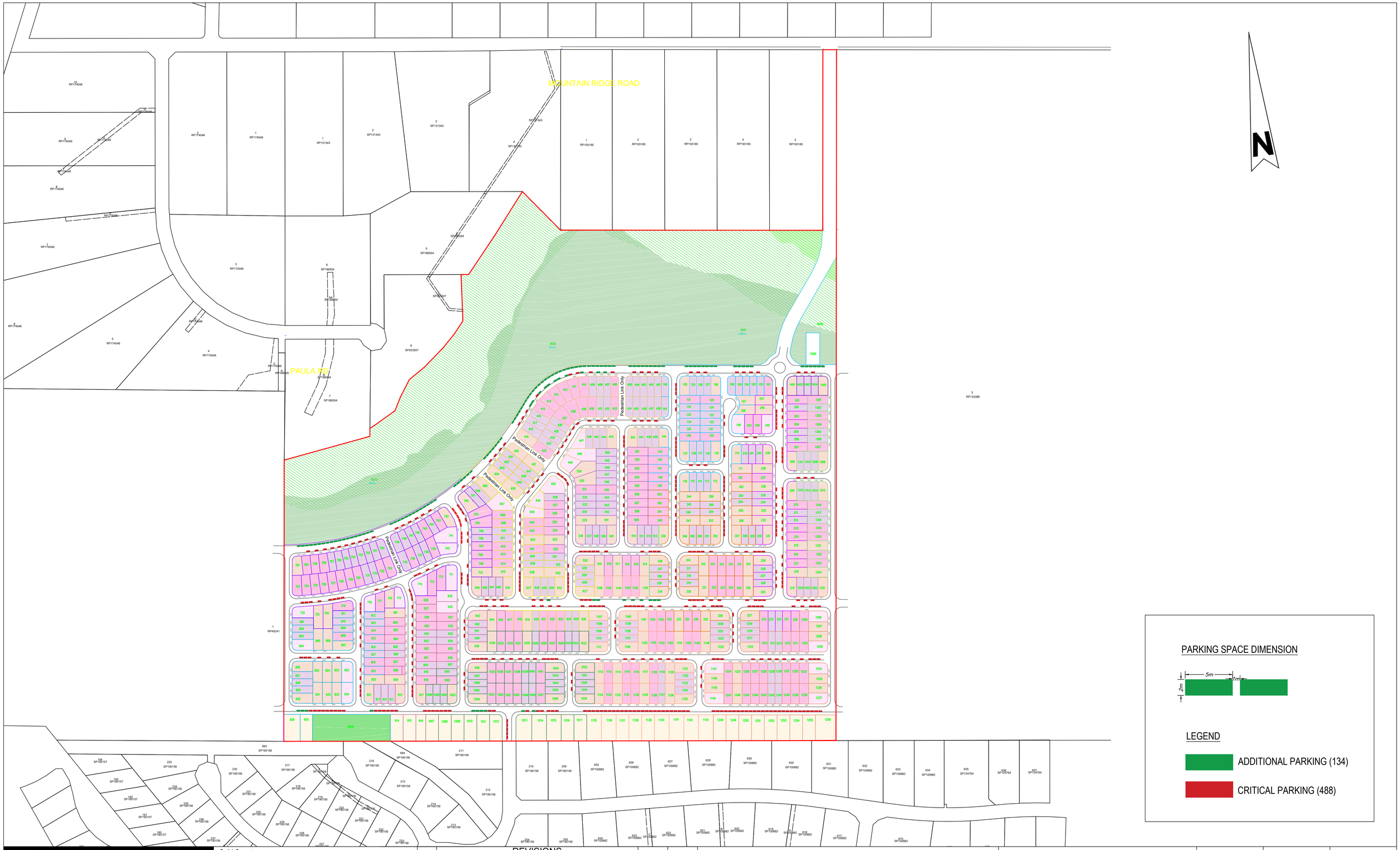
Intersection 2 | Mountain Ridge Road / Site Access
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Site Access											
1	L2	7	2.0	0.073	5.6	LOS A	0.2	1.3	0.03	0.60	53.4
3	R2	126	2.0	0.073	5.7	LOS A	0.2	1.3	0.03	0.60	52.9
Approach		133	2.0	0.073	5.6	LOS A	0.2	1.3	0.03	0.60	52.9
East: Mountain Ridge Road											
4	L2	293	2.0	0.161	5.6	LOS A	0.0	0.0	0.00	0.57	53.5
5	T1	2	2.0	0.161	0.0	LOS A	0.0	0.0	0.00	0.57	55.0
Approach		295	2.0	0.161	5.5	NA	0.0	0.0	0.00	0.57	53.6
West: Mountain Ridge Road											
11	T1	13	2.0	0.018	0.8	LOS A	0.1	0.6	0.34	0.32	56.1
12	R2	15	2.0	0.018	6.4	LOS A	0.1	0.6	0.34	0.32	54.0
Approach		28	2.0	0.018	3.8	NA	0.1	0.6	0.34	0.32	54.9
All Vehicles		456	2.0	0.161	5.5	NA	0.2	1.3	0.03	0.56	53.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

APPENDIX K

PARKING ANALYSIS PLAN



PARKING SPACE DIMENSION

5m × 1m, 2m

LEGEND

- ADDITIONAL PARKING (134)
- CRITICAL PARKING (488)

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Issue	REVISIONS Revisions/Descriptions	Drawn	Date
001	PARKING ANALYSIS PLAN	C.L	06.10.2017
002	PARKING ANALYSIS PLAN	C.L	16.03.2018

Scale @ A3 — 0 50 100 150 200 250 — 1:5000

Project: MOUNTAIN RIDGE ROAD SOUTH
MACLEAN TRAFFIC SERVICES

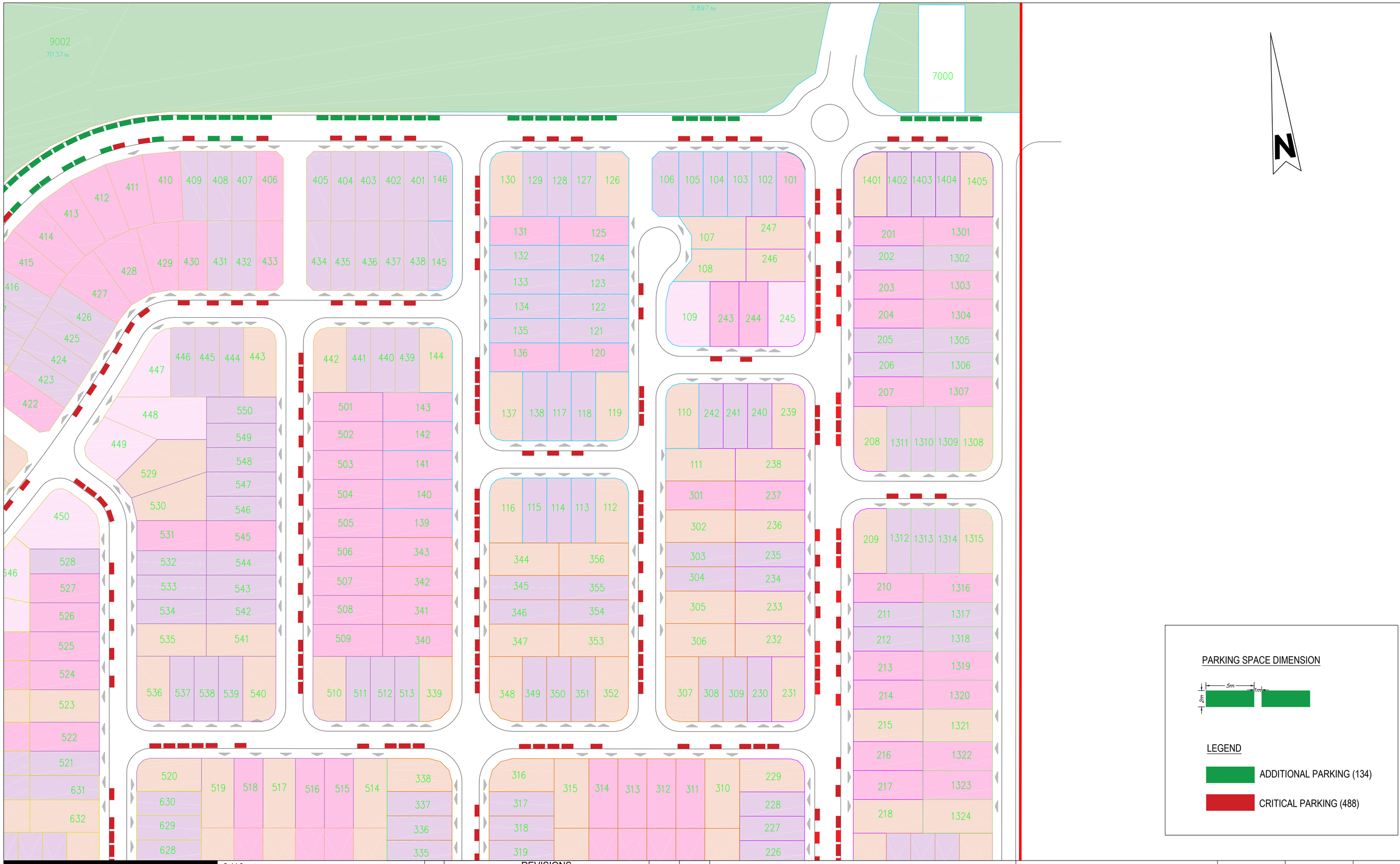
Title: PARKING ANALYSIS PLAN - OVERALL

Design	Drawn	Checked
C.L	C.L	L.D

CONCEPT ONLY

Date: 16.03.2018

Project Number	Sheet Number	Issue
P2895	1	002



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REVISIONS

Issue	Revisions/Descriptions	Drawn	Date
001	PARKING ANALYSIS PLAN	C.L	06.10.2017
002	PARKING ANALYSIS PLAN	C.L	16.03.2018

Scale @ A3 — 0 10 20 30 40 50 60 70 — 1:1500

Project: MOUNTAIN RIDGE ROAD SOUTH
MACLEAN TRAFFIC SERVICES

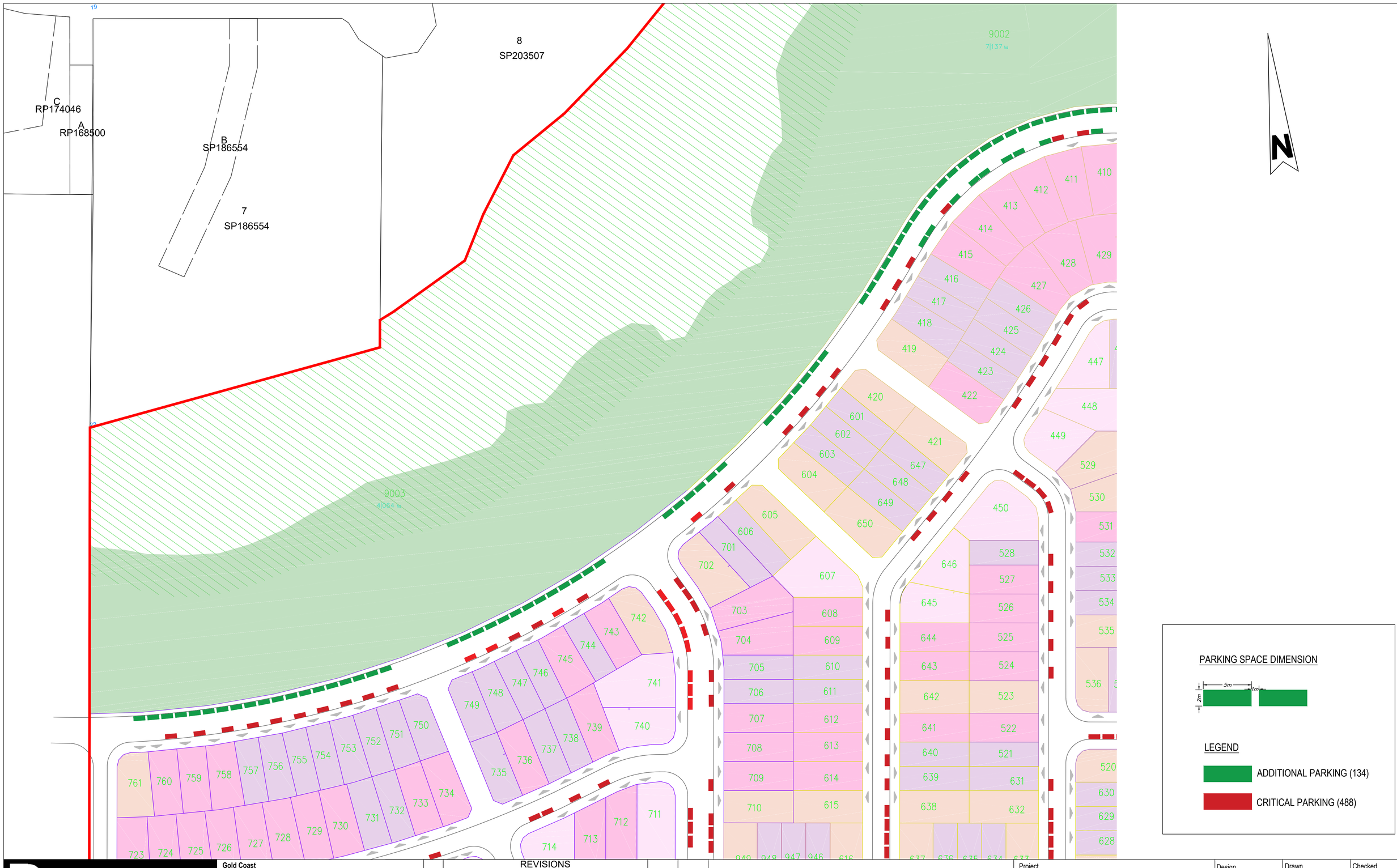
Title: PARKING ANALYSIS PLAN - NORTHEAST

Design	Drawn	Checked
C.L	C.L	L.D

CONCEPT ONLY

Date: 16.03.2018

Project Number	Sheet Number	Issue
P2895	2	002



PARKING SPACE DIMENSION

LEGEND

ADDITIONAL PARKING (134)

CRITICAL PARKING (488)

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REVISIONS

Issue	Revisions/Descriptions	Drawn	Date
001	PARKING ANALYSIS PLAN	C.L	06.10.2017
002	PARKING ANALYSIS PLAN	C.L	16.03.2018

Scale @ A3 — 0 10 20 30 40 50 60 70 — 1:1500

Project: MOUNTAIN RIDGE ROAD SOUTH MACLEAN TRAFFIC SERVICES

Title: PARKING ANALYSIS PLAN - NORTHWEST

Design	Drawn	Checked
C.L	C.L	L.D

CONCEPT ONLY

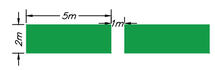
Date: 16.03.2018

Project Number	Sheet Number	Issue
P2895	3	002

1
RP45241

N

PARKING SPACE DIMENSION



LEGEND

ADDITIONAL PARKING (134)

CRITICAL PARKING (488)

993
P190156

994
SP190156

211
SP190156

217
SP190156

A
SP190156

216
SP190156

B
SP190156

215

210
SP190156

209
SP190156

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REVISIONS

Issue	Revisions/Descriptions	Drawn	Date
001	PARKING ANALYSIS PLAN	C.L	06.10.2017
002	PARKING ANALYSIS PLAN	C.L	16.03.2018

Scale @ A3 — 0 10 20 30 40 50 60 70 — 1:1500

Project: MOUNTAIN RIDGE ROAD SOUTH
MACLEAN TRAFFIC SERVICES

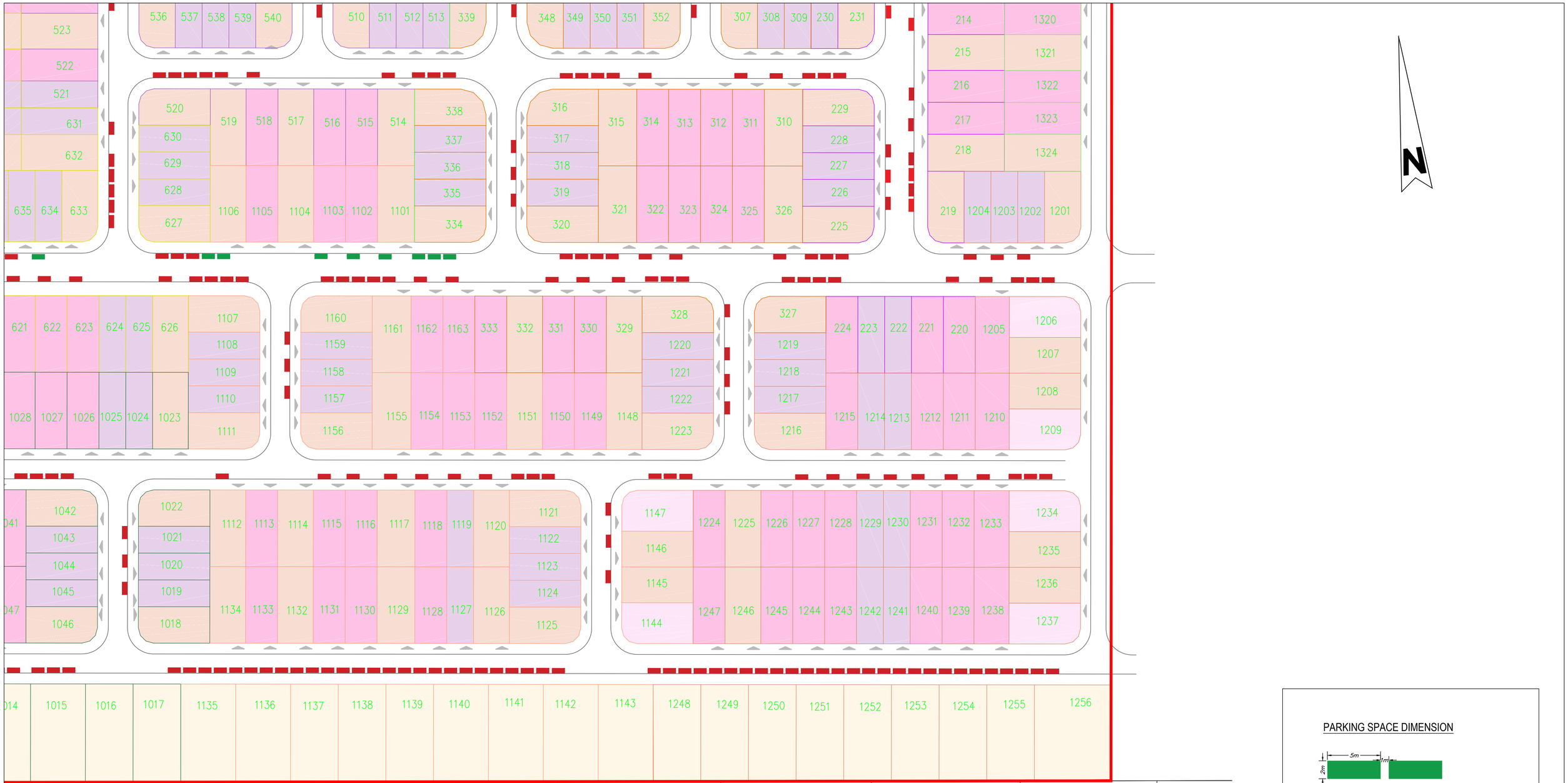
Title: PARKING ANALYSIS PLAN - SOUTHWEST

Design	Drawn	Checked
C.L	C.L	L.D

CONCEPT ONLY

Date: 16.03.2018

Project Number	Sheet Number	Issue
P2895	4	002



209
SP190156

625
SP100882

626
SP100882

627
SP100882

628
SP100882

629
SP100882

630
SP100882

631
SP100882

632
SP100

PARKING SPACE DIMENSION

LEGEND

ADDITIONAL PARKING (134)

CRITICAL PARKING (488)

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Issue	REVISIONS Revisions/Descriptions	Drawn	Date
001	PARKING ANALYSIS PLAN	C.L	06.10.2017
002	PARKING ANALYSIS PLAN	C.L	16.03.2018

Scale @ A3 — 0 10 20 30 40 50 60 70 — 1:1500

Project: MOUNTAIN RIDGE ROAD SOUTH
MACLEAN TRAFFIC SERVICES

Title: PARKING ANALYSIS PLAN - SOUTHEAST

Design	Drawn	Checked
C.L	C.L	L.D

CONCEPT ONLY

Date: 16.03.2018

Project Number	Sheet Number	Issue
P2895	5	002