APPENDIX G6: TRAFFIC IMPACT ASSESSMENT

Balwin Properties Ltd

Jukskei View Ext 128 (Kikuyu Residential Development)

Traffic Impact Assessment

Issue | 4 July 2016

Job number 248841-00

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1 Introduction

Arup (Pty) Ltd was appointed by Balwin Properties Ltd to carry out a traffic impact assessment for the first development phase of Waterfall Heights. The site is earmarked for high density residential development to be delivered in a number of phases. The assessment therefore both considers the short term (first development phase) and long term (full development) scenarios.

Arup previously carried out a traffic impact assessment (TIA) during 2014, when this land was still in the ownership of Waterfall Investment Company. The TIA was in support of a township establishment application on Jukskei View Extension 118 including 1,750 residential units, two schools and some business development rights. This development was approved by both the Johannesburg Roads Agency (JRA) and Gauteng Department of Roads and Transport (GDRT).

The development site is located to the north of the Buccleuch residential area and to the east of the N1 freeway and the K101, which both runs in a northern to southern direction. The site is bounded by the proposed K60 to the north and the K101 to the west. To the south the site is bounded by Maxwell Drive which in the future will extend further to the east. The Gautrain Depot lies to the east of the development site. Figure 1 and Figure 2 includes a site location plan respectively displayed on both Map Studio and aerial photo background. Figure 1 shows development phase one in context of the full development site, while Figure 2 focuses on the first development phase only.

The property was recently sold to Balwin Properties, who intends to develop high density housing on the site up to potentially around 7,000 residential units on the property measuring 111.77 Ha in area.

This traffic impact assessment only addresses the first development phase of the overall development. However, the first development phase will be considered in context of the full development to ensure that sufficient infrastructure is provided to accommodate future demand.

The first development phase will include 1,270 residential units and will be located on a portion of land, of an area 223,129m^2 adjacent to the western boundary of the overall development site as shown in Figure 1. Access to this development site is proposed by extending Maxwell Drive in a south eastern direction.

This report therefore identifies the transportation infrastructure required to accommodate development phase one. This is carried out in context of the full ambition of Balwin Properties to accommodate 7,000 residential units with the ancillary land uses.

2 Approach and methodology

2.1 Waterfall SATURN traffic model

Arup developed a Saturn traffic model for the larger Waterfall area in 2010. Since then the model have been updated at various intervals and is currently the most accurate and comprehensive traffic model available. The model not only takes all the developments within Waterfall into account but also developments within the wider area including Modderfontein, Midrand and Kyalami.

Discussions with the Johannesburg Roads Agency (JRA) have indicated that a network approach should be adopted when considering the impact of the proposed development. The Saturn traffic model is suitable for such an approach as it takes all major developments within the study area into account. It is also a regional model and the strategic impact of adding or removing road links can be determined.

2.2 Model update

A significant amount of land use rights have been approved since 2010 and the TIAs supporting the land use was based on the Saturn traffic model. The approved development rights have only been partially built and is currently in operation.

The JRA proposes that more certainty is required on the accuracy of the transport model by carrying out a new traffic survey.

The Mall of Africa Shopping Centre developed by Atterbury Property Developers opened end of April 2016. This development is one of the largest single developments to open within the area and will have a significant impact on the surrounding road network. The JRA requests that traffic counts should be carried out after traffic has settled. It was agreed with the JRA that these counts should be carried out at the end of May 2016. This information will be used as a new baseline for future traffic studies to be carried out. This will provide a higher level of certainty that the base information is sensible and that forecasts are within acceptable confidence intervals.

However, the above requirement would cause delay in the planning process for the approval of the land use rights. To address this the JRA agreed that this issue could be overcome by carrying out an interim study based on the existing transport model followed by a final study based on the new transport survey information obtained.

In other words the recommendations of the first study will be updated by the findings of the second.

This report represents the first study based on the existing traffic model. The recommendations of this report would therefore be updated after the second study have been completed.

2.3 Extent of the study area

There are major roads within the vicinity of the proposed development site and the impact on the intersections and links of these will need to be understood. The development will impact specifically on the links and intersections that are feeder routes to the development. These include:

Important links	Critical intersections
K60	K60 / K101
	K60 / Development access
	K60 / K111
Maxwell Drive	Maxwell Drive / K101
	Maxwell Drive / Western Access
	Maxwell Drive / Eastern Access
	Maxwell Drive / Future K111

2.4 Peak hours analysed

The critical peak hour or critical traffic scenario from a road capacity point of view occurs when the traffic generated by the development is at peak or when the highest combination of the existing street traffic and traffic generated by the development occurs.

The weekday AM and PM peak hours were analysed for the purpose of this report considering that the intended land use for this development is residential.

On the basis of the traffic count data obtained, the traffic peak hours have been confirmed as being between 07:00 and 08:00 during the morning peak and between 16:00 and 17:00 during the afternoon peak. These peak hours have been used as basis to assess the transport impact of the development.

3 Report structure

This report follows the following structure:

- Section 4 outlines the proposed development and identifies the specific land uses that will form part of the first phase of the development as well as the full development.
- Section 5 discusses the existing road network in terms of strategic roads in the area as well as access roads to the site. The section also discusses the public transport in the vicinity.
- Section 6 discusses the development of the transport model and the update of the Saturn traffic model.
- Section 7 outlines the extent and the expected trip generation of the proposed development.

- Section 8 summarises the results of the intersection capacity analysis of the surrounding road network.
- Section 9 discusses the access to the site and the proposed access configuration.
- Section 10 discusses the proposed walking and cycling facilities for the proposed development.

4 Proposed development

4.1 Development phase one

The first development phase will include 1,270 residential units and will be located on a portion of land, of an area approximately 223,129m^2 adjacent to the western boundary of the overall development site as shown in Figure 1.

The first phase of the development is proposed to gain access by extending Maxwell Drive in an eastern direction as indicated in the drawing and then providing the first section of the proposed north south boulevard that will link Maxwell Drive to the future K60.

4.1.1 Sub phases

For the purpose of this report it is necessary to consider the development in terms of phase 1A and 1B. The reason for this is the provision of the K60 to the north of the site and the temporary road link and underpass to maintain access to the land to the north of the K60. Appendix A shows the temporary road link that will be provided when the K60 is in place. The temporary road link will however become redundant once the full K60/K101 interchange is constructed. The link will be provided as the north approach of the eastern intersection of the proposed Parclow interchange.

To facilitate the temporary road link, development phase 1 will be considered in terms of two sub phases. Phase 1A will be developed first, while phase 1B will only be constructed once the need for the temporary road link is no longer there. Development phase 1A includes 1,160 units while 1B includes the remaining 110 units. This TIA however, will cover the full phase 1, although phase 1B might only be constructed at a later stage.

4.2 Full development of site

The proposal is that the full development will consist of high density housing of potentially around 7,000 residential units as well as educational and business land uses on the property.

It is proposed that three access points be provided for the full development. Two full accesses of Maxwell Drive as well as one full access of the future K60. The access on Maxwell Drive closest to the K101 and the access on the future K60 will be linked to one another by a public road through the development site.

5 Existing transport network

5.1 Introduction

This section outlines the available transport infrastructure within the vicinity of the development site. Roads are discussed in terms of the current road hierarchy within the area, the available lanes on the road and the intersection control available.

In terms of public transport services, the available routes and stops in the vicinity of the site are highlighted.

For both roads and public transport services, any future planning of infrastructure is outlined as well.

5.2 Current road network

5.2.1 Strategic roads

Figure 3 shows the existing network within the vicinity of the development site.

The development is located within the Waterfall area and lies north-east of the Buccleuch interchange – one of the busiest intersections in the Gauteng Province. The Buccleuch interchange connects the N1 North to the N1 Western bypass and the N3 Eastern bypass. The N1 furthermore continues in a southern direction to become the M1 which is the most prominent link to Johannesburg. The freeway system forms the Class 1 road network within the area.

The development site therefore is strategically well located as the location provides future residents a variety of route choice, for both local and long distance trips to employment, education, shopping and other opportunities. This makes the area as a living location highly desirable.

There are two access interchanges that can be used by future residents to gain access to the freeway system or depart from it. The K58 Allandale interchange are available from the N1 North, while Woodmead Drive / M1 interchange are providing access from the south. The proposed development therefore can be approached from both a northern direction and a southern direction.

The provincial k-routes provide the Class 2 road network within the area. These routes include Allandale Road running in an east to west direction and the K101 running north to south but to the east of the N1 north. These routes eventually will provide three lanes in each direction. Currently sections of these roads are already developed to this standard.

The K60, another east west link is only partially developed in terms of continuity. The section of the road between Maxwell Drive and the K71 is not yet constructed as well as the section crossing the N1 and K101 to link to the section already constructed from Allandale Road up to the Gautrain Depot. However, the section between Maxwell Drive and the K71 is expected to be constructed as part of the Polo Fields development. The continuation of this road is expected to change

traffic patterns significantly within the greater Waterfall area as it provides a new high capacity east west link route that would link Tembisa, Ivory Park and Ebony Park across the N1 freeway to Waterfall, Sunninghill and even Rivonia and Fourways.

Maxwell Drive, linking Allandale Road to the K71 Woodmead Drive (at two locations) and the K60 is a strategic road within the vicinity with a dual function of providing local mobility but also access to the local developments. It is a strategic link in the sense that it provides an alternative route from the N1 freeway to Sunninghill and the northern part of Rivonia. This was not the intended function and it is expected that this function will be partially replaced by the K60 once it is fully in place.

5.2.2 Proposed access

The existing road network within the vicinity at the site does not allow any access options to the proposed development. The section below outlines proposed access for development phase one and also for the full development.

Development phase one (Kikuyu Development):

The Kikuyu development will gain access via extension of Maxwell Drive towards the east. This will result in a conversion of the current three legged intersection of Maxwell Drive / K101 into a four legged intersection. The eastern approach of the intersection will be extended up to Denise Road, which is an existing road serving low density residential development in Buccleuch. An access towards the north will provide access to the Kikuyu development, based on the previous agreed road network with the JRA.

Full development:

The full development will generate a significant volume of traffic. To accommodate this traffic access to the development site will be required from other directions as well and traffic needs to be distributed over a number of access points. Therefore, the road infrastructure proposed for the full development requires that access is also available from the east and north of the site. Therefore, it is proposed that Maxwell Drive is extended until it meets the K113. The K113 also needs to be constructed between Allandale Road and Marlboro Drive (M60) to provide alternative strategic routes to the area from areas such as Tembisa and Kempton Park. In addition the K60 should be fully into place between Sunninghill to the west and Allandale Road in the east. An access from the north (the existing Gautrain Depot access) will be provided from the K60.

5.3 Public transport

Existing public transport is shown in Figure 4 and includes minibus taxis, the metrobus and Gautrain feeder bus.

5.3.1 Current public transport services

Minibus taxis

Minibus taxis are operating along the K101 which forms the western boundary of the proposed development site. Therefore, the taxi services are within close proximity to the site.

Metrobus

The Metrobus service operates along the K101 west of the site as well as along the N1. This is in close proximity of the proposed development. According to the COJ Transportation Register 2012, this bus service is route 7D which links Gandhi Square to Centurion.

Gautrain feeder bus

The Gautrain feeder bus service between Sunninghill and Midrand Station operates along Maxwell Drive, the closest bus stop is about 2km from the proposed development. Therefore, Gautrain feeder buses is not expected to have much of an impact on the proposed development.

5.3.2 Proposed public transport

The City of Johannesburg Department of Transportation is currently developing a future public transport network for the North Eastern Quadrant of Johannesburg. This area includes areas such as Waterfall, Kyalami, Midrand, Modderfontein, Bryanston and Sandton amongst other. This plan is called the Strategic Integrated Transport Network 2014 to 2025 for the Johannesburg North East Quadrant and is restructuring existing and proposed new public transport services within the area. A public transport hierarchy is developed incorporating a range of services from rail services (Gautrain and Metro Rail services) to Bus Rapid Transit (BRT) and normal buses operating within mixed traffic lanes.

Figure 5 shows the Strategic Integrated Public Transport Network for 2014 - 2025. The table below shows the type of public transport proposed and a description of its functionality.

Table 1: Strategic IPTN 2014 - 2025

Type	Description	Functionality
Type A GT	Gautrain	Intercity service: Linking one city with the other
Type B	BRT (high capacity)	Intra-city service: Linking major nodes within the city areas with one another
Type C	BRT (medium capacity)	Connector services: Links between secondary nodes or links between Types A and B
Type D	Bus (mixed traffic)	Local services: Feeder and distributor services, demand responsive services
Type E	Metro Bus	

The Gautrain service is the only type A service available within the vicinity and the nearest station to the development is the Midrand Station. However, the

nearest Gautrain Feeder Bus service towards this station is approximately 2km from the site.

A type B service, (high capacity BRT) is proposed to run east west along New Road to the north of the development site. This service is located too far away from the development site to directly serve it.

A type C service, (medium capacity BRT) is proposed to run along the K101, and therefore bypassing the proposed development site. This service links Alexandra via Midrand to Rooihuiskraal in the north.

A type E service, (local Metro buses) is proposed along Maxwell Drive from the development site linking to Sunninghill.

5.4 Non-motorised transport facilities

Currently there are no non-motorised transport facilities in the vicinity of the site. The area is still developing and it is expected that this development will also add to the non-motorised transport being used and therefore non-motorised transport facilities would be required in the area.

5.5 Existing traffic volumes

Traffic counts were carried out in 2013 on the surrounding road network and was used to calibrate the Saturn Traffic Model. It is proposed that additional traffic counts are carried out after the Mall of Africa development is in place and traffic patterns have settled. Traffic counts will be carried out at all strategic intersections within the Waterfall area. Within the vicinity of the proposed development, counts will be carried out at the following intersections:

- Maxwell Drive / Woodmead Drive;
- Maxwell Drive / K101;
- K101 / Allandale Road;
- Allandale Road / Alsatian Road; and
- Allandale Road / Dane Road.

For the purpose of this report, the discussion on the existing traffic volumes on the road network will revert to the 2013 traffic volumes. These counts were used to calibrate the SATURN traffic model and are shown in Figure 6 and Figure 7.

5.5.1 AM peak traffic volumes

Figure 6 shows the 2013 AM peak traffic counts on the road network within the vicinity of the proposed development. As can be expected, during the AM peak the main movement are in a southbound direction towards the Johannesburg region with high volumes of traffic turning right at the intersection from the K101 onto Maxwell Drive westbound.

5.5.2 PM peak traffic volumes

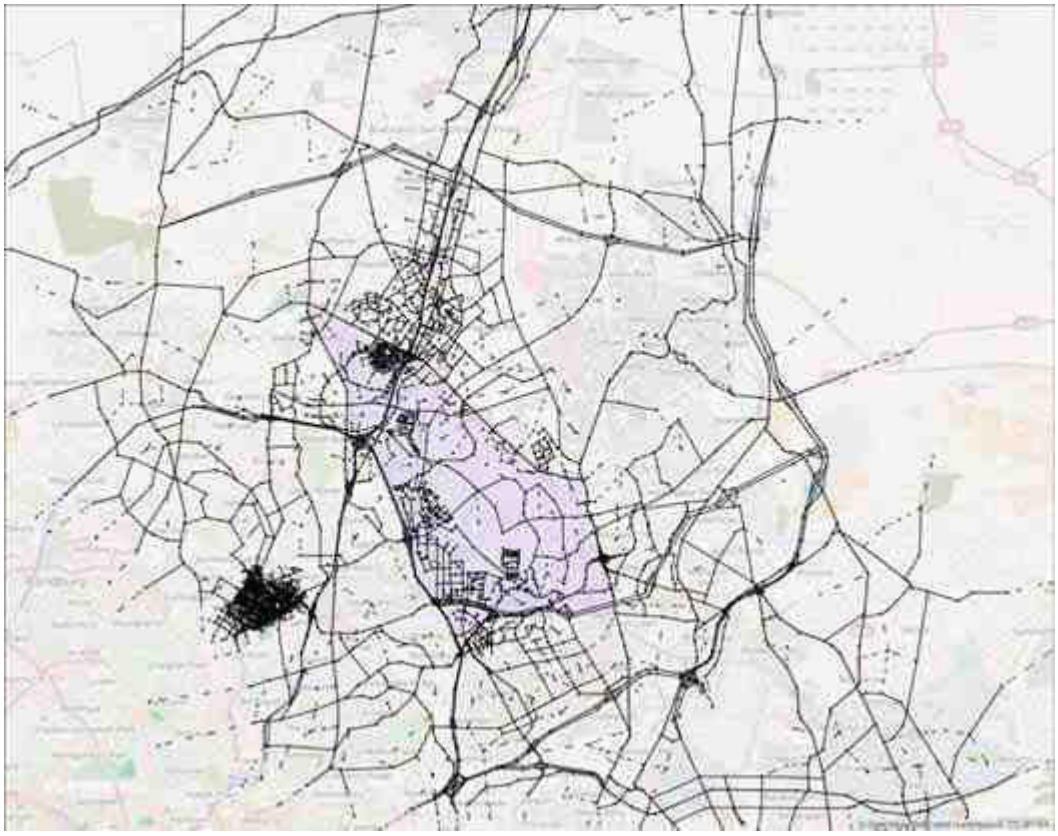
Figure 7 shows the 2013 PM peak traffic counts on the road network within the vicinity of the proposed development. During the PM peak the opposite is true that during the AM with the main movement being towards the north. The highest movement is the left turn movement at the intersection from Maxwell Drive onto the K101.

6 Transport model development

Atterbury Property Developers commissioned Arup to develop a SATURN traffic model in 2009. In agreement with SANRAL, Johannesburg North and East area, including Waterfall, Modderfontein, Sunninghill, Rivonia and Sandton areas were extracted from the Gauteng Freeway Integrated Planning (GFIP) model. This is a highly sophisticated model taking regional movement patterns in Gauteng into account.

The extent of the traffic model is shown in the image below. The core of the model includes a detailed network and traffic zones of the Waterfall and Modderfontein area. However, the model is also strategic in nature to include large part of Ekurhuleni, Midrand, Centurion and Johannesburg North. This large extent of the model allows for strategic route choice on regional scale. In other words, the impact of adding or omitting links on the road network can be determined by the model.

Image 1: Extent of the SATURN North Eastern Johannesburg traffic model



The traffic model was refined and converted from a link based (or buffer) model to a traffic simulation model, representing turning movements at intersections. Not only was the road network refined to represent new road infrastructure proposed, but the traffic zones were disaggregated to represent a refined representation of proposed land use within the area.

The traffic model has been in use since 2010 to carry out various traffic studies within the Waterfall and Modderfontein areas. The model was updated in 2013 by calibrating and validating the traffic forecasts based on traffic surveys. While the Waterfall and Modderfontein areas were two separate models previously, the two models were combined in 2013.

The SATURN traffic model takes all major land use developments within the Northern and Eastern Johannesburg into account. The latent development sites contribute jointly to about 25,000 and 30,000 trips on the road network during the AM and PM peak hours, respectively.

Latent traffic in the 2020 scenario include the following developments:

- All committed Waterfall City Developments;
- Zonke' iSizwe Phase 1;
- Long Lake Ext 1;
- Longlake Ext 2-6 (Modderfontein);
- Pinelands / Founder Hill Ext 9 – 15 (Modderfontein);
- Westlake View Ext 13 (Modderfontein);
- Highlands Ext 7 (Modderfontein); and
- Chloorkop Ext 64, 66, 68, 69 and Klipfontein Ext 5 (Lord's View Industrial Park).

7 Traffic assessment

7.1 Introduction

This section outlines the traffic impact assessment assumptions that were made to carry out the analysis. It outlines the assumptions made in relation to the background traffic growth, trip generation and distribution and it outlines the traffic assessment scenarios that were considered.

The traffic assessment scenarios that were considered include both land use and infrastructure scenarios in order to develop an understanding of the relative impact of the development in context to background traffic growth, latent traffic and the addition or omission of certain road links.

7.2 Background traffic growth rate

Given the number of latent developments that will be taken into consideration covering a significant geographical area, a background traffic growth rate of 1% per annum was assumed.

The total compound traffic growth rate over seven years between 2013 and 2020 is therefore approximately 7.2%. This growth rate will be applied to the 2013 baseline trip ends to derive 2020 trips ends. The total additional background trips added to the model as a consequence was, respectively, approximately 14,000 and 10,400 vehicles in the AM and PM peak hours.

7.3 Trip generation

Trip generation for the proposed development is calculated on applying vehicle trip generation rates to respective land uses, as per the TMH 17 (COTO, 2012) manual.

7.3.1 Phase one development

According to TMH17 the trip rate for residential (multi-level townhouses) is 0.75 trips/unit during both the AM and PM peak hour with a directional split of 25%:75% (in:out) during the AM peak and 70%:30% (in:out) during the PM peak hour.

The following table indicates the expected trip generation for phase one of the proposed development.

Table 2: Trip generation

Land use	Size (units)	AM peak			PM peak		
		In	Out	Total	In	Out	Total
Residential	1,270	238	714	953	667	286	953

The proposed development can be expected to generate about 950 trips during the AM and PM peak hour.

7.3.2 Full development

Phase one has been analysed in context of the full development. This section outlines the expected trip generation for the full development.

Again 0.75 trips/unit is used for the residential development as per phase one.

The trip rate for schools is 0.8 trips/student during the AM peak hour with a directional split of 50%:50% (in:out). However this rate should be divided by the peak hour factor (PHF) of 0.55 to arrive at a trip generation of 1.45 trips/student during the AM peak hour. During the PM peak hour, the recommended trip generation rate of 0.3 trips/student with a directional split of 50%:50% (in:out).

The recommended trip generation rate for office developments is 2.1 trips/100m^2 with a AM peak hour split of 85%:15% (in:out) and a PM peak hour split of 20%:80% (in:out).

As per the original study and comment from the JRA, trip reduction factors for mixed use developments were applied.

The following table indicates the expected trip generation for the full development.

Table 3: Full development trip generation

Land use	Size	Mixed use reduction	AM peak			PM peak		
			In	Out	Total	In	Out	Total
Residential	7,000 units	15%	1,116	3,347	4,463	3,124	1,339	4,463
Office	12,288m^2	20%	175	31	206	41	165	206
Schools	3,000 students	30%	1,527	1,527	3,055	315	315	630
Total			**2,818**	**4,905**	**7,723**	**3,480**	**1,819**	**5,299**

The full development is expected to generate approximately 7,700 trips during the AM peak hour and approximately 5,300 trips during the PM peak hour.

7.4 Trip distribution and assignment

As previously stated in this report, the traffic impact assessment was carried out using a SATURN Model. The trip distribution on the surrounding road network was derived from the SATURN model trip distribution function.

Each traffic zone within the model has a specific trip distribution pattern depending on its location and the type of land use it presents. For this development a trip distribution pattern similar to residential developments in the area was assumed. It can be seen that during the AM peak hour the majority of trips travel towards the north on the K101 and east on the K60. During the PM peak hour the majority of the trips travel south on the K101 and west on the K60.

The images below show the trip distribution.

Image 2: Trip distribution AM

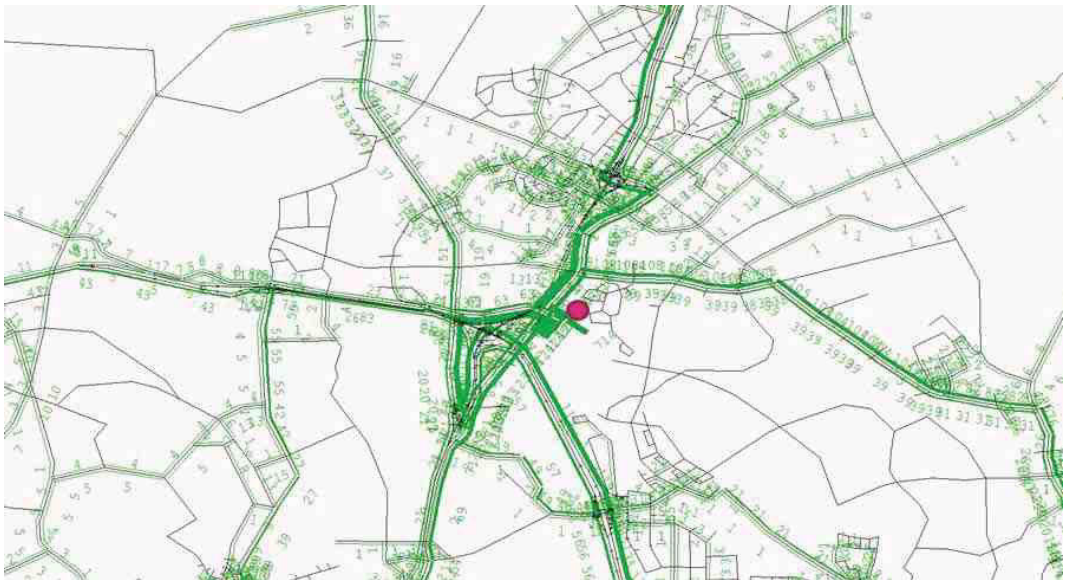
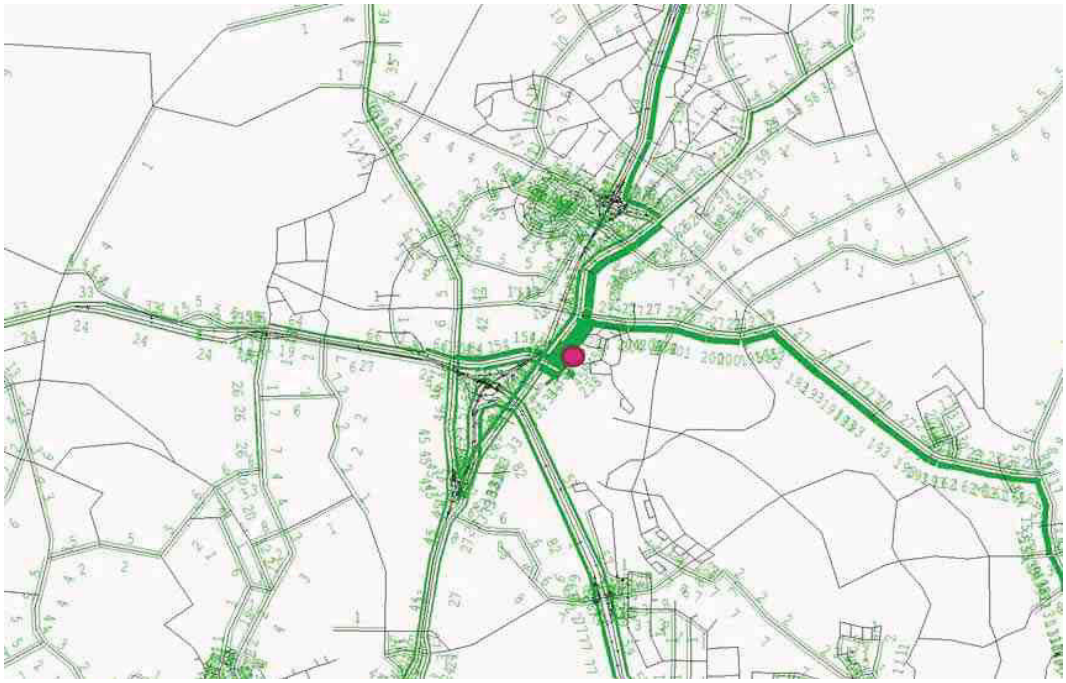


Image 3: Trip distribution PM



If a household size of 2.5 persons per residential unit is assumed for the full development, a total local population of 17,500 people will be created. Apart from this area, there is Buccleuch to the south. Buccleuch seems to have a number of schools already provided. It is therefore expected that the majority of school trips will be from within Waterfall Heights and not from surrounding areas.

Therefore technically it can be assumed that a percentage of school trips will be local trips and therefore not travel on strategic road infrastructure suck as Maxwell Drive and the K60. For the purpose of this analysis no allowance for local school trips have been made. However, a view will be taken on this matter when the TIA specifically for the schools will be carried out.

In terms of trip assignment, the model output varies from scenario to scenario and is affected by time of day, available links within the scenario and land use scenarios. Trip assignment is based on an iteration process where the model strives to reduce the overall travel time and cost for all vehicles on the network, by assigning vehicles to the least time consuming route. This may be in some circumstances the shortest route bur in other cases the least congested routes.

7.5 Scenarios analysed

To determine the road improvements required to mitigate the development traffic a series of traffic scenarios were developed and tested. The following traffic scenarios were assessed:

- SC01 – 2013 Baseline
- SC02 – 2020 Do Something 01 **without development** (including background traffic growth, latent development traffic and committed road infrastructure)
- SC03 – 2020 Do Something 02 **with development phase 1** (including background traffic growth, latent development traffic, committed road infrastructure)
- SC04 – 2020 Do Something 03 **with full development and road upgrades** including background traffic growth, latent development traffic, committed road infrastructure)

The above scenarios are assuming that both latent development are in place and secondly that significant road infrastructure i.e. the K60 is in place. However, some of the latent traffic development rights have been in place for quite some time without much movement on it. It is also risky for this development to rely on the K60 extension across the N1 to be in place. Therefore, alternative scenarios are considered that will consider infrastructure that is in the control of the developer and not become a condition that should be provided by a third party. In this instance a scenario was developed that assumed that local development did not occur and the K60 is not in place. In this instance, it was assumed that the road link between the K60 Gautrain Depot access and Maxwell Drive is in Place, which will provide an additional access from another direction to the development. The following scenario is added:

- SC05 – 2020 Do Something 04 **with development phase 1** (including background traffic growth, development road infrastructure)

Table 4 below provides more detailed information on the scenarios assessed and assumptions made.

Table 4: Scenarios assessed

Ref	Scenario Label	Traffic Demand	Road Infrastructure
SC01	2013 Baseline	2013 Baseline	2013 Baseline
SC02	2020 Do Something 01	2013 Baseline grown to 2020 + Known Future Developments (Without Proposed Development)	Existing road infrastructure K60 between Rivonia Road and Allendale Road
SC03	2020 Do Something 02	Do Something (DS) 01 Demand + Proposed Phase 1 Development	Existing road infrastructure K60 between Rivonia Road and Allendale Road Extension of Maxwell Drive from K101 to the development access
SC04	2020 Do Something 03	DS 02 Demand + Proposed Full Development	Existing road infrastructure K60 between Rivonia Road and Allendale Road K113 between Allendale Road and Maxwell Drive Extension of Maxwell Drive from K101 to K113
SC05	2020 Do Something 04	DS 03 Demand + Proposed Phase 1 Development (excluding land parcel 3 – Jukskei View Ext 110, 111 and 112 and Polo Fields)	Existing road infrastructure Extension of Maxwell Drive from K101 to the development access Road through the development between proposed Maxwell Drive and existing K60 link

8 Intersection capacity analysis

The intersections in the study area were analysed using SATURN traffic model as discussed above. The purpose of the analysis is to determine the level of service (LOS), volume / capacity (v/c) and delays for the different scenarios as well as the impact of the development traffic on the surrounding road network.

The performance criteria for the intersections in the study area are indicated in the table below. The level of service (LOS), volume / capacity (v/c) and delays is defined in accordance with the Highway Capacity Manual (HCM, 2000). An intersection is deemed to be operating acceptable if it operates at LOS A to D. If an intersection operates at LOS E or F or has a v/c ratio higher than 0.95, the intersection is considered to be operating at capacity.

Table 5: Performance criteria

Level of service	Delay in seconds	
	Stop and yield controlled	Signals and traffic circles
A	<10	<10
B	10 – 15	10 – 20
C	15 – 25	20 – 35
D	25 – 35	35 – 55
E	35 – 50	55 – 80
F	>50	>80

8.1 SC01: 2013 Baseline

Intersection capacity analysis were not done for the 2013 baseline scenario as this information will not be relevant for the proposed development.

8.2 SC02: 2020 Background with latent traffic

Figure 8 and Figure 9 shows the AM and PM results for Scenario 2 respectively. The results show that the intersections will operate well with the exception of the following intersections:

K101 and Maxwell Drive

During the AM and PM peak hours the right turn movement on the K101 southbound will operate poorly at a LOS F and v/c ratio exceeding 0.95. The left turn on Maxwell Drive will also have a v/c ratio exceeding 0.95 during both peak hours. During the PM peak hour the through movement on the K101 will operate at capacity with a v/c ratio exceeding 0.95.

K101 and K60

The through and right turn movements on the eastbound approach on the K60 will operate poorly during both peak hours with v/c ratios exceeding 0.95 and they will operate at unacceptable level of services. During the PM peak hour the left turn movement on this approach will also operate at a v/c ratio exceeding 0.95 and LOS F. The left turn movement on the westbound approach on the K60 will also operate at a v/c ratio exceeding 0.95 during both peak hours while the through movement will operate at capacity only during the AM peak hour. The right turn movement on the northbound approach on the K101 will also operate poorly at LOS F during both peak hours with a v/c ratio exceeding 0.95.

K60 and K111

During the AM peak hour both approaches on the K111 will operate at poor levels of service. The westbound approach on the K60 will operate at v/c ratios exceeding 0.95 and at LOS F on all movements.

8.3 SC03: 2020 Background with latent and phase 1 development

Figure 10 and Figure 11 shows the AM and PM results for Scenario 3 respectively. The results show that the majority intersection movements operate well, but some local capacity issues are expected:

K101 and Maxwell Drive

The left turn on Maxwell Drive will also have a v/c ratio exceeding 0.95 during both peak hours. During the PM peak hour the through movement on the K101 will operate at capacity with a v/c ratio exceeding 0.95.

K101 and K60

During both peak hours the right turn movement on the northbound approach on the K101 will operate at a v/c ratio exceeding 0.95 and LOS F, during the PM peak hour the through movement on this approach will also operate at capacity. During the PM peak hour all movements on the eastbound approach on the K60 will operate at v/c ratios exceeding 0.95 and at LOS F the through movement will operate at capacity during the AM peak hour as well. The left turn movement on the westbound approach on K60 will operate at a v/c ratio exceeding 0.95 during both peak hours.

K60 and K111

During the AM peak hour both approaches on the K111 will operate at poor levels of service but the v/c ratios will not exceed 0.95. The westbound approach on the K60 will operate at v/c ratios exceeding 0.95 and at LOS F on all movements. During the PM peak hour the through movements on the K60 will operate at v/c ratios exceeding 0.95.

Proposed development access

No capacity issues are expected at the proposed access for the development phase one.

8.4 SC04: 2020 Background with latent, full development and upgrades

Figure 12 and Figure 13 shows the AM and PM results for Scenario 4 respectively. The results show the intersections will operate well with the following local capacity issues:

K101 and Maxwell Drive

The left turn on Maxwell Drive will have a v/c ratio exceeding 0.95 during both peak hours due to very high traffic volumes. During the PM peak hour the left turn on the K101 southbound will operate at capacity with a v/c ratio exceeding 0.95.

K101 and K60

The left turn movement on the westbound approach on K60 will operate at a v/c ratio exceeding 0.95 during both peak hours. During the PM peak hour the through movement on the K101 southbound approach will operate at capacity with a v/c ratio exceeding 0.95. However, this intersection operates overall at a much better LOS, despite the additional trips due to the extensive road infrastructure provision.

K60 and Access Road

During the AM peak hour the turning movements out of the development will operate at capacity with v/c ratios exceeding 0.95. The through movement on the westbound approach on the K60 will operate at a v/c ratio exceeding 0.95 during both peak hours while the through movement on the eastbound approach will operate at a v/c ratio exceeding 0.95 only during the PM peak hour.

K60 and K111

During the PM peak hour the right turn movement on the southbound approach on the K111 will operate at a v/c ratio exceeding 0.95. The through movements on both approaches on the K60 will operate at capacity with v/c ratios exceeding 0.95 during both peak hours. However, this intersection overall operates at a much better LOS, despite the additional trips due to the extensive road infrastructure provision.

Maxwell Drive Extension and Western Access

During the AM peak hour the right turn movement out of the development will operate at a v/c ratio exceeding 0.95. However, technically there is spare capacity on the right turning movement at the Eastern access that can be utilised by motorists. The left turn movement on the eastbound approach on Maxwell Drive Extension will operate at a v/c ratio exceeding 0.95 during the PM peak hour.

Maxwell Drive Extension and Eastern Access

During the AM peak hour the left turn movement out of the development will operate at LOS E with a v/c ratio exceeding 0.95. During the PM peak hour the through movement on the eastbound approach on Maxwell Drive Extension will operate at a v/c ratio exceeding 0.95.

K111 and Maxwell Drive Extension

During the AM peak hour the right turn movement on Maxwell Drive Extension will operate at capacity with a v/c ratio exceeding 0.95 and LOS D. During the PM peak hour the left turn movement on the northbound approach on the K111 will operate at a v/c ratio exceeding 0.95.

K111 and Gautrain Depot

During both peak hours the through movement on the southbound approach on the K111 will operate at capacity with a v/c ratio exceeding 0.95.

8.5 SC05: 2020 Background with phase 1 development

Figure 14 and Figure 15 shows the AM and PM results for Scenario 5 respectively. The results show the majority of the intersections will operate well with the following local capacity issues:

K101 and Maxwell Drive

The analysis show that during the AM peak hour the westbound through movement on Maxwell Drive Extension will operate at capacity with a v/c ratio exceeding 0.95.

Maxwell Drive Extension and Spine Road

During the AM peak hour the through movement on Denise Road will operate at LOS D as well as the eastbound right turn movement on Maxwell Drive Extension. During the AM peak hour the right turn movement on the southbound approach of the spine road will operate with a v/c ratio exceeding 0.95. During the PM peak hour this intersection will operate well.

Spine Road and Phase 1 Access Road

During the AM peak hour the southbound approach of the spine road will operate poorly at LOS D and will also operate at capacity with v/c ratios exceeding 0.95. During the PM peak hour all movements on the northbound approach as well as the through movement on the south bound approach on the spine road will operate at v/c ratios exceeding 0.95. The right turn movement on the southbound approach of the spine road will operate at LOS D during the PM peak hour.

K60 and K111

During the AM peak hour the K111 will be operating poorly at LOS D. the through movement on the future K60 will be operating at capacity during the AM

peak hour with a v/c ratio exceeding 0.95. During the PM peak hour the intersection will operate well.

8.6 Conclusion

Existing plus latent traffic conditions (Scenario 2) will put a high strain on the available road network. However, proposed road upgrades at Maxwell Drive / K101 and K60 / K101 to accommodate the proposed development, improves expected traffic conditions, even with the development phase one trips (Scenario 3). These proposed road upgrades are indicate in Appendix B.

There are the following ways in which the development phase 1 can be approached.

If the K60 is in place in time to accommodate development phase 1, the road upgrade assumptions as per Scenario 3 applies. If however, the K60 is not in place to accommodate the development, an alternative transport strategy would be to construct the link between the K60 and Maxwell Drive to provide an alternative access. The road upgrades for this strategy are indicated in Appendix C. The strategy would be costly and not feasible from a financial point of view. If this is found to be the case, it is proposed that the solution should be that the local upgrades at Maxwell Drive / K101 and the link to the Kikuyu development should be provided but that the development is limited to only 50% of its full development rights until either the K60 is in place or the link road between the K60 and Maxwell Drive is in place. The road upgrades for this option is indicated in Appendix D.

The full development scenario (Scenario 4) will be developed in more detail once the TIAs for it is being carried out, however, the results show that even with the additional trips, the overall road network operates much better, due to the significant proposed road infrastructure provided. The road upgrades that will be required for the full development is indicated in Appendix E and is for information only.

Therefore, the ambition of the developer to provide in the order of 7,000 residential units in this location is realistic and can be realised.

In reality, it can be expected that many of the school trips (estimated to be in the order of 3,000) will have origins and destinations that are internal to the Waterfall Heights development. Therefore the full traffic impact displayed in the results above is a worst case scenario. In the order of 1,000 trips less will therefore realise in reality.

9 Access

9.1 Queuing analysis

A queuing analysis was done at the access for phase one using the highest expected traffic flow to determine the maximum theoretical delay expected at the access.

It is expected that the access will be security controlled via booms with proximity card readers. A service rate of 450 vehicles per hour has been used for the analysis. This is based on the assumption that on average it takes eight seconds per vehicle to enter the site.

The 90th percentile queue length is deemed acceptable to assess the required stacking space at the access. The 90th percentile queue length means the vehicle queue length will only be exceeded ten times out of a 100.

The table below summarises the queuing analysis results.

Table 6: Queuing analysis

Description	Analysis results
Peak hour inbound traffic volumes	667
Average arrival rate (veh/hr)	667
Average service rate (sec/veh)	8
Average service rate (veh/hr)	450
Traffic intensity per gate	0.49
Number of gates	3
90th percentile queue length (<n vehicles)	4
Average number of vehicles in the system	1.8
Average delay (sec)	9.6

The analysis shows that three inbound lanes and three outbound lanes would be sufficient to accommodate the expected number of trips. The gates should be set back at least 25m from the road reserve to allow stacking space for four vehicles behind each gate.

It is recommended that at least one inbound lane be 4m wide and have a height clearance of 4.2m to accommodate delivery and emergency vehicles.

10 Public transport

10.1 Estimated public transport demand

The expected number of public transport users is derived from the City of Johannesburg's trip generation rates for residential developments. The following assumptions were made in order to determine the recommended trip generation rate:

- Household income of more than R 7,000 per household per month (Category 4);
- One car per household (Category 2); and
- At least one employed person per household (Category 2).

The image below is showing the table used to arrive at the public transport trip generation rate and the rate used is highlighted in the table.

Image 4: Public transport trip generation table (COJ)

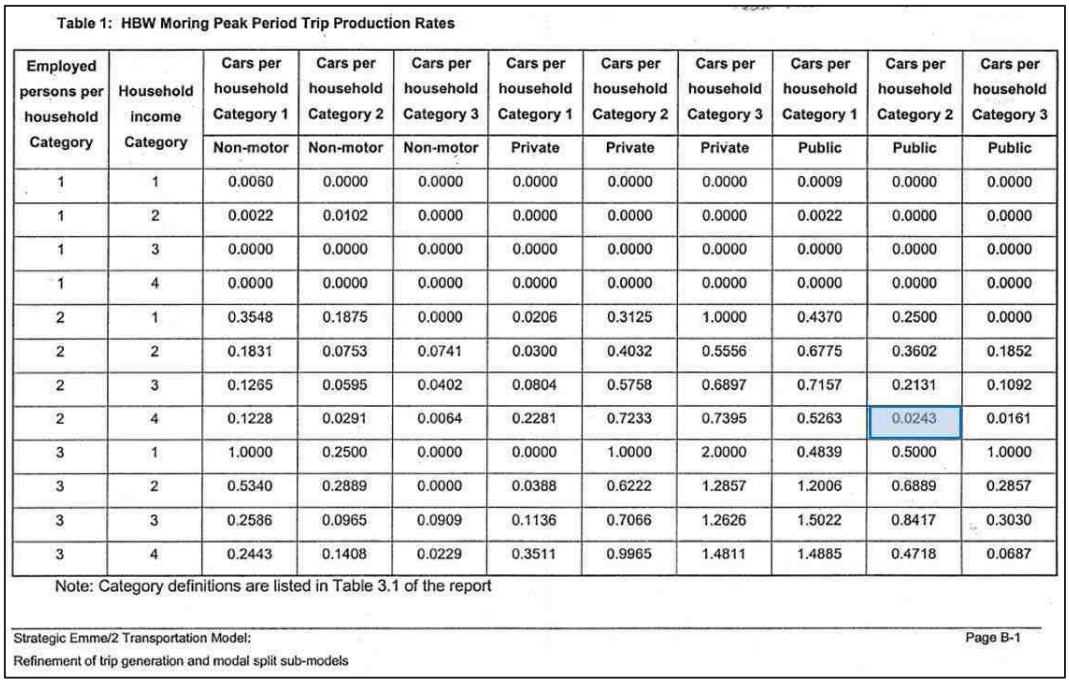


Table 1: HBW Moring Peak Period Trip Production Rates

Employed persons per household Category	Household income Category	Cars per household Category 1 Non-motor	Cars per household Category 2 Non-motor	Cars per household Category 3 Non-motor	Cars per household Category 1 Private	Cars per household Category 2 Private	Cars per household Category 3 Private	Cars per household Category 1 Public	Cars per household Category 2 Public	Cars per household Category 3 Public
1	1	0.0060	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0000	0.0000
1	2	0.0022	0.0102	0.0000	0.0000	0.0000	0.0000	0.0022	0.0000	0.0000
1	3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	1	0.3548	0.1875	0.0000	0.0206	0.3125	1.0000	0.4370	0.2500	0.0000
2	2	0.1831	0.0753	0.0741	0.0300	0.4032	0.5556	0.6775	0.3602	0.1852
2	3	0.1265	0.0595	0.0402	0.0804	0.5758	0.6897	0.7157	0.2131	0.1092
2	4	0.1228	0.0291	0.0064	0.2281	0.7233	0.7395	0.5263	0.0243	0.0161
3	1	1.0000	0.2500	0.0000	0.0000	1.0000	2.0000	0.4839	0.5000	1.0000
3	2	0.5340	0.2889	0.0000	0.0388	0.6222	1.2857	1.2006	0.6889	0.2857
3	3	0.2586	0.0965	0.0909	0.1136	0.7066	1.2626	1.5022	0.8417	0.3030
3	4	0.2443	0.1408	0.0229	0.3511	0.9965	1.4811	1.4885	0.4718	0.0687

Note: Category definitions are listed in Table 3.1 of the report

Strategic Emme/2 Transportation Model:
Refinement of trip generation and modal split sub-models
Page B-1

The above assumptions were used to arrive at the public transport trip generation rate of 0.0243 trips/unit. Based on this the table below is an indication of the expected number of public transport trips.

Table 7: Estimated public transport trips

Land use	Extent	Trip generation rate	Public transport trips
Residential	1,270	0.0243	31

The first phase of the development can be expected to generate approximately 31 public transport users during each peak hour. This can be accommodated in approximately two additional taxis. It is expected that the public transport trips that will be generated will also be generated by the residents living in the area and not only by employees at their households.

10.2 Recommendations

As mentioned in Section 4.3 it is proposed that additional laybys should be provided at the intersection of Maxwell Drive and K101.

11 Walking and cycling

11.1 Expected walking and cycling patterns

It is expected that the public transport users attracted to the development would be dropped off by taxis at the intersection of Maxwell Drive and the K101. The pedestrians will then have to walk along the future Maxwell Drive to the development.

11.2 Recommendations

It is recommended that paved footpaths and cycle ways be provided at least on one side of the road way along the main roadways which will be provided for the development.

12 Conclusions

This report represents the interim study based on the existing traffic model currently available. The recommendations of this report are therefore subject to the final report which will be based on the updated traffic model.

This report investigated the traffic impact of the proposed development on Jukskei View Extension 128 known as Kikuyu. The intension is to develop the full site with approximately 7,000 residential units and other land uses, however this report focuses on the first phase of the development which includes 1,270 residential units.

All other latent development in the area where also considered, as part of the latent development it was assumed that the K60 link over the N1 freeway will be in place.

The capacity analysis results showed that the existing with latent traffic conditions (Scenario 2) will put a high strain on the available road network. However, proposed road upgrades at Maxwell Drive / K101 and K60 / K101 to accommodate the proposed development, improves expected traffic conditions, even with the development phase one trips (Scenario 3).

There are the following ways in which the development phase 1 can be approached.

If the K60 is in place in time to accommodate development phase 1, the road upgrade assumptions as per Scenario 3 applies. If however, the K60 is not in place to accommodate the development, an alternative transport strategy would be to construct the link between the K60 and Maxwell Drive to provide an alternative access (Scenario 5). The strategy would be costly and not feasible from a financial point of view. If this is found to be the case, it is proposed that the solution should be that the local upgrades at Maxwell Drive / K101 and the link to the Kikuyu development should be provided but that the development is limited to only 50%

of its full development rights until either the K60 is in place or the link road between the K60 and Maxwell Drive is in place.

The full development scenario (Scenario 4) will be developed in more detail once the TIAs for it is being carried out, however, the results show that even with the additional trips, the overall road network operates much better, due to the significant proposed road infrastructure provided.

Therefore, the ambition of the developer to provide in the order of 7,000 residential units in this location is realistic and can be realised.

In reality, it can be expected that many of the school trips (estimated to be in the order of 3,000) will have origins and destinations that are internal to the Waterfall Heights development. Therefore the full traffic impact displayed in the results above is a worst case scenario. In the order of 1,000 trips less will therefore realise in reality.

Therefore the following road upgrades are proposed for the development phase one:

- Maxwell Drive and K101
- K60 and K101
- Maxwell Drive and development access road

The proposed road upgrades that will be required to accommodate the full development will be discussed once the TIAs are carried out and are analysed in more detail.

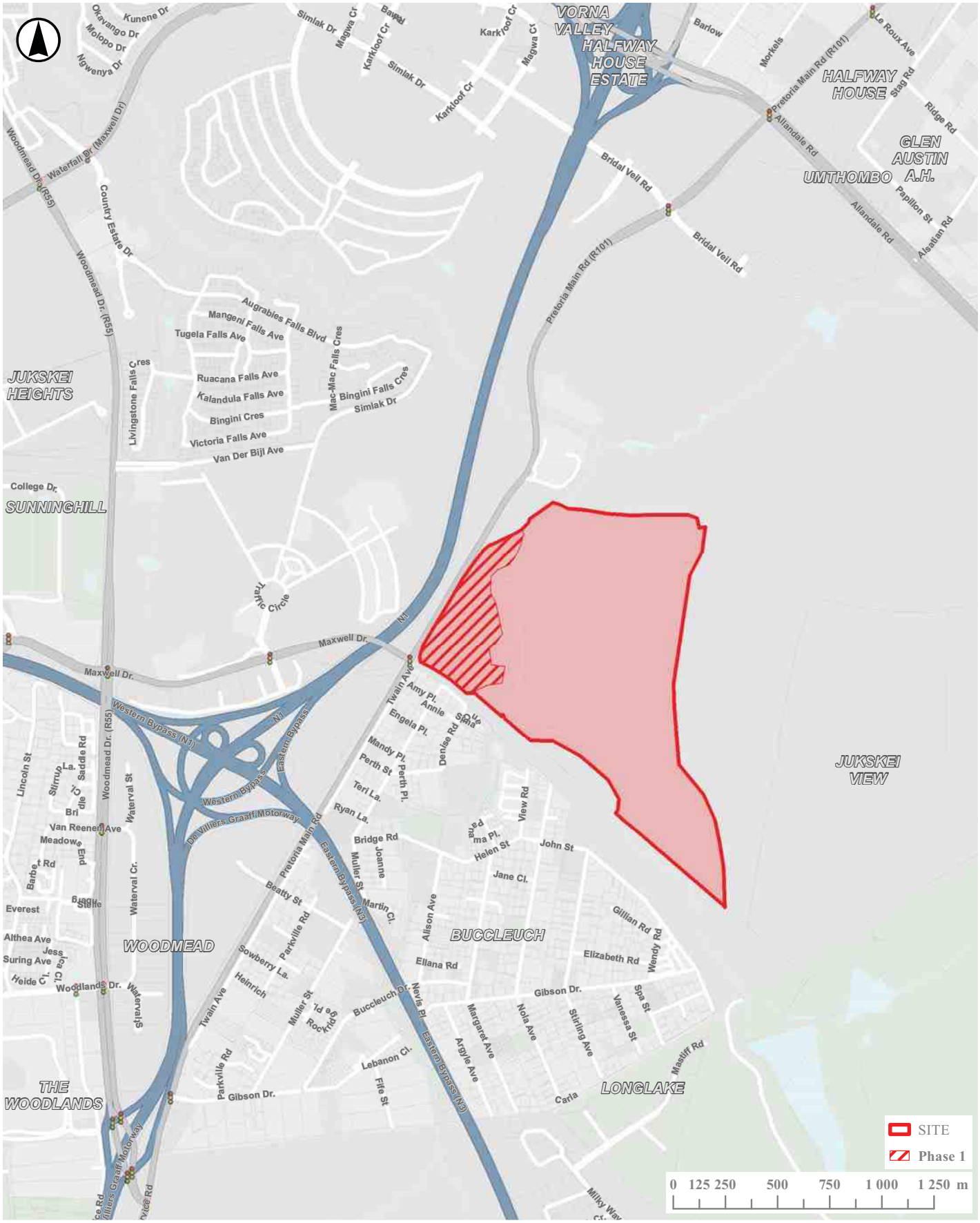
Queuing analysis were done at the development access and the results indicated that three inbound and three outbound lanes would be sufficient to accommodate the expected number of trips. Furthermore, the gates should be set back at least 25m from the road reserve to allow stacking space for four vehicles behind each gate.

It is recommended that paved footpaths and cycle ways be provided at least on one side of the road way along the main roadways which will be provided for the development.

Based on the above the development can be supported from a traffic engineering perspective, subject to the final report based on the update Saturn traffic model.

Figures

Locality plan - Figure 1

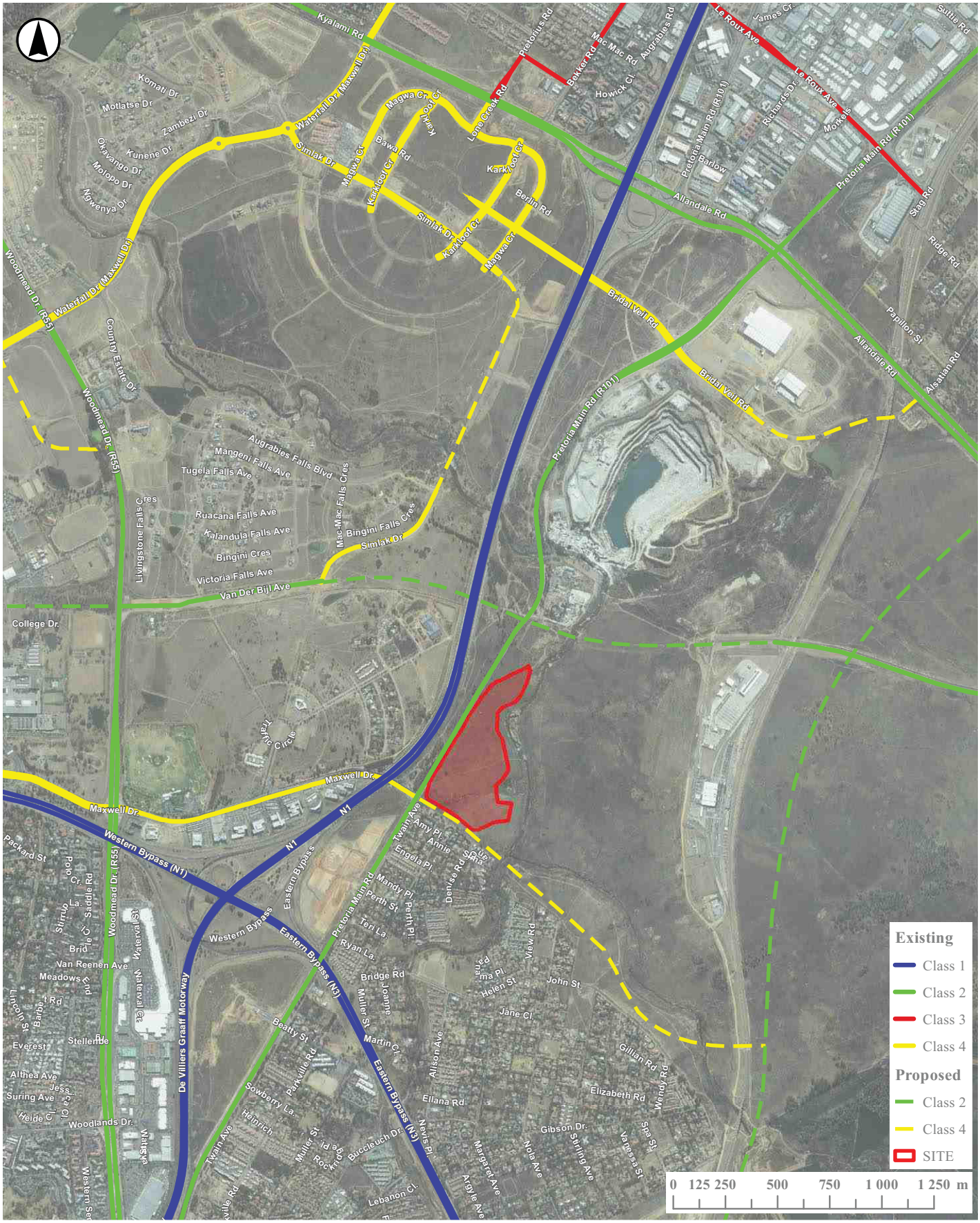


ARUP

Aerial View - Figure 2

ARUP

Road hierarchy - Figure 3



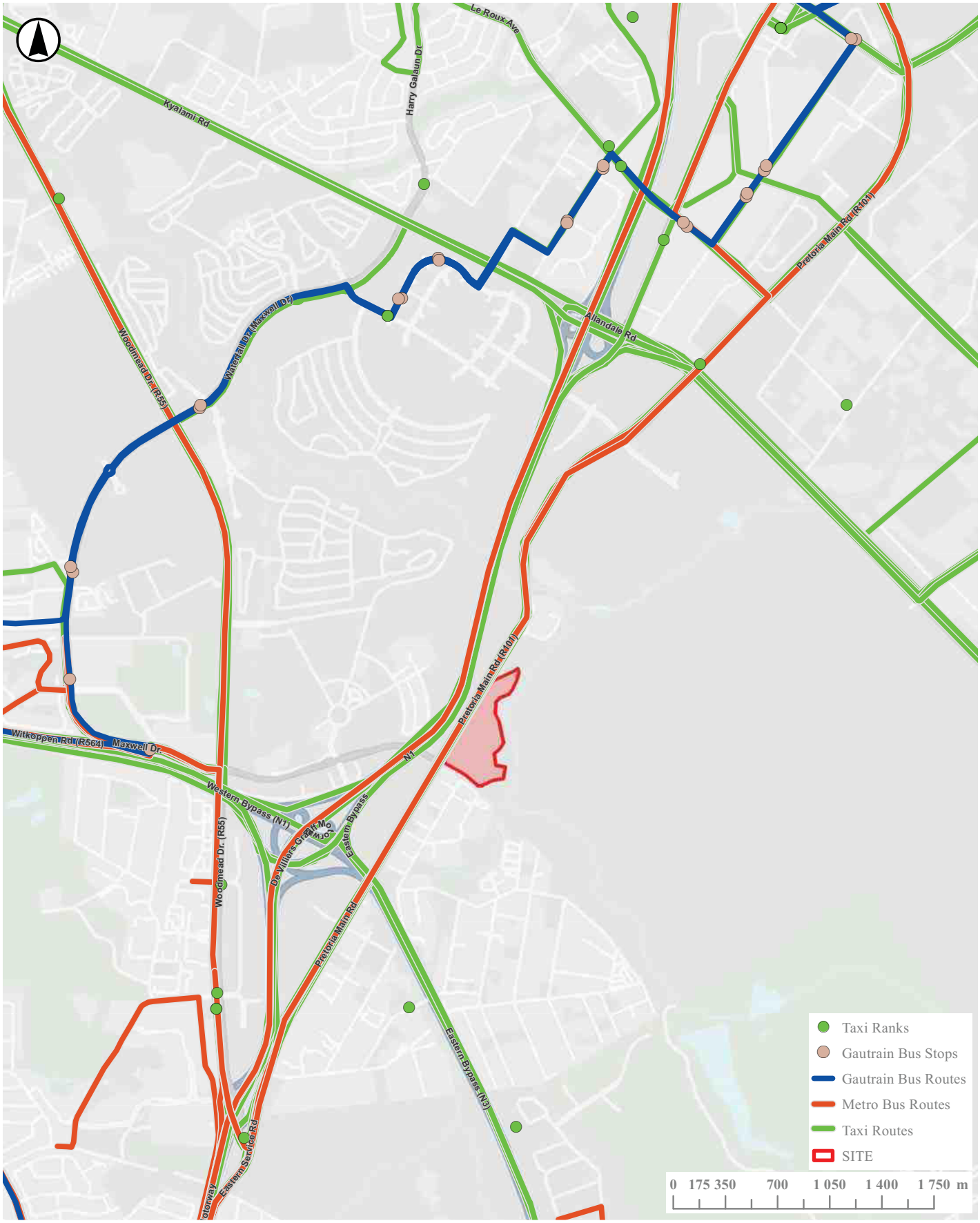
Jukskei View Ext 128 (Kikuyu Residential Development)

248841-00

ARUP

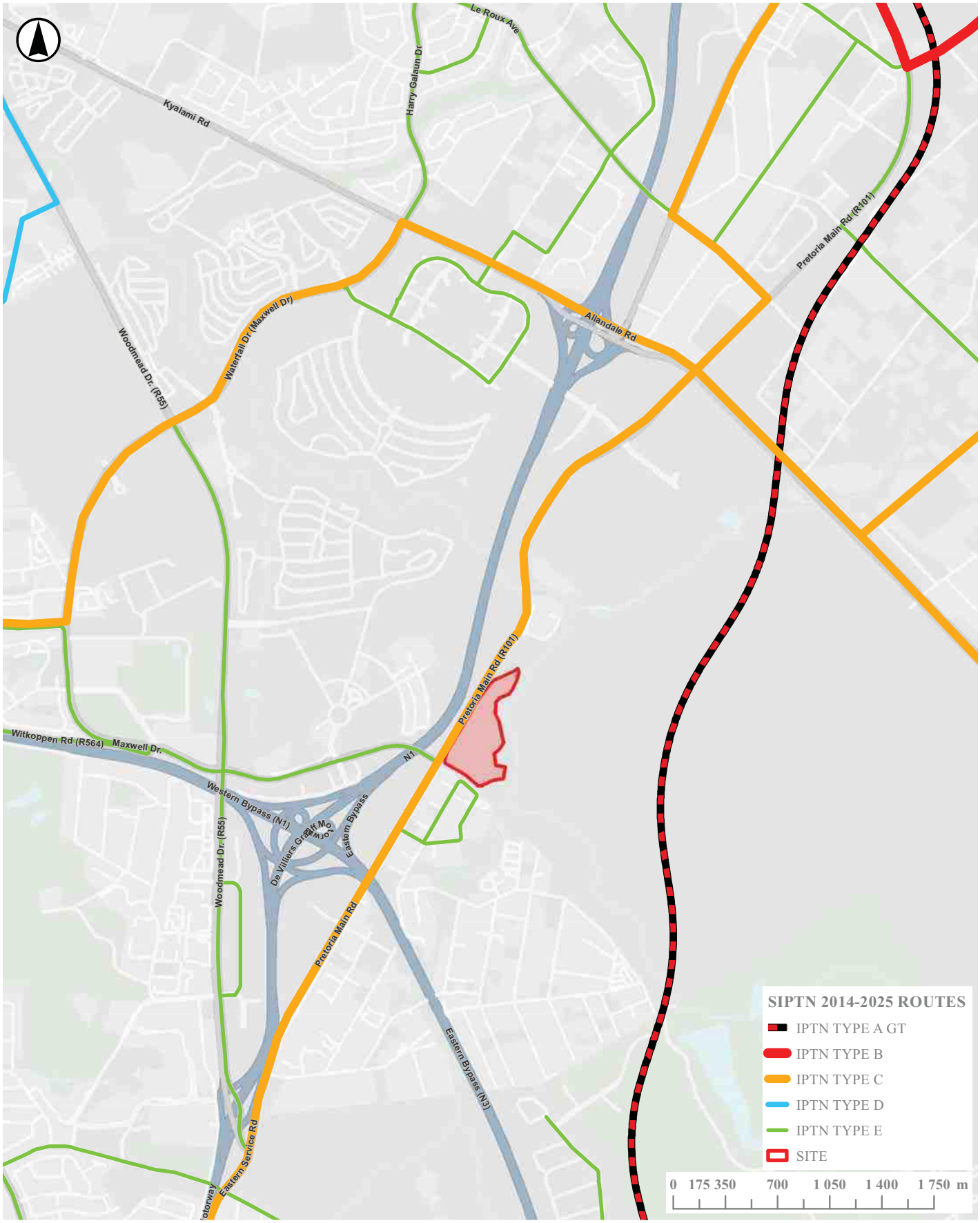
Source: The information is derived from the Corporate Geo-Informatics (CGIS) database of the City of Johannesburg. CGIS does not assume any liability for the damages arising from errors, ommissions or the use of this information. Users of the information are advised to use this data appropriately.

Available public transport - Figure 4



ARUP

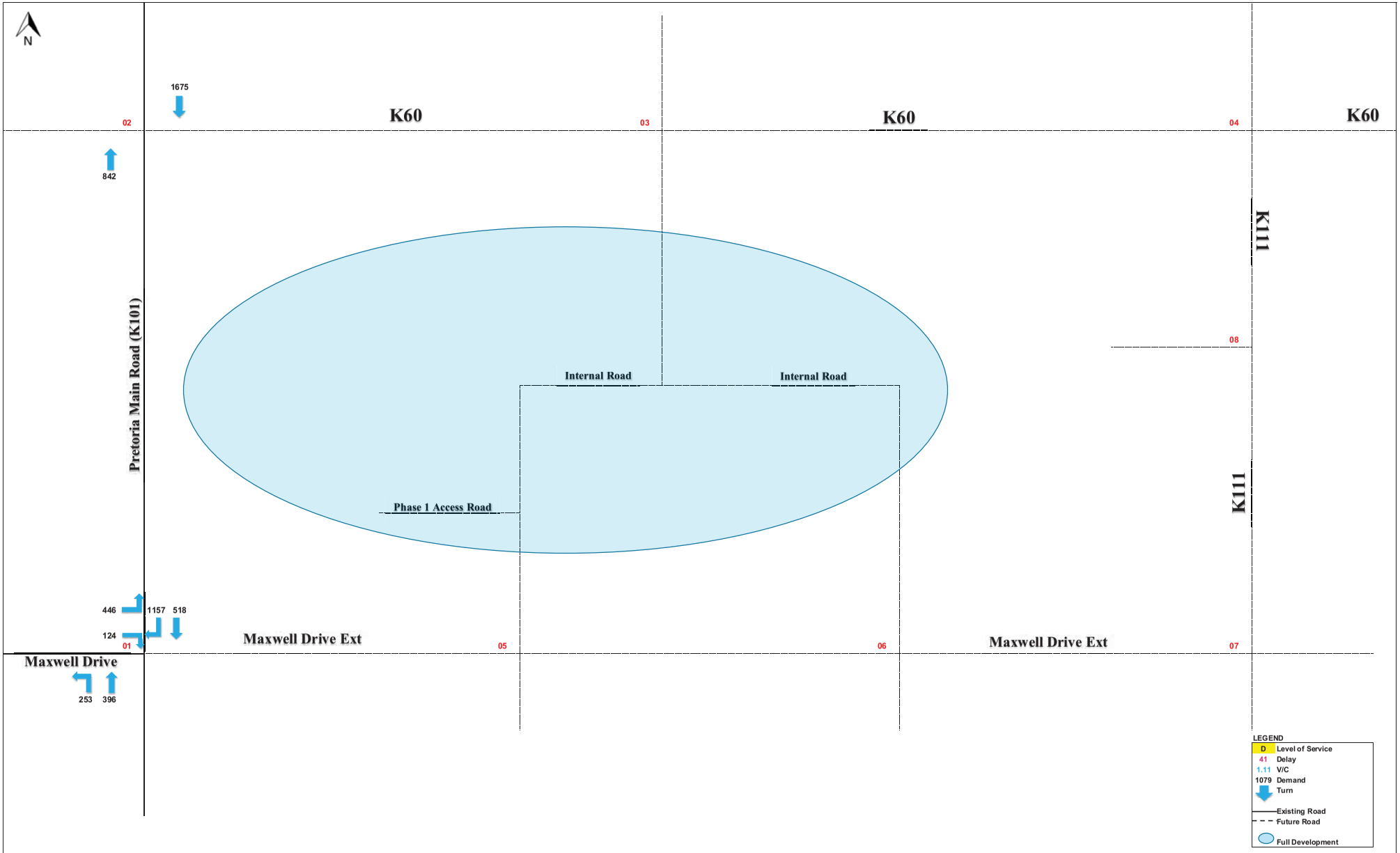
Strategic IPTN 2014 - 2025 - Figure 5



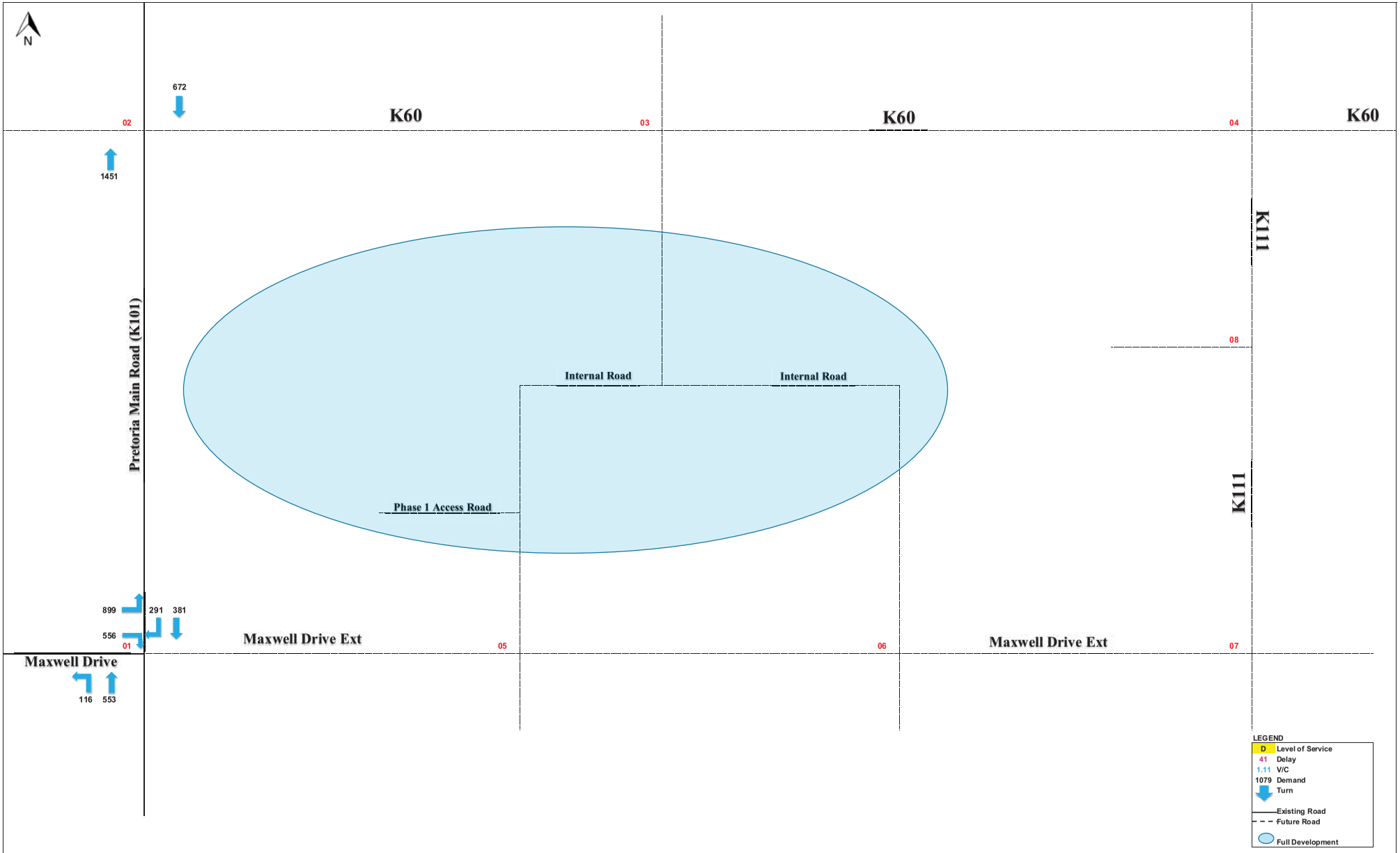
Jukskei View Ext 128 (Kikuyu Residential Development)

248841-00

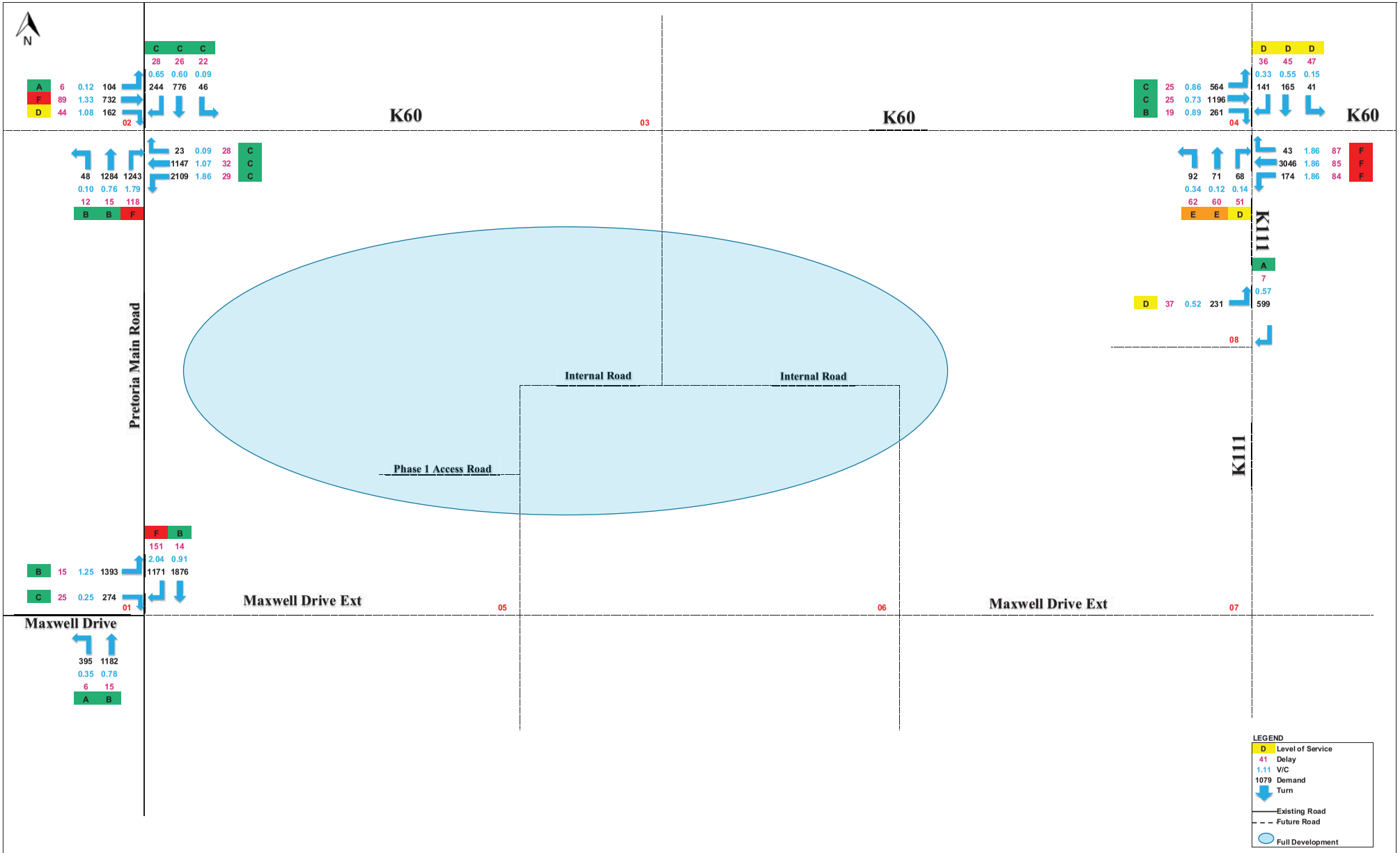
ARUP



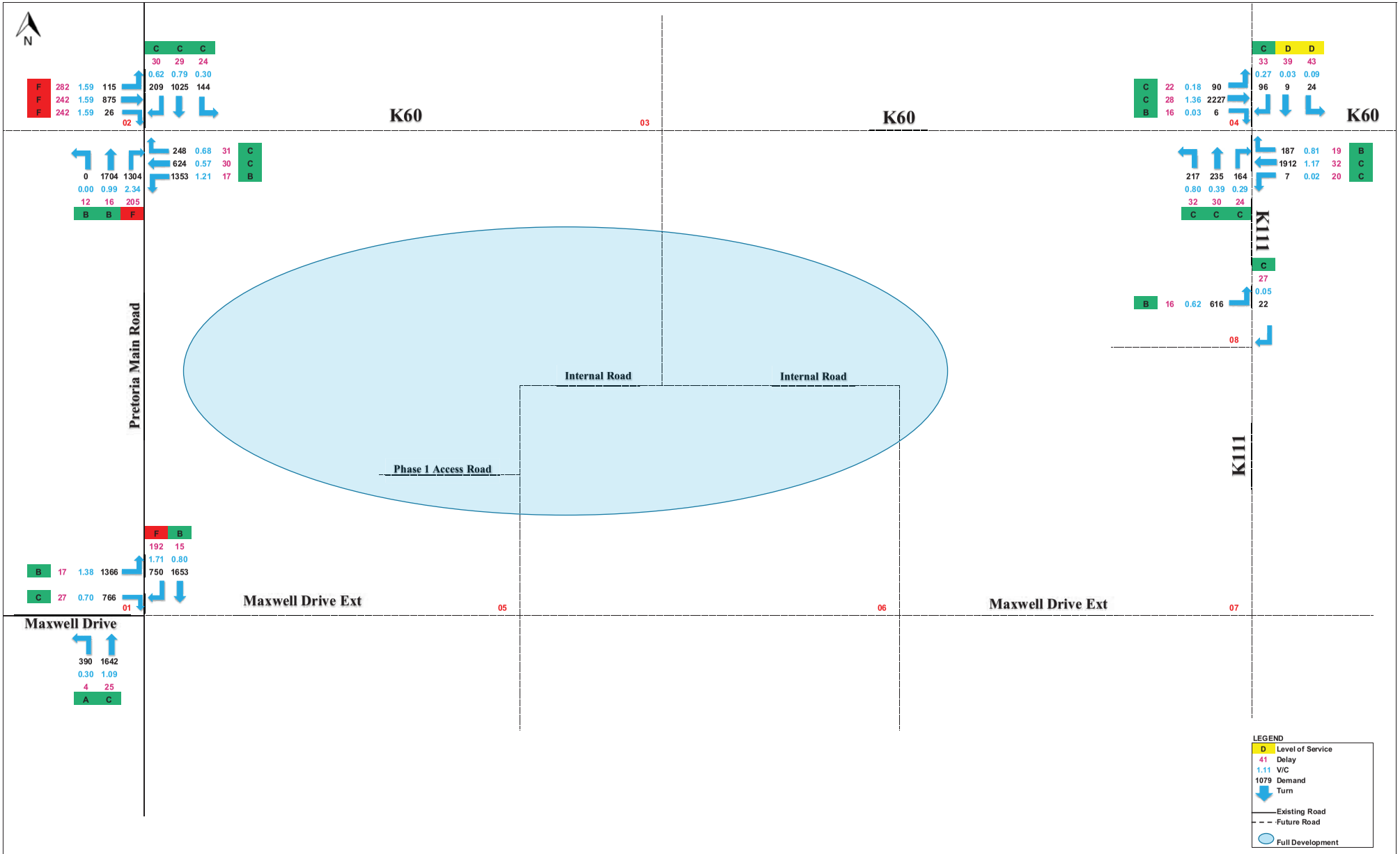
ARUP +27 11 218 7600	SC01a: AM Peak - 2013 Traffic Counts	Project: 248841-00
	2013 Network	Figure: 6



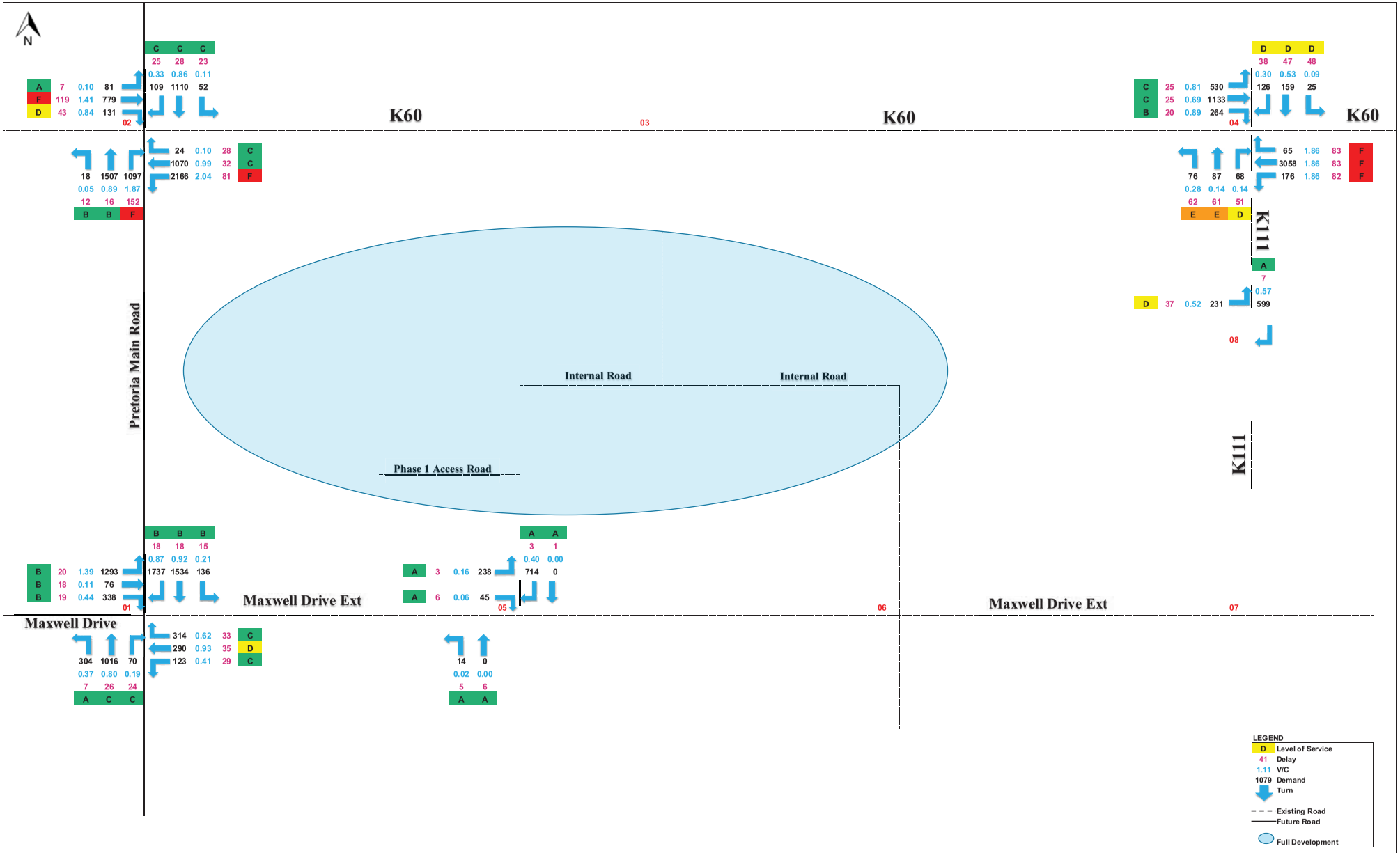
ARUP +27 11 218 7600	SC01b: PM Peak - 2013 Traffic Counts	Project: 248841-00
	2013 Network	Figure: 7



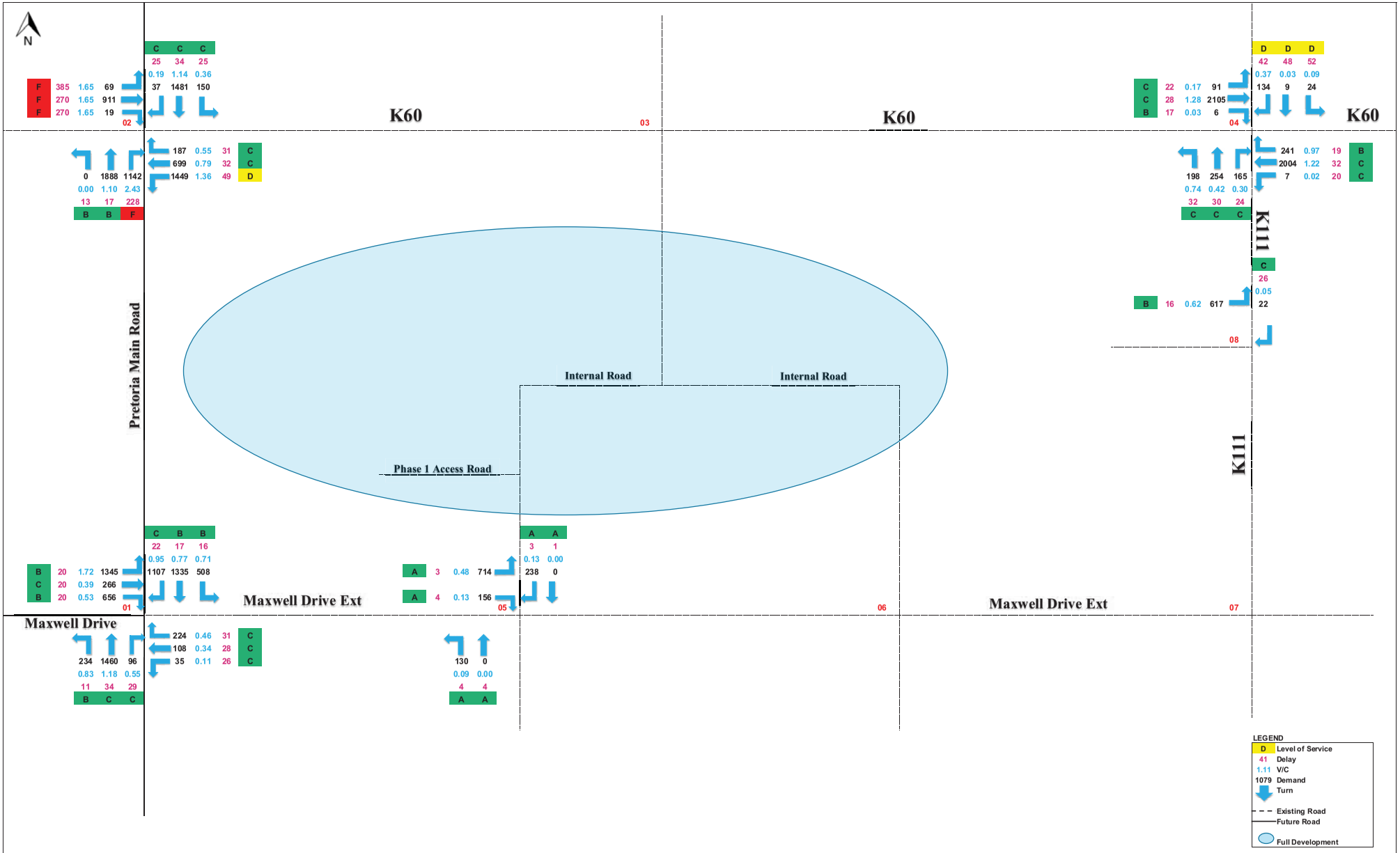
ARUP +27 11 218 7600	SC02a: AM Peak - 2020 Background with latent traffic - Without Development	Project: 248841-00
	2020 Network - With K60 between K58 (Allandale Road) and K73 (Rivonia Road)	Figure: 8



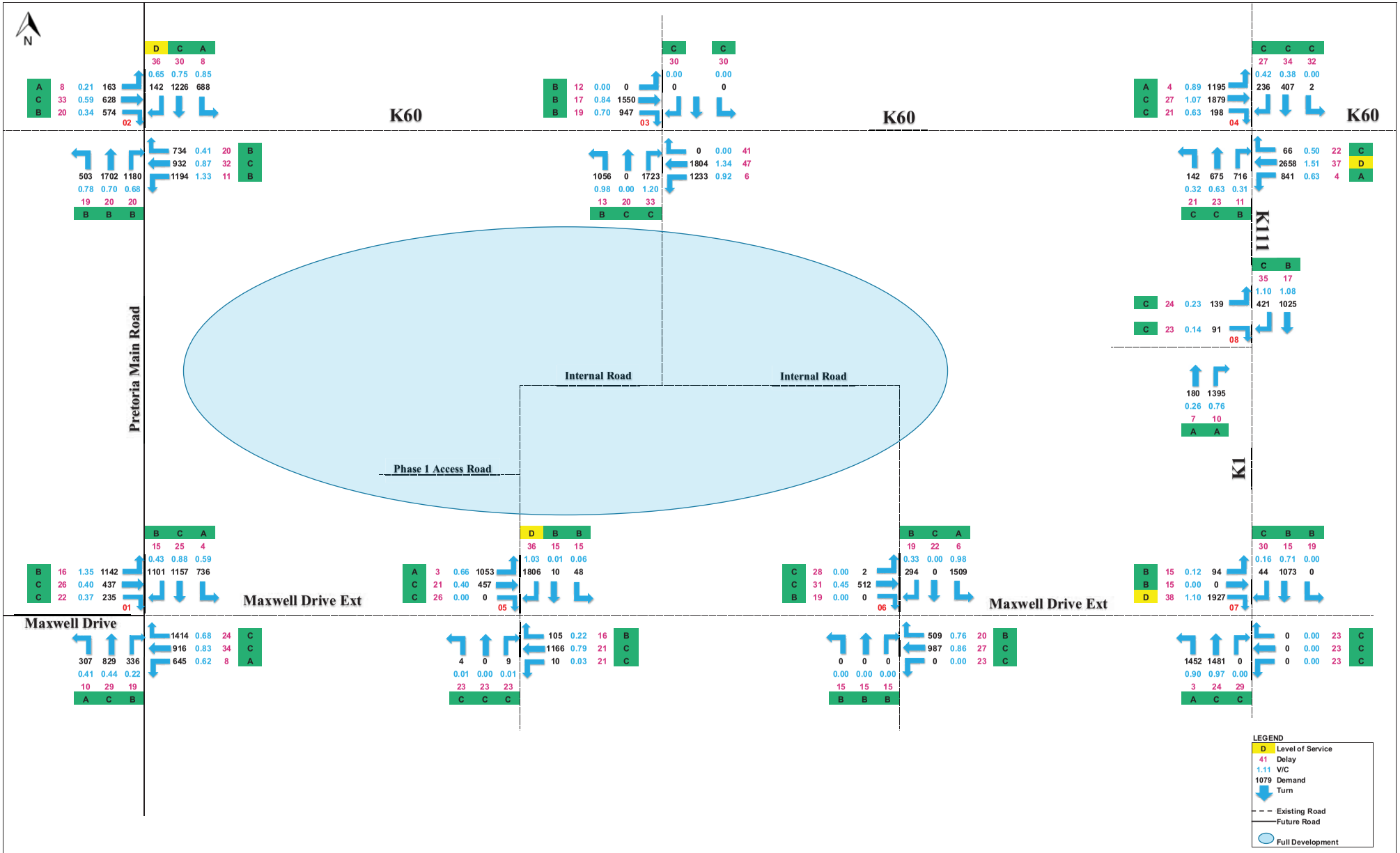
ARUP +27 11 218 7600	SC02b: PM Peak - 2020 Background with latent traffic - Without Development	Project: 248841-00
	2020 Network - With K60 between K58 (Allandale Road) and K73 (Rivonia Road)	Figure: 9



ARUP +27 11 218 7600	SC03a: AM Peak - 2020 Background with latent traffic and Phase 1 2020 Network - With K60 between K58 (Allandale Road) and K73 (Rivonia Road) + Maxwell Drive Extension	Project: 248841-00 Figure: 10



ARUP +27 11 218 7600	SC03b: PM Peak - 2020 Background with latent traffic and Phase 1	Project: 248841-00
	2021 Network - With K60 between K58 (Allandale Road) and K73 (Rivonia Road) + Maxwell Drive Extension	Figure: 11



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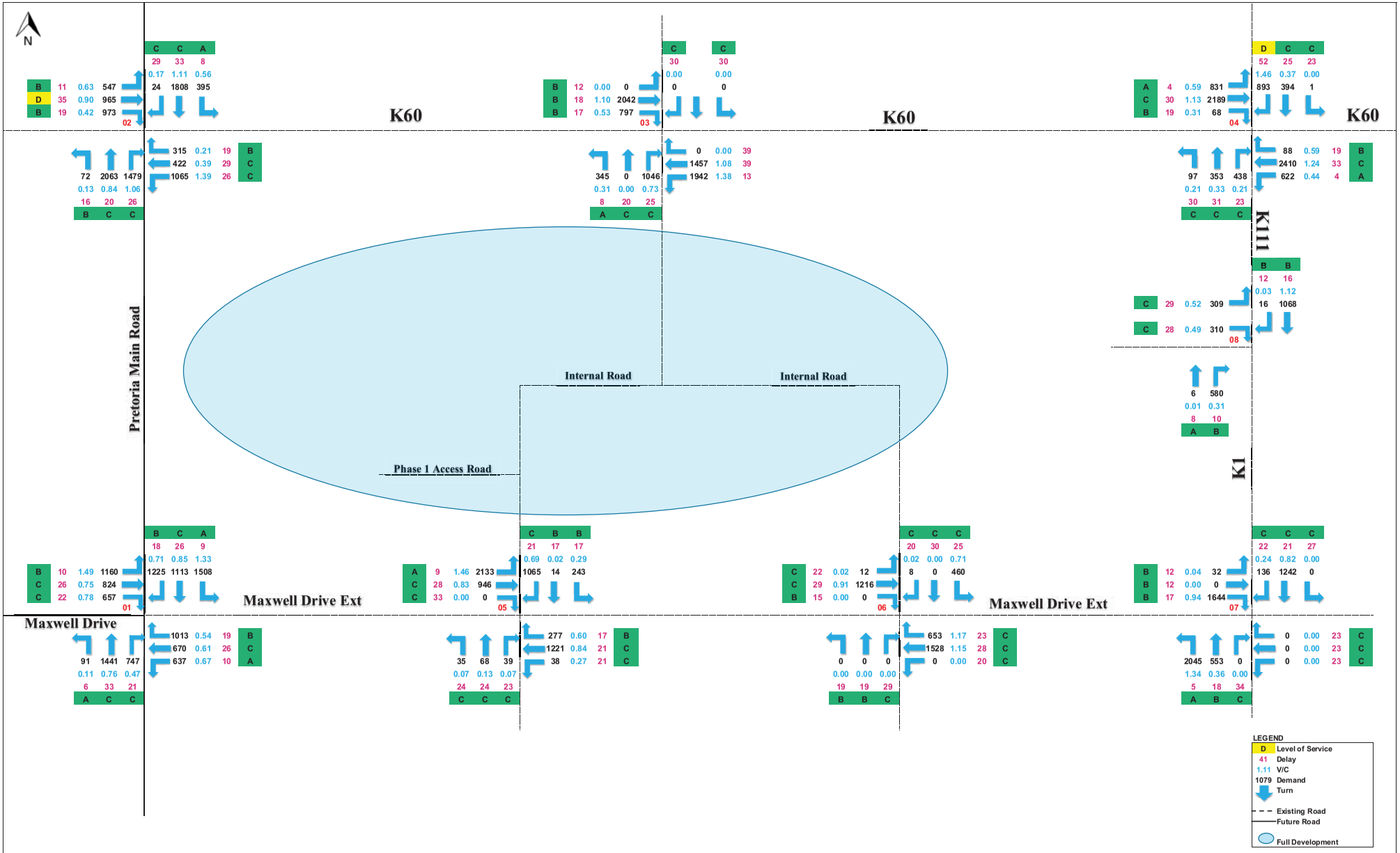
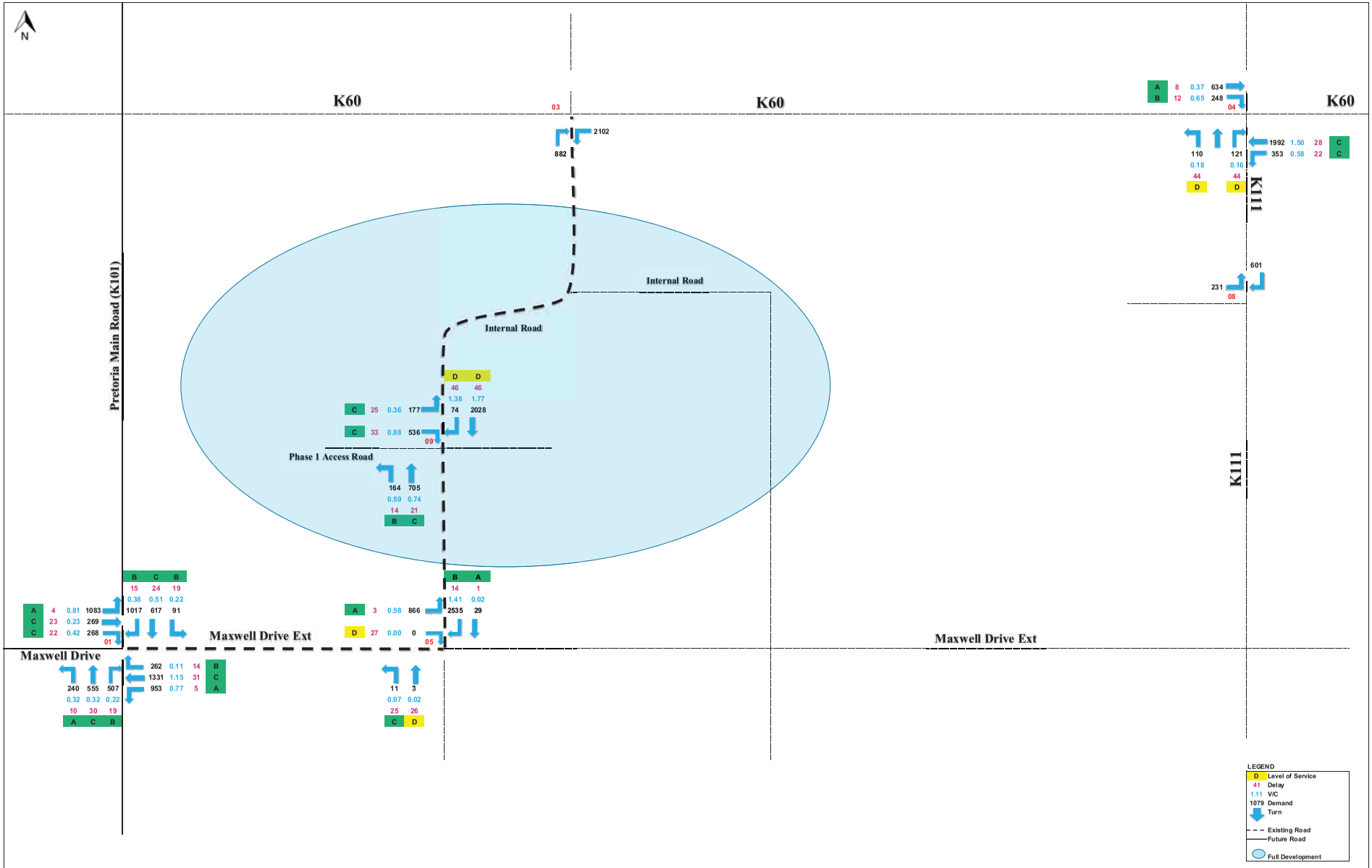
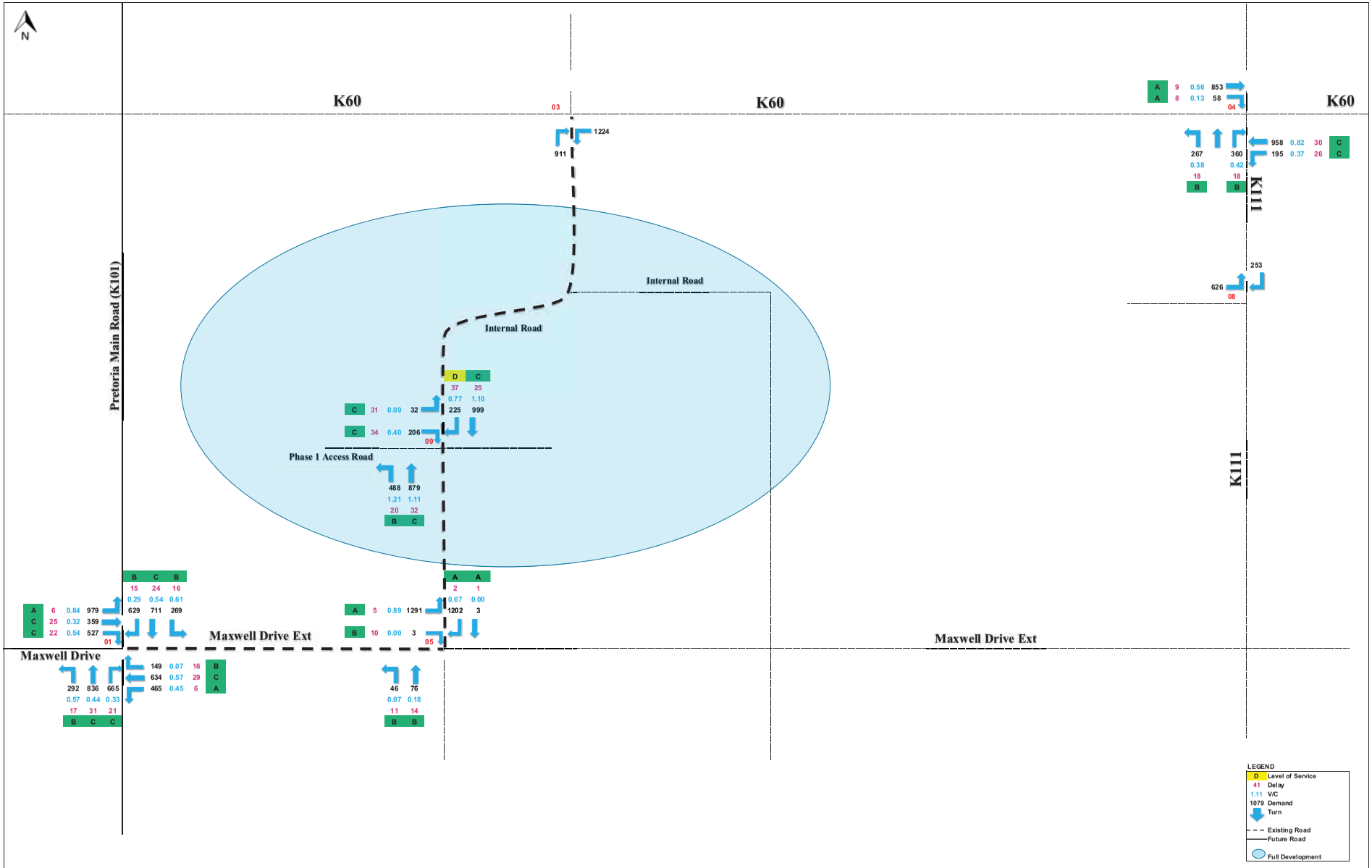
	2020 Network - With K60 between K58 (Allandale Road) and K73 (Rivonia Road) + Upgrades	Figure: 12



ARUP +27 11 218 7600	SC04b: PM Peak - 2020 Background with latent traffic, Full Development and Upgrades	Project: 248841-00
	2020 Network - With K60 between K58 (Allandale Road) and K73 (Rivonia Road) + Upgrades	Figure: 13



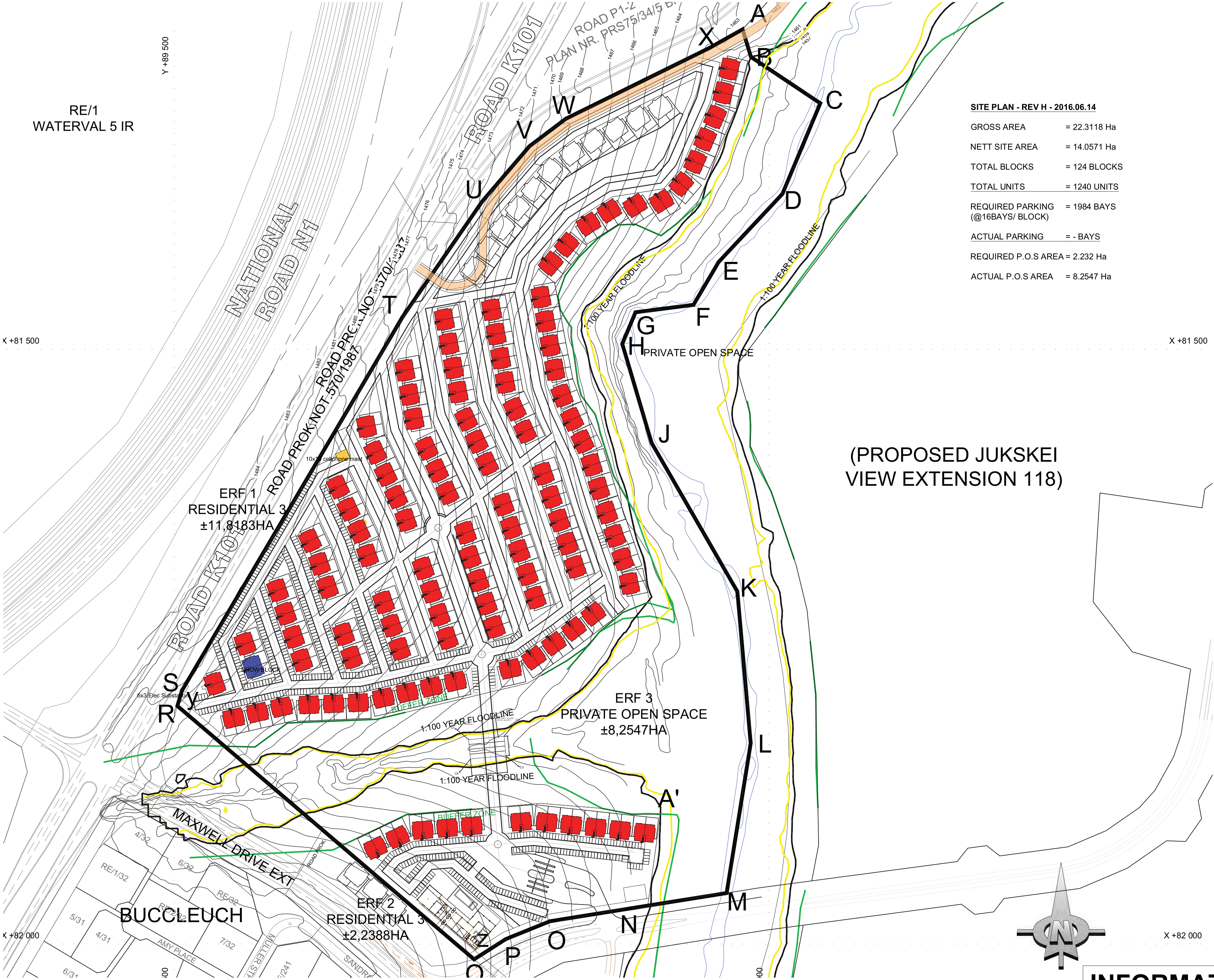
ARUP +27 11 218 7600	SC05a: AM Peak - 2020 Background + latent traffic+Phase1	Project: 248841-00
	Existing Road Network - With Development Spine Road	Figure: 14



ARUP +27 11 218 7600	SC05b: PM Peak - 2020 Background + latent traffic+Phase1	Project: 248841-00
	Existing Road Network - With Development Spine Road	Figure: 15

Appendix A

Temporary access road



SITE PLAN - REV H - 2016.06.14

GROSS AREA	= 22.3118 Ha
NETT SITE AREA	= 14.0571 Ha
TOTAL BLOCKS	= 124 BLOCKS
TOTAL UNITS	= 1240 UNITS
REQUIRED PARKING (@16BAYS/ BLOCK)	= 1984 BAYS
ACTUAL PARKING	= - BAYS
REQUIRED P.O.S AREA	= 2.232 Ha
ACTUAL P.O.S AREA	= 8.2547 Ha

General Notes

format: A1

This drawing is not to be scaled, all figured dimensions to be used.

All Dimensions and cadastral setting out information to be thoroughly checked on site and all or any discrepancies to be reported to the **Architect** before any work is put in hand.

All work is to comply with the **NATIONAL BUILDING REGULATIONS (NBR) AND BUILDING STANDARDS** act 103 of 1977 as amended

All work is to comply with all relevant specifications and codes of practice of the **SOUTH AFRICAN BUREAU OF STANDARDS (SABS) / SOUTH AFRICAN NATIONAL STANDARDS (SANS)** and amendments thereto.

HEALTH AND SAFETY: All construction activities to conform to the **OCCUPATIONAL HEALTH AND SAFETY ACT 1993 (Act No 85 of 1993)**

All materials and workmanship to be as per the **MODEL PREAMBLES FOR TRADES 2008**, and any further additional preambles as noted in the Bills of Quantities.

All work is to comply with all relevant specifications and codes of practice of the **NATIONAL HOME BUILDERS REGISTRATION COUNCIL (NHBRC)** (Where applicable)

ELECTRICAL Engineer: (Where applicable) All materials and workmanship to be as specified on the Consultants drawings.

STRUCTURAL and CIVIL Engineer: (Where applicable) All materials and workmanship to be as specified on the Consultants drawings.

RATIONAL FIRE Engineer: (Where applicable) All materials and workmanship to be as specified on the Consultants drawings.

WET SERVICES Engineer: (Where applicable) All materials and workmanship to be as specified on the Consultants drawings.

SPECIALIST CONSULTANTS (Where applicable) All materials and workmanship to be as specified on the Consultants drawing.

GENERAL
-Keep unauthorised persons off the site at all times.
-Maintain and protect the site datum level, set up by the land surveyor.
-Prevent structural or other damage to remaining portions of the buiding(s). Make good a existing work damaged during alterations.
-Ensure that service connections (electrical, telephone, water supply, sewers, etc.) are not interfered with. give notice to the local authority and the architect if disconnection of alteration is necessary.
-Minimise disturbance and nuisance from dust and noise.
-Remove all removable fittings that could be damaged, mark and store until after painting and refit where applicable.
-All work is to comply with the National Building Regulations and Building Standards Act number 103 of 1977 as amended and all relevant specifications and codes of practice of the SABS and amendments thereto.
-Vertical dpc's to all changes in floor level where ground level is higher than finished floor level, continuous vertical dpm to be installed.
-Dpc's under all walls and screen walls to be a minimum of 150mm above finished ground level.
-All drains under building to be adequately encased in concrete with river sand, suitable for carrying loads unless otherwise specified.
-Inspection eyes to all bends and junctions to be easily accessible with marked covers at ground level.
-Rodding eyes to be provided where necessary.
-100mmø upvc soil pipes to have a minimum fall of 1:60. all vent pipes to extend 900mm above roof level unless otherwise stated. all waste fittings to have deep 'p' re-seal traps and to be fully accessible for repairs.
-Top of any drain to be at least 300mm above ground level. concealed waste pipes to be sleeved.
-Stair treads to be a minimum 250mm, stair risers to be a maximum of 200mm.
-Balustrade heights to be 1000mm minimum. Baluster openings to be a minimum of 100mm.
-Flashings to all changes in roof levels.
-Surface beds to be on approved waterproofing membrane forming a continuous membrane with the dpc's under walls.
-All habitable rooms to have a minimum of 10% natural light.
-All glazing to comply with Part N of SABS 10400.
-Maximum permissible air leakage for openable glazing to comply with Clause 4.4.3.1.1 of SANS 204:2011.
-Maximum permissible air leakage for non-openable glazing to comply with Clause 4.4.3.1.2 of SANS 204:2011.
-Solar water heating systems to comply with SANS 204, Clause 4.5.2.
-All exposed pipes to and from hot water cylinders to be insulated to comply with SANS 204, Clauses 4.5.2.4 &5

rev:	description:	date:
Hh	ISSUED FOR INFORMATION	2016.06.22
H	ISSUED FOR INFORMATION	2016.06.14
G	ISSUED FOR INFORMATION	2016.06.03
F	ISSUED FOR INFORMATION	2016.05.31
E OPTION B	ISSUED FOR INFORMATION	2016.05.30
D	ISSUED FOR INFORMATION	2016.05.21
C	ISSUED FOR INFORMATION	2016.05.18
B	ISSUED FOR INFORMATION	2016.05.12
A	ISSUED FOR INFORMATION	2016.05.10

client: Balwin PROPERTIES

KIKUYU

project: WATERFALL FIELDS & WATERFALL RIDGE

erf no:

LYT
ARCHITECTURE.CONCEPTS.LIFE.FORM.SPACE

Reception: 2nd Floor, 3 Melrose Square, Melrose Arch, +27 11 061 9700
www.lyt.co.za

drawing title: Waterfall Fields - Kikuyu
SITE PLAN

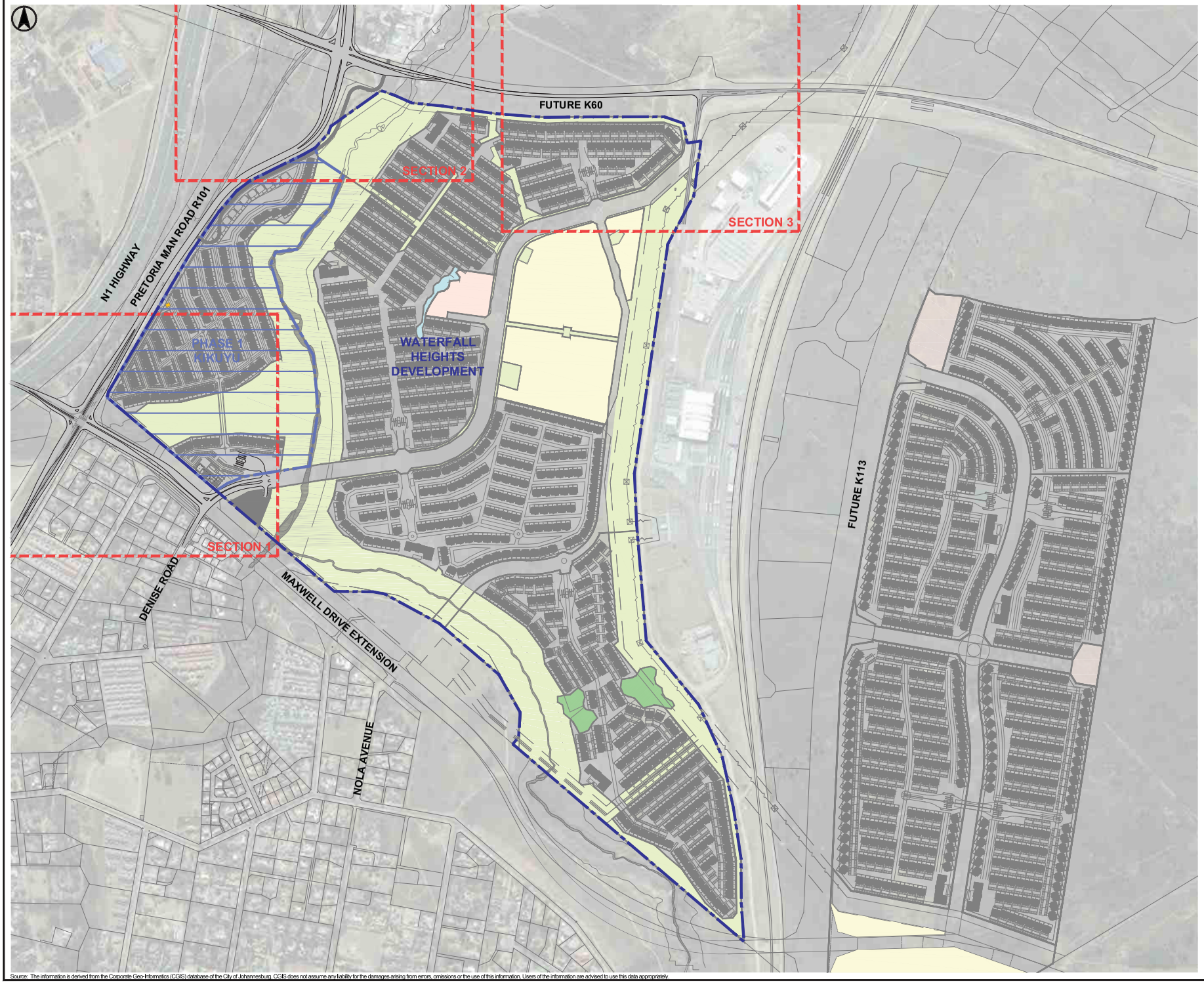
INFORMATION	tender	construction
Architectural	1:1500 @A1	2016.05.10
discipline:	scale:	date:
E S / LDB	L DB	E S /LDB
design:	drawn:	check:

project:	dwg no:	rev:
3539	SP-A100	Hh

INFORMATION

Appendix B

Proposed road upgrades
Option 1



Source: The information is derived from the Corporate Geo-Informatics (CGIS) database of the City of Johannesburg. CGIS does not assume any liability for the damages arising from errors, omissions or the use of this information. Users of the information are advised to use this data appropriately.

Issue	Date	By	Chkd	Appd
01	27-06-2016	ES	MM	SvJ

ARUP

Arup Transport Planning
10 High Street, Melrose Arch, South Africa
Postnet Suite No 93, Private Bag X1, Melrose Arch, 2076
Tel: +2711 218 7600 Fax: +2711 218 7601
www.arup.com

Client

Balwin Properties Ltd

Job Title

Jukskei View Extension 128
Kikuyu Residential Development
Traffic Impact Assessment

Drawing Title

Proposed Road Upgrades
Option 1 - Key Plan

Job No	Drawing Status
248841	For Information

Drawing No	Issue
B00	01

Source: The information is derived from the Corporate Geo-Informatics (CGIS) database of the City of Johannesburg. CGIS does not assume any liability for the damages arising from errors, omissions or the use of this information. Users of the information are advised to use this data appropriately.

Issue	Date	By	Chkd	Appd
01	27-06-2016	ES	MM	SvJ

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Scale 1:2000 (A3)

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www.arup.com

Client

Balwin Properties Ltd

Job Title

Jukskei View Extension 128
Kikuyu Residential Development
Traffic Impact Assessment

Drawing Title

Proposed Road Upgrades
Option 1 - Section 1

Job No	Drawing Status
248841	For Information

Drawing No	Issue
B01	01

Source: The information is derived from the Corporate Geo-Informatics (CGIS) database of the City of Johannesburg. CGIS does not assume any liability for the damages arising from errors, omissions or the use of this information. Users of the information are advised to use this data appropriately.

Issue	Date	By	Chkd	Appd
01	27-06-2016	ES	MM	SvJ

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Scale 1:2000 (A3)

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Client

Balwin Properties Ltd

Job Title

Jukskei View Extension 128
Kikuyu Residential Development
Traffic Impact Assessment

Drawing Title

Proposed Road Upgrades
Option 1 - Section 2

Job No	Drawing Status
248841	For Information

Drawing No	Issue
B02	01

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Issue	Date	By	Chkd	Appd
01	27-06-2016	ES	MM	SvJ

0m 20 40 60 80 100
Scale 1:2000 (A3)

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Client

Balwin Properties Ltd

Job Title

Jukskei View Extension 128
Kikuyu Residential Development
Traffic Impact Assessment

Drawing Title

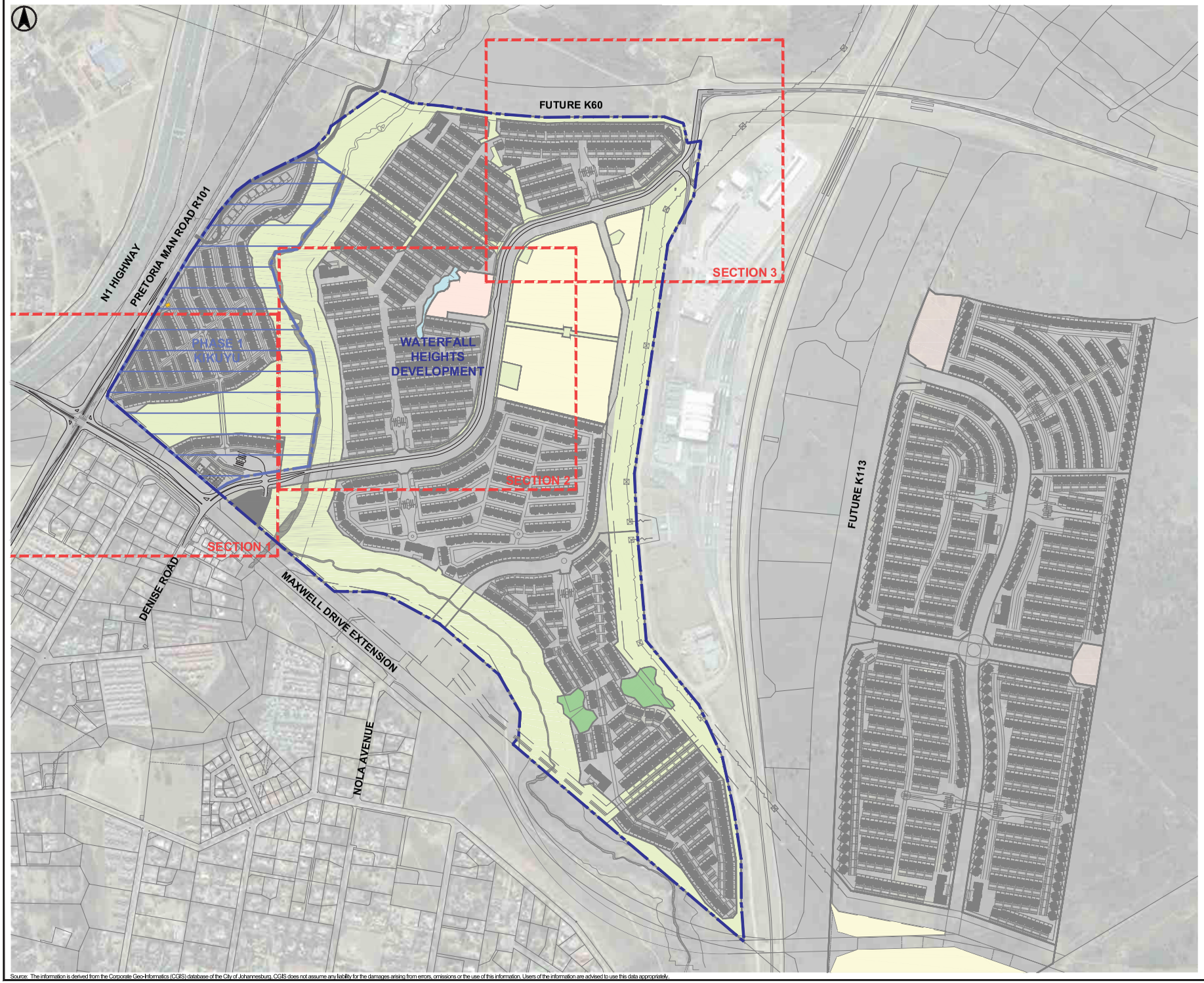
Proposed Road Upgrades
Option 1 - Section 3

Job No	Drawing Status
248841	For Information

Drawing No	Issue
B03	01

Appendix C

Proposed road upgrades
Option 2



Issue	Date	By	Chkd	Appd
01	27-06-2016	ES	MM	SvJ

ARUP

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Client

Balwin Properties Ltd

Job Title

Jukskei View Extension 128
Kikuyu Residential Development
Traffic Impact Assessment

Drawing Title

Proposed Road Upgrades
Option 2 - Key Plan

Job No	Drawing Status
248841	For Information

Drawing No	Issue
C00	01

Source: The information is derived from the Corporate Geo-Informatics (CGIS) database of the City of Johannesburg. CGIS does not assume any liability for the damages arising from errors, omissions or the use of this information. Users of the information are advised to use this data appropriately.

Issue	Date	By	Chkd	Appd
01	27-06-2016	ES	MM	SvJ

0m 20 40 60 80 100
Scale 1:2000 (A3)

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Client

Balwin Properties Ltd

Job Title

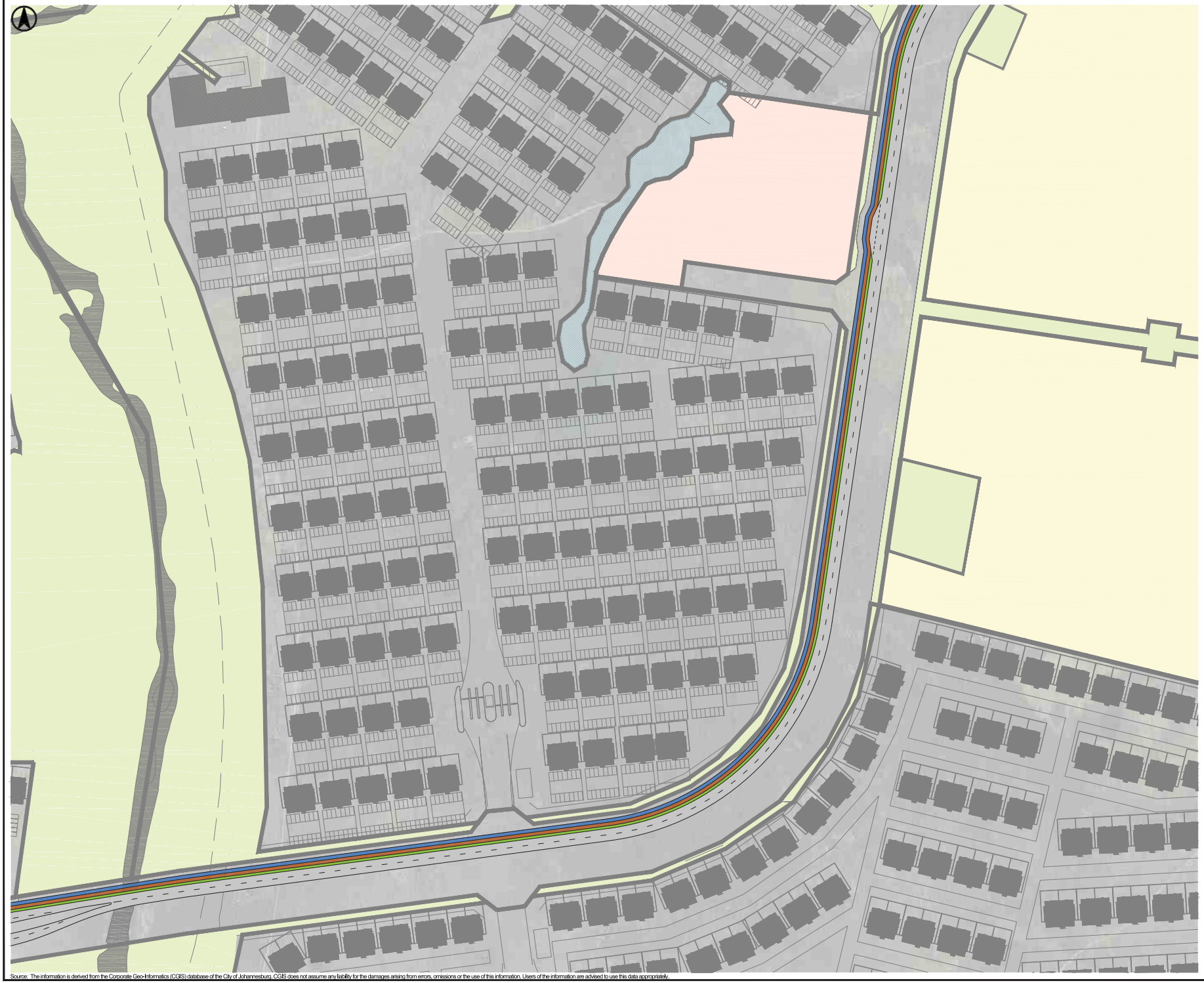
Jukskei View Extension 128
Kikuyu Residential Development
Traffic Impact Assessment

Drawing Title

Proposed Road Upgrades
Option 2 - Section 1

Job No	Drawing Status
248841	For Information

Drawing No	Issue
C01	01



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Issue	Date	By	Chkd	Appd
01	27-06-2016	ES	MM	SvJ

0m 20 40 60 80 100
Scale 1:2000 (A3)

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Client

Balwin Properties Ltd

Job Title

Jukskei View Extension 128
Kikuyu Residential Development
Traffic Impact Assessment

Drawing Title

Proposed Road Upgrades
Option 1 - Section 2

Job No	Drawing Status
248841	For Information

Drawing No	Issue
C02	01

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01	27-06-2016	ES	MM	SvJ

0m 20 40 60 80 100
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Kikuyu Residential Development
Traffic Impact Assessment

Drawing Title

Proposed Road Upgrades
Option 1 - Section 3

Job No	Drawing Status
248841	For Information

Drawing No	Issue
C03	01