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# Proposed Residential Township located situated on The Remainder of the Farm Bosch Hoek 3345-HS, Newcastle, KZN

# TRAFFIC IMPACT STUDY

August 2011

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# 1 Introduction

WSP SA Civil and Structural Engineers (Pty) Ltd have been appointed to undertake a Traffic Impact Study for a proposed residential township situated on the Remainder of the Farm Bosch Hoek 3345-HS, Newcastle. The site is located on the southern periphery of Newcastle, as in shown in **Figure 1**.

The proposed township, located on a site of approximately 142,3ha, will be a predominantly residential township of approximately 2600 residential erven, which will cater for the lower income households. Given the extent of the township, other associated land uses are also proposed such as community facilities, schools, crèches, churches and sports facility. A small business centre is also proposed.

An area of approximately 70ha, immediately to the north of the application site (see **Figure 1**), have been acquired by the Council for a proposed subsidised residential township, which is intended to be an expansion and formalisation of the existing informal settlements to the north of this site. The site would have a potential for approximately 2 000 dwelling units.

This study investigates the impact of the additional traffic generated by the proposed township on the immediate surrounding road network and determines whether it is necessary to implement any road and/or intersection improvements to mitigate the anticipated traffic impact. Comments are also made in respect of site access and non-motorised & public transport.

# 2 Site Location & Surrounding Road Network

**Figures 1, 2,** and **3a** show the site location and nearby road network within the study area. Given the extent of the proposed township on a currently vacant site, it was necessary to consider the existing and future road network in the area. In this respect the internal road network of the proposed township (see **Annexure A**) had been designed as such to tie in with the future road planning.

## 2.1 EXISTING ROAD NETWORK

The following existing key roads and intersections are relevant to the study area, which will become significant from a traffic perspective especially in the short to medium term:

**Boundary Road:** This road can be classified as a Class 2/3 provincial road which is located directly to the west of the site, and which will also be the only road providing access to the proposed township in the short to medium term. Its current nearest intersection of significance is its 4-legged 4-way stop controlled intersection with Panorama Drive, which is about 380m to the north of the proposed site access intersection. To note from **Figure 1** is that Boundary Road is one of only a few main routes into the Newcastle CBD; further to the north Boundary Road becomes Scott Street. To the south it is a rural road that connects to Normandien, but which generally serves the farming community to the southwest of Newcastle. Despite the fact that Boundary Road feeds into the CBD, which is about 4,5km to the northeast, the current traffic volumes past the site are of a low order. According to recent surveys the peak traffic volumes past the site are only about 110vph and 130vph (total both directions) during the weekday AM and PM peak hours respectively. The main reason for the low traffic volumes is that this outskirt of the town is still undeveloped.

**Panorama Drive:** This road is viewed as a Class 4 collector street, located to the north-west of the site. Panorama Drive is a 2-lane paved road through the Boundary Road intersection. The current traffic volumes near its intersection with the Boundary Road intersection are about 140vph (total both directions) during both the weekday AM and PM peak hours respectively, which is also of a low order.

**Link Road (West & East):** This road is viewed as a Class 4 collector street that forms a stop controlled staggered intersection with Boundary Road, which is approximately 1,5km to the north of Panorama Drive. This road carries relatively low traffic volumes near its intersection with the Boundary Road intersection during the weekday AM and PM peak hours.

**Ladysmith Road (R34):** This road can be classified as another Class 2/3 provincial road, similar to that of Boundary Road, although its traffic volumes are higher. It is also a major link to the Newcastle CBD. To note is that Ladysmith Road forms an intersection with the N11 on the southeastern side of the town.

## 2.2 FUTURE ROADS

The local Spatial Development Framework (SDF) (copy attached in **Annexure B**) as obtained from the Council had been taken into account and the access(es) to the township and its main internal roads had been designed as such to tie in with the future

road network. With reference to **Figure 2** and **3b**, the following can be note with respect to the future road network:

- **Future Major Arterial Road**: According to the Newcastle Local Municipality Spatial Development Framework, a Class 2/3 major arterial road that will link the western part of the town with Ladysmith Road (R34) and Albert Wessels Drive to the east of the town. This planned link road will be of strategic importance since it will connect the east and west of Newcastle with one another without traffic through the CBD;
- **Future Minor Arterial Link Roads**: Other planned Class 3/4 arterial roads that will support the above east-west link, includes an extension of Link Road East up to the N11 as well as an extension of Centre Street;
- **N11 Realignment**: As noted in **Figure 2**, a realignment of the N11 is planned on the south eastern side of the town where it currently intersects with Ladysmith Road (R34). The proposed realignment will result in a more direct/straight route, whilst parts of the existing N11 will then become local roads.

It should be noted that no details of the abovementioned roads are yet available and it is also not known when these planned roads will be implemented.

Given the existing spare capacity on Boundary Road to the west of the site and the anticipated traffic generations of the proposed township, it is submitted that the proposed township is not dependent on the implementation of the abovementioned future roads. However, once implemented, the future roads would significantly improve the accessibility to/from the proposed township. As noted in **Figure 3b** and **Annexure A**, the necessary provision has been made in the township layout so that the proposed development and its residents can take full advantage of the future roads once implemented.

# 3 Proposed Development & Site Access

## 3.1 PROPOSED DEVELOPMENT

The subject site comprises the Remainder of the Farm Bosch Hoek 3345-HS, Newcastle and it is approximately 142,3ha in extent. A new township is proposed on this currently undeveloped farm land, which will offer residential opportunities for the lower income market. With reference to the proposed township layout in **Annexure A,** it will be a predominantly residential township with minor ancillary uses. In brief, the proposed township will consist of the following land uses:

- 2593 residential erven;
- Crèche & Church;
- Schools (secondary and combined);
- Community & Sports Facilities; and
- Business.

The residential erven varies in sizes of approximately 200m$^2$ to 300m$^2$, of which most erven are 250m$^2$ is size. These erven allows for rather small houses, which will be taken up by the lower income bracket and first home owners. These households typical have a lower socio economic profile and it is expected that their usage of private vehicles to commute to work are also low. Most of the working people would make use of public transport such as minibus taxis to/from work.

The ancillary uses such as the schools, crèches, churches and community facilities will predominantly serve the local residents and the external traffic generations can therefore be ignored.

The business component extends an area of approximately 2,85ha, which can be developed in future as a small retail centre and/or other business uses such as offices. Taking account of the provision of parking, the two erven allows for a total business/retail development of approximately 12,000m$^2$ GLA. The proposed business component would therefore be at most a small neighbourhood centre, which would mostly cater for the local residents of the proposed residential townships and its surrounds. Although it is expected that some of the peak traffic generations would be external, and therefore may have some additional traffic impact, it is recommended that an additional traffic study be undertaken for the business at the time of submission of the Site Development Plans (SDP). Such study should focus on the access to the centre as well as nearby intersection.

## 3.2 SITE ACCESS

Due to the extent of the development, this document will investigate the short to medium term and long term accesses as follows:

- **Short to medium term access (see Figure 3a)**: The proposed main east-west spine road through the proposed township will form a new T-intersection with Boundary Road, which will serve as the only access to the township in the short to medium term. The location of the proposed intersection has taken account of the limited access restriction along Boundary Road and it is line with the access principles of a Class 2 road. The nearest intersection will be the planned future east-

west link road shown in Figure 3b, which will be approximately 620m to the north. It is further proposed that the T-intersection will be a priority controlled intersection with Boundary Road traffic having free flow conditions. Once the through traffic along Boundary Road has increased substantially of time, other types of intersection control (i.e. 3-way stop or traffic signals) can be considered in the long term.

- **Long term access (see Figure 3b):** As mentioned in Section 2.2 of this report, a Class 2/3 major arterial road is planned to connect the western and eastern parts of the town. This planned road will be located in close proximity to the north of the application site. It is likely that the part of the future road will be constructed in the medium term to serve the proposed housing development to the north, but its full implementation to the north and east as shown in Figure 2 is likely to be operation only in the long term. Once implemented, additional accesses to the application site will be available as shown in **Figure 3b**. The future major arterial road that will intersect with the R34 will also serve as a link to the site. Accessibility to the site will also be feasible from N11 via the R34. In the future the short term access may become a secondary access and the traffic volumes will become less.

Individual accesses to erven of especially the non-residential uses fall outside the scope of this study and should be dealt with as part of the SDP submissions, which will follow at a later stage. Access to the residential erven is self-explanatory as per the township layout in **Annexure A**.

# 4 Traffic Flows & Trip Generation

## 4.1 EXISTING TRAFFIC FLOWS

Given the type and extent of the proposed development, as well as the short to medium term road network, detailed traffic surveys were carried out during the critical peak periods, namely the weekday AM and PM peak hour periods. The surveys comprised manual traffic counts which were carried out in June 2011 at the following key intersections along Boundary Road:

- Boundary Road / Panorama Drive(4-way stop);and
- Boundary Road / Link Road (2-way stop).

The existing weekday AM and Weekday PM peak hour traffic volumes at the above intersections are summarised in **Figure 3**.

## 4.2 FUTURE 2016 BASE TRAFFIC FLOWS

As per the requirements of the *Manual for Traffic Impact Studies (1995)* for developments which generate more than 150 peak hour trips, it is necessary to escalate the existing traffic volumes to a future base, using at least a 5-year horizon.

In order to make provision for an increase in background traffic due to growth and other unknown developments in the area, it has been assumed that the background traffic would increase at the rate of 3.0% per annum over the next 5 years to a future 2016 base year. **Figure 4** shows the estimated future 2016 base traffic flows.

## 4.3 DEVELOPMENT TRIP GENERATION

In order to determine the expected trip generation of the proposed development, the trip generation rates as contained in the *South African Trip Generation Rates Manual, 1995 (SATGRM)* were scrutinized. However, as mentioned before, the proposed township will cater for the lower to lower/medium income end of the market which assumes that a substantial portion of the residents would make use of public transport to commute to/from work. The *SATGRM* suggests 0,5 trips/unit for low income areas, which is the 75th percentile of an old data set. The site is located adjacent to the squatter shacks, where a large number of low income households reside and where the vehicle trip generations are substantially lower than in higher income areas. For this reason the trip generation rate of 0,35 trips/unit have been applied which is conservatively lower than that of the *SATGM*, but which had been considered appropriate given the local road network, land use type and existing traffic volumes. The trip rate is also similar to the rates used in Gauteng for such low income townships.

By applying the trip rate of 0,35 trips/unit it is estimated that the proposed 2593 residential unit township would generate about 910 peak hour trips during the AM and PM peaks. The directional splits used are 75%: 25%, which is the same as per the *SATGRM*. **Table 1** below summarises the total estimated AM and PM peak traffic generations for the proposed residential development.

**Table 1: Estimated Development Trips**

| Peak | Development Trips (vph) | | |
|---|---|---|---|
| | IN | OUT | TOTAL |
| Weekday AM Peak Hour | 225 | 685 | **910** |
| Weekday PM Peak Hour | 685 | 225 | **910** |

To note in the estimated traffic generations is that no deduction had been made for internal trips, which for such large township could be up to some 10%. Thus, the traffic estimation can be viewed as conservative.

## 4.4 TRIP DISTRIBUTION

Assumptions on the expected trip distribution were based on the location of the site access in relation with the surrounding road network, location of its proposed access, existing traffic volumes and patterns.

Two scenarios were considered in this case, namely:

- **Short to medium term:** Access to the township as per Figure 3a, for which the expected trip distribution is shown in **Figure 6a** and with the respective assignment of the development trips shown in **Figure 7a**.
- **Long term:** Access to the township as per Figure 3b, for which the expected trip distribution is shown in **Figure 6b** and with the respective assignment of the development trips shown in **Figure 7b**. With the additional links available, it is expected that the development traffic generations onto Boundary Road will be less compared with the previous scenario.

## 4.5 TOTAL FUTURE TRAFFIC FLOWS WITH DEVELOPMENT

For the purposes of investigating the worst case traffic conditions with respect to capacity, the short to medium scenario will be the critical scenario since all site generated traffic will have to make use of Boundary Road.

**Figure 8** shows the total 2011 background traffic plus development peak hour traffic flows, which is the summation of **Figures 4** and **7a**.

**Figure 9** shows the total future 2016 base traffic plus development peak hour traffic flows, which is the summation of **Figures 5** and **7a**. In this case it also assumed that the future road network and accessibility as per Figure 3b will not be available by 2016 yet.

# 5 Traffic Impact & Capacity Analyses

SIDRA INTERSECTION 5.1 capacity analyses for the weekday AM and PM peak hours were carried out to determine the expected traffic impact at the following key intersections:

- Boundary Road / Panorama Drive (4-way stop);
- Boundary Road / Link Road (east) (2-way stop);
- Boundary Road / Link Road (west) (2-way stop); and
- Boundary Road / Access Road (2-way stop).

The following scenarios were analysed, namely:

- Scenario 1: Existing 2011 Weekday AM and Weekday PM peak hour traffic flows without the proposed development (as per **Figure 4**);
- Scenario 2: Future 2016 Base without the proposed development Weekday AM and Weekday PM peak hour traffic flows (as per **Figure 5**);
- Scenario 3: Existing 2011 plus Proposed Development Weekday AM and Weekday PM peak hour traffic flows (as per **Figure 8**); and
- Scenario 4: Future 2016 Base plus Proposed Development plus Weekday AM and Weekday PM peak hour traffic flows (as per **Figure 9**).

Both Scenarios 3 and 4 only considered the short-medium access scenario. To note is that no traffic analyses were done for the future access scenarios. The latter will be far less critical since the new links will cause traffic from the subject site to use alternative routes instead of Boundary Road – thus, the traffic will be distributed more and consequently less traffic will use Boundary Road.

Results of the SIDRA INTERSECTION 5.1 capacity analyses at the various intersections are discussed in the following sub sections, with the details of the outputs enclosed in **Annexures C1** to **C4**.

## 5.1 BOUNDARY ROAD / PANORAMA DRIVE INTERSECTION

**Annexures C1.1** to **C1.8** have reference:

This is a 4-legged stop controlled intersection; all approaches have one lane per direction.

**Existing 2011 traffic flows (existing geometry) (Annexures C1.1 to C1.2)**– According to the SIDRA capacity analyses this intersection currently operates at an overall LOS A during both the weekday AM and PM peak hours with the average intersection delays of about 18 and 25 seconds during these peak hours respectively. The v/c ratios are less than 0,5 for both peaks which indicates that there is ample spare capacity.

**Future 2016 Base traffic flows (Annexures C1.3 to C1.4)**– The growth of the background traffic will have marginal impact on the operating capacity of this intersection during the AM and PM peaks, when comparing the results with the previous scenario.

**Existing 2011 traffic flows with development (Annexures C1.5 to C1.6**) – The addition of the development traffic to the background 2011 traffic volumes will have an impact on the operation of this intersection during both the AM and PM peak periods. Overall LOS D and E can be expected during the weekday AM and PM peaks respectively, with increased v/c ratios and delays. The operating conditions will still be marginally below capacity.

**Future 2016 Base traffic flows with development (Annexures C1.7 to C1.8)** – The addition of the development traffic to the future 2016 base traffic volumes, shows similar results to the previous scenario, namely overall LOS D and E during the weekday AM and PM peaks respectively, and operating conditions will still be marginally below capacity.

It is concluded that although the substantial increase in through traffic along Boundary Road will cause an impact to the operating conditions of this 4-way stop controlled intersection, it is expected that the intersection will still operate below its capacity, and consequently there is no need for any road upgrades or improvements. It can also be noted that once the other planned future roads (as discussed Section 2.2) are implemented, the traffic flow on Boundary Road will reduce again.

## 5.2 BOUNDARY ROAD / LINK ROAD WESTERN LEG INTERSECTION

**Annexures C2.1** to **C2.8** have reference:

This is a 2-way stop controlled 3-legged intersection with priority to Boundary Road. The western approach of Link Road has one right turn lane and a left turn slip lane with a single exit lane. The southern approach of Boundary Road has one per direction, whilst the northern approach has an exclusive short left-turning lane and a through lane.

**Existing 2011 traffic flows (Annexures C2.1 to C2.2)** – According to the SIDRA capacity analyses the critical approach of Link Road operates at an overall LOS A during the weekday AM and PM peak hours with the approach delays of 10 and 9 seconds during these peak hours respectively

**Future 2016 Base traffic flows (Annexures C2.3 to C2.4)** – The growth of the background traffic will not have a significant impact on the operating capacity of this intersection during the weekday AM peak hour. The SIDRA capacity analyses indicate the critical approach of Link Road will operate at LOS A during the weekday AM and PM peak hours respectively with approach delays of 11 and 15 seconds respectively.

**Existing 2011 traffic flows with (Annexures C2.5 to C2.6)** – The addition of the development traffic to the background 2011 traffic volumes will have a minimal impact on the operating capacity of this intersection during the weekday AM and PM peaks. The SIDRA capacity analyses indicate overall LOS B and A, and that the critical approach of Link Road (west approach) will at worse experience LOS B during the AM peak.

**Future 2016 Base traffic flows with development (Annexures C2.7 to C2.8)** – The addition of the development traffic to the future 2016 base traffic volumes will have some impact on the operating capacity of this intersection during the peaks. The SIDRA capacity analyses indicate that the critical approach of Link Road (west approach) will operate at LOS E and C during the weekday AM and PM peak hours respectively. The expected v/c ratios for this worst condition are still below capacity.

It is concluded that this priority controlled intersection have sufficient spare capacity to accommodate the additional traffic generated by the proposed township, without the need for upgrades. The next logical upgrade for this intersection would be the installation of traffic signals, but which will not be warranted according the South African Road Traffic Signs Manual (SARTSM). Also to note is that once the other planned future roads (as discussed Section 2.2) are implemented, the traffic flow on Boundary Road will reduce again.

## 5.3 BOUNDARY ROAD / LINK ROAD EASTERN LEG INTERSECTION

**Annexures C3.1** to **C3.8** have reference:

Currently this is a 2-way stop controlled 3-legged intersection with priority to Boundary Road. The eastern leg of Link Road (East) is a dual carriageway road and at its intersection with Boundary Road it has one right turn lane and one left turn lane and two exit lanes. The southern approach of Boundary Road has an exclusive short right-turning lane and a through lane, whilst the northern approach has an exclusive short left-turning lane and a through lane.

**Existing 2011 traffic flows (Annexures C3.1 to C3.2)** – According to the SIDRA capacity analyses the critical approach of Link Road East operates at an overall LOS A during both the weekday AM and PM peak hours with the approach delays of 17 and 15 seconds during these peak hours respectively.

**Future 2016 Base traffic flows (no development) (Annexures C3.3 to C3.4)** – The growth of the background traffic will not have an impact on the operating capacity of this intersection during the Weekday AM peak hour. The SIDRA capacity analyses indicate the critical approach of Link Road will still operate at LOS A during both the weekday AM and PM peak hours respectively with approach delays of about 20 and 16 seconds during these peak hours respectively. The v/c ratios will be less than 0,4.

**Existing 2011 traffic flows with development (Annexures C3.5 to C3.6**) – The addition of the development traffic to the background 2011 traffic volumes will only have a marginal traffic impact on the operating capacity of this intersection during the peaks. The SIDRA capacity analyses indicate a LOS A on the critical stop approach of Link Road, and v/c ratios of about 0,5 during both these peaks. Thus, there will still be ample spare capacity after the addition of the development traffic.

**Future 2016 Base traffic flows with development (Annexures C3.7 to C3.8)** – The addition of the development traffic to the future 2016 base traffic volumes will have some impact on the operating capacity of this intersection during the peaks. The SIDRA capacity analyses indicate that the critical approach of Link Road (east approach) will operate at LOS D and B during the weekday AM and PM peak hours respectively. The expected v/c ratios for the worst condition be 0,85 during the AM peak, which is still well below capacity.

It is concluded that this priority controlled intersection have sufficient spare capacity to accommodate the additional traffic of the proposed township, without the need for upgrades. As for the other intersection, it should be noted that once the other planned future roads (as discussed Section 2.2) are implemented, the traffic flow on Boundary Road will reduce again.

## 5.4 BOUNDARY ROAD / ACCESS ROAD INTERSECTION

**Annexures C4.1** to **C4.2** have reference:

As part of the implementing the short-medium access to the township, a new third leg is proposed off Boundary Road which will serve as the primary access road. **Figure 10** shows the proposed geometry of this Boundary Road / Access Road intersection, which will be a T-intersection with stop controlled on the new eastern approach and free flow conditions along Boundary Road. A new deceleration lane and taper are proposed on northern approach of Boundary Road. Since there will be no traffic demand to/from the south along Boundary Road, it is submitted that one approach lane for the new road will be sufficient.

**Future 2016 Base traffic flows with development (Annexures C4.1 to C4.2**– According to the SIDRA capacity analyses the critical stop controlled approach of the site access will operate at an overall LOS D during weekday AM peak and LOS A during the PM peak respectively. The traffic during the more critical AM peak will experience an average delay of about 23 seconds, which is still well within acceptable levels. Thus, the proposed access will have sufficient capacity to accommodate the development traffic as well as growth in traffic volumes along Boundary Road.

It is therefore concluded that the proposed geometry as per **Figure 10** will be sufficient to also accommodate future traffic and additional traffic from the proposed township.

# 6 Road and/or Intersection Upgrades

Based on the type and extent of development proposed, the expected peak trip generations (Section 4), the capacity analyses covered in Section 5 as well as our site observations, the following proposed road infrastructure are relevant:

- **Boundary Road / Access Road Intersection:** As part of the implementing the short-medium access to the township, a new third leg is proposed off Boundary Road which will serve as the primary access road. **Figure 10** shows the proposed geometry of this Boundary Road / Access Road intersection, which will be a T-intersection with a single lane stop controlled on the new eastern approach and free flow conditions along Boundary Road. A new deceleration lane and taper are proposed on northern approach of Boundary Road;
- **Internal Roads:** As part of implementing the proposed township, a new network of local roads is proposed as shown in the township layout in **Annexure A**. Key characteristics of these streets, such as road reserve widths, intersection spacing, roadway widths, types of kerbs, surfacing, etc will be dealt with and negotiated with the municipality as part of the services agreement.

The above road infrastructure is essential as part of the implementation of the proposed township and therefore the cost associated with this infrastructure will be the responsibility of the developer.

# 7 Non-Motorised & Public Transport

As noted in Sections 3.1 and 4.3, the proposed township will cater for the lower income market. These households typical have a low socio economic profile and it is expected that the majority of the residents will commute to/from work by means of public transport such as minibus taxis.

Although there are currently no public transport services in the vicinity of the subject site, it is expected that taxi operators will respond to the demand created by the new township. It is anticipated that the minibus taxis will at least run along the main internal spine roads from where residents will have less than 1km to walk.

Given the extent and type of the development proposed, it is recommended that provision be made for the following facilities:

- On-site public transport facility: It is suggested that an erf, or part thereof be reserved for a facility such as a taxi rank or holding area. The site should in a centralised location in order to minimise the walking distance to the facility;
- Public Transport Laybys: It is recommended that at least 6 laybys for minibus taxis be constructed along the main internal spine road when constructing the road. The locations of the laybys should be placed downstream of key intersections; details thereof will be provided at the time of the detail design stage of the roads;
- Sidewalks: In order to cater for the commuters/ pedestrians who will walk between site access and the nearest public transport services and as a contribution towards public transport, it is recommended that a paved sidewalk of at least 2,0m wide be constructed on at least one side of the road along main internal roads.

# 8 Conclusions & Recommendations

Based on the content of this document, the following key conclusions and recommendations are relevant:

- This Traffic Impact Study has been prepared for a proposed township situated on the Remainder of the Farm Bosch Hoek 3345-HS, located on the southern periphery of Newcastle and which is approximately 142,3ha in extent. The proposed township (layout attached in **Annexure A**) will be a predominantly residential township of approximately 2600 residential erven, which will cater for the lower income households. Given the extent of the township, other associated land uses are also proposed such as community facilities, schools, crèches, churches and sports facility. A small business centre is also proposed;
- Most of the residential erven would be typically 250m$^2$ in size. These erven allows for rather small houses, which will be taken up by the lower income bracket and first home owners. These households typical have a lower socio economic profile and it is expected that their usage of private vehicles to commute to work will be low. Most of the working people would make use of public transport such as minibus taxis to/from work;
- The business erven located to the west of the township next to Boundary Road, can be developed in future as a small retail centre and/or other business uses such as offices, which would be potentially about 12,000m$^2$ GLA. Although it is expected that some of the peak traffic generations would be external, and therefore may have some additional traffic impact, it is recommended that an additional traffic study be undertaken for the business site at the time of submission of the Site Development Plans (SDP). Such study should focus on the access to the centre as well as nearby intersection with Boundary Road;
- **Figures 1 and 3a** show the site location and nearby existing road network within the study area. Given the extent of the proposed township on a currently vacant site, it was necessary to consider the existing and future road network in the area. The local Spatial Development Framework (SDF) had been taken into account and the main internal roads of the township had been designed as such to tie in with the future road network. **Figures 2 and 3b** show the application site in relation with the proposed future road network. It should be noted that no details of these planned future roads are available as yet and it is also not known when these planned roads will be implemented;
- Given the existing spare capacity on Boundary Road to the west of the site and the anticipated traffic generations of the proposed township, it is submitted that the proposed township is not dependent on the implementation of the abovementioned future roads. However, once implemented, the future roads will significantly improve the accessibility to/from the proposed township. The necessary provision has been made in the township layout so that the proposed development and its residents can take full advantage of the future roads once implemented;
- Accessibility of the proposed township had been investigated for both the short/medium and long term, briefly as follows:
    - Short to medium term access (see **Figure 3a**): The proposed main east-west spine road through the proposed township will form a new T-intersection with

Boundary Road, which will serve as the only access to the township in the short to medium term;

- Long term access (see **Figure 3b**): A future Class 2/3 major arterial road is planned to connect the western and eastern parts of the town, and located in close proximity to the north of the application site. Once implemented, additional accesses to the application site will be available, especially more directly to the northeast of Newcastle;

- It is estimated that the proposed residential township would at most generate approximately 910 vehicle trip per hour (totals in and out) during the typical weekday AM and PM peak hours. The normal 75/25 in/out directional split for residential uses had been assumed. Since the proposed township will not be dependent on the planned future road, this study had assumed a worst case scenario by assigning all the site traffic generations onto Boundary Road, as per the short-medium term access scenario. Once the planned future roads are available and residents use other routes as well, the site generated traffic along Boundary Road will most likely reduce by some 50%;

- The following road infrastructure are proposed:

  - Boundary Road / Access Road Intersection: As part of the implementing the short-medium access to the township, a new third leg is proposed off Boundary Road which will serve as the primary access road. **Figure 10** shows the proposed geometry of this Boundary Road / Access Road intersection, which will be a T-intersection with a single lane stop controlled on the new eastern approach and free flow conditions along Boundary Road. A new deceleration lane and taper are proposed on northern approach of Boundary Road;

  - Internal Roads: As part of implementing the proposed township, a new network of local roads is proposed as shown in the township layout in **Annexure A**. Key characteristics of these streets, such as road reserve widths, intersection spacing, roadway widths, types of kerbs, surfacing, etc will be dealt with and negotiated with the municipality as part of the services agreement.

- The above road infrastructure is essential as part of the implementation of the proposed township and therefore the cost associated with this infrastructure will be the responsibility of the developer.

- In terms of non-motorised and public transport, it is concluded that a substantial number of the commuters in the proposed township will make use of public transport services, such as minibus taxis. In order to cater for these commuters, the following are proposed:

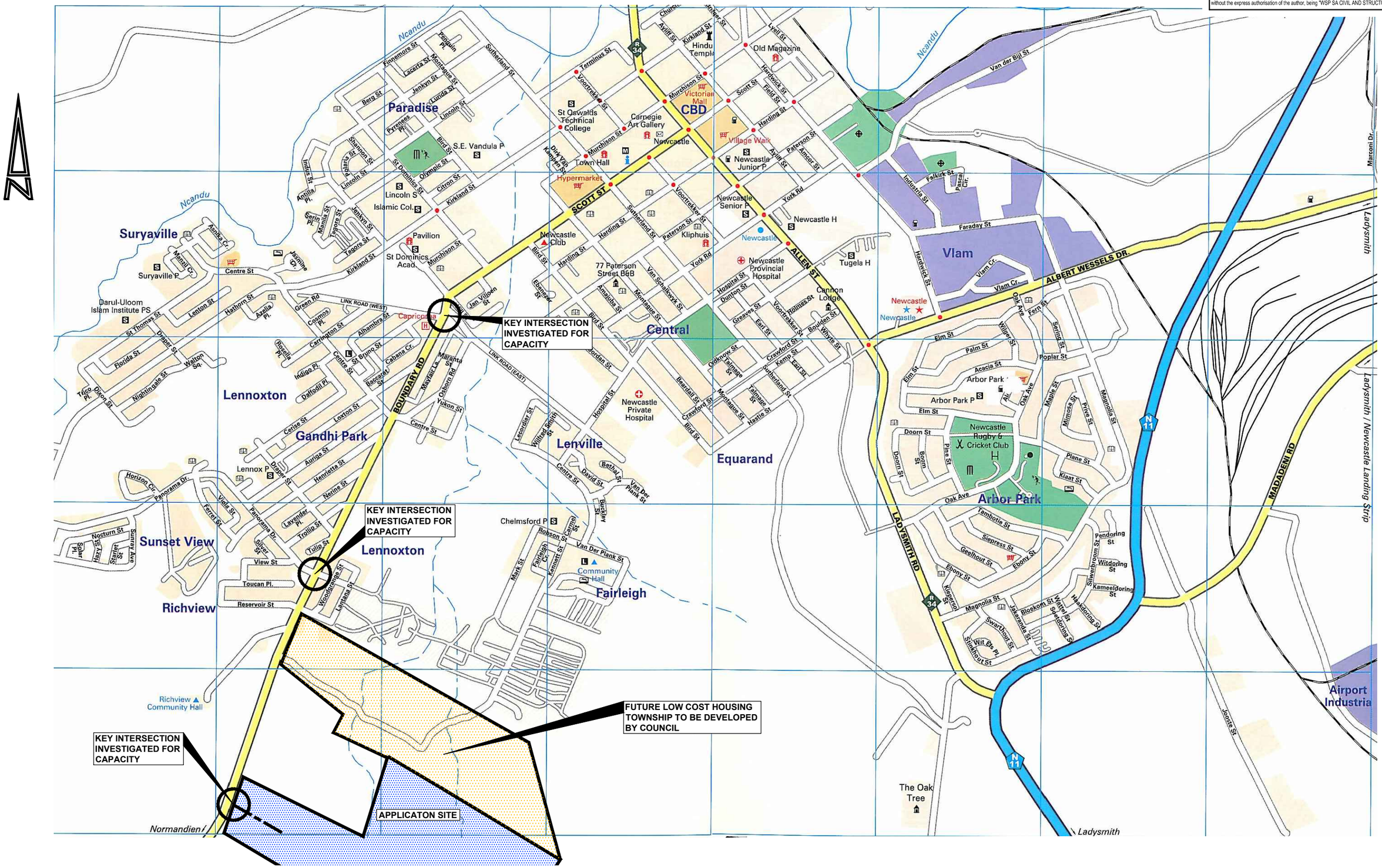
  - On-site public transport facility: It is suggested that an erf, or part thereof be reserved for a facility such as a taxi rank or holding area. The site should in a centralised location in order to minimise the walking distance to the facility;

  - Public Transport Laybys: It is recommended that at least 6 laybys for minibus taxis be constructed along the main internal spine road when constructing the road. The locations of the laybys should be placed downstream of key intersections; details thereof will be provided at the time of the detail design stage of the roads;

- Sidewalks: In order to cater for the commuters/ pedestrians who will walk between site access and the nearest public transport services and as a contribution towards public transport, it is recommended that a paved sidewalk of at least 2,0m wide be constructed on at least one side of the road along main internal roads.

From a traffic engineering perspective, the proposed township is supported provided that the proposed internal roads, intersection upgrade and suggested non-motorised and public transport facilities be implemented to the relevant design standards of the local and/or provincial roads authority.

# Figures




| REV | DATE | BY | DESCRIPTION | CHK | APD |
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| A | - | - | INITIAL ISSUE | - | - |

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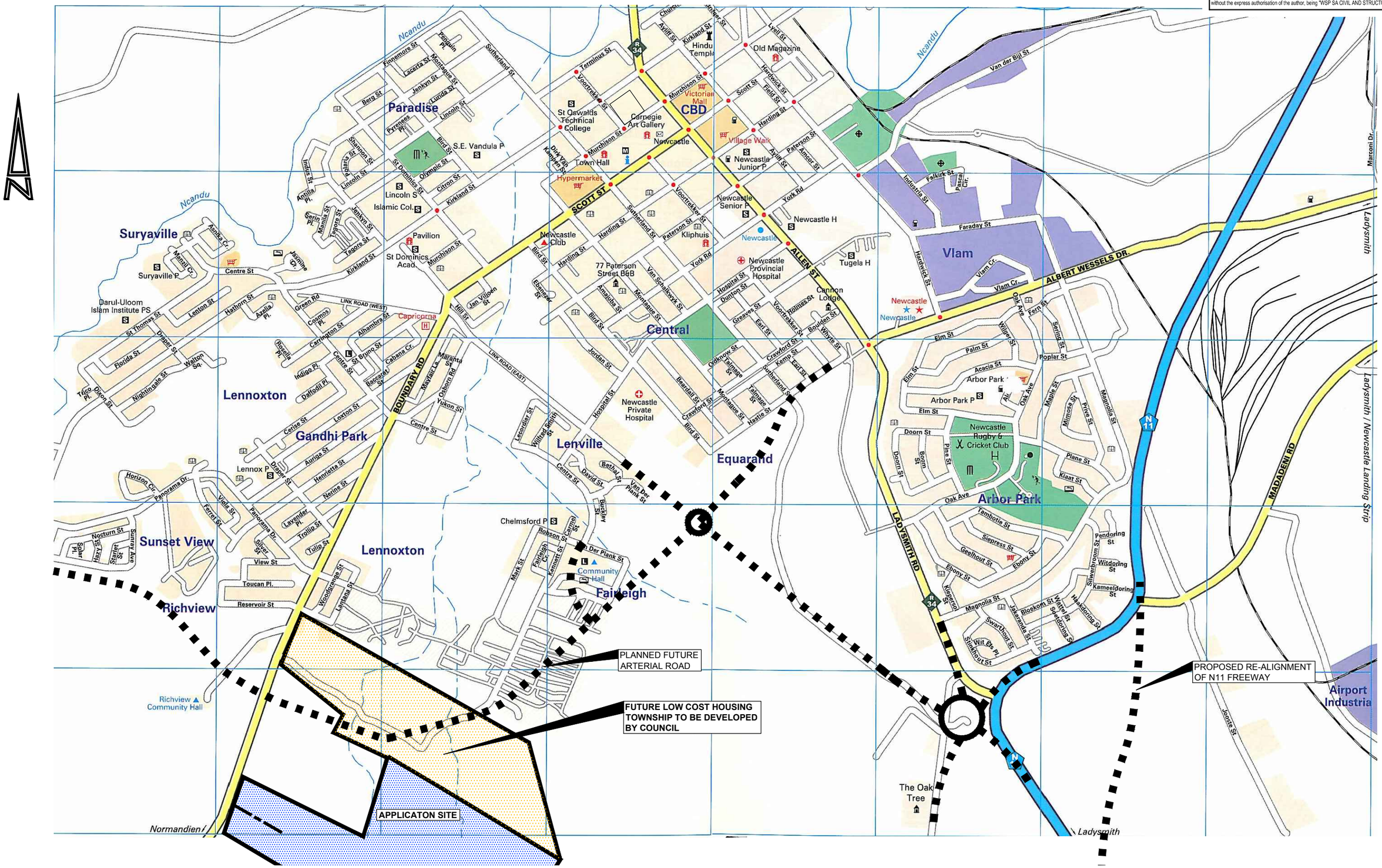
Tel: +27(0)12-361-4141 Fax: +27(0)12-361-4142
www.wspgroup.com

PROJECT: REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE

TITLE: LOCALITY PLAN

| SCALE : | CHECKED: | APPROVED: |
|---|---|---|
| 1:20 000 | D. Hundermark | D. Hundermark |
| DESIGN: - | DRAWN: - | DATE: 2011/07/10 |
| PROJECT No: 336579 | DRAWING No: 1 | REV: - |




| REV | DATE | BY | DESCRIPTION | CHK | APD |
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DRAWING STATUS: FOR INFORMATION

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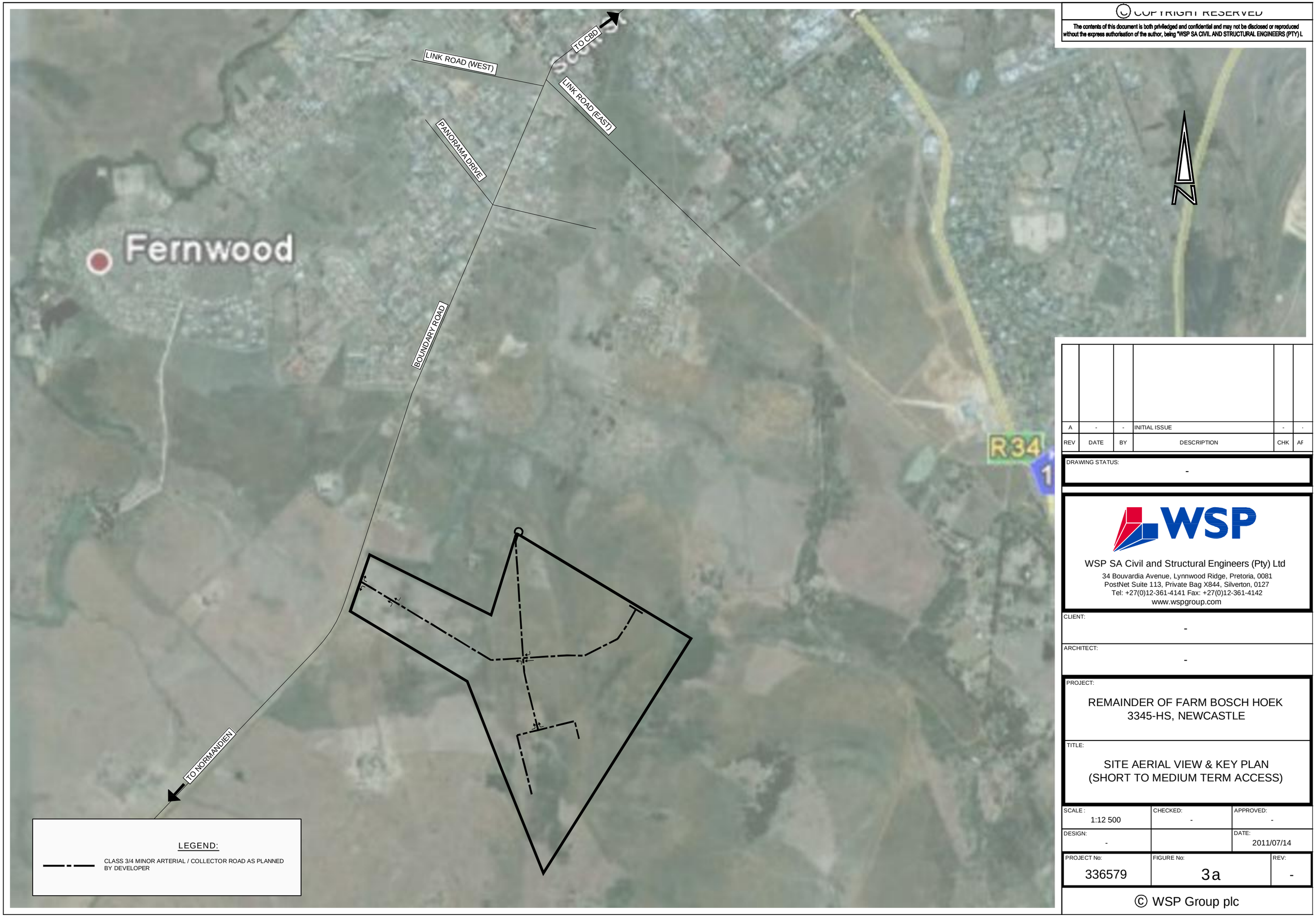
PROJECT: REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE

TITLE: LOCALITY OF PLANNED FUTURE ARTERIAL ROADS

| SCALE : | CHECKED: | APPROVED: |
|---|---|---|
| 1:20 000 | D. Hundermark | D. Hundermark |
| DESIGN: - | DRAWN: - | DATE: 2011/07/10 |
| PROJECT No: 336579 | DRAWING No: 2 | REV: - |




| REV | DATE | BY | DESCRIPTION | CHK | AF |
|---|---|---|---|---|---|
| A | - | - | INITIAL ISSUE | - | · |

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www.wspgroup.com

CLIENT: -

ARCHITECT: -

PROJECT: REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE

TITLE: SITE AERIAL VIEW & KEY PLAN (SHORT TO MEDIUM TERM ACCESS)

| SCALE : | CHECKED: | APPROVED: |
|---|---|---|
| 1:12 500 | - | - |
| DESIGN: - | | DATE: 2011/07/14 |

| PROJECT No: | FIGURE No: | REV: |
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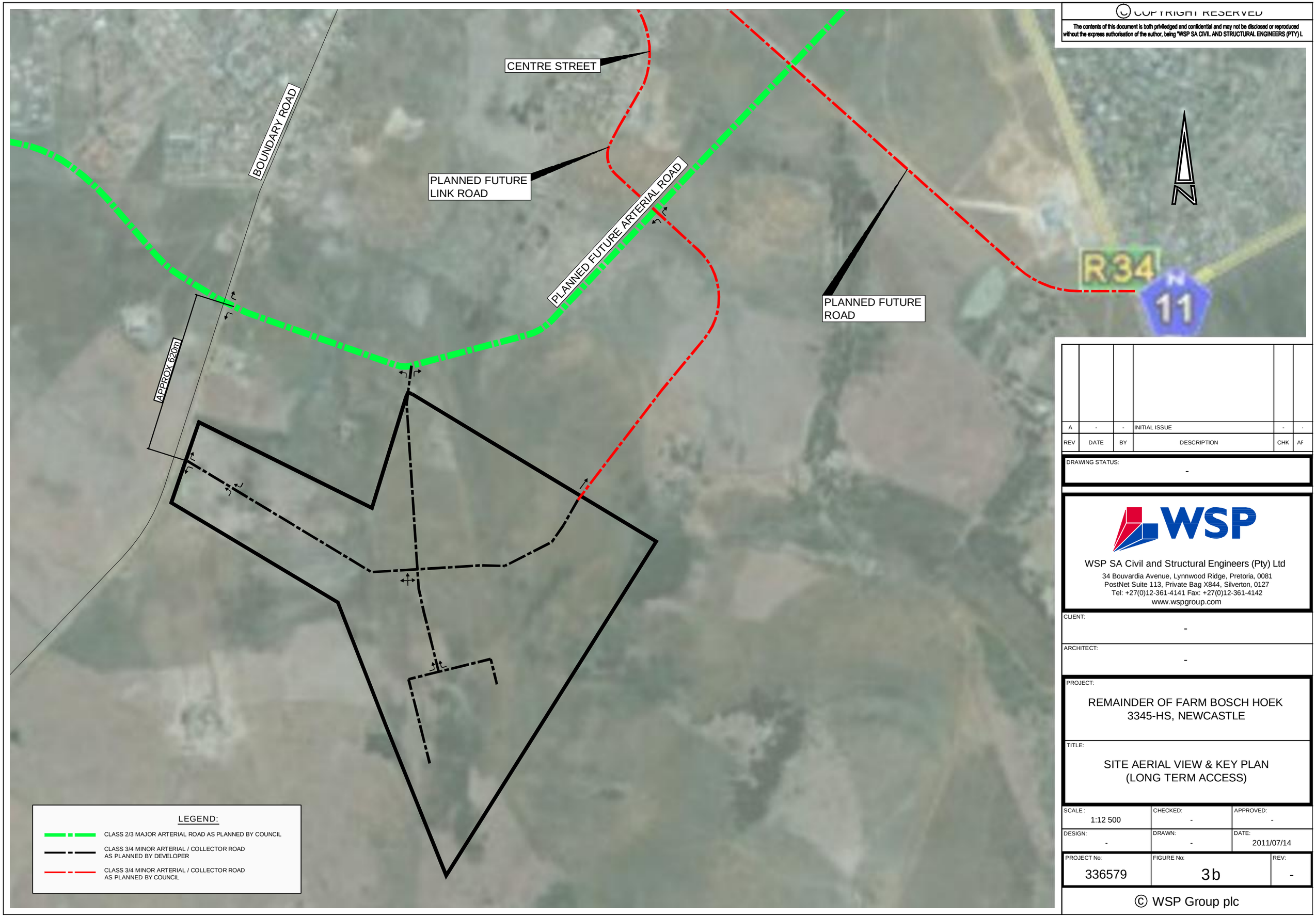


| REV | DATE | BY | DESCRIPTION | CHK | AF |
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CLIENT: -

ARCHITECT: -

PROJECT: REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE

TITLE: SITE AERIAL VIEW & KEY PLAN (LONG TERM ACCESS)

| SCALE : | CHECKED: | APPROVED: |
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| - | - | 2011/07/14 |

| PROJECT No: | FIGURE No: | REV: |
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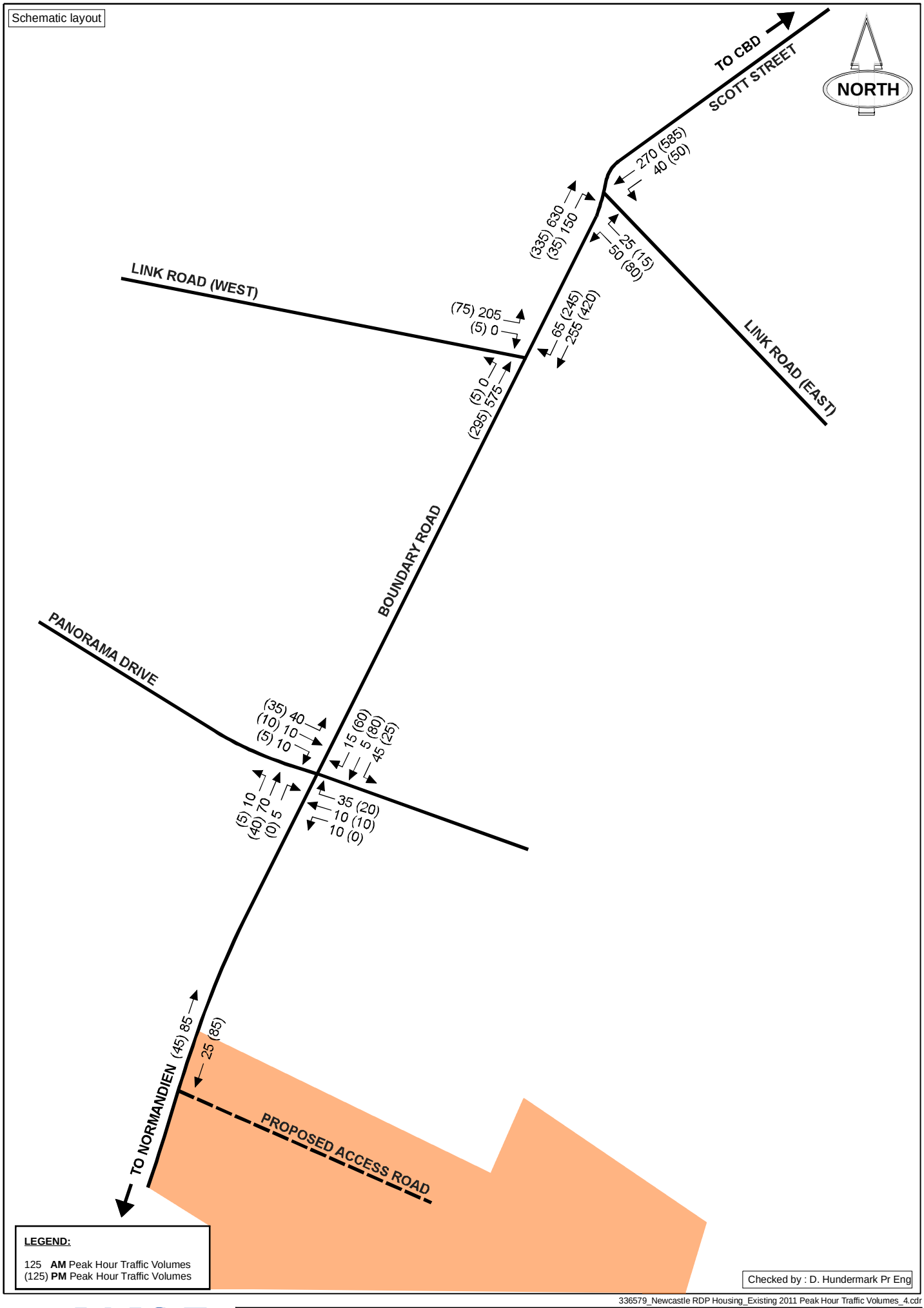
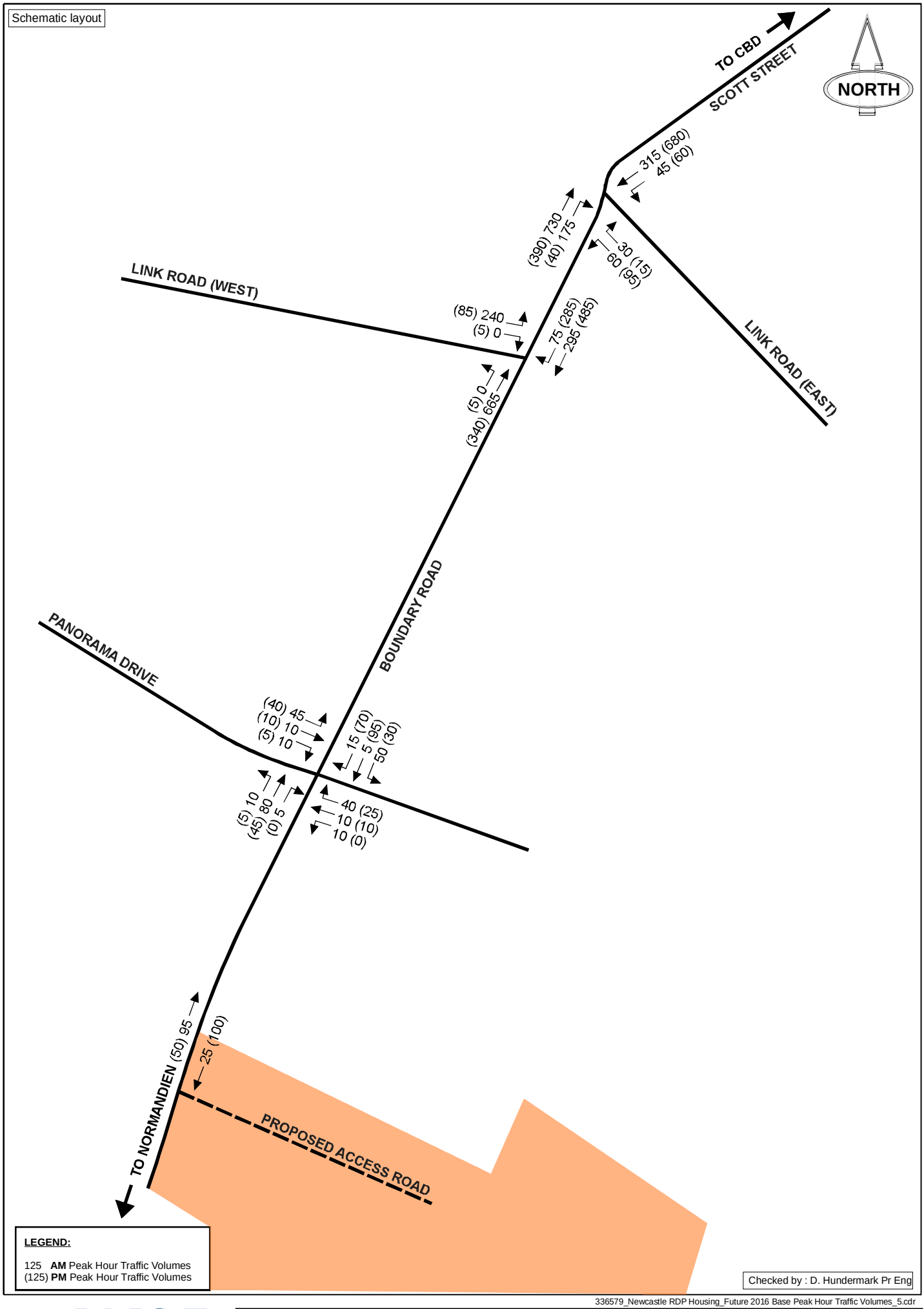



336579_Newcastle RDP Housing_Existing 2011 Peak Hour Traffic Volumes_4.cdr

| Project: | Figure: | No. |
|---|---|---|
| REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE | EXISTING 2011 PEAK HOUR TRAFFIC VOLUMES | 4 |




336579_Newcastle RDP Housing_Future 2016 Base Peak Hour Traffic Volumes_5.cdr

| Project: | Figure: | No. |
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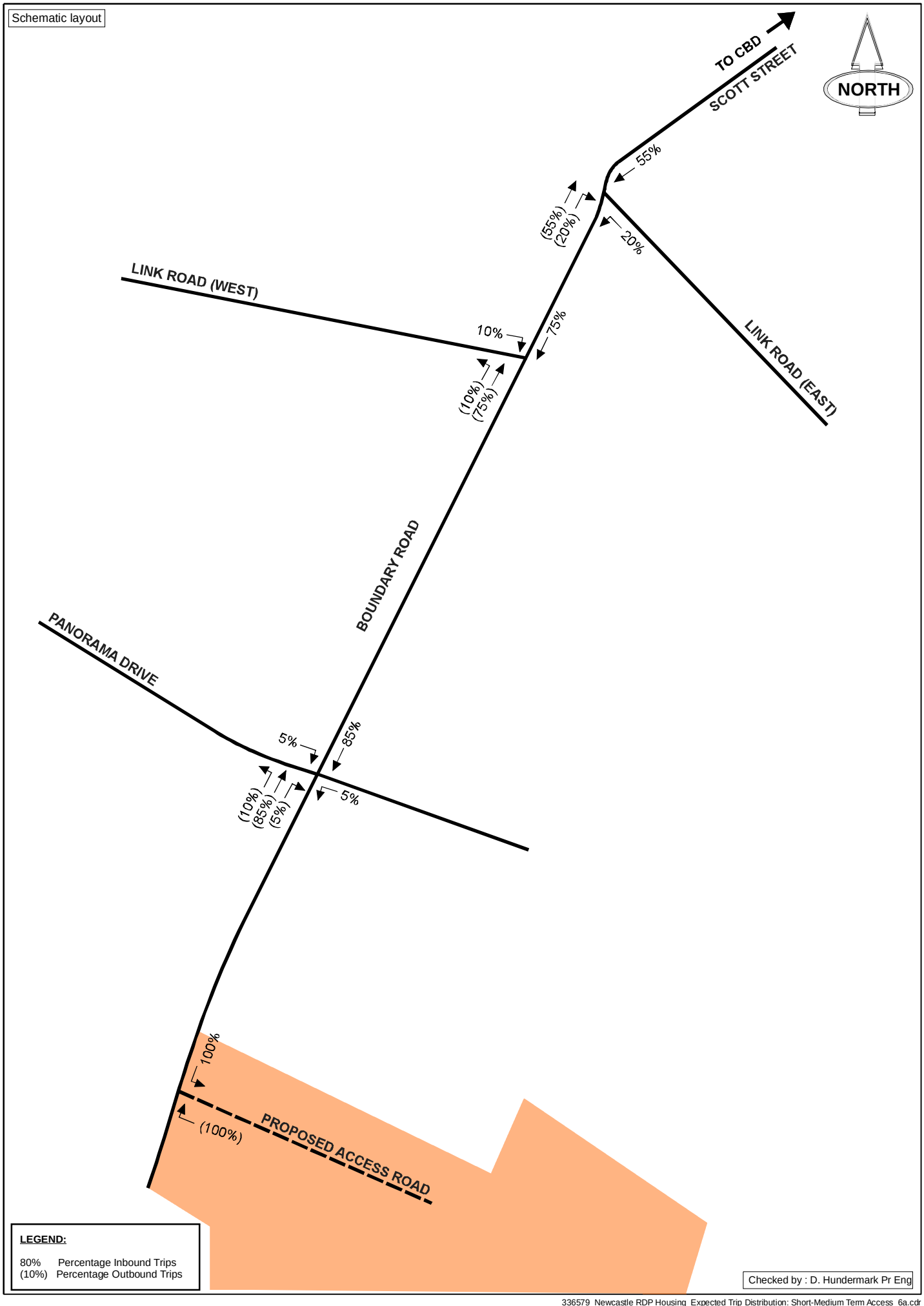


336579_Newcastle RDP Housing_Expected Trip Distribution: Short-Medium Term Access_6a.cdr

| Project: | Figure: | No. |
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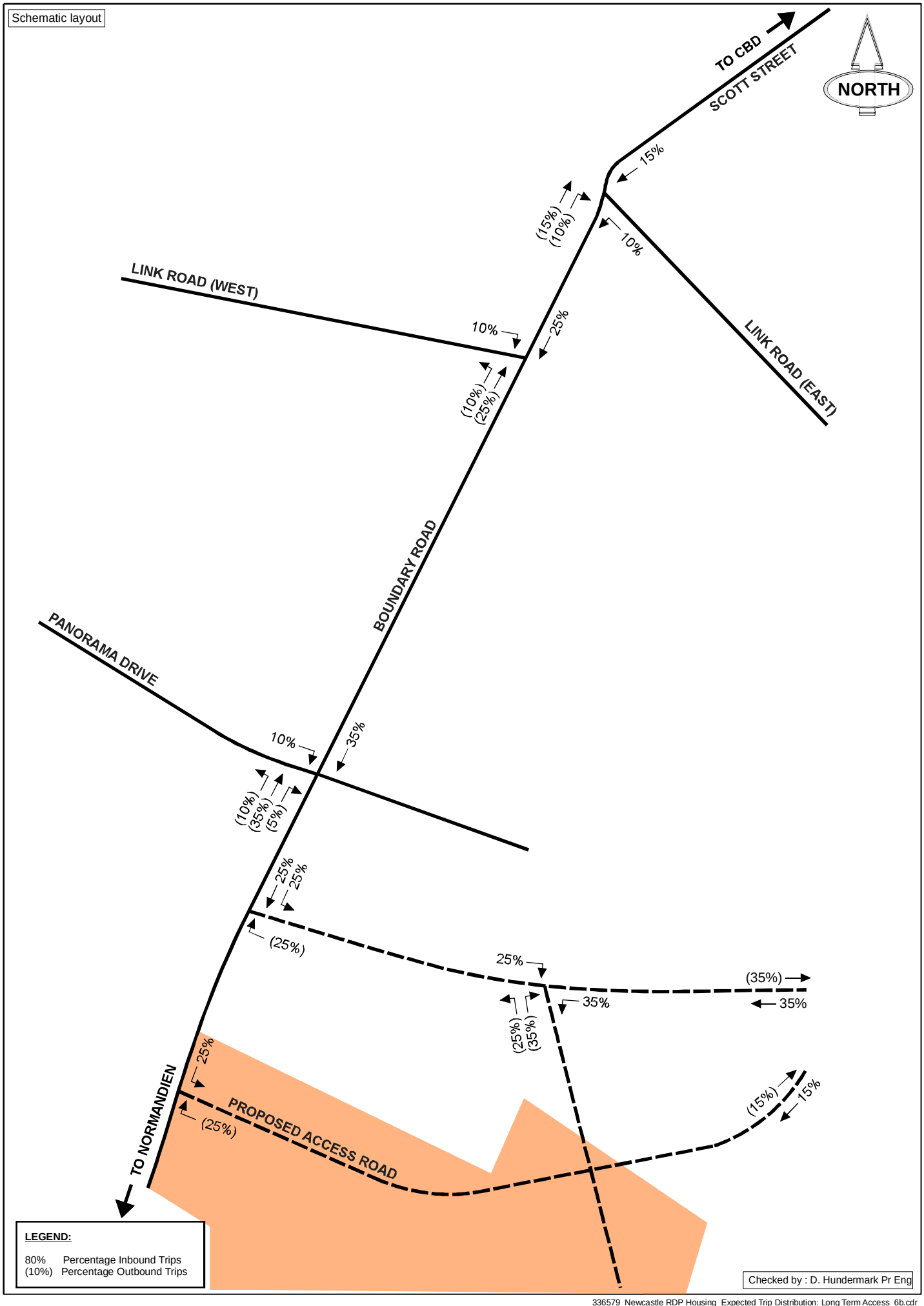
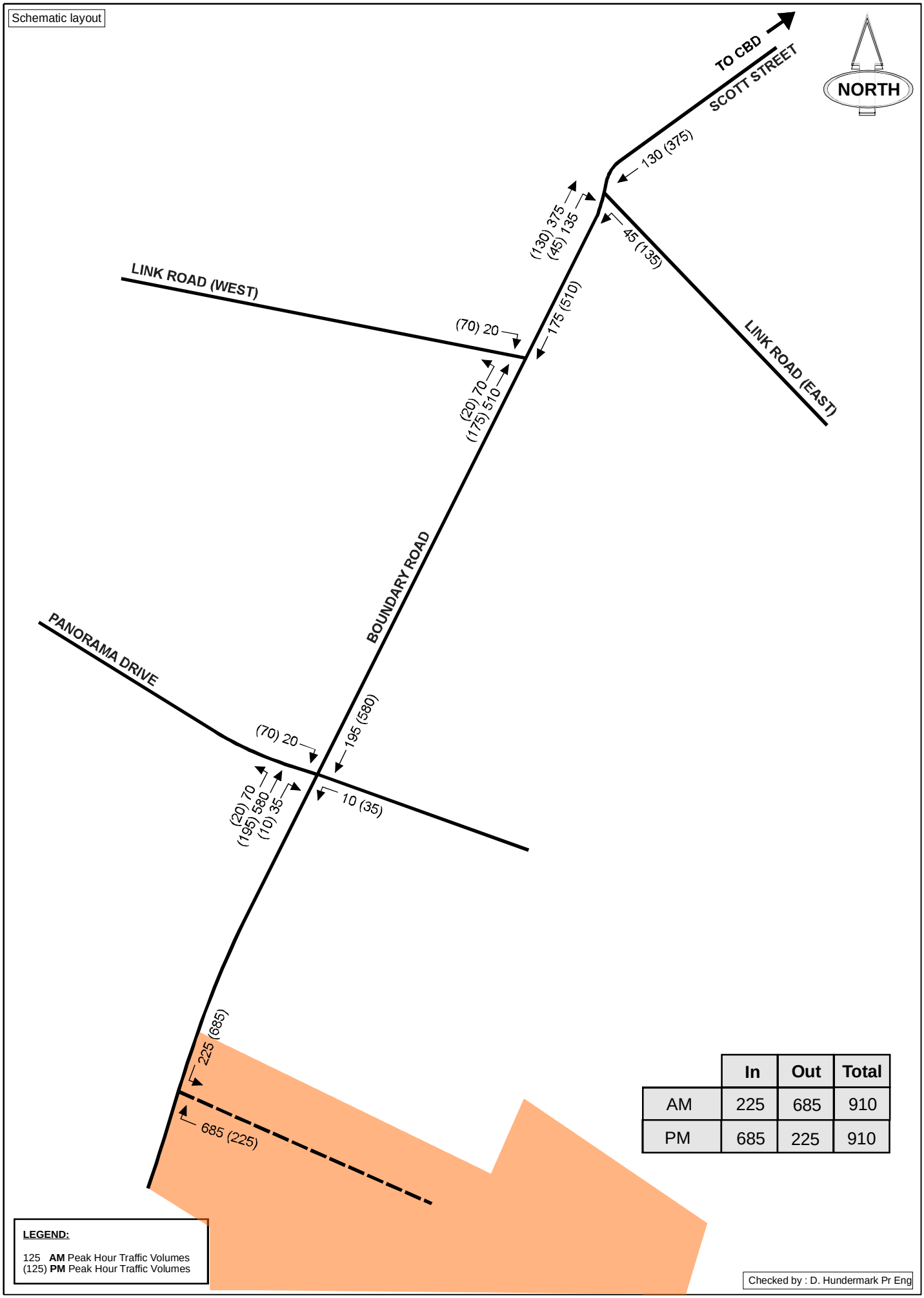



336579_Newcastle RDP Housing_Expected Trip Distribution: Long Term Access_6b.cdr

| Project: | Figure: | No. |
|---|---|---|
| **REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE** | **EXPECTED TRIP DISTRIBUTION: LONG TERM ACCESSES** | **6b** |

Schematic layout




| | In | Out | Total |
|---|---|---|---|
| AM | 225 | 685 | 910 |
| PM | 685 | 225 | 910 |

**LEGEND:**

125 **AM** Peak Hour Traffic Volumes
(125) **PM** Peak Hour Traffic Volumes

Checked by : D. Hundermark Pr Eng

336579_Newcastle RDP Housing_Estimated Development Trips: Short-Meduim Term Access_7a.cdr

WSP

| Project: | Figure: | No. |
|---|---|---|
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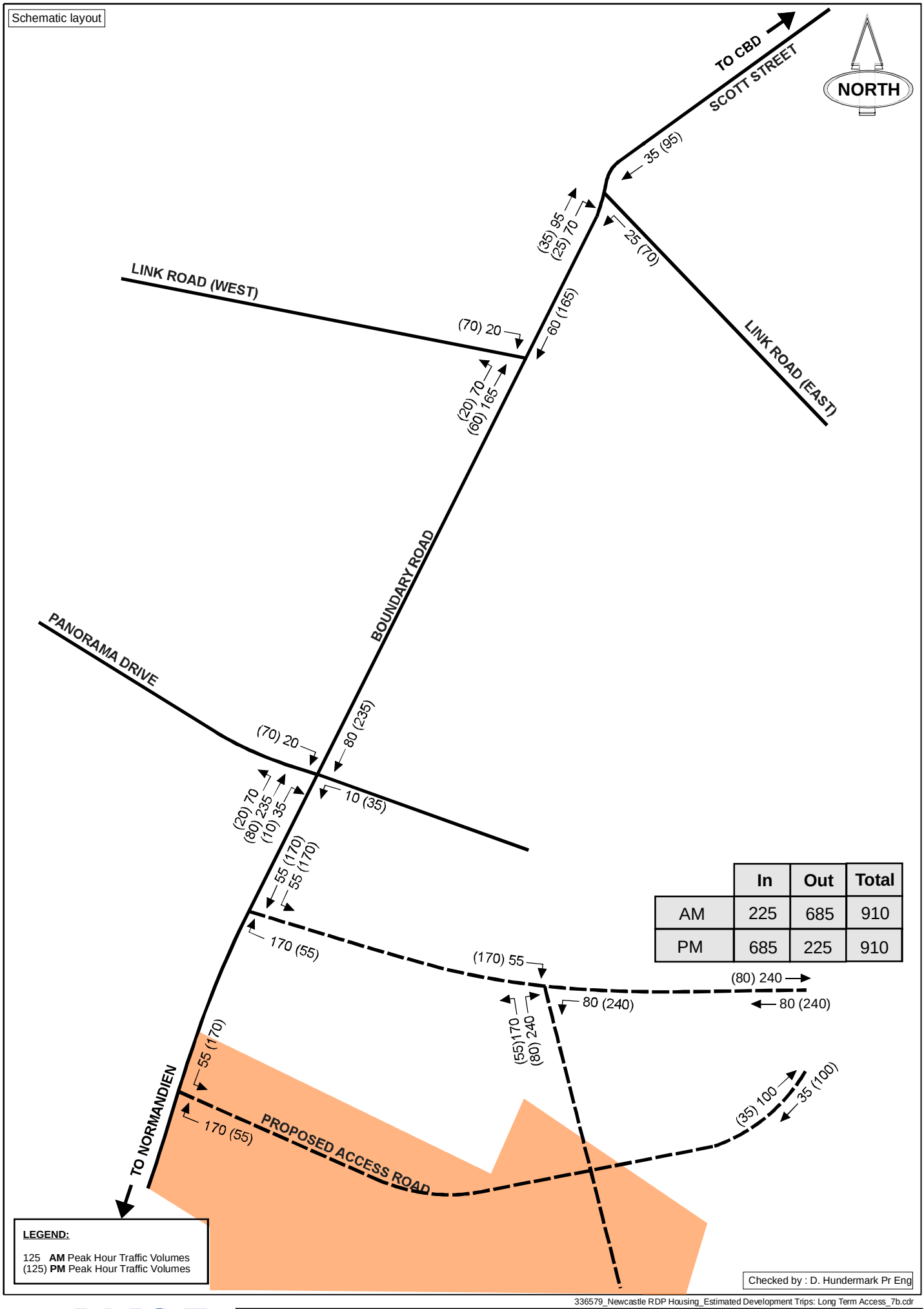
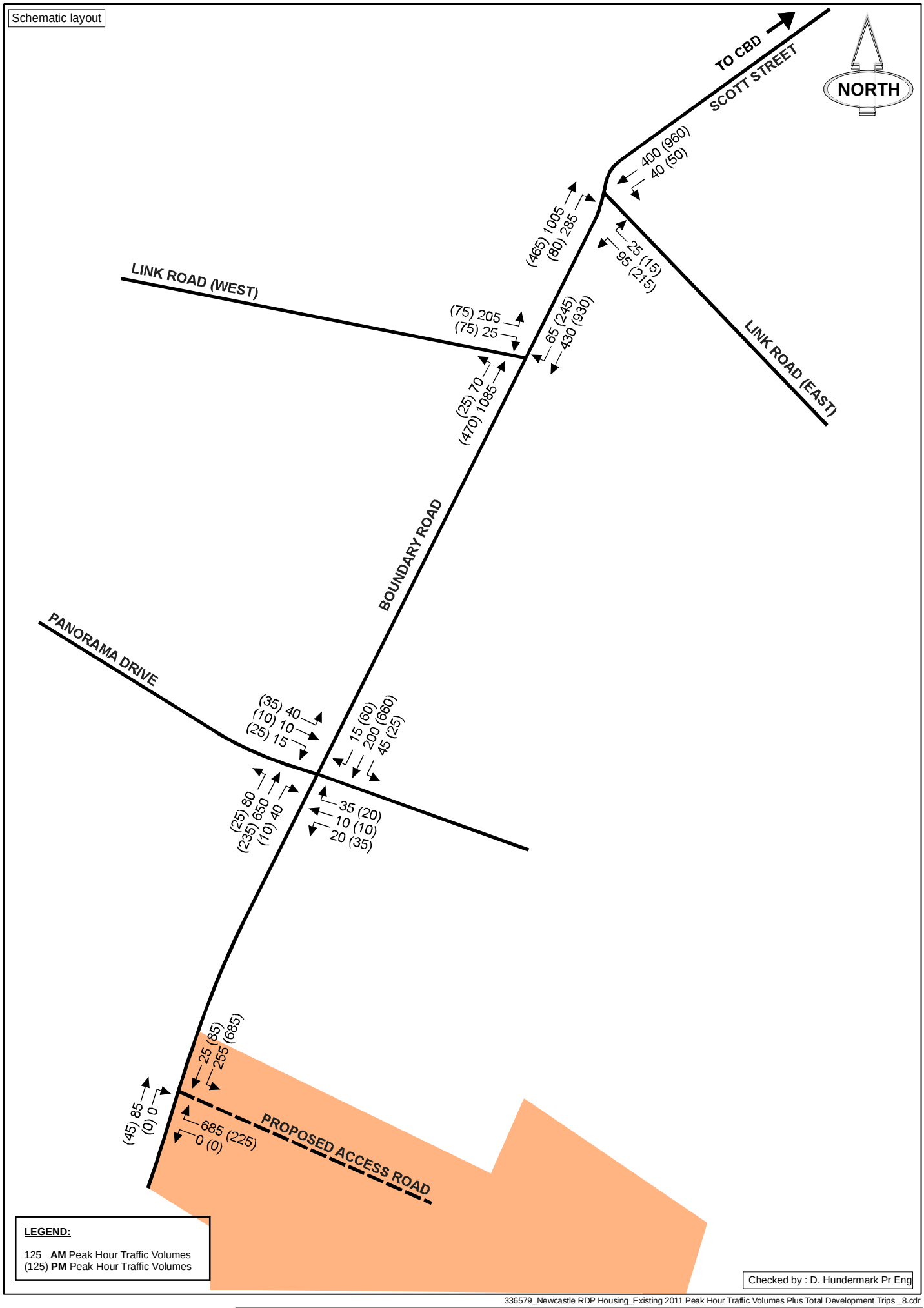



| | In | Out | Total |
|---|---|---|---|
| AM | 225 | 685 | 910 |
| PM | 685 | 225 | 910 |

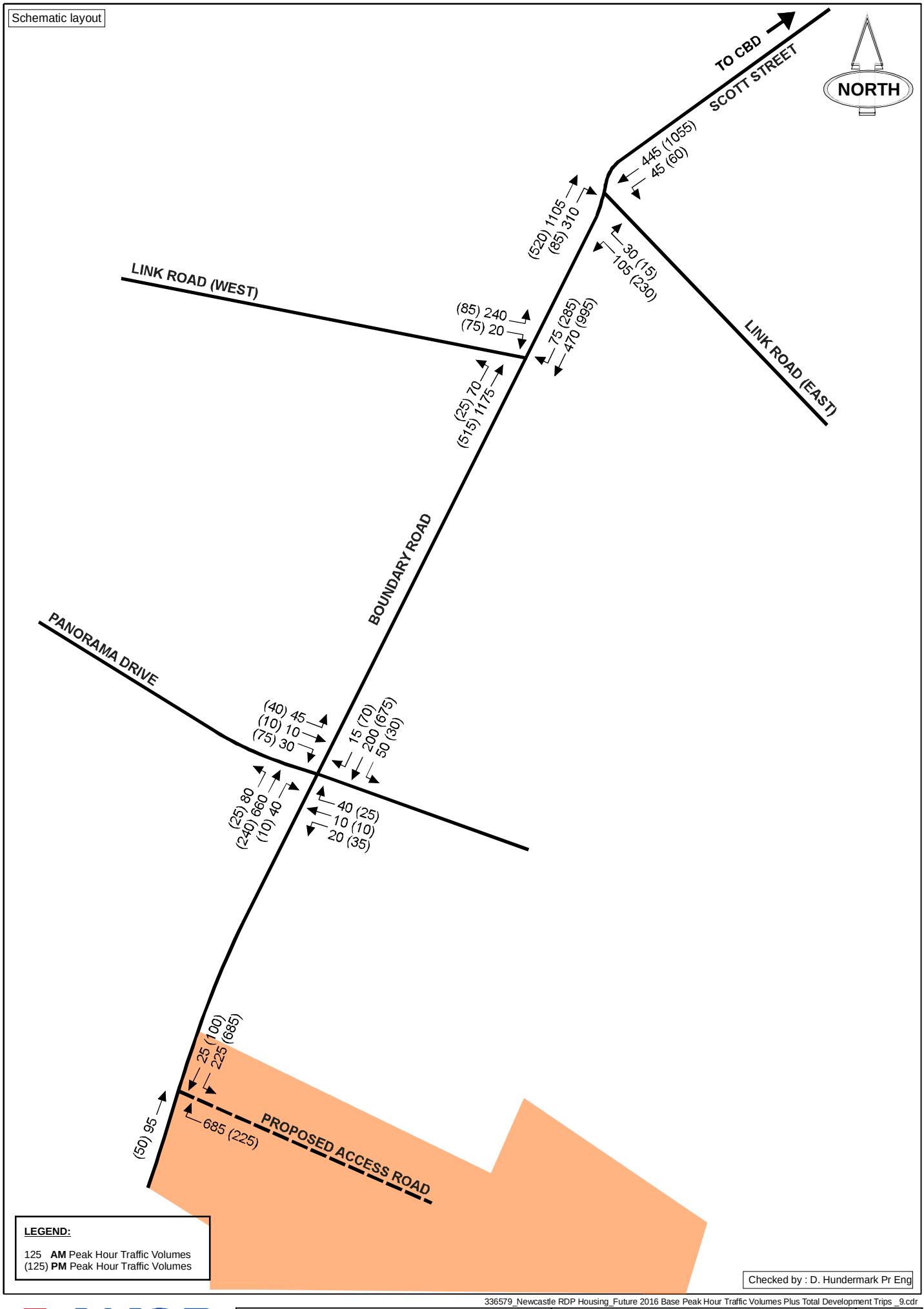
336579_Newcastle RDP Housing_Estimated Development Trips: Long Term Access_7b.cdr

| Project: | Figure: | No. |
|---|---|---|
| REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE | ESTIMATED DEVELOPMENT TRIPS: LONG TERM ACCESSES | 7b |




336579_Newcastle RDP Housing_Existing 2011 Peak Hour Traffic Volumes Plus Total Development Trips _8.cdr

| Project: | Figure: | No. |
|---|---|---|
| **REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE** | **EXISTING 2011 PLUS DEVELOPMENT TRIPS (SHORT-MEDIUM TERM ACCESS)** | **8** |




336579_Newcastle RDP Housing_Future 2016 Base Peak Hour Traffic Volumes Plus Total Development Trips _9.cdr

| Project: | Figure: | No. |
|---|---|---|
| **REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE** | **FUTURE 2011 PLUS DEVELOPMENT TRIPS (SHORT-MEDIUM TERM ACCESS)** | **9** |


| REV | DATE | BY | DESCRIPTION | CHK | APD |
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PROJECT: REMAINDER OF FARM BOSCH HOEK 3345-HS, NEWCASTLE

TITLE: PROPOSED INTERSECTION UPGRADES

| SCALE : | CHECKED: | APPROVED: |
|---|---|---|
| 1:2000 | D HUNDERMARK | D HUNDERMARK |
| DESIGN: | DRAWN: | DATE: |
| D HUNDERMARK | HW BASSON | 2011/08/16 |

| PROJECT No: | FIGURE No: | REV: |
|---|---|---|
| 336 579 | 10 | - |

# Annexures

| | |
|---|---|
| Annexure A | Town Planner's Proposed Township Layout |
| Annexure B | Newcastle Spatial Development Framework |
| Annexure C | Relevant outputs of the SIDRA 5.1 intersection capacity analyses |

# Annexure A

Town Planner's Proposed Township Layout

# Annexure B

Newcastle Spatial Development Framework (SDF)

# Annexure C

Relevant outputs of the SIDRA 5.1 intersection capacity analyses

- C1 – Boundary Road / Panorama Drive (4-way stop);
- C2 – Boundary Road / Link Road West (2-way stop);
- C3 – Boundary Road / Link Road East (2-way stop); and
- C4 – Boundary Road / Access Road (2-way stop).

# Annexure C1.1

## SIDRA Output: Boundary Road / Panorama Drive

## Existing 2011 Weekday AM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Panorama Drive | | | | | | | | | | | |
| 1 | L | 11 | 0.0 | 0.093 | 17.1 | LOS A | 0.3 | 2.0 | 0.75 | 1.24 | 41.8 |
| 2 | T | 11 | 0.0 | 0.093 | 16.6 | LOS A | 0.3 | 2.0 | 0.75 | 1.24 | 42.1 |
| 3 | R | 37 | 0.0 | 0.093 | 16.9 | LOS A | 0.3 | 2.0 | 0.75 | 1.25 | 42.1 |
| Approach | | 58 | 0.0 | 0.093 | 16.9 | LOS A | 0.3 | 2.0 | 0.75 | 1.25 | 42.0 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 47 | 0.0 | 0.116 | 17.6 | LOS A | 0.4 | 2.6 | 0.77 | 1.25 | 41.6 |
| 5 | T | 5 | 0.0 | 0.116 | 17.1 | LOS A | 0.4 | 2.6 | 0.77 | 1.25 | 41.9 |
| 6 | R | 16 | 0.0 | 0.116 | 17.4 | LOS A | 0.4 | 2.6 | 0.77 | 1.27 | 41.8 |
| Approach | | 68 | 0.0 | 0.116 | 17.5 | LOS A | 0.4 | 2.6 | 0.77 | 1.26 | 41.7 |
| North: Panorama Drive | | | | | | | | | | | |
| 7 | L | 42 | 0.0 | 0.163 | 21.8 | LOS A | 0.6 | 4.0 | 0.89 | 1.27 | 38.7 |
| 8 | T | 11 | 0.0 | 0.163 | 21.3 | LOS A | 0.6 | 4.0 | 0.89 | 1.27 | 38.9 |
| 9 | R | 11 | 0.0 | 0.163 | 21.6 | LOS A | 0.6 | 4.0 | 0.89 | 1.28 | 38.9 |
| Approach | | 63 | 0.0 | 0.163 | 21.7 | LOS A | 0.6 | 4.0 | 0.89 | 1.27 | 38.8 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 11 | 0.0 | 0.133 | 16.8 | LOS A | 0.4 | 2.9 | 0.72 | 1.26 | 42.2 |
| 11 | T | 74 | 0.0 | 0.133 | 16.4 | LOS A | 0.4 | 2.9 | 0.72 | 1.26 | 42.5 |
| 12 | R | 5 | 0.0 | 0.133 | 16.6 | LOS A | 0.4 | 2.9 | 0.72 | 1.27 | 42.4 |
| Approach | | 89 | 0.0 | 0.133 | 16.4 | LOS A | 0.4 | 2.9 | 0.72 | 1.26 | 42.4 |
| All Vehicles | | 279 | 0.0 | 0.163 | 18.0 | LOS A | 0.6 | 4.0 | 0.78 | 1.26 | 41.3 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C1.2

## SIDRA Output: Boundary Road / Panorama Drive

## Existing 2011 Weekday PM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Panorama Drive | | | | | | | | | | | |
| 1 | L | 1 | 0.0 | 0.083 | 20.7 | LOS A | 0.3 | 1.9 | 0.88 | 1.24 | 39.3 |
| 2 | T | 11 | 0.0 | 0.083 | 20.2 | LOS A | 0.3 | 1.9 | 0.88 | 1.24 | 39.5 |
| 3 | R | 21 | 0.0 | 0.083 | 20.5 | LOS A | 0.3 | 1.9 | 0.88 | 1.25 | 39.5 |
| Approach | | 33 | 0.0 | 0.083 | 20.4 | LOS A | 0.3 | 1.9 | 0.88 | 1.25 | 39.5 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 26 | 0.0 | 0.209 | 16.1 | LOS A | 0.7 | 4.7 | 0.66 | 1.28 | 42.5 |
| 5 | T | 84 | 0.0 | 0.209 | 15.7 | LOS A | 0.7 | 4.7 | 0.66 | 1.28 | 42.8 |
| 6 | R | 63 | 0.0 | 0.209 | 15.9 | LOS A | 0.7 | 4.7 | 0.66 | 1.30 | 42.8 |
| Approach | | 174 | 0.0 | 0.209 | 15.8 | LOS A | 0.7 | 4.7 | 0.66 | 1.29 | 42.8 |
| North: Panorama Drive | | | | | | | | | | | |
| 7 | L | 37 | 0.0 | 0.460 | 67.6 | LOS A | 2.2 | 15.2 | 1.00 | 1.40 | 21.4 |
| 8 | T | 11 | 0.0 | 0.460 | 67.2 | LOS A | 2.2 | 15.2 | 1.00 | 1.40 | 21.4 |
| 9 | R | 5 | 0.0 | 0.460 | 67.4 | LOS A | 2.2 | 15.2 | 1.00 | 1.40 | 21.4 |
| Approach | | 53 | 0.0 | 0.460 | 67.5 | LOS A | 2.2 | 15.2 | 1.00 | 1.40 | 21.4 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 5 | 0.0 | 0.079 | 17.0 | LOS A | 0.2 | 1.7 | 0.74 | 1.25 | 42.0 |
| 11 | T | 42 | 0.0 | 0.079 | 16.6 | LOS A | 0.2 | 1.7 | 0.74 | 1.25 | 42.3 |
| 12 | R | 1 | 0.0 | 0.079 | 16.8 | LOS A | 0.2 | 1.7 | 0.74 | 1.26 | 42.3 |
| Approach | | 48 | 0.0 | 0.079 | 16.6 | LOS A | 0.2 | 1.7 | 0.74 | 1.25 | 42.3 |
| All Vehicles | | 307 | 0.0 | 0.460 | 25.3 | LOS A | 2.2 | 15.2 | 0.75 | 1.30 | 36.2 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C1.3

### SIDRA Output: Boundary Road / Panorama Drive

### Future 2016 Base Weekday AM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Panorama Drive | | | | | | | | | | | |
| 1 | L | 11 | 0.0 | 0.100 | 17.0 | LOS A | 0.3 | 2.2 | 0.74 | 1.24 | 41.9 |
| 2 | T | 11 | 0.0 | 0.100 | 16.6 | LOS A | 0.3 | 2.2 | 0.74 | 1.25 | 42.1 |
| 3 | R | 42 | 0.0 | 0.100 | 16.8 | LOS A | 0.3 | 2.2 | 0.74 | 1.26 | 42.1 |
| Approach | | 63 | 0.0 | 0.100 | 16.8 | LOS A | 0.3 | 2.2 | 0.74 | 1.25 | 42.1 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 53 | 0.0 | 0.125 | 17.7 | LOS A | 0.4 | 2.8 | 0.77 | 1.26 | 41.5 |
| 5 | T | 5 | 0.0 | 0.125 | 17.2 | LOS A | 0.4 | 2.8 | 0.77 | 1.26 | 41.8 |
| 6 | R | 16 | 0.0 | 0.125 | 17.4 | LOS A | 0.4 | 2.8 | 0.77 | 1.27 | 41.7 |
| Approach | | 74 | 0.0 | 0.125 | 17.6 | LOS A | 0.4 | 2.8 | 0.77 | 1.26 | 41.6 |
| North: Panorama Drive | | | | | | | | | | | |
| 7 | L | 47 | 0.0 | 0.182 | 22.4 | LOS A | 0.6 | 4.5 | 0.91 | 1.28 | 38.3 |
| 8 | T | 11 | 0.0 | 0.182 | 22.0 | LOS A | 0.6 | 4.5 | 0.91 | 1.28 | 38.5 |
| 9 | R | 11 | 0.0 | 0.182 | 22.2 | LOS A | 0.6 | 4.5 | 0.91 | 1.28 | 38.5 |
| Approach | | 68 | 0.0 | 0.182 | 22.3 | LOS A | 0.6 | 4.5 | 0.91 | 1.28 | 38.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 11 | 0.0 | 0.146 | 16.8 | LOS A | 0.5 | 3.2 | 0.72 | 1.26 | 42.2 |
| 11 | T | 84 | 0.0 | 0.146 | 16.4 | LOS A | 0.5 | 3.2 | 0.72 | 1.26 | 42.5 |
| 12 | R | 5 | 0.0 | 0.146 | 16.6 | LOS A | 0.5 | 3.2 | 0.72 | 1.28 | 42.4 |
| Approach | | 100 | 0.0 | 0.146 | 16.4 | LOS A | 0.5 | 3.2 | 0.72 | 1.27 | 42.4 |
| All Vehicles | | 305 | 0.0 | 0.182 | 18.1 | LOS A | 0.6 | 4.5 | 0.78 | 1.26 | 41.2 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C1.4

## SIDRA Output: Boundary Road / Panorama Drive

## Future 2016 Base Weekday PM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Panorama Drive | | | | | | | | | | | |
| 1 | L | 1 | 0.0 | 0.096 | 20.7 | LOS A | 0.3 | 2.2 | 0.88 | 1.25 | 39.2 |
| 2 | T | 11 | 0.0 | 0.096 | 20.3 | LOS A | 0.3 | 2.2 | 0.88 | 1.25 | 39.5 |
| 3 | R | 26 | 0.0 | 0.096 | 20.5 | LOS A | 0.3 | 2.2 | 0.88 | 1.25 | 39.4 |
| Approach | | 38 | 0.0 | 0.096 | 20.5 | LOS A | 0.3 | 2.2 | 0.88 | 1.25 | 39.4 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 32 | 0.0 | 0.246 | 16.4 | LOS A | 0.8 | 5.7 | 0.67 | 1.29 | 42.4 |
| 5 | T | 100 | 0.0 | 0.246 | 15.9 | LOS A | 0.8 | 5.7 | 0.67 | 1.30 | 42.6 |
| 6 | R | 74 | 0.0 | 0.246 | 16.2 | LOS A | 0.8 | 5.7 | 0.67 | 1.31 | 42.6 |
| Approach | | 205 | 0.0 | 0.246 | 16.1 | LOS A | 0.8 | 5.7 | 0.67 | 1.30 | 42.6 |
| North: Panorama Drive | | | | | | | | | | | |
| 7 | L | 42 | 0.0 | 0.634 | 108.2 | LOS B | 3.6 | 25.2 | 1.00 | 1.53 | 15.3 |
| 8 | T | 11 | 0.0 | 0.634 | 107.7 | LOS B | 3.6 | 25.2 | 1.00 | 1.53 | 15.3 |
| 9 | R | 5 | 0.0 | 0.634 | 108.0 | LOS B | 3.6 | 25.2 | 1.00 | 1.53 | 15.3 |
| Approach | | 58 | 0.0 | 0.634 | 108.1 | LOS B | 3.6 | 25.2 | 1.00 | 1.53 | 15.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 5 | 0.0 | 0.087 | 17.1 | LOS A | 0.3 | 1.9 | 0.75 | 1.25 | 42.0 |
| 11 | T | 47 | 0.0 | 0.087 | 16.6 | LOS A | 0.3 | 1.9 | 0.75 | 1.25 | 42.3 |
| 12 | R | 1 | 0.0 | 0.087 | 16.9 | LOS A | 0.3 | 1.9 | 0.75 | 1.26 | 42.2 |
| Approach | | 54 | 0.0 | 0.087 | 16.7 | LOS A | 0.3 | 1.9 | 0.75 | 1.25 | 42.3 |
| All Vehicles | | 355 | 0.0 | 0.634 | 31.7 | LOS B | 3.6 | 25.2 | 0.76 | 1.32 | 32.7 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure B1.5

## SIDRA Output: Boundary Road / Panorama Drive

## Existing 2011 Weekday AM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Panorama Drive | | | | | | | | | | | |
| 1 | L | 21 | 0.0 | 0.324 | 35.8 | LOS A | 1.3 | 9.4 | 1.00 | 1.33 | 31.0 |
| 2 | T | 11 | 0.0 | 0.324 | 35.4 | LOS A | 1.3 | 9.4 | 1.00 | 1.33 | 31.1 |
| 3 | R | 37 | 0.0 | 0.324 | 35.6 | LOS A | 1.3 | 9.4 | 1.00 | 1.33 | 31.1 |
| Approach | | 68 | 0.0 | 0.324 | 35.6 | LOS A | 1.3 | 9.4 | 1.00 | 1.33 | 31.0 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 47 | 0.0 | 0.353 | 17.8 | LOS A | 1.3 | 9.4 | 0.74 | 1.35 | 41.4 |
| 5 | T | 211 | 0.0 | 0.353 | 17.4 | LOS A | 1.3 | 9.4 | 0.74 | 1.35 | 41.6 |
| 6 | R | 16 | 0.0 | 0.353 | 17.6 | LOS A | 1.3 | 9.4 | 0.74 | 1.36 | 41.6 |
| Approach | | 274 | 0.0 | 0.353 | 17.5 | LOS A | 1.3 | 9.4 | 0.74 | 1.35 | 41.6 |
| North: Panorama Drive | | | | | | | | | | | |
| 7 | L | 42 | 0.0 | 0.662 | 86.9 | LOS B | 4.0 | 28.1 | 1.00 | 1.58 | 17.9 |
| 8 | T | 11 | 0.0 | 0.662 | 86.4 | LOS B | 4.0 | 28.1 | 1.00 | 1.58 | 17.9 |
| 9 | R | 32 | 0.0 | 0.662 | 86.7 | LOS B | 4.0 | 28.1 | 1.00 | 1.58 | 17.9 |
| Approach | | 84 | 0.0 | 0.662 | 86.7 | LOS B | 4.0 | 28.1 | 1.00 | 1.58 | 17.9 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 84 | 0.0 | 0.884 | 38.8 | LOS D | 11.8 | 82.4 | 0.98 | 2.59 | 29.8 |
| 11 | T | 684 | 0.0 | 0.884 | 38.4 | LOS D | 11.8 | 82.4 | 0.98 | 2.59 | 29.9 |
| 12 | R | 42 | 0.0 | 0.884 | 38.6 | LOS D | 11.8 | 82.4 | 0.98 | 2.59 | 29.9 |
| Approach | | 811 | 0.0 | 0.884 | 38.4 | LOS D | 11.8 | 82.4 | 0.98 | 2.59 | 29.9 |
| All Vehicles | | 1237 | 0.0 | 0.884 | 36.9 | LOS D | 11.8 | 82.4 | 0.93 | 2.17 | 30.4 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C1.6

### SIDRA Output: Boundary Road / Panorama Drive

### Existing 2011 Weekday PM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Panorama Drive | | | | | | | | | | | |
| 1 | L | 37 | 0.0 | 0.768 | 143.7 | LOS C | 5.2 | 36.6 | 1.00 | 1.68 | 12.2 |
| 2 | T | 11 | 0.0 | 0.768 | 143.3 | LOS C | 5.2 | 36.6 | 1.00 | 1.68 | 12.2 |
| 3 | R | 21 | 0.0 | 0.768 | 143.5 | LOS C | 5.2 | 36.6 | 1.00 | 1.68 | 12.2 |
| Approach | | 68 | 0.0 | 0.768 | 143.6 | LOS C | 5.2 | 36.6 | 1.00 | 1.68 | 12.2 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 26 | 0.0 | 0.928 | 50.4 | LOS E | 15.5 | 108.6 | 1.00 | 3.04 | 25.7 |
| 5 | T | 695 | 0.0 | 0.928 | 49.9 | LOS E | 15.5 | 108.6 | 1.00 | 3.04 | 25.8 |
| 6 | R | 63 | 0.0 | 0.928 | 50.1 | LOS E | 15.5 | 108.6 | 1.00 | 3.04 | 25.8 |
| Approach | | 784 | 0.0 | 0.928 | 49.9 | LOS E | 15.5 | 108.6 | 1.00 | 3.04 | 25.8 |
| North: Panorama Drive | | | | | | | | | | | |
| 7 | L | 37 | 0.0 | 0.511 | 39.9 | LOS A | 2.6 | 17.9 | 1.00 | 1.45 | 29.3 |
| 8 | T | 11 | 0.0 | 0.511 | 39.5 | LOS A | 2.6 | 17.9 | 1.00 | 1.45 | 29.3 |
| 9 | R | 79 | 0.0 | 0.511 | 39.7 | LOS A | 2.6 | 17.9 | 1.00 | 1.45 | 29.3 |
| Approach | | 126 | 0.0 | 0.511 | 39.7 | LOS A | 2.6 | 17.9 | 1.00 | 1.45 | 29.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 26 | 0.0 | 0.405 | 19.3 | LOS A | 1.7 | 11.7 | 0.80 | 1.38 | 40.4 |
| 11 | T | 247 | 0.0 | 0.405 | 18.8 | LOS A | 1.7 | 11.7 | 0.80 | 1.38 | 40.6 |
| 12 | R | 11 | 0.0 | 0.405 | 19.0 | LOS A | 1.7 | 11.7 | 0.80 | 1.39 | 40.6 |
| Approach | | 284 | 0.0 | 0.405 | 18.9 | LOS A | 1.7 | 11.7 | 0.80 | 1.38 | 40.6 |
| All Vehicles | | 1263 | 0.0 | 0.928 | 47.0 | LOS E | 15.5 | 108.6 | 0.95 | 2.43 | 26.7 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C1.7

### SIDRA Output: Boundary Road / Panorama Drive

### Future 2016 Base Weekday AM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Panorama Drive | | | | | | | | | | | |
| 1 | L | 21 | 0.0 | 0.321 | 33.7 | LOS A | 1.3 | 9.2 | 1.00 | 1.33 | 31.9 |
| 2 | T | 11 | 0.0 | 0.321 | 33.2 | LOS A | 1.3 | 9.2 | 1.00 | 1.33 | 32.1 |
| 3 | R | 42 | 0.0 | 0.321 | 33.5 | LOS A | 1.3 | 9.2 | 1.00 | 1.33 | 32.0 |
| Approach | | 74 | 0.0 | 0.321 | 33.5 | LOS A | 1.3 | 9.2 | 1.00 | 1.33 | 32.0 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 53 | 0.0 | 0.362 | 18.0 | LOS A | 1.4 | 9.8 | 0.74 | 1.35 | 41.3 |
| 5 | T | 211 | 0.0 | 0.362 | 17.5 | LOS A | 1.4 | 9.8 | 0.74 | 1.35 | 41.6 |
| 6 | R | 16 | 0.0 | 0.362 | 17.7 | LOS A | 1.4 | 9.8 | 0.74 | 1.37 | 41.5 |
| Approach | | 279 | 0.0 | 0.362 | 17.6 | LOS A | 1.4 | 9.8 | 0.74 | 1.35 | 41.5 |
| North: Panorama Drive | | | | | | | | | | | |
| 7 | L | 47 | 0.0 | 0.752 | 110.9 | LOS C | 5.2 | 36.6 | 1.00 | 1.70 | 15.0 |
| 8 | T | 11 | 0.0 | 0.752 | 110.5 | LOS C | 5.2 | 36.6 | 1.00 | 1.70 | 14.9 |
| 9 | R | 32 | 0.0 | 0.752 | 110.7 | LOS C | 5.2 | 36.6 | 1.00 | 1.70 | 14.9 |
| Approach | | 89 | 0.0 | 0.752 | 110.8 | LOS C | 5.2 | 36.6 | 1.00 | 1.70 | 15.0 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 84 | 0.0 | 0.897 | 41.1 | LOS D | 12.8 | 89.4 | 0.99 | 2.71 | 28.9 |
| 11 | T | 695 | 0.0 | 0.897 | 40.7 | LOS D | 12.8 | 89.4 | 0.99 | 2.71 | 28.9 |
| 12 | R | 42 | 0.0 | 0.897 | 40.9 | LOS D | 12.8 | 89.4 | 0.99 | 2.71 | 28.9 |
| Approach | | 821 | 0.0 | 0.897 | 40.8 | LOS D | 12.8 | 89.4 | 0.99 | 2.71 | 28.9 |
| All Vehicles | | 1263 | 0.0 | 0.897 | 40.2 | LOS D | 12.8 | 89.4 | 0.94 | 2.26 | 29.1 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C1.8

## SIDRA Output: Boundary Road / Panorama Drive

## Future 2016 Base Weekday PM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Panorama Drive | | | | | | | | | | | |
| 1 | L | 37 | 0.0 | 0.713 | 113.9 | LOS C | 4.6 | 32.0 | 1.00 | 1.63 | 14.7 |
| 2 | T | 11 | 0.0 | 0.713 | 113.4 | LOS C | 4.6 | 32.0 | 1.00 | 1.63 | 14.7 |
| 3 | R | 26 | 0.0 | 0.713 | 113.7 | LOS C | 4.6 | 32.0 | 1.00 | 1.63 | 14.7 |
| Approach | | 74 | 0.0 | 0.713 | 113.7 | LOS C | 4.6 | 32.0 | 1.00 | 1.63 | 14.7 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 32 | 0.0 | 0.964 | 61.7 | LOS E | 20.1 | 140.8 | 1.00 | 3.59 | 22.7 |
| 5 | T | 711 | 0.0 | 0.964 | 61.3 | LOS E | 20.1 | 140.8 | 1.00 | 3.59 | 22.7 |
| 6 | R | 74 | 0.0 | 0.964 | 61.5 | LOS E | 20.1 | 140.8 | 1.00 | 3.59 | 22.7 |
| Approach | | 816 | 0.0 | 0.964 | 61.3 | LOS E | 20.1 | 140.8 | 1.00 | 3.59 | 22.7 |
| North: Panorama Drive | | | | | | | | | | | |
| 7 | L | 42 | 0.0 | 0.584 | 47.8 | LOS A | 3.2 | 22.6 | 1.00 | 1.52 | 26.4 |
| 8 | T | 11 | 0.0 | 0.584 | 47.4 | LOS A | 3.2 | 22.6 | 1.00 | 1.52 | 26.5 |
| 9 | R | 79 | 0.0 | 0.584 | 47.6 | LOS A | 3.2 | 22.6 | 1.00 | 1.52 | 26.5 |
| Approach | | 132 | 0.0 | 0.584 | 47.6 | LOS A | 3.2 | 22.6 | 1.00 | 1.52 | 26.5 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 26 | 0.0 | 0.414 | 19.4 | LOS A | 1.7 | 12.1 | 0.80 | 1.38 | 40.3 |
| 11 | T | 253 | 0.0 | 0.414 | 19.0 | LOS A | 1.7 | 12.1 | 0.80 | 1.38 | 40.5 |
| 12 | R | 11 | 0.0 | 0.414 | 19.2 | LOS A | 1.7 | 12.1 | 0.80 | 1.39 | 40.5 |
| Approach | | 289 | 0.0 | 0.414 | 19.0 | LOS A | 1.7 | 12.1 | 0.80 | 1.38 | 40.5 |
| All Vehicles | | 1311 | 0.0 | 0.964 | 53.6 | LOS E | 20.1 | 140.8 | 0.96 | 2.78 | 24.7 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C2.1

**SIDRA Output: Boundary Road / Link Road (west leg)**

**Existing 2011 Weekday AM Peak Hour (no development)**

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: Boundary Rd | | | | | | | | | | | |
| 5 | T | 268 | 0.0 | 0.136 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 6 | R | 68 | 0.0 | 0.096 | 5.5 | LOS A | 0.5 | 3.4 | 0.70 | 0.82 | 43.4 |
| Approach | | 337 | 0.0 | 0.136 | 1.1 | LOS A | 0.5 | 3.4 | 0.14 | 0.17 | 55.7 |
| North: Link Rd | | | | | | | | | | | |
| 7 | L | 216 | 0.0 | 0.227 | 9.9 | LOS A | 1.0 | 7.0 | 0.60 | 0.97 | 39.3 |
| 9 | R | 1 | 0.0 | 0.002 | 11.6 | LOS A | 0.0 | 0.1 | 0.72 | 0.74 | 38.1 |
| Approach | | 217 | 0.0 | 0.227 | 9.9 | LOS A | 1.0 | 7.0 | 0.60 | 0.97 | 39.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 1 | 0.0 | 0.308 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 1.09 | 49.0 |
| 11 | T | 605 | 0.0 | 0.308 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 606 | 0.0 | 0.308 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| All Vehicles | | 1160 | 0.0 | 0.308 | 2.2 | LOS A | 1.0 | 7.0 | 0.15 | 0.23 | 53.5 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
HCM Delay Model used.

# Annexure C2.2

**SIDRA Output: Boundary Road / Link Road (west leg)**

**Existing 2011 Weekday PM Peak Hour (no development)**

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: Boundary Rd | | | | | | | | | | | |
| 5 | T | 442 | 0.0 | 0.224 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 6 | R | 258 | 0.0 | 0.346 | 7.0 | LOS A | 2.1 | 14.4 | 0.60 | 0.83 | 42.2 |
| Approach | | 700 | 0.0 | 0.346 | 2.6 | LOS A | 2.1 | 14.4 | 0.22 | 0.31 | 52.0 |
| North: Link Rd | | | | | | | | | | | |
| 7 | L | 79 | 0.0 | 0.058 | 7.8 | LOS A | 0.3 | 1.8 | 0.39 | 0.85 | 40.5 |
| 9 | R | 5 | 0.0 | 0.011 | 12.4 | LOS A | 0.0 | 0.3 | 0.73 | 0.84 | 37.6 |
| Approach | | 84 | 0.0 | 0.058 | 8.1 | LOS A | 0.3 | 1.8 | 0.41 | 0.85 | 40.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 5 | 0.0 | 0.160 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 1.08 | 49.0 |
| 11 | T | 311 | 0.0 | 0.160 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 316 | 0.0 | 0.160 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.02 | 59.8 |
| All Vehicles | | 1100 | 0.0 | 0.346 | 2.3 | LOS A | 2.1 | 14.4 | 0.17 | 0.27 | 52.8 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
HCM Delay Model used.

# Annexure C2.3

## SIDRA Output: Boundary Road / Link Road (west leg)

## Future 2016 Base Weekday AM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: Boundary Rd | | | | | | | | | | | |
| 5 | T | 311 | 0.0 | 0.158 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 6 | R | 79 | 0.0 | 0.133 | 6.7 | LOS A | 0.6 | 4.5 | 0.73 | 0.89 | 42.4 |
| Approach | | 389 | 0.0 | 0.158 | 1.4 | LOS A | 0.6 | 4.5 | 0.15 | 0.18 | 55.4 |
| North: Link Rd | | | | | | | | | | | |
| 7 | L | 253 | 0.0 | 0.305 | 11.2 | LOS A | 1.5 | 10.5 | 0.65 | 1.04 | 38.5 |
| 9 | R | 1 | 0.0 | 0.002 | 13.3 | LOS A | 0.0 | 0.1 | 0.76 | 0.77 | 37.1 |
| Approach | | 254 | 0.0 | 0.305 | 11.3 | LOS A | 1.5 | 10.5 | 0.65 | 1.03 | 38.5 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 1 | 0.0 | 0.356 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 1.09 | 49.0 |
| 11 | T | 700 | 0.0 | 0.356 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 701 | 0.0 | 0.356 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| All Vehicles | | 1344 | 0.0 | 0.356 | 2.5 | LOS A | 1.5 | 10.5 | 0.17 | 0.25 | 53.1 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
HCM Delay Model used.

# Annexure C2.4

## SIDRA Output: Boundary Road / Link Road (west leg)

## Future 2016 Base Weekday PM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: Boundary Rd | | | | | | | | | | | |
| 5 | T | 511 | 0.0 | 0.259 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 6 | R | 300 | 0.0 | 0.436 | 8.7 | LOS A | 3.1 | 21.7 | 0.67 | 0.94 | 40.9 |
| Approach | | 811 | 0.0 | 0.436 | 3.2 | LOS A | 3.1 | 21.7 | 0.25 | 0.35 | 51.2 |
| North: Link Rd | | | | | | | | | | | |
| 7 | L | 89 | 0.0 | 0.069 | 8.0 | LOS A | 0.3 | 2.1 | 0.43 | 0.86 | 40.4 |
| 9 | R | 5 | 0.0 | 0.014 | 14.5 | LOS A | 0.1 | 0.4 | 0.79 | 0.88 | 36.3 |
| Approach | | 95 | 0.0 | 0.069 | 8.4 | LOS A | 0.3 | 2.1 | 0.45 | 0.86 | 40.1 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 5 | 0.0 | 0.185 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 1.08 | 49.0 |
| 11 | T | 358 | 0.0 | 0.185 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 363 | 0.0 | 0.185 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.02 | 59.8 |
| All Vehicles | | 1268 | 0.0 | 0.436 | 2.7 | LOS A | 3.1 | 21.7 | 0.19 | 0.29 | 52.2 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
HCM Delay Model used.

# Annexure C2.5

### SIDRA Output: Boundary Road / Link Road (west leg)

### Existing 2011 Weekday AM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: Boundary Rd | | | | | | | | | | | |
| 5 | T | 453 | 0.0 | 0.230 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 6 | R | 68 | 0.0 | 0.291 | 19.7 | LOS A | 1.3 | 9.0 | 0.91 | 1.01 | 33.8 |
| Approach | | 521 | 0.0 | 0.291 | 2.6 | LOS A | 1.3 | 9.0 | 0.12 | 0.13 | 54.5 |
| North: Link Rd | | | | | | | | | | | |
| 7 | L | 216 | 0.0 | 0.631 | 32.7 | LOS B | 3.2 | 22.2 | 0.92 | 1.17 | 28.3 |
| 9 | R | 26 | 0.0 | 0.159 | 30.8 | LOS A | 0.6 | 4.2 | 0.92 | 1.00 | 28.6 |
| Approach | | 242 | 0.0 | 0.631 | 32.5 | LOS B | 3.2 | 22.2 | 0.92 | 1.15 | 28.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 74 | 0.0 | 0.619 | 0.0 | LOS B | 0.0 | 0.0 | 0.00 | 1.05 | 49.0 |
| 11 | T | 1142 | 0.0 | 0.619 | 0.0 | LOS B | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 1216 | 0.0 | 0.619 | 0.0 | LOS B | 0.0 | 0.0 | 0.00 | 0.06 | 59.2 |
| All Vehicles | | 1979 | 0.0 | 0.631 | 4.7 | LOS B | 3.2 | 22.2 | 0.14 | 0.21 | 51.1 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.

# Annexure C2.6

**SIDRA Output: Boundary Road / Link Road (west leg)**

**Existing 2011 Weekday PM Peak Hour with development**

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: Boundary Rd | | | | | | | | | | | |
| 5 | T | 979 | 0.0 | 0.497 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 6 | R | 258 | 0.0 | 0.479 | 11.4 | LOS A | 3.3 | 22.8 | 0.73 | 1.04 | 38.9 |
| Approach | | 1237 | 0.0 | 0.497 | 2.4 | LOS A | 3.3 | 22.8 | 0.15 | 0.22 | 53.9 |
| North: Link Rd | | | | | | | | | | | |
| 7 | L | 79 | 0.0 | 0.072 | 8.5 | LOS A | 0.3 | 2.1 | 0.50 | 0.89 | 40.1 |
| 9 | R | 79 | 0.0 | 0.540 | 56.8 | LOS A | 2.5 | 17.6 | 0.96 | 1.10 | 21.3 |
| Approach | | 158 | 0.0 | 0.540 | 32.7 | LOS A | 2.5 | 17.6 | 0.73 | 0.99 | 27.9 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 26 | 0.0 | 0.265 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 1.06 | 49.0 |
| 11 | T | 495 | 0.0 | 0.265 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 521 | 0.0 | 0.265 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.05 | 59.3 |
| All Vehicles | | 1916 | 0.0 | 0.540 | 4.2 | LOS A | 3.3 | 22.8 | 0.16 | 0.24 | 51.3 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.

# Annexure C2.7

### SIDRA Output: Boundary Road / Link Road (west leg)

### Future 2016 Base Weekday AM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: Boundary Rd | | | | | | | | | | | |
| 5 | T | 495 | 0.0 | 0.251 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 6 | R | 79 | 0.0 | 0.432 | 30.8 | LOS A | 2.0 | 13.8 | 0.94 | 1.05 | 28.9 |
| Approach | | 574 | 0.0 | 0.432 | 4.2 | LOS A | 2.0 | 13.8 | 0.13 | 0.14 | 52.3 |
| North: Link Rd | | | | | | | | | | | |
| 7 | L | 253 | 0.0 | 0.968 | 114.7 | LOS E | 10.3 | 72.0 | 1.00 | 1.80 | 13.8 |
| 9 | R | 21 | 0.0 | 0.167 | 39.3 | LOS A | 0.6 | 4.3 | 0.94 | 1.00 | 25.7 |
| Approach | | 274 | 0.0 | 0.968 | 108.9 | LOS E | 10.3 | 72.0 | 0.99 | 1.74 | 14.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 74 | 0.0 | 0.667 | 0.0 | LOS B | 0.0 | 0.0 | 0.00 | 1.05 | 49.0 |
| 11 | T | 1237 | 0.0 | 0.667 | 0.0 | LOS B | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 1311 | 0.0 | 0.667 | 0.0 | LOS B | 0.0 | 0.0 | 0.00 | 0.06 | 59.3 |
| All Vehicles | | 2158 | 0.0 | 0.968 | 14.9 | LOS E | 10.3 | 72.0 | 0.16 | 0.30 | 41.2 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.

# Annexure C2.8

### SIDRA Output: Boundary Road / Link Road (west leg)

### Future 2016 Base Weekday PM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| East: Boundary Rd | | | | | | | | | | | |
| 5 | T | 1047 | 0.0 | 0.532 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 6 | R | 300 | 0.0 | 0.609 | 14.9 | LOS B | 4.8 | 33.9 | 0.79 | 1.15 | 36.6 |
| Approach | | 1347 | 0.0 | 0.609 | 3.3 | LOS B | 4.8 | 33.9 | 0.18 | 0.26 | 52.5 |
| North: Link Rd | | | | | | | | | | | |
| 7 | L | 89 | 0.0 | 0.086 | 8.8 | LOS A | 0.4 | 2.5 | 0.53 | 0.91 | 40.0 |
| 9 | R | 79 | 0.0 | 0.733 | 109.2 | LOS C | 3.7 | 25.7 | 0.98 | 1.17 | 14.1 |
| Approach | | 168 | 0.0 | 0.733 | 55.9 | LOS C | 3.7 | 25.7 | 0.74 | 1.03 | 21.6 |
| West: Boundary Rd | | | | | | | | | | | |
| 10 | L | 26 | 0.0 | 0.289 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 1.06 | 49.0 |
| 11 | T | 542 | 0.0 | 0.289 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 568 | 0.0 | 0.289 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.05 | 59.4 |
| All Vehicles | | 2084 | 0.0 | 0.733 | 6.7 | LOS C | 4.8 | 33.9 | 0.17 | 0.26 | 48.4 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
HCM Delay Model used.

# Annexure C3.1

## SIDRA Output: SIDRA Output: Boundary Road / Link Road (east leg)

## Existing 2011 Weekday AM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Link Rd | | | | | | | | | | | |
| 1 | L | 53 | 0.0 | 0.038 | 11.6 | LOS A | 0.2 | 1.2 | 0.37 | 0.84 | 46.2 |
| 3 | R | 26 | 0.0 | 0.118 | 27.6 | LOS A | 0.4 | 3.0 | 0.83 | 1.00 | 35.1 |
| Approach | | 79 | 0.0 | 0.118 | 16.9 | LOS A | 0.4 | 3.0 | 0.52 | 0.90 | 41.8 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 42 | 0.0 | 0.023 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.67 | 49.0 |
| 5 | T | 284 | 0.0 | 0.146 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 326 | 0.0 | 0.146 | 1.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.09 | 58.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 663 | 0.0 | 0.340 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 12 | R | 158 | 0.0 | 0.210 | 11.3 | LOS A | 1.0 | 7.0 | 0.54 | 0.76 | 45.7 |
| Approach | | 821 | 0.0 | 0.340 | 2.2 | LOS A | 1.0 | 7.0 | 0.10 | 0.15 | 56.6 |
| All Vehicles | | 1226 | 0.0 | 0.340 | 2.8 | LOS A | 1.0 | 7.0 | 0.10 | 0.18 | 55.8 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C3.2

**SIDRA Output: SIDRA Output: Boundary Road / Link Road (east leg)**

**Existing 2011 Weekday PM Peak Hour (no development)**

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Link Rd | | | | | | | | | | | |
| 1 | L | 84 | 0.0 | 0.091 | 13.4 | LOS A | 0.4 | 2.6 | 0.56 | 0.93 | 44.9 |
| 3 | R | 16 | 0.0 | 0.059 | 24.2 | LOS A | 0.2 | 1.5 | 0.79 | 1.00 | 37.1 |
| Approach | | 100 | 0.0 | 0.091 | 15.1 | LOS A | 0.4 | 2.6 | 0.60 | 0.94 | 43.4 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 53 | 0.0 | 0.028 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.67 | 49.0 |
| 5 | T | 616 | 0.0 | 0.316 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 668 | 0.0 | 0.316 | 0.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.05 | 59.0 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 353 | 0.0 | 0.181 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 12 | R | 37 | 0.0 | 0.084 | 15.5 | LOS A | 0.3 | 2.4 | 0.66 | 0.86 | 42.0 |
| Approach | | 389 | 0.0 | 0.181 | 1.5 | LOS A | 0.3 | 2.4 | 0.06 | 0.08 | 57.7 |
| All Vehicles | | 1158 | 0.0 | 0.316 | 2.2 | LOS A | 0.4 | 2.6 | 0.07 | 0.14 | 56.8 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C3.3

## SIDRA Output: SIDRA Output: Boundary Road / Link Road (east leg)

## Future 2016 Base Weekday AM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Link Rd | | | | | | | | | | | |
| 1 | L | 63 | 0.0 | 0.048 | 11.8 | LOS A | 0.2 | 1.5 | 0.40 | 0.85 | 46.1 |
| 3 | R | 32 | 0.0 | 0.198 | 36.3 | LOS A | 0.7 | 4.9 | 0.89 | 1.01 | 30.9 |
| Approach | | 95 | 0.0 | 0.198 | 19.9 | LOS A | 0.7 | 4.9 | 0.57 | 0.90 | 39.6 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 47 | 0.0 | 0.026 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.67 | 49.0 |
| 5 | T | 332 | 0.0 | 0.170 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 379 | 0.0 | 0.170 | 1.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.08 | 58.4 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 768 | 0.0 | 0.394 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 12 | R | 184 | 0.0 | 0.267 | 12.1 | LOS A | 1.3 | 9.0 | 0.59 | 0.80 | 45.0 |
| Approach | | 953 | 0.0 | 0.394 | 2.3 | LOS A | 1.3 | 9.0 | 0.11 | 0.16 | 56.4 |
| All Vehicles | | 1426 | 0.0 | 0.394 | 3.2 | LOS A | 1.3 | 9.0 | 0.11 | 0.19 | 55.3 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C3.4

## SIDRA Output: SIDRA Output: Boundary Road / Link Road (east leg)

## Future 2016 Base Weekday PM Peak Hour (no development)

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Link Rd | | | | | | | | | | | |
| 1 | L | 100 | 0.0 | 0.125 | 14.3 | LOS A | 0.5 | 3.5 | 0.61 | 0.98 | 44.2 |
| 3 | R | 16 | 0.0 | 0.080 | 29.6 | LOS A | 0.3 | 1.9 | 0.85 | 1.00 | 34.0 |
| Approach | | 116 | 0.0 | 0.125 | 16.4 | LOS A | 0.5 | 3.5 | 0.64 | 0.98 | 42.4 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 63 | 0.0 | 0.034 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.67 | 49.0 |
| 5 | T | 716 | 0.0 | 0.367 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 779 | 0.0 | 0.367 | 0.7 | LOS A | 0.0 | 0.0 | 0.00 | 0.05 | 58.9 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 411 | 0.0 | 0.211 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 12 | R | 42 | 0.0 | 0.117 | 17.9 | LOS A | 0.5 | 3.2 | 0.72 | 0.91 | 40.2 |
| Approach | | 453 | 0.0 | 0.211 | 1.7 | LOS A | 0.5 | 3.2 | 0.07 | 0.08 | 57.4 |
| All Vehicles | | 1347 | 0.0 | 0.367 | 2.3 | LOS A | 0.5 | 3.5 | 0.08 | 0.14 | 56.5 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C3.5

## SIDRA Output: SIDRA Output: Boundary Road / Link Road (east leg)

## Existing 2011 Weekday AM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Link Rd | | | | | | | | | | | |
| 1 | L | 100 | 0.0 | 0.084 | 12.2 | LOS A | 0.4 | 2.5 | 0.47 | 0.88 | 45.8 |
| 3 | R | 26 | 0.0 | 0.467 | 106.6 | LOS A | 1.5 | 10.8 | 0.97 | 1.04 | 15.5 |
| Approach | | 126 | 0.0 | 0.467 | 31.9 | LOS A | 1.5 | 10.8 | 0.57 | 0.91 | 32.5 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 42 | 0.0 | 0.023 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.67 | 49.0 |
| 5 | T | 421 | 0.0 | 0.216 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 463 | 0.0 | 0.216 | 0.7 | LOS A | 0.0 | 0.0 | 0.00 | 0.06 | 58.8 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 1058 | 0.0 | 0.543 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 12 | R | 300 | 0.0 | 0.505 | 16.6 | LOS A | 3.8 | 26.4 | 0.73 | 1.04 | 41.1 |
| Approach | | 1358 | 0.0 | 0.543 | 3.7 | LOS A | 3.8 | 26.4 | 0.16 | 0.23 | 54.5 |
| All Vehicles | | 1947 | 0.0 | 0.543 | 4.8 | LOS A | 3.8 | 26.4 | 0.15 | 0.23 | 53.1 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C3.6

## SIDRA Output: SIDRA Output: Boundary Road / Link Road (east leg)

## Existing 2011 Weekday PM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Link Rd | | | | | | | | | | | |
| 1 | L | 226 | 0.0 | 0.487 | 21.9 | LOS A | 2.4 | 16.6 | 0.85 | 1.11 | 38.6 |
| 3 | R | 16 | 0.0 | 0.182 | 56.6 | LOS A | 0.6 | 4.1 | 0.94 | 1.01 | 24.0 |
| Approach | | 242 | 0.0 | 0.487 | 24.1 | LOS A | 2.4 | 16.6 | 0.85 | 1.10 | 37.1 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 53 | 0.0 | 0.028 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.67 | 49.0 |
| 5 | T | 1011 | 0.0 | 0.518 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 1063 | 0.0 | 0.518 | 0.4 | LOS A | 0.0 | 0.0 | 0.00 | 0.03 | 59.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 489 | 0.0 | 0.251 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 12 | R | 84 | 0.0 | 0.430 | 35.3 | LOS A | 1.9 | 13.0 | 0.90 | 1.04 | 30.4 |
| Approach | | 574 | 0.0 | 0.430 | 5.2 | LOS A | 1.9 | 13.0 | 0.13 | 0.15 | 52.5 |
| All Vehicles | | 1879 | 0.0 | 0.518 | 4.9 | LOS A | 2.4 | 16.6 | 0.15 | 0.21 | 53.1 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C3.7

**SIDRA Output: SIDRA Output: Boundary Road / Link Road (east leg)**

**Future 2016 Base Weekday AM Peak Hour with development**

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Link Rd | | | | | | | | | | | |
| 1 | L | 111 | 0.0 | 0.098 | 12.5 | LOS A | 0.4 | 2.9 | 0.50 | 0.89 | 45.6 |
| 3 | R | 32 | 0.0 | 0.854 | 256.7 | LOS D | 3.3 | 23.3 | 1.00 | 1.15 | 7.5 |
| Approach | | 142 | 0.0 | 0.854 | 66.8 | LOS D | 3.3 | 23.3 | 0.61 | 0.95 | 21.4 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 47 | 0.0 | 0.026 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.67 | 49.0 |
| 5 | T | 468 | 0.0 | 0.240 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 516 | 0.0 | 0.240 | 0.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.06 | 58.8 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 1163 | 0.0 | 0.596 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 12 | R | 326 | 0.0 | 0.600 | 19.5 | LOS A | 5.0 | 35.0 | 0.78 | 1.13 | 39.0 |
| Approach | | 1489 | 0.0 | 0.600 | 4.3 | LOS A | 5.0 | 35.0 | 0.17 | 0.25 | 53.7 |
| All Vehicles | | 2147 | 0.0 | 0.854 | 7.6 | LOS D | 5.0 | 35.0 | 0.16 | 0.25 | 49.8 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C3.8

## SIDRA Output: SIDRA Output: Boundary Road / Link Road (east leg)

## Future 2016 Base Weekday PM Peak Hour with development

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Link Rd | | | | | | | | | | | |
| 1 | L | 242 | 0.0 | 0.659 | 29.0 | LOS B | 3.5 | 24.6 | 0.92 | 1.19 | 34.4 |
| 3 | R | 16 | 0.0 | 0.261 | 81.9 | LOS A | 0.8 | 5.7 | 0.96 | 1.02 | 18.8 |
| Approach | | 258 | 0.0 | 0.659 | 32.2 | LOS B | 3.5 | 24.6 | 0.92 | 1.18 | 32.7 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 63 | 0.0 | 0.034 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.67 | 49.0 |
| 5 | T | 1111 | 0.0 | 0.570 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 1174 | 0.0 | 0.570 | 0.4 | LOS A | 0.0 | 0.0 | 0.00 | 0.04 | 59.3 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 547 | 0.0 | 0.281 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| 12 | R | 89 | 0.0 | 0.573 | 48.8 | LOS A | 2.6 | 18.1 | 0.94 | 1.10 | 25.6 |
| Approach | | 637 | 0.0 | 0.573 | 6.9 | LOS A | 2.6 | 18.1 | 0.13 | 0.15 | 50.5 |
| All Vehicles | | 2068 | 0.0 | 0.659 | 6.4 | LOS B | 3.5 | 24.6 | 0.16 | 0.22 | 51.3 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C4.1

**SIDRA Output: Boundary Road / "new" road (priority control)**

**Future 2016 Base Weekday AM Peak Hour with development**

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Access Rd | | | | | | | | | | | |
| 1 | L | 1 | 0.0 | 0.834 | 23.2 | LOS D | 20.6 | 144.0 | 0.91 | 1.05 | 37.6 |
| 3 | R | 721 | 0.0 | 0.834 | 23.0 | LOS D | 20.6 | 144.0 | 0.91 | 1.23 | 37.7 |
| Approach | | 722 | 0.0 | 0.834 | 23.0 | LOS D | 20.6 | 144.0 | 0.91 | 1.23 | 37.7 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 237 | 0.0 | 0.141 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.69 | 49.0 |
| 5 | T | 26 | 0.0 | 0.141 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 263 | 0.0 | 0.141 | 7.4 | LOS A | 0.0 | 0.0 | 0.00 | 0.62 | 49.9 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 100 | 0.0 | 0.053 | 2.1 | LOS A | 0.5 | 3.8 | 0.53 | 0.00 | 50.9 |
| 12 | R | 1 | 0.0 | 0.053 | 10.5 | LOS A | 0.5 | 3.8 | 0.53 | 0.91 | 49.1 |
| Approach | | 101 | 0.0 | 0.053 | 2.2 | LOS A | 0.5 | 3.8 | 0.53 | 0.01 | 50.9 |
| All Vehicles | | 1086 | 0.0 | 0.834 | 17.3 | LOS D | 20.6 | 144.0 | 0.65 | 0.97 | 41.2 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model used.

# Annexure C4.2

**SIDRA Output: Boundary Road / "new" road (priority control)**

**Future 2016 Base Weekday PM Peak Hour with development**

Capacity and Level of Service

**Movement Performance - Vehicles**

| Mov ID | Turn | Demand Flow | HV | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vehicles | Distance | | | |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Access Rd | | | | | | | | | | | |
| 1 | L | 1 | 0.0 | 0.416 | 18.3 | LOS A | 2.6 | 18.2 | 0.70 | 1.01 | 40.8 |
| 3 | R | 237 | 0.0 | 0.416 | 18.1 | LOS A | 2.6 | 18.2 | 0.70 | 1.09 | 40.9 |
| Approach | | 238 | 0.0 | 0.416 | 18.1 | LOS A | 2.6 | 18.2 | 0.70 | 1.09 | 40.9 |
| East: Boundary Rd | | | | | | | | | | | |
| 4 | L | 721 | 0.0 | 0.442 | 8.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.70 | 49.0 |
| 5 | T | 105 | 0.0 | 0.442 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 60.0 |
| Approach | | 826 | 0.0 | 0.442 | 7.1 | LOS A | 0.0 | 0.0 | 0.00 | 0.61 | 50.1 |
| West: Boundary Rd | | | | | | | | | | | |
| 11 | T | 53 | 0.0 | 0.031 | 14.6 | LOS A | 0.8 | 5.3 | 0.82 | 0.00 | 40.5 |
| 12 | R | 1 | 0.0 | 0.031 | 23.0 | LOS A | 0.8 | 5.3 | 0.82 | 1.03 | 39.2 |
| Approach | | 54 | 0.0 | 0.031 | 14.8 | LOS A | 0.8 | 5.3 | 0.82 | 0.02 | 40.4 |
| All Vehicles | | 1118 | 0.0 | 0.442 | 9.8 | LOS A | 2.6 | 18.2 | 0.19 | 0.68 | 47.3 |

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Minor Road Approach LOS values are based on worst degree of saturation for any vehicle movement.