



# **Ordinary Council Meeting 23/03/21**


**Item 12.1 refers**

## **Attachment 8**

### **Infrastructure Servicing and Cost Estimate Report**

*Creating opportunities*



The background of the cover features a large, abstract graphic. On the left, there is a dark silhouette of a stepped structure, resembling a staircase or a series of rectangular blocks. To the right of this, there are several concentric, semi-circular shapes in shades of blue and grey, creating a sense of depth and movement. The overall color palette is dark, with the text and logo elements in white and orange.

## **BELMONT DEVELOPMENT AREA 6 INFRASTRUCTURE SERVICING AND COST ESTIMATE REPORT**

Taylor Burrell Barnett Planning

January 2021

**CLIENT: TAYLOR BURRELL BARNETT PLANNING****PROJECT: DEVELOPMENT AREA 6, CITY OF BELMONT****TITLE: INFRASTRUCTURE AND COST REPORT**

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## 1 INTRODUCTION

TABEC Pty Ltd has prepared this report to support the proposed rezoning of Development Area 6 (DA6) excluding Perth Airport, within the City of Belmont. The majority of DA6 is residential and currently zoned R20 as depicted in Figure 1, with pockets of mixed use and commercial properties. The proposed future density increases will require various upgrades and extensions of existing infrastructure to accommodate the moderate and high growth scenarios which includes 2,930 dwellings and 4,255 dwellings accordingly. In addition there is 31,919m<sup>2</sup> of commercial floor space shown on the Taylor Burrell Barnett (TBB) Plan. The Yield Analysis Plan, found in Appendix A, details the planned density increase and growth scenarios of DA6.

The report provides engineering advice on the capability and future infrastructure requirements of the site to support the proposed mixed residential and commercial development and the civil engineering influences on the development plan form. In particular we have considered earthworks, roads, drainage, wastewater, water, gas, power and communication servicing requirements to support development. The report also provides an estimate of cost for the upgrade of existing infrastructure and distributes responsibility between service authorities and proposed developers for the purposes of a Development Contribution Plan (DCP).

The site investigation and servicing recommendations are primarily based on preliminary advice from the City of Belmont, Public Transport Authority, Department of Water, Water Corporation, ATCO Gas, Western Power and various telecommunication providers. The information provided within this report is current as of January 2021 and is subject to change as detailed reviews progress, and further information is resolved with each servicing Authority and City of Belmont.

The site is identified by the black boundary on Figure 1 presented below:

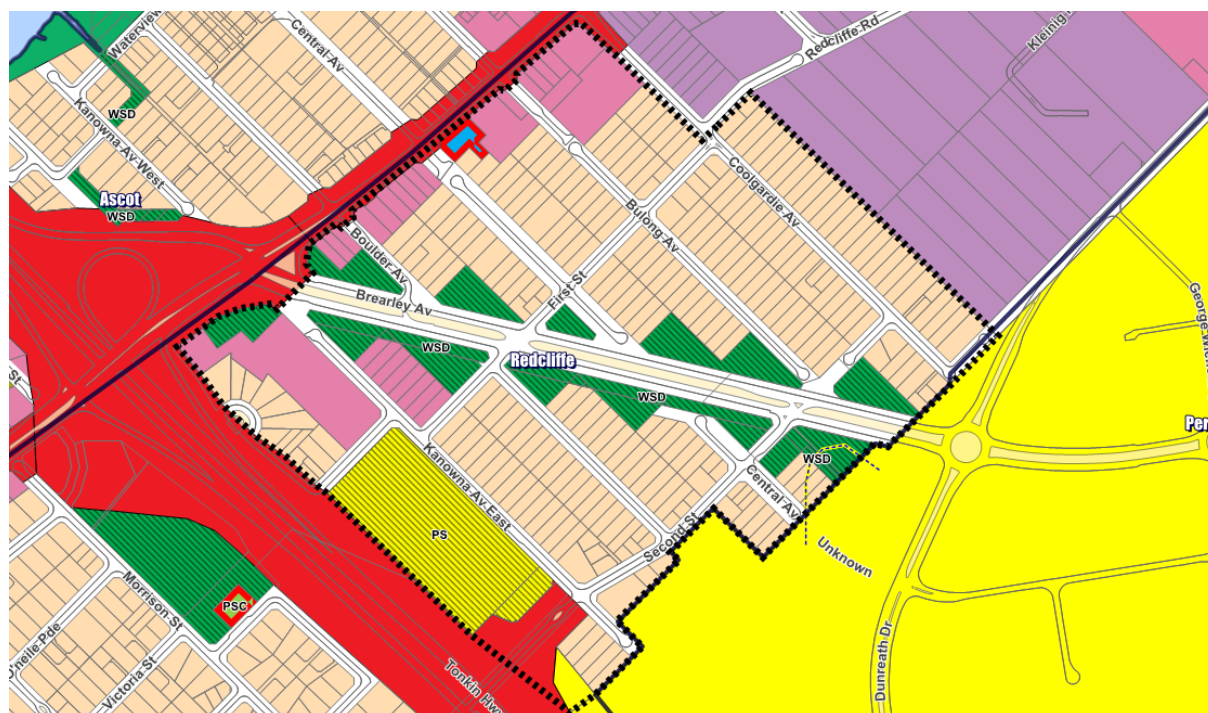


Figure 1 – City of Belmont Local Planning Scheme 15 (Intramaps)

## 2 THE STUDY AREA

### 2.1 Site Description

DA6 is situated within the suburb of Redcliffe, approximately 8km to the east of Perth within the City of Belmont. The development site spans an area of almost 50ha, bound by Great Eastern Highway (GEH) to the north-west, Tonkin Highway to the south-west and Perth Airport to the east.

Access to Perth Airport via Brearley Avenue has been closed at the intersection of First Street to make way for the construction of the Redcliffe Train Station and the creation of new roads and links to the existing roads. The Brearley Avenue intersection with Great Eastern Highway has been removed. Parallel to Brearley Avenue is the Perth Airport Main Drain which grades from east to west, eventually discharging into the Swan River.

The site is currently mostly residential with the exceptions of the Redcliffe Primary School to the south west and commercial properties fronting GEH.

### 2.2 Landform / Topography

Natural surface contours available from Water Corporation's ESInet depicts the land falling steadily from RL18.0m in the southern corner to RL7.0m AHD in the northern corner. The overall topography is however relatively flat, as the 11m vertical difference across the site is experienced over a distance of 900m equating to a grade of 1%. The only significant deviation from the typical topography is the Main Drain at RL8.0m AHD running conversely to natural surface, grading from east to west.

Figure 2 is an aerial image of DA6 illustrating the large residential lots, with the now closed Brearley Avenue traversing the site centrally. Numerous small pockets of POS, wide road reserves and large residential lots have aided the retention of many large trees as depicted below.



Figure 2 – DA6 Aerial image (Nearmap)



## **2.3 Ground Conditions**

A desktop review of the Perth Groundwater Atlas indicates the majority of DA6 contains Bassendean Sand (quartz sand) with only a small portion of the northern corner designated as Guildford Clay (alluvium, clay, loam, sand and gravel).

Individual Geotechnical Investigations will be required to determine the design parameters for future development within DA6.

## **2.4 Groundwater**

The Perth Groundwater Atlas reveals the historical maximum groundwater levels range from RL12.0m in the southern corner to RL 5.0m AHD in the northern corner. It is therefore estimate that clearance to groundwater from natural surface ranges from approximately 6m in the south to 2m in the north of DA6.

## **2.5 Acid Sulfate Soils**

A desktop review of the Swan Coastal Plain Acid Sulfate Soils (ASS) Risk Map designates the site location as having “moderate to low ASS disturbance risk” (within 3m from surface). Based on the anticipated ground conditions and depth to ground water, management of ASS is not likely to be a significant factor during the installation or upgrade of services in DA6.

# **3 SITE WORKS AND EARTHWORKS**

Siteworks for urban development generally comprises the clearing of existing vegetation, stripping topsoil and the earth working of existing ground surfaces to facilitate a required form of development. This will apply in localised areas within DA6, noting this requirement will be undertaken on a smaller scale to address redevelopment proposal for increased densities.

Earthworks will need to be individually tailored to the proposed development type and contingent on geotechnical advice sought prior to detailed design.

# **4 ROADS**

In response to the proposed rezoning and high density development within DA6, the existing road network is reviewed, with various upgrade, treatments, connections and intersections proposed as outlined below.

## **4.1 Existing Road Network**

The site is primarily accessed from GEH to the west, with a southern access into the DA6 area also available from Stanton Road which connections to Second Street over Tonkin Highway. Central Avenue and Bulong Avenue intersect with GEH, though each are “no through roads” in order to direct the majority of traffic through the primary access roads. Access is available through Boulder Avenue and Coolgardie Avenue.

With the exception of Brearley Avenue and Central Avenue, all road pavements are typically 6m wide within 20m wide roads reserves. Central Avenue has a 30m wide road reserve and 6m pavement width north of Brearley Avenue and is a dual carriageway south of Brearley Avenue, comprised of 5m wide paved lanes separated by a median strip, including 1.5m wide cycle lanes. Boulder Avenue, Central Avenue, Bulong Avenue and Second Street currently are not continuous, cut off by Brearley Avenue.

## 4.2 Proposed Road Upgrades

Flyt Transport Consultancy have undertaken the traffic modeling and determined the upgrades proposed in the table below. A graphical representation of the list below can be found in Appendix B. The allowances included in the Opinion of Probable Cost for the various road upgrades is also captured in this table.

Road Name	Proposed Works
Brearley Ave	- Complete closure and removal of remaining road pavements
Coolgardie Avenue including Henderson Avenue	- Incorporation of on-street car parking. - Modifications to existing pavements to construct meandering road. - Installation of traffic calming devices. - Localised Street drainage.
Road 1	- New road to link Boulder Avenue to Kanowna Avenue. - Installation of traffic calming devices. - Modifications to existing pavements to construct meandering road. - Localised Street drainage.
Kanowna Avenue	- Connection with new Road 1. - Modifications to existing pavements to construct meandering road. - Installation of traffic calming devices. - Localised Street drainage.
Boulder Avenue	- Connection with new Road 1. - Installation of traffic calming devices. - Localised Street drainage.
First Street	- Installation of traffic calming devices. - Modifications to existing pavements to construct meandering road. - Localised Street drainage.
Second Street	- Street connection with Bulong Ave. - Incorporation of on-street car parking. - Localised Street drainage.
Bulong Avenue	- Street connection to provide access to GEH (ultimate design). - Street connection with Road 3. - Modifications to existing pavements to construct meandering road. - Installation of traffic calming devices. - Localised Street drainage.

Central Ave	<ul style="list-style-type: none"> <li>- Street connection to provide access to GEH.</li> <li>- Removal of no through road.</li> <li>- Street connection between First Street and Second Street.</li> <li>- Central median and cycle path.</li> <li>- Incorporation of on-street car parking.</li> <li>- Modifications to existing pavements to construct meandering road.</li> <li>- Installation of traffic calming devices.</li> <li>- Localised Street drainage.</li> </ul>
Victoria Street	<ul style="list-style-type: none"> <li>- Footpaths and on-street car parking.</li> <li>- Localised Street drainage.</li> </ul>
The Court	<ul style="list-style-type: none"> <li>- Footpaths and on-street car parking.</li> <li>- Localised Street drainage.</li> </ul>
Road 3	<ul style="list-style-type: none"> <li>- Connection of Bulong Avenue to Second Street.</li> <li>- Traffic calming device.</li> </ul>
Stanton Road	<ul style="list-style-type: none"> <li>- Footpaths and on-street car parking.</li> <li>- Localised Street drainage.</li> </ul>
Intersection Treatments	<ul style="list-style-type: none"> <li>- Second Street signaled intersection at Central Avenue.</li> <li>- Second Street roundabout at Boulder Avenue.</li> <li>- Roadworks including raised median and traffic calming devices.</li> </ul>

Roads not listed in the above table have no proposed changes to existing surface treatment, kerbing or alignment.

Where road alignments are not suggested to be modified, the existing pavement appears to be in satisfactory condition and should be retained. Kerb profiles will need to be modified to suit the proposed adjacent development. Beyond road upgrades and nominated alignment changes, cost associated with profiling existing roads and resurfacing works are nominally included in the cost schedule.

### 4.3 Great Eastern Highway

Brearley Avenue has been removed with works undertaken in late 2018 and the former intersection with GEH re-configured. GEH now exists as a T-intersection with the Tonkin Highway off-ramp adjacent the DA6 site. There is no road access available into DA6 through Brearley Avenue.

### 4.4 Cost Estimate

The costs for all roadworks have been presented in the table below and are reflective of each section of road being upgraded in single contracts. Given the schematic level of detail to date, with no design undertaken and concept sketches only prepared, the project definition is expressed as 1% to 15%.

Based on this project definition and the Australian Cost Engineering Society/AACE International's five estimate class levels, the figures contained in each of the below Opinions of Probable Cost are considered a Class 4 estimate with accuracy typically Low -10% to -20% and High +20% to +30%.

Each road has been separately identified based on possible future staging as advised by City of Belmont. Based on this concept nature, the below figures in the summary table include a 30% construction contingency, and 20% allowance for professional fees.

Item	Road	Cost
1.0	Brearley Avenue	\$253,000.00
2.0	Coolgardie Avenue – Great Eastern Highway to Second Street	\$809,000.00
2.1	Coolgardie Avenue – East of Second Street incl. Henderson Avenue	\$253,000.00
3.0	Road 1	\$389,000.00
4.0	Kanowna Avenue – West of First Street to POS	\$320,000.00
4.1	Kanowna Avenue – First Street to Second Street	\$377,000.00
4.2	Kanowna Avenue – Second Street to Perth Airport	\$128,000.00
5.0	Boulder Avenue – Great Eastern Highway to First Street	\$153,000.00
5.1	Boulder Avenue – First Street to Second Street	\$431,000.00
6.0	First Street	\$411,000.00
7.0	Second Street – Coolgardie Avenue to Bulong Avenue	\$146,000.00
7.1	Second Street – Central Avenue to Kanowna Avenue	\$428,000.00
8.0	Bulong Avenue – Great Eastern Highway to First Street	\$424,000.00
8.1	Bulong Avenue – First Street to Second Street	\$503,000.00
9.0	Central Avenue – Great Eastern Highway to First Street	\$504,000.00
9.1	Central Avenue – First Street to Second Street	\$912,000.00
10.0	Victoria Street	\$227,000.00
11.0	The Court	\$202,000.00
12.0	Intersection Treatments	\$492,000.00
13.0	Road 3	\$176,000.00
14.0	Stanton Road	\$205,000.00
	<b>Total (excluding GST):</b>	<b>\$7,743,000.00</b>

The Development Contribution Plan (DCP) cost per square metre is the cost each development will need to pay per square metre of their developable land in order to fund the all major infrastructure works detailed in this report. Traffic will be generated from all proposed development with DA6, this volume increase will affect all roads and therefore the cost contribution is proposed to be spread evenly across all developable land.

## **5 STORMWATER DRAINAGE**

In accordance with best practice Water Sensitive Urban Design (WSUD) principles, stormwater within the DA6 area is intended to be managed locally and infiltrated as close to source as possible. In accordance with the drainage management approach, the street scape will include source infiltration devices that will not add stormwater flows to the Southern Main Drain.

### **5.1 Existing Drainage Network**

A vast network of pit and pipe drainage collects the runoff that falls within DA6. A review of Water Corporation's ESInet mapping shows several drainage connections to Perth Airport Southern Main Drain. The Main Drain grades from east to west, ultimately discharging into the Swan River.

With increased density through the DA6 area, higher runoff from lots is anticipated. While new developments are ordinarily required to accommodate the drainage within their particular site, increases paved and hard surfaces throughout the road network is also anticipated.

Therefore, an integrated stormwater system in the streetscape network is necessary through a stormwater detention and infiltration strategy which should be investigated further and detailed through a Local Water Management Strategy.

Water Corporation's existing Southern Main Drain can only accept predevelopment flows. Development within the DA6 area will therefore need to model and confirm the current contributing stormwater flow volumes to the Main Drain and prevent predevelopment flows from being exceeded with localised detention.

### **5.2 Proposed Drainage Network**

In order to achieve higher levels of stormwater infiltration through Water Sensitive Urban Design features in each of the local roads, roadside swales, bio-retention areas and rain gardens are envisioned. The purpose is to ensure high levels of water treatment is promoted and to minimise the potential for pollutants such as phosphorus, nitrogen and metals from road runoff entering groundwater. Bio-retention and local surface treatments typically trap and infiltrate the minor events. Larger storm events require additional storage, which can be achieved with below-ground infiltration galleries. There are a variety of proprietary products available, which are trafficable, however the general intention would be to locate in existing road verges, and beneath swale and bio-retention facilities.

Notwithstanding that some cost allowances within the DA6 area are included for localised street drainage facilities within the road upgrade cost contribution table above, a Local Water Management Strategy for the DA6 area is required to be developed which should document the best practice stormwater management responses, confirm indicative design and staging of stormwater treatment facilities and confirm the sizing requirements. The strategy should also determine interface treatments such as bunding requirements around public open space areas which are proposed either side of the Perth Airport Southern Main Drain.

In concept, realignment and living stream upgrades to the Southern Main Drain are proposed. Water Corporation shall be consulted on design progression of the Public Open Space and Southern Main Drain treatments with particular attention to public safety and future maintenance access.



### 5.3 Cost of Upgrade

The estimated cost for the currently preferred Southern Main Drain option is included below, along with the anticipated LWMS preparation, modelling and detailed drainage design.

<b>Southern Main Drain</b>	<b>Estimated Cost</b>
EPCAD Option C - Living Stream	\$2,456,000.00
Modelling, LWMS preparation and detailed design	\$150,000.00
<b>Total (excluding GST):</b>	<b>\$2,606,000.00</b>

## 6 WASTEWATER

### 6.1 Existing Wastewater Network

The wastewater reticulation for the entirety of DA6 falls to the Type 40 Coolgardie Avenue Pumping Station location in Coolgardie Avenue west of the intersection of Bulong Avenue. The existing network consists of mainly DN150 reticulation grading centrally to a DN225 pipe in First Street, Bulong Avenue and Coolgardie Street before travelling north to the pumping station.

A portion of sewerage reticulation can be found within easements at the rear of private properties or in POS, providing connections for existing dwellings. It has been assumed that these easements and the reticulation will be maintained during future development. There is no costs allowance for the relocation of these assets.

In addition to the existing gravity network, the Perth Airport is serviced by a DN150 private pressure main traversing the full length of First Street but does not discharge into the gravity network and completely bypasses the Coolgardie Avenue Pumping Station.

When future demands are finalised and planning for the DA6 area is confirmed, advice should be provided to Water Corporation for a review and update of proposed upgrades to downstream sewer infrastructure.

### 6.2 Proposed Wastewater Reticulation Upgrades

Both the “moderate” and “high” growth scenarios, detailed in Appendix A, trigger the same requirements for upgrading the existing wastewater reticulation.

The upgrades internal to DA6 and suggested to be included within the DCP are:

- 85m section of DN150 in Boulder Avenue will be need to be upgraded to a DN225. A plan depicting the areas requiring upgrade can be found in Appendix B; and
- 775m of DN225 upgraded to DN300 within First Street and Bulong Avenue down to the Coolgardie Avenue Pumping Station. This includes 375m outside of the DA6 boundary, west of GEH.

Beyond upgrades to existing mains, new DN150 sewer reticulation extensions to service additional development that may be required shall be funded by each respective developer, as the sewer main would be constructed solely to service that particular development. New service extensions would therefore be attributed to individual developers and funded by each developer as required.

In addition, the developers are required to fund the full cost of protecting or modifying any of the existing infrastructure which may be affected by the proposed developments. Whenever development is proposed near Water Corporation assets the applicant will need to submit an Approval of Works application.

Separately, headworks upgrades downstream to the existing sewer network are required at the cost of Water Corporation. These items are not as follows:

- Type 40 Coolgardie Avenue Pumping Station upgraded to a Type 90;
- 1,100m DN200 pressure main from the Coolgardie Avenue Pumping Station to a AC L3589 upgraded to DN300;
- 713m varied section of gravity main from AC L3589 to AC L7510 upgraded to DN450; and
- 980m varied section of gravity main from AC L7510 to AC L0246 upgraded to DN600.

A plan depicting the areas requiring upgrade can be found in Appendix B. The works listed immediately above are outside the DA6 boundary and, while not currently on Water Corporation's Capital Works Program, will be funded and constructed when required by the Water Corporation. Developers are not required to fund these works through DCP contributions.

### **6.3 Estimated Wastewater Reticulation Upgrade Cost**

The 85m upgrade of DN150 to DN225 would be fully funded by developers under the DCP. In addition, the DN300 gravity main upgrade along Bulong Avenue would also be funded by developers when required. When completed, the proponent can make a request to Water Corporation for a contribution to the DN300 sewer and receive from an agreed sum \$600/m.

The reimbursement is included in the estimated cost table to arrive at a final figure for Opinion of Probable Cost purposes, however it is advised that initial funding for the whole DN300mm sewer upgrade would initially be required.

The below figures in the Opinion of Probable Cost include a 30% contingency and 20% allowance for professional fees.

The table below contains the cost estimate for the two separate wastewater upgrades:

<b>Upgrade</b>	<b>Estimated Cost</b>	<b>Refund</b>	<b>Total</b>
DN150 to DN225	\$218,000.00	N/A	\$218,000.00
DN225 to DN300	\$1,594,000.00	(\$450,000.00)	\$1,144,000.00
<b>Total (excluding GST):</b>	<b>\$1,812,000.00</b>		<b>\$1,362,000.00</b>

The contributions to wastewater have been divided into two catchments of 74,451m<sup>2</sup> and 249,396m<sup>2</sup> for DN225 and DN300 upgrades respectively. Wastewater is a gravity fed network with clear catchment boundaries that are depicted in Appendix 2. The total cost nominated above is summarised as an allocation across the combined catchments.

## **7 WATER SUPPLY**

### **7.1 Existing Water Reticulation**

The existing water supply consists of Cast Iron, Asbestos Cement, PVC and Steel pipes ranging from DN100, DN150 and DN205 internal to DA6. The area is supplied from a major distribution from a major DN800 steel distribution main in GEH, near Boulder Avenue.

### **7.2 Proposed Water Reticulation Upgrades**

Growth scenarios have been assessed based on the possible dwelling numbers. With input from Water Corporation, upgrades, mains extensions and increased water supply requirements have been identified to cater for the increased water demand.

The upgrade proposed by Water Corporation would see duplication of existing mains to the opposite side of the road in Central Road and Bulong Avenue. Additional water mains to provide interconnections between Kanowna Avenue to Boulder Avenue, along with Bulong Avenue to Central Avenue have also been identified to ensure adequate supply. Abandonment and replacement of existing mains would also occur under this proposal illustrated in Appendix B.

Notwithstanding the extensions and upgrades identified, the works to increase water supply will ultimately not only depend entirely on the development rate with DA6, but also where development is taking place. The extensions or upgrades could be undertaken to minimise interruptions and reinstatements which may result in various sections being brought forward of otherwise planned timing.

All water main extensions required for the development site, must be laid within the existing and proposed road reserves on correct alignment in accordance with Utility Providers Code of Practice.

Notwithstanding that when future demands are finalized based on ultimate planning, this information should be provided to Water Corporation to review the proposed mains upgrade requirements. The proposed upgrade strategy outlined, will need to be further refined in consultation with Water Corporation's Land Servicing Section.

The following outlines the most likely upgrade and extension works required to water supply:

<b>Street</b>	<b>Moderate and High Growth Scenario</b>
Central Avenue	<ul style="list-style-type: none"> <li>- New DN150P in the northern verge for full length of road.</li> <li>- New DN100P through POS 3 across former Brearley Avenue.</li> </ul>
Bulong Avenue	<ul style="list-style-type: none"> <li>- New DN100P in northern verge between Road 2 and Second Street.</li> </ul>
Road 1	<ul style="list-style-type: none"> <li>- New DN100P from Kanowna Street to former Brearley Avenue.</li> <li>- New DN150P from Boulder Ave to former Brearley Avenue.</li> </ul>
Road 2	<ul style="list-style-type: none"> <li>- New DN100P full length of road.</li> </ul>
POS1	<ul style="list-style-type: none"> <li>- Replace DN100CI with new DN100P.</li> <li>- New D150P through to POS1 to Road 1.</li> </ul>
Kanowna Avenue	<ul style="list-style-type: none"> <li>- Abandon DN100AC.</li> </ul>

P = PVC, AC = Asbestos Cement, CI = Cast Iron, S = Steel.

### 7.3 Estimated Water Reticulation Upgrade Cost

All water main extensions and upgrades that are DN250 and smaller are considered reticulation and are therefore fully funded by developers. It is proposed the capacity upgrades and connections throughout the DA6 development area be funded through DCP contributions.

The water reticulation is generally comprised of numerous loops that circulate and maintain a clean free flow of water. Development and pressure demand anywhere in DA6 could trigger the need for an upgrade and would need hydraulic modelling by Water Corporation each time a new development is proposed in order to determine the impact. For this reason, the contribution for the ultimate water upgrade shall be the same for the entire development area.

The estimated cost of the water reticulation main upgrades and extensions based on the Opinion of Probable Cost in below table includes a 30% contingency and 20% allowance for professional fees.

Upgrade	Estimated Cost
<b>Total additional water mains (excluding GST):</b>	<b>\$1,038,000.00</b>

## 8 GAS SUPPLY

### 8.1 Existing Gas Reticulation

The suburban streets of Belmont DA6 contain numerous medium pressure reticulated gas mains varying DN50 – 100. The largest main, DN155, is present along Brearley Avenue, servicing Perth Airport.

### 8.2 Proposed Gas Reticulation

ATCO Gas have proposed relocating their existing main from Brearley Avenue to Boulder Avenue and Kanowna Avenue in order to tie back in and serve Perth Airport. The increased density will require a reinforcement to the existing upstream network which will consist of 2 High Pressure Regulators (HPR), 3.3km of DN160 polyethylene high pressure mains and 1.5km of DN100 Steel high pressure mains. The internal reticulation will require new mains to the new roads and road links created by the removal of Brearley Avenue as well as external network links via Coolgardie Avenue and First Street.

Given the schematic and preliminary nature of the advice received to date from ATCO Gas, a 30% contingency has been included in the below figures:

Item	Estimated Cost
Removal and relocation of Brearley Avenue mains	\$471,172.00
New internal reticulation	\$467,626.00
External upgrade and network reinforcement (subject to negotiated outcomes with ATCO Gas)	\$4,941,626.00
<b>Total (excluding GST):</b>	<b>\$5,881,000.00</b>

Clearly, there is a significant cost associated with the external upgrades and network reinforcement to provide capacity upgrades from the existing high pressure mains to the south of Perth Airport. Given

the significant increase in potential customers for ATCO Gas, there is opportunity to recover the cost of the external upgrades through a negotiated outcome with ATCO Gas.

When assessing claims for capital contributions, ATCO Gas look at the projected gas volume versus the current demand and make assessments on the net present value. A positive net present value will be looked at favourably towards a contribution by ATCO Gas.

Furthermore, the supply of gas mains is not a subdivision condition with the West Australian Planning Commission. While there is a commercial interest for ATCO Gas to expand their network to service additional users, opportunity to reduce the significant cost associated with upgrades external to the DA6 boundary should be sought.

## **9 POWER & COMMUNICATIONS**

The existing and proposed upgrades to the power and telecommunications infrastructure is detailed in a report by 3E Consulting Engineers titled Electrical and Communication Infrastructure and Cost Analysis, located in Appendix 5.

The review by 3E has been updated to November 2020 to assess the revised anticipated dwelling yields from the DA6 area. Information is provided relating to the current state of the existing electrical and communications networks within the subject site, including the capacity of the interconnecting or upstream networks. Analysis is also provided on impacts of the proposed re-development on the networks, in terms of capacity and any reinforcement that may be required, as well as any asset relocations that may be applicable. Advice relating to cost estimates for the proposed upgrade, reinforcement and relocation works is also included.

### **9.1 Power Cost**

The power infrastructure scheduled for distribution via the DCP includes the relocation of existing Western Power assets, which primarily includes the remaining LV supplies in Brearley Avenue following the relocation works already completed as part of the train station construction. There are also existing below ground HV networks in Kanowna Avenue, where the land above this cable route is identified for development and so the cable will be required to be re-routed along the new road reserves to maintain HV links.

The existing overhead HV and LV power network is also required to be relocated underground. There is cause to underground the aerial network due to clashes between the poles and wires and the proposed development works. In order to avoid the otherwise ad-hoc approach which would prove inefficient, the City may elect to complete this underground conversion in advance, under the DCP to facilitate the future development. The costs to do so are therefore estimated and included below. However, it is noted that a DCP contribution for conversion of overhead power to underground is not typical practice.

The HV network will also require reinforcement and extension, to provide suitable access to power for the ultimate development. In addition to this, there will be some significant reinforcing of the HV network throughout the site, to create HV ring networks with sufficient redundancy to provide a suitably reliable power supply to all connections.

Generally, it's envisaged that network reinforcement and upgrades is the responsibility of the ultimate developers. It is advised by 3E that costs to install new underground HV network through the site is not typically included in DCP funding schedules.

Developers will generally be required, for technical reasons, and through the WAPC process for creating titled lots, to provide HV infrastructure in the immediate vicinity of their development, and also outside of their site to facilitate an appropriate connection to the existing network. The costs related to ultimate power network upgrades is therefore excluded from the below DCP cost schedule.

Notwithstanding, the detailed layout of the ultimate HV network will likely be determined in more detail during a further planning phase of this project, in conjunction with Western Power. And in due course, it is recommended that a HV concept plan, which aims to plan the locations of transformers and switchgears, to support the HV network, is completed as part of further planning for the re-development of this site.

New LV and HV assets will be required to serve individual development needs but this would be paid for by the private developer similar to a greenfield situation which includes the Western Power HV Pool scheme. The costs for the ultimate network are therefore also excluded, as this is dependent on each development that may occur.

If costs relating to the ultimate network through the development area were intended to form part of the DCP contributions, then an additional allowance of \$6.5M – \$8.0M would be recommended based on the potential development form.

In relation to the headworks required to supply estimated load increases, Western Power typically limits the load on their HV networks to 8MVA. As the load on the existing HV network that feeds the site is not known until a Western Power feasibility assessment is completed, it is unknown at this time how much of the additional load can be placed on to the existing network.

The total increase in power demand is anticipated to be in the order of 13.1–19.6MVA. Therefore, it is most likely that up to two new dedicated external HV feeders will be required. The potential cable routes are diagrammatically shown in a sketch contained in 3E report.

Under current Western Power policy, additional load requests below 1.5MVA are treated as underline (or natural) load growth. Under this policy, Western Power will augment the network at its own cost to support natural load growth.

If development occurs by a number of independent developers, each with load below 1.5MVA, over 15 years or more, then it's likely that Western Power would cover the network augmentation costs.

The costs for network augmentation and HV feeder cables are therefore also excluded from the below estimated DCP cost contributions.

Under an alternate scenario, where for example a single developer chose to complete a single significantly large development, or multiple medium sized developments a short time apart, then Western Power may nominate that developer as the responsible party for the augmentation costs. The parameters for a developer becoming the responsible party, we understand, would be a load of 1.5MVA, in a period of 1 – 2 years. In this case, the below cost estimates may need to be reviewed.

Summary of costs for electrical related contributions are included in the following table, which is limited to asset relocations and the underground conversion of the existing HV and LV network. Given the clarifications outlined by 3E, with costs and capacity subject to more detailed reviews and feasibility assessments, a 30% contingency has been included in the figures:

Item	Estimated Cost
Relocation works	\$650,000.00
Underground conversion of existing network	\$7,150,000.00
<b>Total (excluding GST):</b>	<b>\$7,800,000.00</b>

## 9.2 Communications Cost

As detailed in the 3E report, several Telecommunication providers assets are present in Brearley Avenue, servicing Perth Airport. Telstra, Optus, NBN Co, Vocus and Nextgen assets are proposed for removal and relocation along Central Ave and Boulder Ave respectively, illustrated within Appendix 2.

Within the remainder of the DA6 area, a number of other asset providers also have communication assets and locations may be affected by proposed development, road construction and possible level changes. Road reserve changes and level changes would need to be known in greater detail before a more accurate estimate of impact could be given, therefore cost estimates are approximate.

A summary of the costs for the different providers relocations is below. Due to the preliminary nature of this advice and relocation requirements being subject to detailed reviews and assessments by each asset owner, a 30% contingency has been included in the figures:

Item	Estimated Cost
Removal and relocation of Brearley Ave assets	\$4,823,000.00
Other relocation costs	\$650,000.00
<b>Total (excluding GST):</b>	<b>\$5,473,000.00</b>

The WAPC has released a proposed policy to make the provision of telecommunications infrastructure a condition of subdivision. It is expected that the policy will be eventually introduced in WA and when that occurs Developers will be under the additional obligation.

NBN Co's primary network access is understood to be located on Great Eastern Hwy, which may connect the DA6 area to the Telstra Ascot Exchange on Hardy Rd and then on to a to its Fibre Access Node (FAN) located FAN at Bassendean Exchange or direct to the FAN via Great Eastern Hwy and Guildford Rd. It is likely that NBN Co would deliver Fibre to the Premises (FTTP) technology to the proposed development.

Costs associated with expansion of NBN services, including possible backhaul and per-lot deployment charges are not included in the DCP cost schedule. It is assumed these costs will be at the individual developer's expense as would be the case for a typical development.



## 10 CONCLUSION

From an engineering perspective, the site requires significant relocations of existing services, and upgrades to existing infrastructure to satisfy the proposed moderate and high growth scenarios. While Opinions of Probable Cost have been nominated, the actual costs are subject to greater level of detailed design, staging and coordination of works.

Also, there is opportunity for various cost contributions due to off-site network reinforcements that should be negotiated further with servicing Authorities for clarifications on cost schedules.

Since the Opinions of Probable Cost are based on schematic design and concept sketches, we would consider the cost estimate provided above to be Class 4 based on the recommendation of Engineers Australia – Australian Cost Engineering Society with current project definition expressed as 1% to 15%.

The Opinion of Probable Cost must therefore be read with typical accuracy Low -10% to -20% and High +20% to +30%.

The total cost to be contained within the DCP is summarised in the following table:

Item	Cost
Roadworks and Drainage	\$7,743,000.00
Southern Main Drain	\$2,606,000.00
Wastewater	\$1,362,000.00
Water Reticulation	\$1,038,000.00
Gas	\$5,881,000.00
Power	\$7,800,000.00
Communications	\$5,473,000.00
<b>Total Cost (excluding GST):</b>	<b>\$31,903,000.00</b>

## 11 REFERENCES

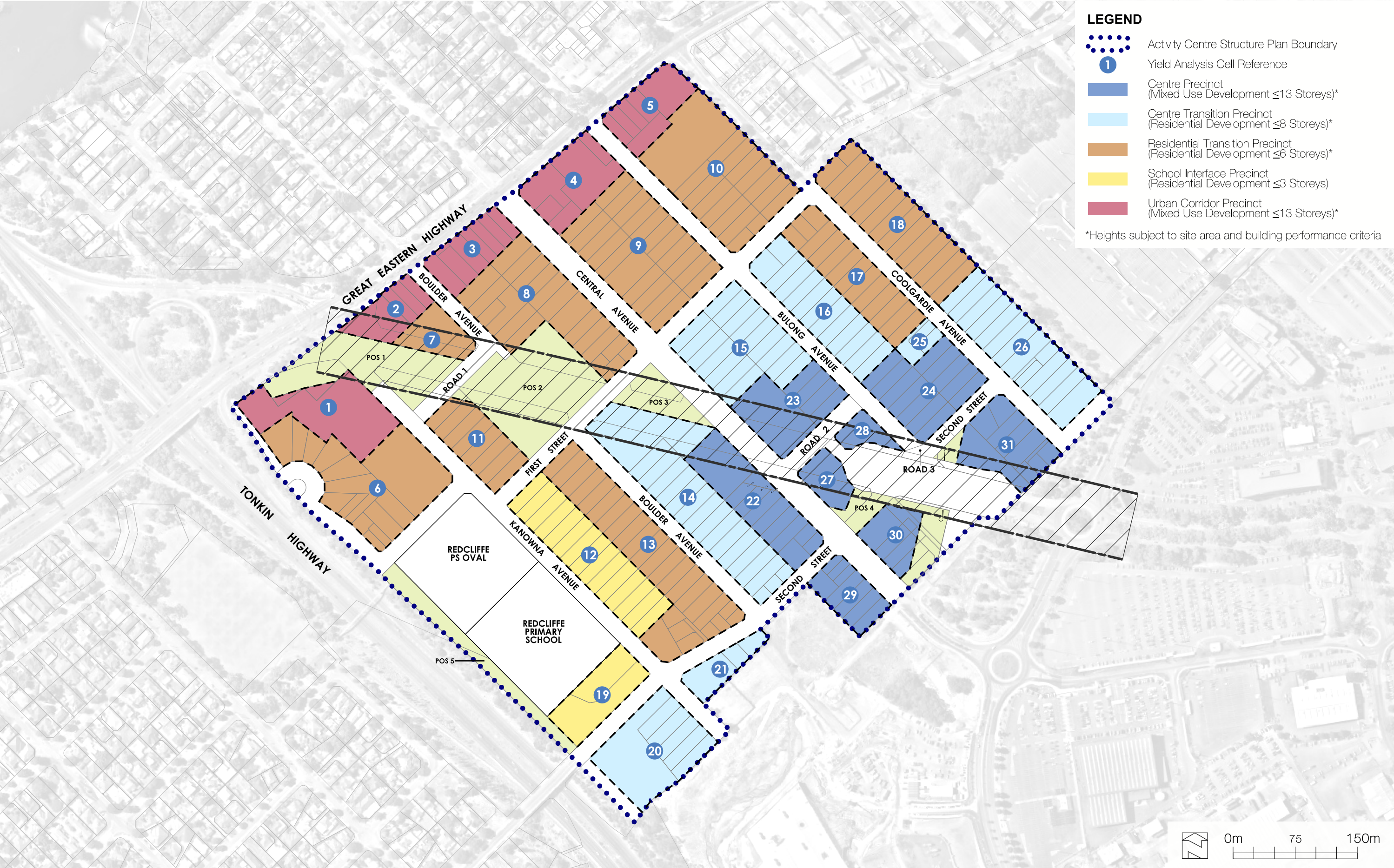
- City of Belmont Intramaps, Geographic Information System. Local Planning Scheme 15
- Taylor Burrell Barnett, Moderate and High Growth Dwelling Yield Scenarios, September 2019
- Photomaps by Nearmap, Online Aerial Imagery. Redcliffe, September 2019.
- EPCAD Southern Main Drain Overall Plan Rec C, September 2019.
- Flyt Traffic Consulting, Traffic Modelling Report. Belmont DA6 Traffic and Transport Modelling Report, March 2018.
- 3E Consulting Engineers, Power and Communications Cost Report. Electrical and Communication Infrastructure and Cost Analysis, November 2020.



**APPENDIX A YIELD ANALYSIS PLAN & GROWTH SCENARIOS**

Development Area 6, Belmont

TBB Planning (September 2019)



Precinct	Moderate Growth Scenario	High Growth Scenario
<b>Centre</b>		
Residential - Single/Grouped	-	-
Residential - Apartments (Units)	752	895
Commercial - Floorspace (m2)	10,226	20,452
<b>Centre Transition</b>		
Residential - Single/Grouped	260	121
Residential - Apartments	459	888
<b>Residential Transition</b>		
Residential - Single/Grouped	514	377
Residential - Apartments	445	1,218
<b>School Interface</b>		
Residential - Single/Grouped	79	74
Residential - Apartments	32	74
<b>Urban Corridor</b>		
Residential - Single/Grouped	-	-
Residential - Apartments	389	608
Commercial - Floorspace	18,244	29,190
<b>Total Single/Grouped Dwellings</b>	<b>853</b>	<b>573</b>
<b>Total Apartments (units)</b>	<b>2,077</b>	<b>3,682</b>
<b>Total Dwellings</b>	<b>2,930</b>	<b>4,255</b>
<b>Total Commercial Floorspace (m2)</b>	<b>28,470</b>	<b>49,642</b>

**APPENDIX B    PROPOSED INFRASTRUCTURE UPGRADE PLANS**

Development Area 6, Belmont

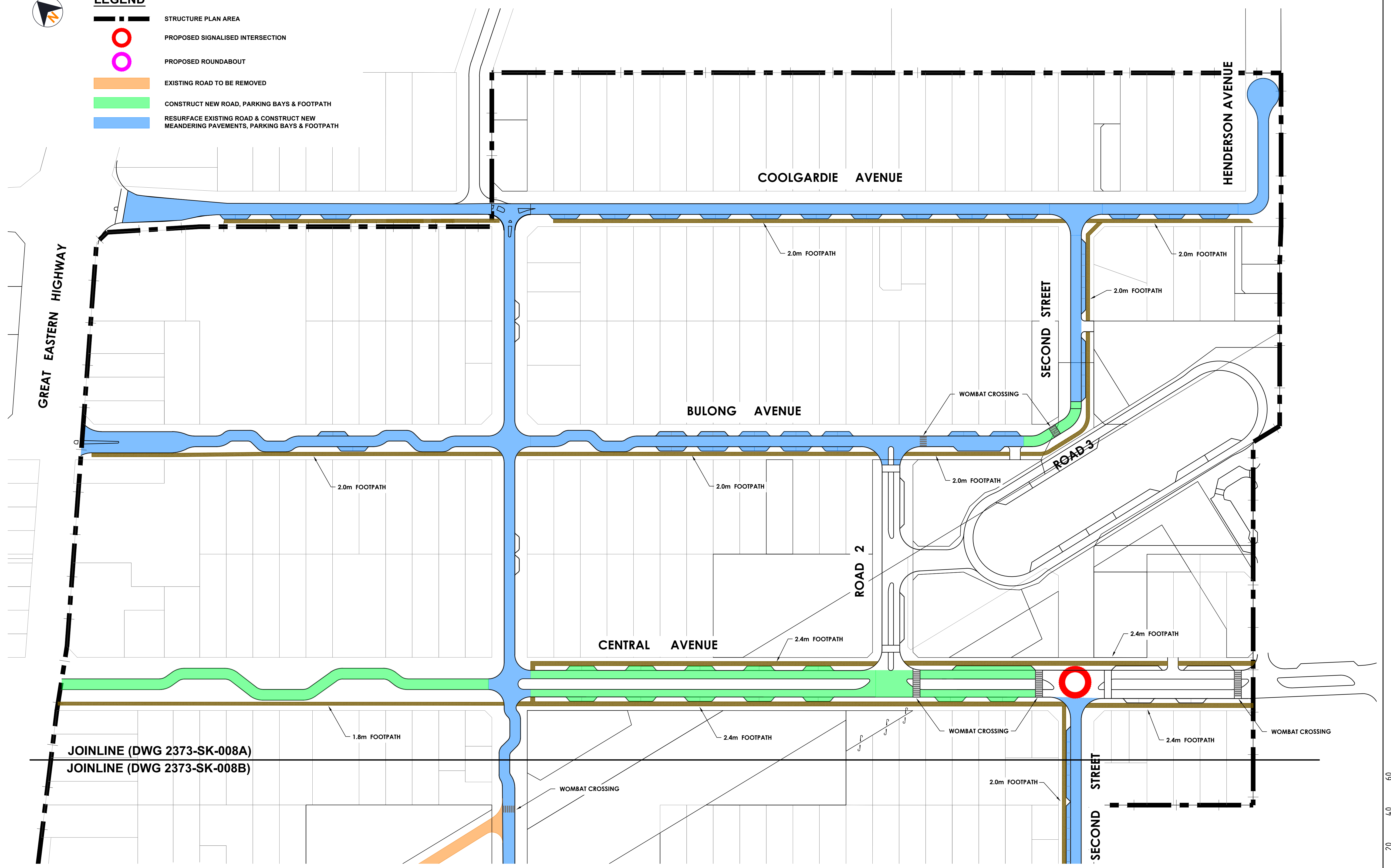
TABEC (December 2020)





**LEGEND**

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- PROPOSED SIGNALISED INTERSECTION
- PROPOSED ROUNDABOUT
- EXISTING ROAD TO BE REMOVED
- CONSTRUCT NEW ROAD, PARKING BAYS & FOOTPATH
- RESURFACE EXISTING ROAD & CONSTRUCT NEW MEANDERING PAVEMENTS, PARKING BAYS & FOOTPATH

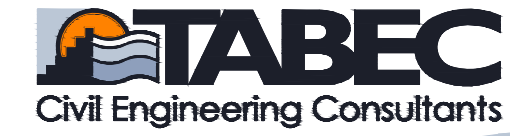


JOINLINE (DWG 2373-SK-008A)  
JOINLINE (DWG 2373-SK-008B)

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**City of Belmont - Development Area 6**

**Road Upgrade Plan**  
DRAWING NUMBER  
**2373-SK-008A**  
ISSUE  
**A**



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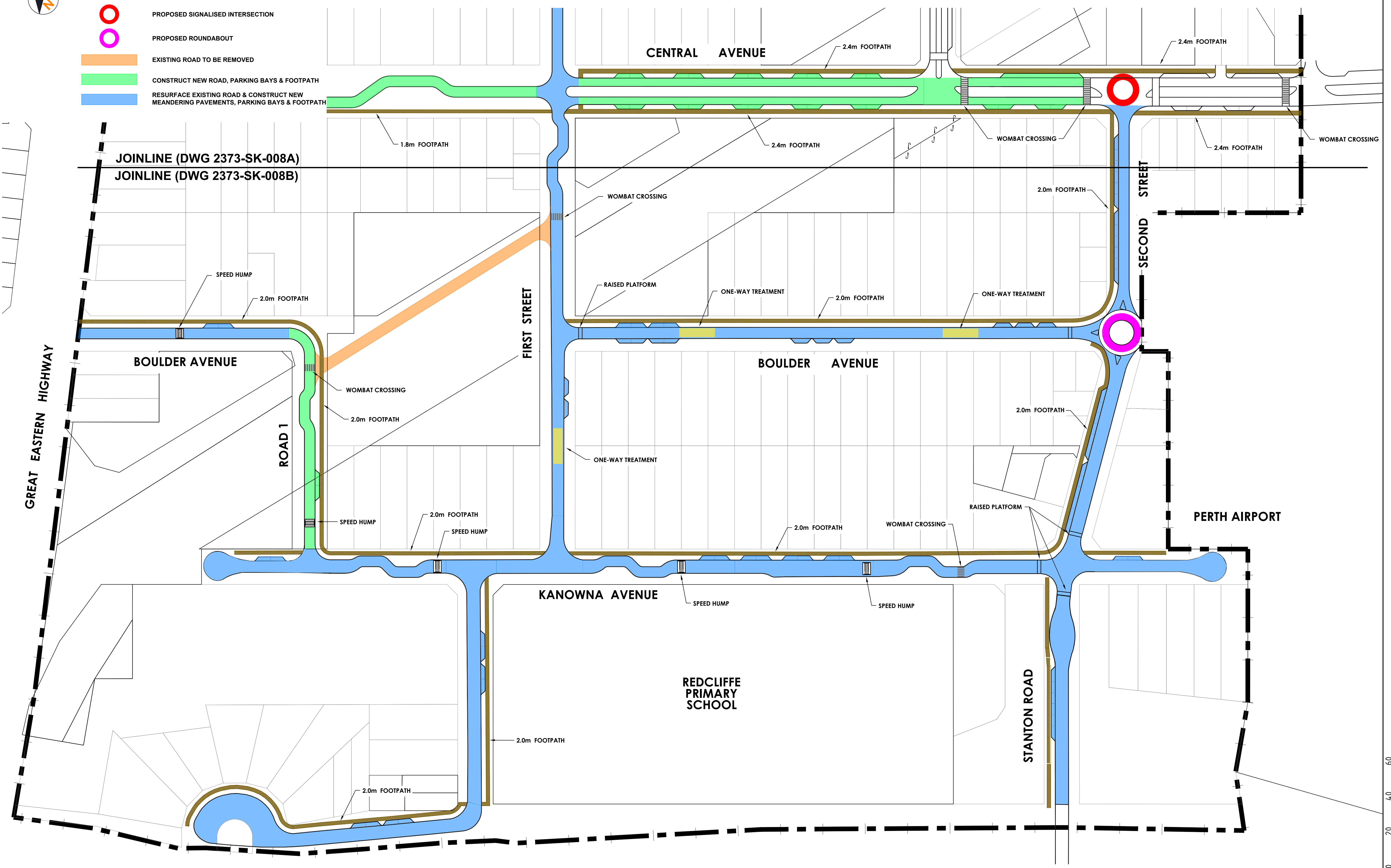
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**LEGEND**

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- PROPOSED SIGNALISED INTERSECTION
- PROPOSED ROUNDABOUT
- EXISTING ROAD TO BE REMOVED
- CONSTRUCT NEW ROAD, PARKING BAYS & FOOTPATH
- RESURFACE EXISTING ROAD & CONSTRUCT NEW MEANDERING PAVEMENTS, PARKING BAYS & FOOTPATH



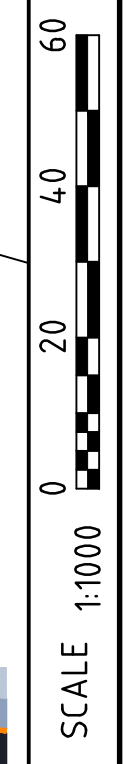
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**Road Upgrade Plan**  
DRAWING NUMBER  
**2373-SK-008B**  
ISSUE  
**A**

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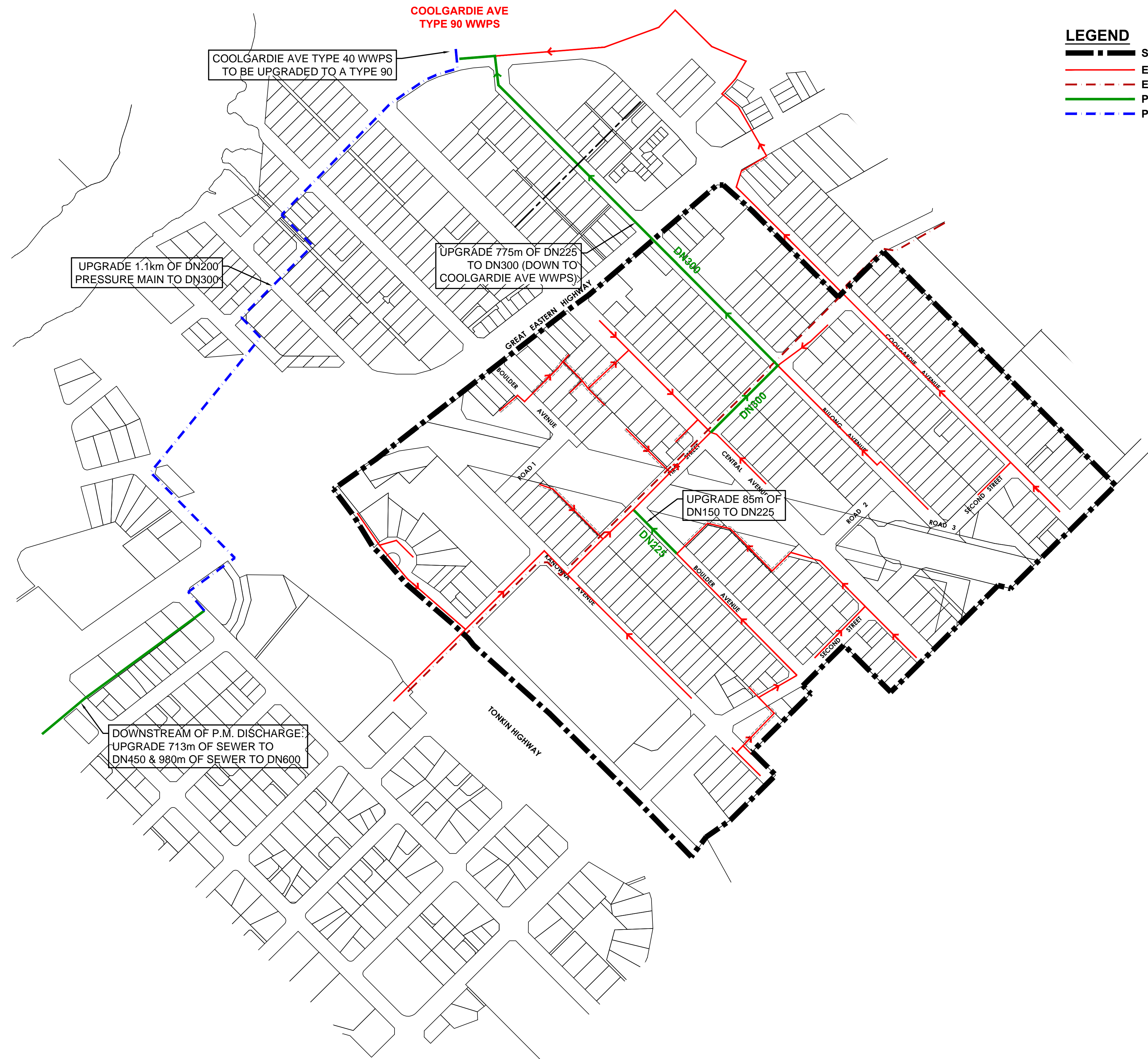
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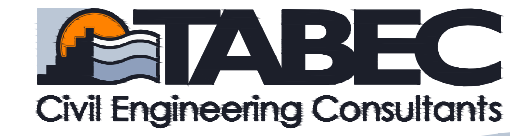
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- EXISTING GRAVITY SEWER
- EXISTING SEWER PRESSURE MAIN
- PROPOSED GRAVITY SEWER UPGRADE
- PROPOSED GRAVITY SEWER PRESSURE MAIN UPGRADE



**PLAN**  
N.TS.

**City of Belmont - Development Area 6**

**Sewer Upgrade Plan**  
DRAWING NUMBER  
**2373-SK-004**  
ISSUE  
**B**



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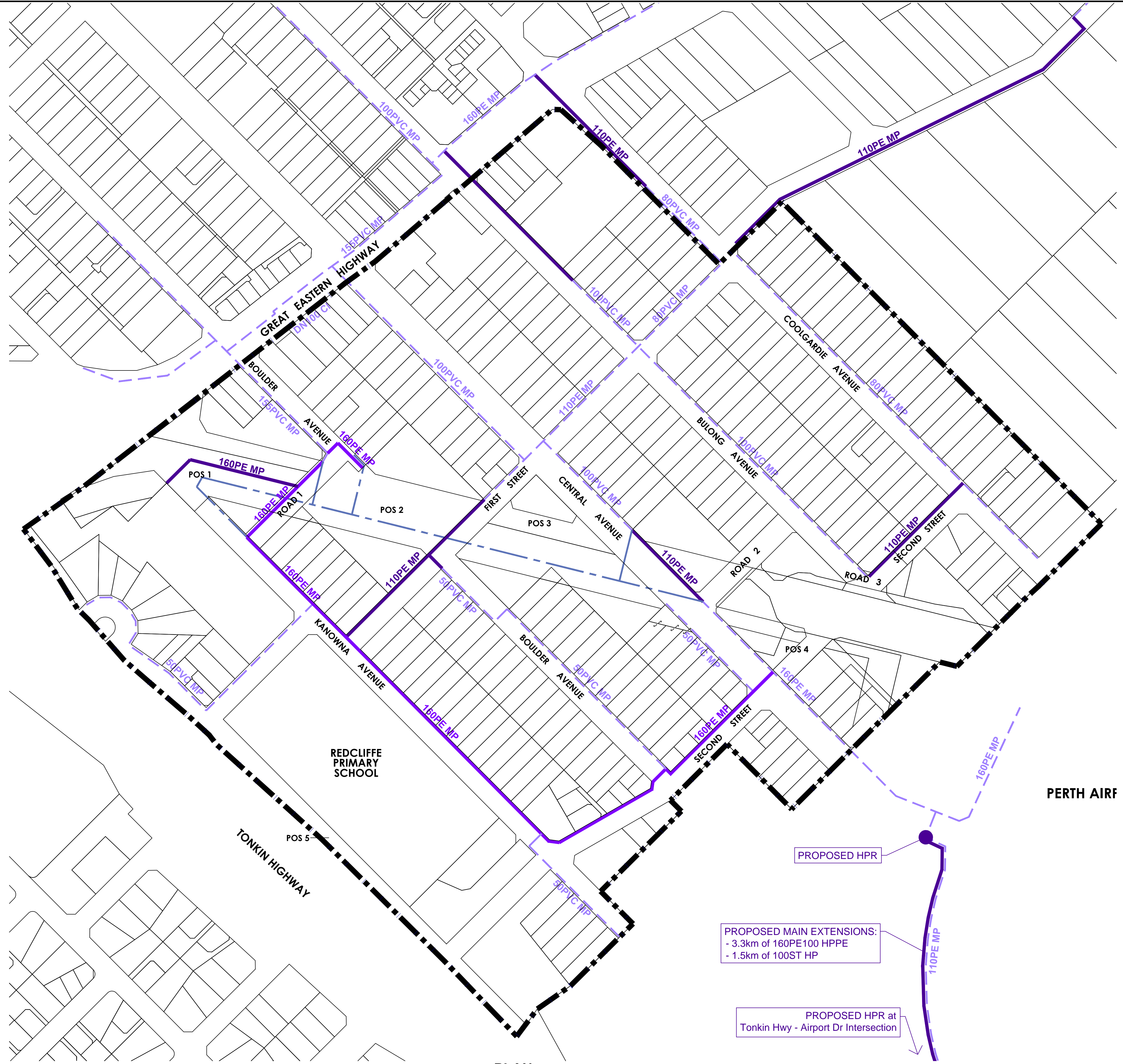
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  - 110PE MP PIPE SIZE, MATERIAL & PRESSURE
  - PROPOSED GAS UPGRADE
  - 110PE MP PIPE SIZE, MATERIAL & PRESSURE
  - EXISTING GAS TO BE REPLACED
  - 110PE MP PIPE SIZE, MATERIAL & PRESSURE
  - EXISTING GAS TO BE DECOMMISSIONED

PLAN  
1:2000

PROPOSED MAIN EXTENSIONS:  
- 3.3km of 160PE100 HPPE  
- 1.5km of 100ST HP

PROPOSED HPR at  
Tonkin Hwy - Airport Dr Intersection

PROPOSED HPR

PERTH AIRF

REDCLIFFE  
PRIMARY  
SCHOOL

TONKIN HIGHWAY

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# City of Belmont - Development Area 6

Gas Upgrade Plan  
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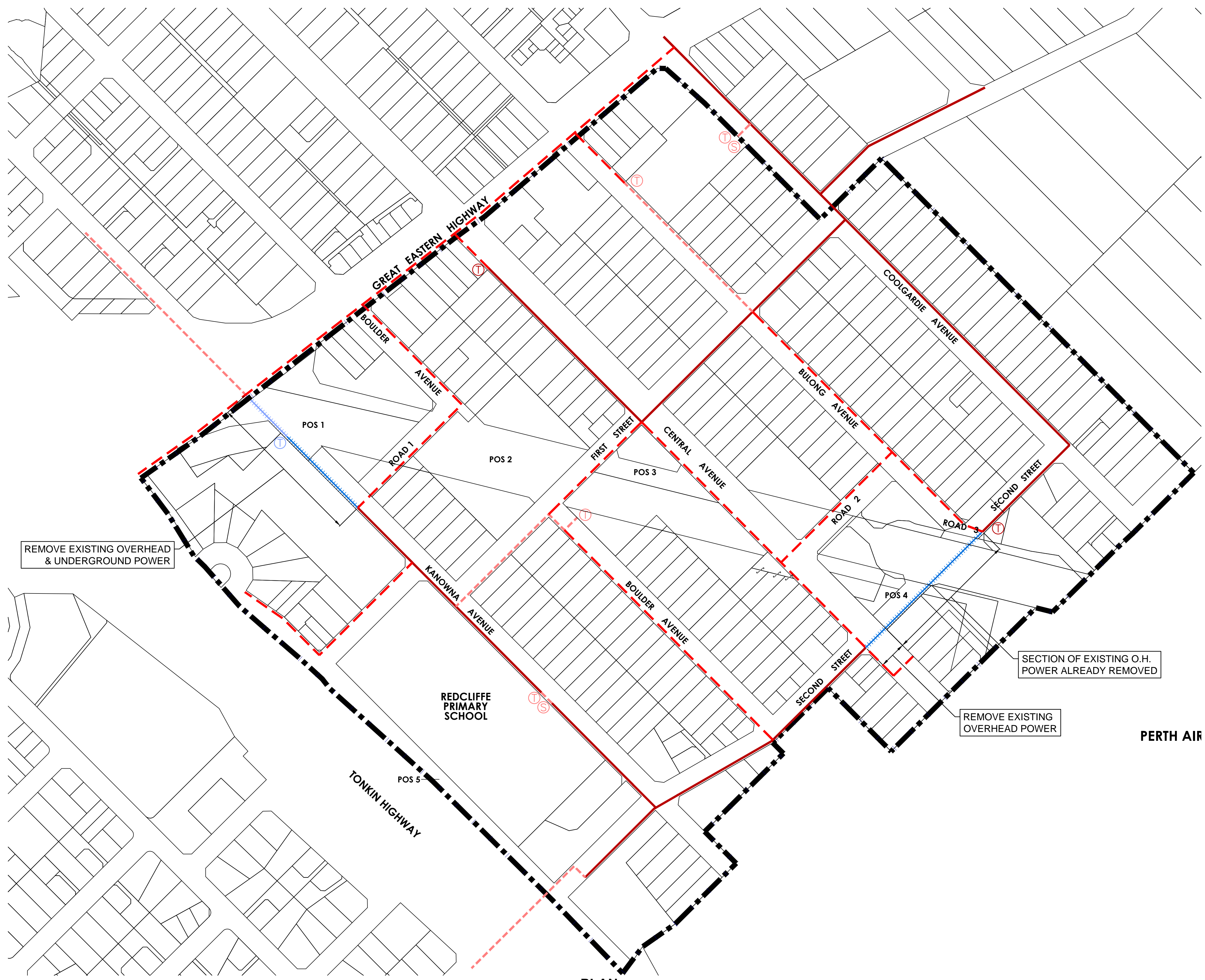
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  - EXISTING H.V. UNDERGROUND POWER
  - EXISTING H.V. OVERHEAD POWER TO BE REMOVED & REPLACED WITH H.V. UNDERGROUND POWER
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  - EXISTING H.V. UNDERGROUND POWER TO BE REMOVED
  - EXISTING TRANSFORMER & SWITCH

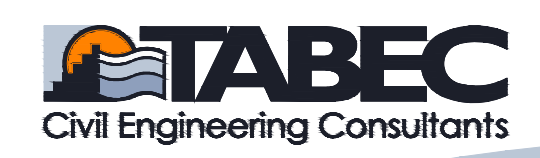


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# City of Belmont - Development Area 6

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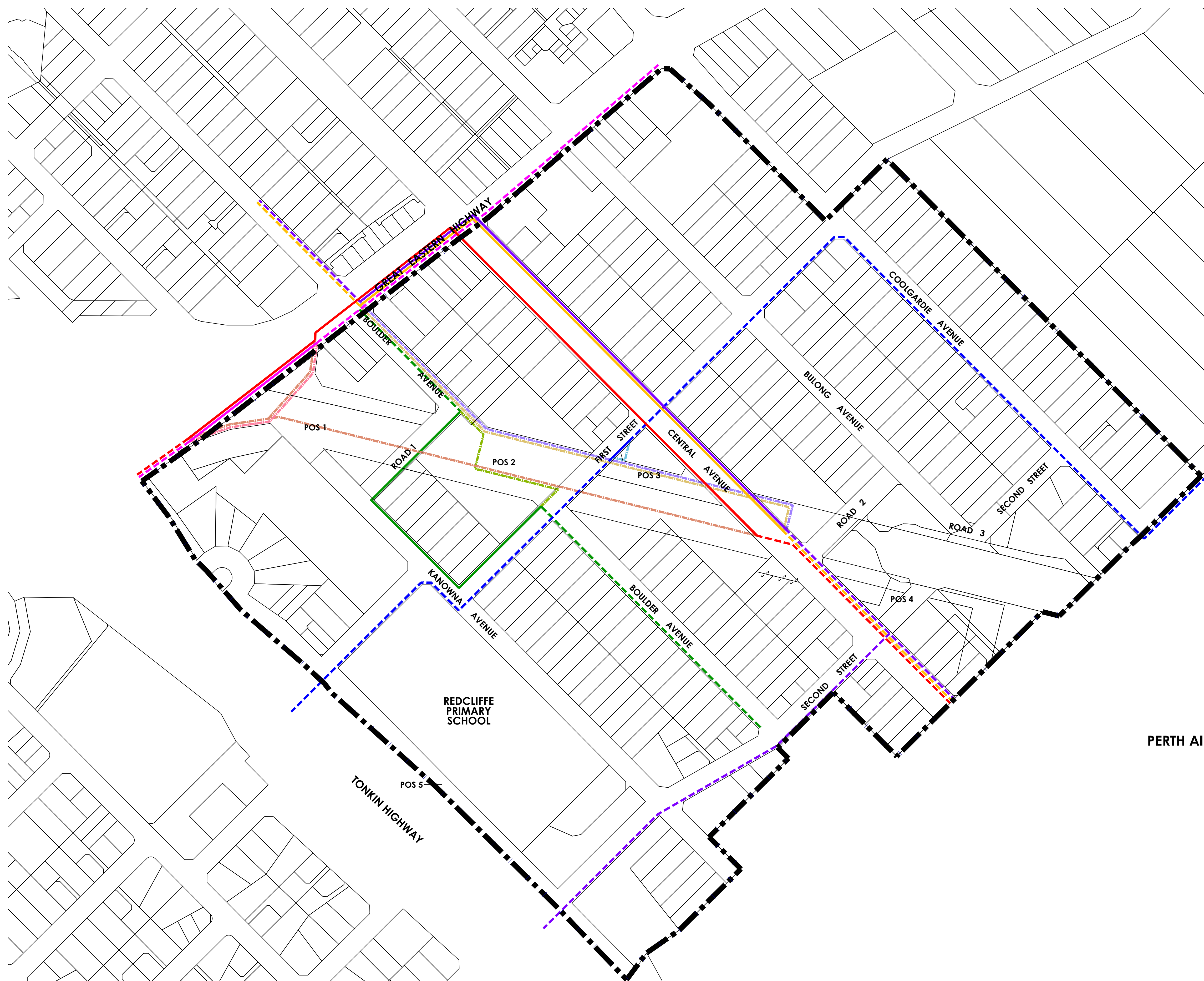
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- LEGEND**
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  - PROPOSED TELSTRA
  - EXISTING TELSTRA - To Be Relocated
  - EXISTING VOCUS
  - PROPOSED VOCUS
  - EXISTING VOCUS- To Be Relocated
  - EXISTING NEXTGEN
  - PROPOSED NEXTGEN
  - EXISTING NEXTGEN- To Be Relocated
  - EXISTING WP
  - PROPOSED WP
  - EXISTING WP- To Be Relocated
  - EXISTING NBN Co
  - PROPOSED NBN Co
  - EXISTING NBN Co- To Be Relocated
  - EXISTING OPTUS
  - PROPOSED OPTUS
  - EXISTING OPTUS- To Be Relocated

PERTH AIR

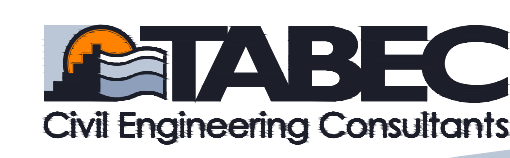
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# City of Belmont - Development Area 6

## Communications Relocation Plan

DRAWING NUMBER  
2373-SK-007

ISSUE  
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**APPENDIX C    ELECTRICAL & COMMUNICATIONS INFRASTRUCTURE & COST  
ANALYSIS REPORT**

Development Area 6, Belmont

3E Consulting Engineers (November 2020)

PROJECT:

**DEVELOPMENT AREA 6 (REDCLIFFE)**

REPORT FOR:

**ELECTRICAL AND COMMUNICATION INFRASTRUCTURE AND COST ANALYSIS**

DOCUMENT NO: **3E18007-R-01**

CIVIL ENGINEERS:

**TABEC CIVIL ENGINEERING CONSULTANTS**

DOCUMENT PREPARED BY:

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**Document History and Status**

Revision	Date issued	Author	Reviewed by	Approved by	Revision Description
0	15/03/18	JH & BB	VH	DJ	For Review
1	30/11/2020	JH & BB	VH	JH	For Information

**Distribution of copies**

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## SECTION 1 INTRODUCTION

### 1.1 SCOPE, BASIS OF SERVICING ESTIMATES AND ASSUMPTIONS

We understand that the subject site is a portion of Development Area 6 (DA6), as defined by the City of Belmont's Planning Scheme No. 15. This portion is bound by Tonkin Highway, Great Eastern Highway, the Perth Airport's western property boundary and a line just east of Coolgardie Avenue, as shown on the City of Belmont's DA6 Vision Plan (May 2015).

We understand that the proposed re-development of this area consist of the construction of a new Public Transport Authority (PTA) train station "Airport West" station, the closure of Brearley Avenue, other road extensions and widening's, as well as other broader works to suit traffic flows, such as a new interchange on the Tonkin Highway. We also understand that re-development includes significant re-zoning of land that would allow much higher density and multi-level development for both residential and commercial purposes.

The zoning information and the related yield used in this servicing estimates is as per the latest information provided to us by TABEC Civil Engineering Consultants.

	<b>Moderate Growth Scenario</b>	<b>High Growth Scenario</b>
<b>Total Single/Grouped Dwellings</b>	853	573
<b>Total Apartments</b>	2,077	3,682
<b>Commercial/Retail Floor Space (~120m<sup>2</sup>/unit)</b>	28,470 m <sup>2</sup> (237* units)	49,642 (414* units)

\*Refer to the detailed yield dimensioning for communications services in the communications section below.

This report assumes that desirable residential growth scenario yields are approved in the Development Application with commercial yields based on 120m<sup>2</sup> per unit. The proposed use of the sites is mixed between residential, commercial and retail.

It is understood that the existing properties would be acquired by independent developers, likely amalgamated in to super lots on which multi-storey buildings are then constructed. It is assumed that actual development will occur over a period of 20 to 30 years.

We understand that the order of the current residential dwellings is 250. The site also includes the Redcliffe School, the Maracoonda hotel and several commercial facilities, generally closer to the Great Eastern Highway.

This report shall provide information on the state of the existing electrical and communications networks within the subject site, including the capacity of the interconnecting or upstream networks. It shall then provide analysis of the effects of the proposed re-development on the networks, in terms of capacity and any reinforcement that may be required, as well as any asset relocations that may be applicable. Where applicable, it will provide options to address constraints, or to facilitate future development. Lastly, it will provide order of cost estimates for the proposed works.

## SECTION 2 ELECTRICAL SERVICES

### 2.1 EXISTING POWER NETWORK DISTRIBUTION

#### 2.1.1 PHYSICAL NETWORK

The existing Western Power (WP) distribution infrastructure within the site comprises of a network which consist mostly of an aerial 22kV three phase aerial High Voltage (HV) and Low Voltage (LV) power lines. This includes three pole top transformers and several pole top HV fuse frames. There are four ground mounted substations, with short sections of associated underground power cables. As a minimum, the LV aerial network extends through the majority of streets, supplying the existing premises.

The power to the site appears to be from the nearby WP Belmont Zone (132kV/22kV) Substation (BEL), which is approximately 2.5km south west of the DA6 site, at the corner of Alexander Rd and Belgravia St. The HV network meanders through the area in between the Zone Substation and the DA6 site, servicing a large number of premises, before entering the site via Stanton Rd.

Through the site, the main HV network splits in two directions at Kanowna Ave East. One line heads north along Kanowna Ave East, exciting the site under the Great Eastern Highway, while the other continues along Second st and then Coolgardie st, before splitting and exiting the site at Redcliffe Rd and under the Great Eastern Highway again. There are several short HV spur lines from the main HV line, feeding transformers.

There is a WP communications network, consisting of an underground cable entering the under the Great Eastern Highway at Central Avenue and continuing along Brearley Avenue in to the Perth Airport's land. There is a junction on that cable near the intersection of Second street and Brearley Avenue, where the cable then runs along Second Ave and exits the site at Stanton Rd. Refer to Section 3 "Communication Services" for more detail.

#### 2.1.2 NETWORK CAPACITY

##### ZONE SUBSTATION CAPACITY

Some information on the capacity of the nearby Zone Substations can be determined from Western Power's public Network Capacity Mapping Tool (NCMT). The following table summarises the available capacity at the time of writing, at 2026 and at 2036 (the limit of currently available forecasting information).

Zone Substation	Available Capacity		
	2020	2026	2036
Belmont (BEL)	30+MVA	30+MVA	30+MVA
Morley (MO)	20-25MVA	20-25MVA	20-25MVA
Hadfields (H)	25-30MVA	25-30MVA	20-25MVA
Kewdale (KDL)	30+MVA	30+MVA	30+MVA

It is assumed that Western Power has not included the anticipated load of the DA6 re-development in its forecasting. Therefore, the load required for the re-development is assumed to come out of the listed spare capacity.



## HV FEEDER CIRCUITS

The capacity of HV feeder circuits is typically in the order of 8MVA. As the HV network from the Belmont substation that supplies the DA6 site is shared with a large number of customers outside of the site, there is likely to be significant load on the network. The order of the load on the network is not known at the time of writing. Further information can be obtained on this by way of a Feasibility Study application to Western Power.

Please refer to extract of WP NCMT plans in the Appendix.

## 2.2 LIKELY ELECTRICAL LOAD

The load allocations are based on the listed types of development that are expected to be realised. For the residential component, the Western Power standard ADMD power allocation is as follows:

- for single freestanding dwellings (freehold lots) and also for small, low density or small grouped housing developments - 4.7kVA/dwelling
- for high density grouped housing developments and apartment buildings - 3.1kVA/unit

For the commercial component, the AS3000 power allocations for retail (140VA/sqm) and office space (120VA/sqm) have been applied, with the assumption that the use of space will be evenly split across the two usage types .

Based on the yield listed on in section 1 the contributions to the load are as follows:

Load Type	Moderate Growth Scenario	High Growth Scenario
Residential Dwellings	4 MVA	2.7 MVA
Residential Units (Apartments)	6.4 MVA	11.4 MVA
Commercial Space	3.7 MVA	6.5 MVA
TOTAL	14.1 MVA	20.6 MVA

Note that of the areas being redeveloped that there are existing dwellings and facilities, and so some existing load allocation to the site exists, supplied from existing infrastructure. The broad estimates of the order of the existing load are as follows:

- Residential: ~1MVA
- Commercial: ~1MVA

Therefore the total existing demand is anticipated to be in the order of 2MVA. Note that this excludes existing facilities that are anticipated to remain, such as the school. A power supply for the Redcliffe Train appears to have already been procured.

As the existing residential load will be disconnected as part of the re-development, the total increase in power demand is therefore anticipated to be in the order of 13.1–19.6MVA.

## 2.3 LIKELY POWER SUPPLY SCENARIO

### 2.3.1 ELECTRICAL NETWORK WITHIN DA6 SITE

#### INITIAL ASSET RELOCATIONS

Any entity or agency that requires that WP assets are relocated or removed, whether above ground or below ground, will be responsible for the costs for WP to do so.

The proposed construction of the Perth Airport train station, and the closure of Brearley Avenue and other road reserves, will force some significant relocations of existing Western Power assets. The main areas identified are described below.

***Train Station Area***

The relocation works associated with the train station appear to have been completed recently.

***Brearley Ave***

The closure of the remainder of the Brearley Avenue road reserve will require the relocation of the existing WP assets within that road reserve. The network predominantly consists of LV network and street lighting. The street lighting would be removed, and the LV network would need to be modified to maintain supplies and interconnectivity. The LV network removed from Brearley Ave would likely introduce the need for new LV link across the new road reserve of Road 2. This means that the availability of that road reserve would be a constraint on the closure of Brearley Ave and the associated asset relocation.

***Kanowna Ave***

There is an existing HV cable link under the Great Eastern Highway, in line with Kanowna Ave, linking the aerial network along Kanowna Ave East within the site and Kanowna Ave West, outside of the site. The land above this cable route is earmarked for development, and so the cable will be required to be re-routed along the new road reserves, likely Road 2 & Boulder Avenue, to maintain that HV link. This means that the availability of these new road reserves are a possible constraint on the development of the land in the area.

A sketch showing the existing HV network, with the key asset relocations highlighted, is included in the appendix of this report. An indicative order of costs estimate for the works is included in the cost estimate section.

**UNDERGROUND CONVERSION OF EXISTING HV & LV NETWORK**

It is likely that the existing aerial power network throughout the site will need to be converted to a new underground network. This is anticipated to be required to facilitate development in terms of the capacity of the electrical network. There may also be cause to underground the aerial network due to clashes between the poles and wires and the proposed works or for aesthetic reasons. The City may opt to complete this underground conversion in advance to facilitate the future development. The costs to do so may be included in any development contribution fund, although we understand this is not typical practice. The City would more likely opt to allow this to be completed in an incremental fashion by the ultimate developers. If the City is funding works that cause the underground conversion works, such as drainage works, or new roundabouts etc, the costs will be the responsibility of the City.

If the overhead to underground power network conversion were to occur while the existing residences are still standing and connected, the existing aerial network would need to be replaced with a new underground cable network, which closely mimics the existing network. To replace the existing pole top fuse frames and transformers, new ground mounted substations (HV switches and transformers) will be required. Power pillars will be installed to allow each premise to access the new underground power network. The connection from the premise to the power network will need to be converted to a new underground consumer cable, connecting to the new power pillar. New free standing street light poles will need to be installed to replace the existing lighting mounted to the existing power poles. This will be to the

specification of the City of Belmont and AS1158. An indicative order of costs estimate for the works is included in the cost estimate section.

## **ULTIMATE NETWORK THROUGH DEVELOPMENT AREA**

### ***HV NETWORK UPGRADES***

The HV network will also require reinforcement and extension, to provide suitable access to power for the ultimate development. Generally, it's envisaged that the City would not be responsible for this and that this would be the responsibility of the ultimate developers.

The detailed layout of the ultimate HV network will likely be determined in more detail during a further planning phase of this project, in conjunction with Western Power.

There are sections of the development area that do not have access to HV power, and the network will need to be extended to these areas, including existing roads without HV network, as well as any new road extensions. In Addition to this, there will be some significant reinforcing of the HV network throughout the site, to create HV ring networks with sufficient redundancy to provide a suitably reliable power supply to all connections.

A re-zoning process does not bring with it the need to install or upgrade WP infrastructure to provide a supply. So, the City would not be obligated to install a new underground HV network through the site. The costs to do so may be included in any development contribution fund, although we understand this is not typical practice. Developers will generally be required, for technical reasons, and through the WAPC process for creating titled lots, to provide HV infrastructure in the immediate vicinity of their development, and also outside of their site to facilitate an appropriate connection to the existing network. Western Power's "HV pool" provides refunds to Developer's, for HV materials installed for residential developments that meet certain conditions.

A broad concept of the ultimate HV network is included in the appendix of this report. An indicative order of costs estimate for the works is included in the cost estimate section, which are most likely to be shared across all of the eventual developer's. This includes a broad estimate on the number and type of transformer substations that will be required to supply the load at the buildings.

### ***EXTERNAL HV SUBSTATION LOCATIONS***

HV Switchgear substations that are required for the backbone HV network (district substations) will be installed outside, in the advance of any buildings, and will be located strategically throughout the development. District transformer substations that supply multiple smaller buildings, streetlights and other general services will also be located outside, in advance of the buildings. Dedicated (sole-use) substations that feed larger buildings may be located within the building, and would then only be installed once the building is nearing completion.

The preference for locating new external ground mounted substations would be on Public Open Space (POS) lots to avoid affecting an existing private property. This cannot always be achieved as POS space may not be available, or due to the location of the substation needing to meet particular technical requirements.

It is recommended that a HV concept plan, which aims to plan the locations of these units in conjunction with all relevant parties, is completed as part of further planning for the re-development of this site.

District substations are required to be setback behind property lines, in a road reserve extension in to that lot. Typical land requirements for HV substations are as follows (the units are approximately 1.6m – 1.8m tall):

- HV Switchgear and transformer 6.2m (W) x 4m (D)
- Transformer only 3.7m (W) x 4m (D)
- Switchgear only 4.5m (W) x 3m (D)

## **LIGHTING FOR NEW ROADWAYS OR UPGRADES TO ROADS**

All newly created or upgraded roadways (including roundabouts) will require new lighting to satisfy the specification of the City of Belmont and AS1158.

The lighting could consist of standard or decorative Western Power lighting poles, or if the Local Government preferred, “privately” (Local Government) owned lighting, where any range of suitable lighting products could be utilised, opening up the opportunity to use broader technologies and strategies, including:

- Architectural lighting poles and luminaires.
- High efficiency and low glare LED luminaires.
- Multi-technology poles, including banner mounts, CCTV cameras and power outlets.
- Time based, light level and motion detection controlled lighting operation and output levels
- Incorporating other Internet of Things (IoT) type technologies.

## **2.3.2 HEADWORKS REQUIRED TO SUPPLY ESTIMATED LOAD INCREASE**

### **ZONE SUBSTATION CAPACITY**

According to the WP NCMT, the Zone substations listed above have spare sufficient capacity to service the estimated load of the development. Therefore no works are envisaged to augment the capacity at any Zone substations to service the development.

### **HV FEEDER NETWORK**

WP typically limits the load on their HV networks to 8MVA. As the load on the existing HV network that feeds the site is not known, it is unknown how much of the additional load can be placed on to the existing network. With an estimated load increase in the order of 13.1–19.6MVA, it is most likely that up to two new dedicated external HV feeders will be required. The feeders will most likely emanate from the Belmont (BEL) and/or Hadfields (H) Zone Substations and each would terminate at a HV switchgear unit within the DA6 site, although this is subject to advice from WP. The length of the cable route of a feeder from the Belmont substation is estimated to be in the order of 3.5kms, while the cable route from the Hadfields substation is estimated to be in the order of 4kms. This is diagrammatically shown in a sketch in the appendix of this report. The cable routes are to be determined during a detailed design phase, most likely by Western Power. Where two HV feeder cable circuits emanate from one zone substation, they will be required to utilise differing routes, to reduce the risk that both are damaged by a single event.

Further clarification on the load on the existing network, can be obtained from Western Power through a WP feasibility study.

## **RESPONSIBILITY FOR COSTS TO AUGMENT WP HV FEEDER NETWORK**

It is our understanding, that under current WP policy that additional load requests below 1.5MVA are treated as underline (or natural) load growth. Under this policy, WP will augment the network at its own cost to support natural load growth.

With the ultimate build out potentially being beyond 2031, and assuming the first load increase occurs in 2016, there is a minimum of 15 years over which the load growth will occur.

WP charge for network augmentation to provide capacity on a per-application basis. The City of Belmont's involvement in the load increase, as we understand, will be limited to re-zoning of the subject land to allow for others to complete the actual development of living units or commercial floor space. So, the City will not necessarily be the applicant who WP seek to charge for the augmentation costs.

There are three likely scenarios. The first scenario is, if development occurs by a number of independent developers, each with load below 1.5MVA, over the 15 years or more, then it's likely that Western Power would cover the network augmentation costs as mentioned above.

The second possible scenario is, if a single developer chose to complete a single significantly large development, or multiple medium sized developments a short time apart, then WP may nominate that developer as the responsible party for the augmentation costs. The parameters for a developer becoming the responsible party, we understand, would be a load of 1.5MVA, in a period of 1 – 2 years.

The third possible scenario is if two or more independent developers are completing medium sized developments within a short time of each other, such that they also exceed the 1.5MVA parameter within 1 – 2 years in combination, then WP may advise all the current developers that they will need to contribute to the HV network augmentation works, on a cost sharing basis. WP refers to this as a Competing Access Group (CAG).

The City might view the second and third scenarios as undesirable, if these costs restrict development. As such, the City may then choose to fund the augmentation works as to allow continued development in the area, without the burden of the costs for the HV upgrade works. The costs for this may be recovered through a development contribution fund, although we understand this is not typical practice.

## **RESERVED CAPACITY IN NEW NETWORK**

It should be noted that WP do not reserve the spare capacity of any new network for the party that funded the works. Once the new network is installed to provide the load of the current application(s), it is then just seen as part of the broader network, available for anyone who applies to access. This should not have an impact for this project, as the route of the dedicated HV feeder cable is most likely contained within the City of Belmont, through already built up residential areas.

## **2.4 POWER WORKS TIMELINES**

The timelines for Western Power design and construction works depend on the complexity. Design and approval timeframes can vary from 1 to 6 months. Construction works would be at least 10 weeks but could be many months for large and complex projects.

## **2.5 ELECTRICAL SERVICES COST ESTIMATES**

### 2.5.1 COST ESTIMATES

Our very early order of probable cost estimates for power networks to service the development, separated in to phases or components, is as follows:

Component	Cost
<b>INITIAL ASSET RELOCATIONS</b>	
Brearley Ave	\$250k
Kanowna Ave	\$250k
<b>TOTAL</b>	<b>\$0.5M</b>
<b>UNDERGROUND CONVERSION OF EXISTING HV &amp; LV NETWORK</b>	
	<b>\$5.5M</b>
<b>ULTIMATE NETWORK THROUGH DEVELOPMENT AREA</b>	
	<b>\$6.5 - 8.0M</b>
<b>HV FEEDER NETWORK</b>	
	<b>\$6.5M</b>
<b>GRAND TOTAL OPC</b>	
	<b>\$19 – 20.5M</b>

### 2.5.2 QUALIFICATIONS AND EXCLUSIONS

We confirm that the budgets presented are indicative only. If the reader intends to use these costs for financial purposes they should be satisfied that they are adequate. 3E Consulting Engineers does not accept liability or responsibility for their interpretation or use.

All cost in today's dollars, all design costs and GST excluded.

With respects to the power headworks implications for the site, we have allowed for estimating the headworks implications based on the information available and we would have to qualify our estimates on this basis. More certainty with respect to Western Power capacity, implications and costs could readily be determined by the application to and provision of a Design Information Package or Feasibility Study from WP.



## SECTION 3 COMMUNICATION SERVICES

### 3.1 EXISTING NETWORK

#### 3.1.1 AIRPORT WEST TRAIN STATION AND BREARLEY AVE

Although some current versions of DBYD do not show communications networks relocated, we understand that affected networks have been relocated, in the vicinity of the proposed new Airport West train station and in on case along Brearley Ave, as follows:

- Telstra network in the vicinity of the new Airport West Train Station has been rerouted via the western side of Central Ave Central Ave, then via the northern side of Dunreath Dr and reconnects to Brearley Ave, east of the Dunreath Ave roundabout – see DBYD attached. However, the balance of Telstra’s network remains on Brearley Ave from Great Eastern Hwy to Central Ave and would need to be relocated where affected.
- The NBN Co network on Brearley Ave didn’t conflict with of the new Airport West Train Station but NBN Co now use the northern side of Dunreath Dr route to access the Domestic Terminal. A small portion of NBN Co network remains on Brearley Ave that may need to be relocated.
- The Optus network on Great Eastern Hwy accesses the Domestic Terminal via Fauntleroy Ave and was unaffected by the new Airport West Train Station but the crossing at the entrance of Brierley Ave may need relocation
- The Vocus route on the eastern end of Brearley Ave has been rerouted via Coolgardie Ave to avoid the new Airport West Train Station, linking up with the existing Brearley Ave route east of the Dunreath Dr roundabout.
- WP Comms optical fibre has been rerouted to avoid the new Airport West Train Station such that it crosses routes via the eastern side of Central Ave, extending via the northern side of Dunreath Dr to connect up with the existing Brearely Ave route east of the Dunreath roundabout – see latest DBDY. However the remainder of the route on Brearley Ave, form Boulder Ave to Central Ave may need to be relocated
- The Nextgen network resides within the WP duct and fibre network and thus the WP relocation above applies, with the Nextgen DBYD plan continuing to be out of date.

See DBYD attached for all carriers attached.

#### 3.1.2 REMAINDER OF DA6

The original report was based on possible levels being raised on the northern part of the communications networks and Boulder Ave would continue to affect a number of networks:

- As expected, Telstra pit and pipe is located on all streets within all stages and would only be affected if road reserve alignments changed at all or levels were reducing minimally or increased substantial. Road crossing would be particularly sensitive to level changes and thus we recommend against reducing existing levels. Telstra would have retained ownership of its Main and Branch copper and optical fibre network, after the NBN Co Brownfields Rollout

- NBN Co's lease Telstra's pit and pipe network throughout the development and have now taken ownership of Telstra's old distribution copper cable network, which could be affected in a similar fashion as indicated above for the Telstra pit and pipe network
- The Optus network on Great Eastern Hwy would only be affected by the proposed development, if road reserve alignments changed at all or levels were reducing minimally or increased substantial
- The Vocus network on First St and Coolgardie Ave would only be affected by the proposed development, if road reserve alignments changed at all or levels were reducing minimally or increased substantial
- The WP Network on Boulder Ave, Brearley Ave, Central Ave and Dunreath Dr would only be affected by the proposed development, if road reserve alignments changed at all or levels were reducing minimally or increased substantial
- The impact on the Nextgen network would be the same as for WP

Road reserve changes and level changes would need to be known before a more accurate estimate of impact could be given, therefore cost estimates are approximate.

### 3.1.3 EXISTING NETWORK CAPACITY

The most significant communication assets in DA6 route down part of Brearley Av and cross Brearley Ave, at the intersection of Great Eastern Hwy - as listed below:

#### CROSSING BREARLEY AVE, ON GREAT EASTERN HWY

Telstra	Optus	NBN Co
7xP100 + 1x P80	Assume leasing	Assume leasing
1000 PIUT	Telstra ducts	Telstra duct
600 PIUT	Assume 144 SMOF	Assume 288 SMOF
312 SMOF		
144 SMOF		
72 SMOF		
72 SMOF		
72 SMOF		
12 SMOF		
100/0.64 PIUT		
100/0.64 PIUT		
1200/0.64 PIUT		
2xP35 subducts		

**ON BREARLEY AVE**

<b>Telstra</b>	<b>Vocus</b>	<b>Nextgen</b>	<b>Western Power</b>
2x A100 or 2xP100 300/0.64 300/0.64 300/0.64 120 SMOF 60 SMOF 6 SMOF 2xP35 subducts	Assume 1xP100 Assume 48 SMOF	(leasing WP duct) 12 SMOF in WP cable	P80 Assume 144 SMOF

NBN Co would now currently service DA6 from Telstra's Ascot Exchange on Hardy Rd, ranging from 2 -> 3.5 Km to the west or direct to the Bassendean Exchange. NBN Co distribution network radiates out from two pillars (P23 and P13), located on Great Eastern Hwy but would now be connected to the relevant NBN Co FTTN Nodes, so works internal to DA6, apart from Brearley Av, would only affect the extremities of the NBN Co's network, minimising the cost impact.

Telstra assets on Great Eastern Hwy are extensive and are located on both the north and south sides of the road. Telstra pipe and NBN cable capacity on internal streets of DA6 would have limited potential to support growth and in one instance cable is direct buried. Most of Telstra distribution cable assets would have ownership transferred to NBN Co under the Brownfields Rollout and so the major impact of any relocations within DA6 would be to NBN Cos assets. Telstra has a programme to recover its Main and Branch cables once they are no longer in use but the status of services on these cables on Great Eastern Hwy is not known.

NBN Co would by now have and most likely hauled SMOF to its nearest Fibre Access Node (FAN) – possibly at the Bassendean Telstra exchange. Inter-FAN and inter-POI SMOF may also be present on the Great Eastern Hwy route. NBN Co's DBYD record is silent on such assets.

### **3.2 RELOCATION OF ASSETS**

Although we understand that relocations adjacent to the Airport West Train Station have already taken place, due to the commencement of construction of the new station, we are not certain of the status of assets on the remainder of Brearley Ave. Carriers networks on other portions of Brearley Ave could be retained, until super lots encroaching on them forced relocation, but it would be much more efficient to relocate all assets out of Brearley Ave and any other road affected by the development proposal, in the short term, to permit orderly development. To do otherwise, would result in multiple prohibitive relocation costs.

Telstra, NBN Co and WP now charge for relocation quotes to be prepared. The option of relocating on Brearley Ave, is no longer practical, given the proposed footprint of the high rise buildings and storm water control. Relocation estimates below have been revised on the basis of more current information.

It is now clear that all remaining communications assets on Brearley Ave will require relocation. Since that the communications assets affected by the construction of the Airport West Train Station have occurred, it just remains to relocate residual assets on Brearley Ave. To avoid repeat relocations, we recommend shifting all assets off Brearley Ave and on to future or existing road reserves that are being retained in the long term – see Communications Relocations Plan attached. Whilst Telstra most would most likely prefer to route the west to Brearley Ave, to minimise attenuation for its remaining copper based point to point services, that is probably not possible, given the proposed road layout. Therefore, relocating down Central Ave, then back along Great Eastern Hwy to the west may be the only viable option. We estimate relocation costs to be of the following order or magnitude but actual quotes would need to be sought from individual carriers:

<b>Brearley Av Comms Network</b>		
<b>Affected Network</b>	<b>Proposed relocation</b>	<b>Relocation Cost (\$K)</b>
<b>Telstra</b>		
Crossing Brearley Av at Great Eastern Hwy	Straighten route to avoid truncations	2,300
On Brearley Ave, west of Airport West Train Station	Reroute via Central Ave to Great Eastern Hwy	1,000
<b>Vocus</b>		
Across Brearley Ave between Central Ave and First St	All network moved off Brearley Ave and only a crossing now	0
<b>Nextgen</b>		
On Brearley Ave, west of Airport West Train Station	Reroute via Central Ave to Great Eastern Hwy	Under WP relocation
<b>Optus</b>		
Crossing Brearley Av at Great Eastern Hwy	Straighten route to avoid truncations	50
<b>Western Power</b>		
On Brearley Ave, west of Airport West Train Station	Reroute via Central Ave to Great Eastern Hwy	80
<b>NBN Co</b>		
Possible inter-network route Crossing Brearley Av at Great Eastern Hwy West Train Station	Straighten route to avoid truncations Eastern Hwy	200
<b>SubTotal</b>		<b>3,710</b>
<b>Network within DA6, other than on Brearley Av</b>		<b>Cost \$K</b>
<b>Proposed road extension works, for the establishment of super lots</b>		

<b>Telstra</b>	
Raising of network associated with storm water control	80
<b>NBN Co</b>	
Raising of network associated with storm water control	120
<b>Domestic Airport</b>	
Decommissioning of Terminal and Equipment Recovery	300
<b>SubTotal</b>	<b>500</b>

### General Notes and Assumptions regarding Relocations

- Telstra will replace network like for like – including both duct and subduct, regardless of whether or not the old network was built to current standards. Note that fibre will require replacing from Fibre Access Point (FAP) to nearest FAP, therefore the replacement may extend beyond the development boundary. New fibre enclosures will generally not be introduced as that will detrimentally affect the available optical power budget, the transmission design capability on the route or compromise the transmission capacity of existing systems. Also copper cable would normally be run from existing joint to existing joint
- Telstra and other carriers will only quote for the impact of relocations on existing assets. Cables hauled or ducts installed, subsequent to this report, would be the subject of additional relocation costs
- No major level changes within DA6, apart from on First St and Bulong Av, that affect communications assets on Brearley Av or elsewhere
- Great Eastern Hwy upgrades excluded from analysis
- All assets on old Brearley Av being relocated, except for those on existing or proposed roads reserves that cross Brearley Ave
- Common trenches not provided by Developer and allowance for individual trenching for each carrier on the basis that all alignments are unknown at this point in time
- Existing asset alignments will be required to properly assess the need and cost of relocation
- The presence of asbestos conduits or pits on this route may impact the cost of Telstra's relocation
- Carriers and utilities relocation costs are generally non-negotiable
- No allowance made for cutover to Consolidated Terminal or provision of comms to Consolidated Terminal
- All costs exclude GST

### 3.3 PROPOSED NBN COMMUNICATIONS

### 3.3.1 Yield for Communications

The table below represents the revised moderate and high growth scenarios. The scope of this redevelopment is understood to comprise 37 high rise buildings, with a potential communications yield as follows:

#### Moderate Growth

Residential - Single/Grouped Dwellings	Residential - Apartments (Built Strata)	Commercial (Built Strata) 120m <sup>2</sup> /premise	Lift and Fire Services	Total Services
853	2,077	237	84	3,251

#### High Growth

Residential - Single/Grouped Dwellings	Residential - Apartments (Built Strata)	Commercial (Built Strata) 120m <sup>2</sup> /premise	Lift and Fire Services	Total Services
573	3,682	414	84	4,753

This report assumes that proposed residential growth scenario yields are approved in the Development Application. Commercial yields have been based on 120m<sup>2</sup> per unit.

### 3.3.2 Telecommunications Policy, Technology, Charging and Costs

The existing services within DA6 have been converted to Fibre to the Node (FTTN) under NBN Co's Brownfields Rollout.

#### Recent or proposed changes to Telecommunications Policy and Legislation

In September 2020 the Federal Government revised its *Telecommunications in New Developments* policy (TIND). Most significantly the charging regime from the previous policy is unchanged, except that NBN Co can offer infrastructure at lower prices, than previously, with prices now capped at the previous levels. Furthermore, the policy has changed such that NBN Co is now the Statutory Infrastructure Provider (SIP) ie the default provider and is obliged to provide infrastructure within the NBN Co Fixed Line Footprint, if engaged by Developers. If an alternative Developer is engaged, then they would become the SIP for the development. The Telecommunications Act 1997 was amended in July 2020, to reflect NBN Co's status.



The Federal Department of Infrastructure, Transport, Regional Development and Communications is proposing to amend the Telecommunications Act 1997, such that all Developers, regardless of whether or not they are a Constitutional Corporation, are required to provide Fibre Ready pit and pipe, in new developments, within the Fixed Line Footprint. Such a legislative change probably won't affect this development, unless small Mum and Dad investors are involved in redeveloping their lots.

The WAPC has released a proposed policy to make the provision of telecommunications infrastructure a condition of subdivision. It is expected that the policy will be eventually introduced in WA and when that occurs Developers will be under the additional obligation. Given that fibre/cable is delivered some 5 months after PC, it is expected that bonds will need to be lodged, in order to obtain subdivision clearance, until such time as the NBN Co wholesale network is ready for service.

Developers still have two responsibilities in relation to telecommunications:

- To provide fibre ready pit and pipe
- To provide telecommunications infrastructure to all premises

### **Proposed Staging and the impact of Telecommunications Development**

NBN Co's primary network access is understood to be located on Great Eastern Hwy, which may connect the DA6 area to the Telstra Ascot Exchange on Hardy Rd and then on to a to its Fibre Access Node (FAN) located FAN at Bassendean Exchange or direct to the FAN via Great Eastern Hwy and Guildford Rd. NBN Co's Backhaul charge would have been assessed based on it's spare capacity to Ascot Exchange and the higher yield under previous proposal. The reduction in yield and the completion of the Brownfields Rollout to Redcliffe would possibly reduce the Backhaul Charge but that could only be determined by another Feasibility Assessment. We would recommend that an application be lodged with NBN Co to reassess the feasibility, given the substantial change in NBN Co's network in the meantime and the reduced yield.

It is likely that NBN Co would deliver Fibre to the Premises (FTTP) technology to the proposed development.

### **Costs**

Deployment Charges used in the review of costs have been based on standard policy rates but there may be a possibility to negotiate more attractive rates and we recommend that a proposal be put to NBN Co seeking a more attractive rate. Such proposals are required to be gated by Senior Management within NBN Co but we wouldn't see this as an insurmountable obstacle, given that Federal government have published the possibility in the latest TIND policy.

NBN Co recover two infrastructure charges, Deployment and Backhaul Charges, from Developers. Single residential lot attract a Deployment Charge of \$600/lot and strata lots,

\$400/multi dwelling unit. Backhaul Charges would most likely be calculated to the nearest Fibre Access Node, which we understand is located at Bassendean Exchange. Total costs over the life of the project would be:

<b>NBN Co Charges</b>	<b>Moderate Growth</b>		<b>High Growth</b>	
	<b>Premises</b>	<b>Deployment Charge (\$)</b>	<b>Premises</b>	<b>Deployment Charge (\$)</b>
Residential - Single/Grouped Dwellings	853	511,800	<b>573</b>	343,800
Residential - Apartments (Built Strata)	2077	830,800	3,682	1,472,800
Commercial - Built Strata	237	94,900	414	165,473
Lift & Fire Services	84	33,600	84	33,600
Backhaul		69		69
<b>Total</b>	<b>3,251</b>	<b>1,471,169</b>	<b>4,753</b>	<b>2,015,742</b>

The Backhaul Charge would be recovered from the Developer of the super lots and the Deployment Charges from the Developers of the built form. These charges would be recovered from individual Developers. Under the Brownfields Rollout and the Definitive Agreements, Telstra must disconnect all existing telephony and broadband services on its copper network, once an area is declared NBN fibre ready. Following Brownfields conversion, Telstra is unable to use the existing copper network for telephony and broadband, for 20 years, except where the NBN network is unavailable. The copper network can be utilised for point to point services. Telstra must utilise the NBN wholesale network for telephony and broadband, for the next 20 years.

NBN Co no longer install Fibre Distribution Hubs (FDH), since they have adopted a more economical skinny fibre architecture, which relies on optical splitters being installed in underground joint enclosures. FDH's were generally the only above ground device to be installed within Greenfields developments and were usually installed on road verge. It is likely that the 37 high rise buildings will be serviced with Premises Distribution Hubs (PDH's). PDH's are installed internal to buildings and would require a communications room or equivalent. The PDH does not require 240V AC power, since it forms part of the passive optical fibre network. Several of the larger buildings will require multiple PDH's.

All Retail Service Providers can provide telephony and broadband on the NBN Co wholesale FTTN or FTTP network. Note that Telstra have the First Right of Refusal to provide point to point fibre, under the Definitive Agreement with NBN Co. Telstra exercise their right, where commercially attractive.

NBN Co support Third Party design and construction of pit and pipe and the costs below specify expected pit and pipe construction for the servicing of the super lots:

	<b>Moderate Growth</b>	<b>High Growth</b>
<b>NBN Pit and Pipe Construction</b>	<b>\$K</b>	<b>\$K</b>

<b>Grand Total</b>	<b>450</b>	<b>500</b>
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**Assumptions & Exclusions:**

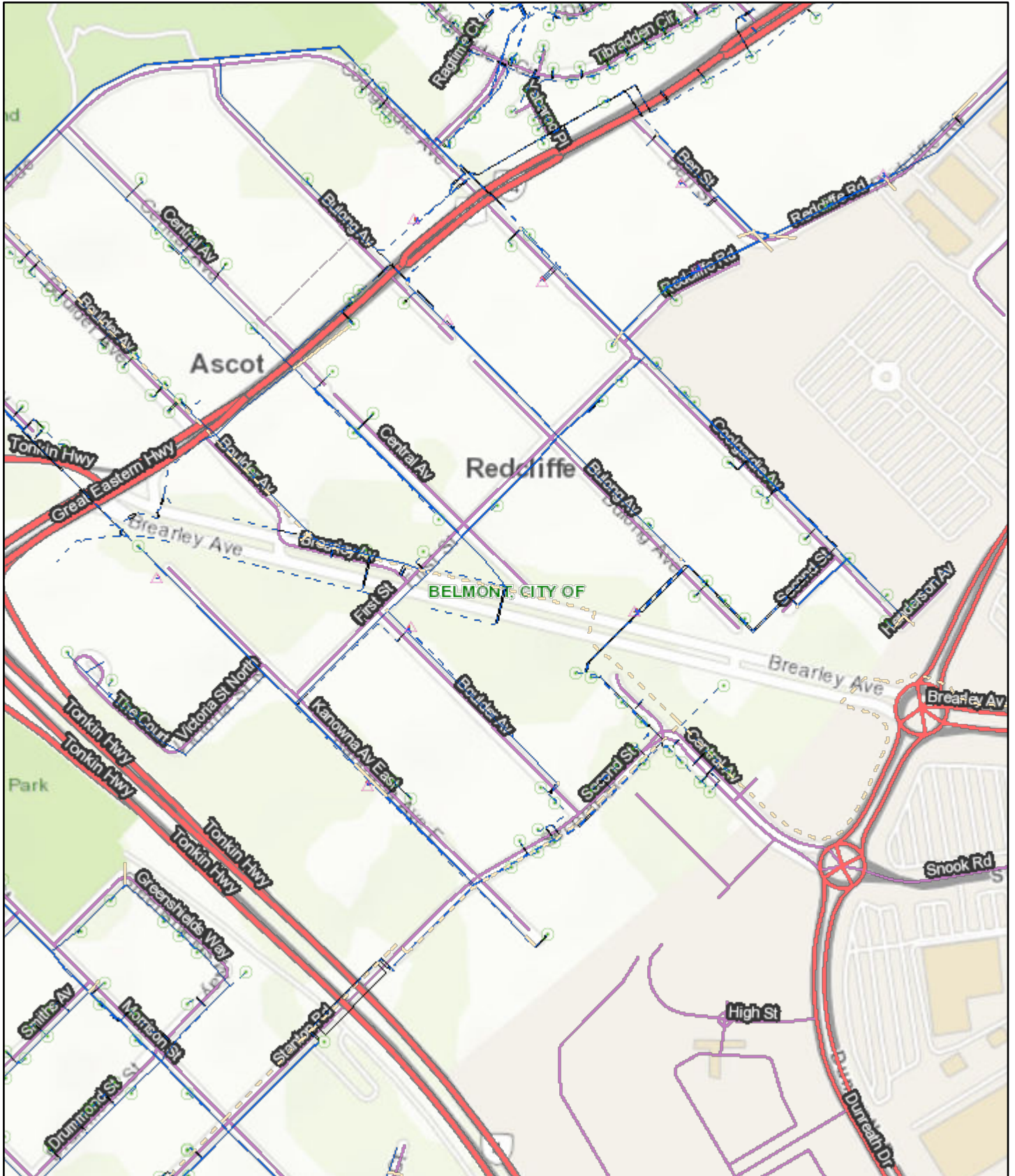
- All cost in today's dollars, all design costs and GST excluded, except for NBN Co charges which include GST.
- New NBN pit and pipe network installed throughout and network not leased off Telstra
- An open trench is available for installation of pit and pipe
- New NBN network for the redevelopment would normally be installed on the 0.9m alignment
- Costs of servicing, internal to the built form have been excluded
- Backhaul Charge estimated by NBN Co

### **3.4 SUMMARY OF COMMUNICATIONS COSTS**






<b>Summary</b>	<b>Moderate Growth (\$K)</b>	<b>High Growth (\$K)</b>
<b>Brearley Ave Relocations</b>	<b>3,710</b>	<b>3,710</b>
<b>Other DA6 Relocations</b>	<b>500</b>	<b>500</b>
<b>Pit and Pipe Construction</b>	<b>450</b>	<b>500</b>
<b>NBN Backhaul Charge</b>	<b>69</b>	<b>69</b>
<b>NBN Deployment Charges</b>	<b>1,471</b>	<b>2,016</b>
<b>Grand Total</b>	<b>6,200</b>	<b>6,795</b>

## **APPENDIX 1 – ELECTRICAL**

## Redcliffe WP HV



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-  Substations/Terminals/Power Stations (WP-046)
-  State Underground Power Program Project Areas (WP-042)
-  Restriction Zone (WP-044)
-  Electrical Enclosures (WP-040)
-  Underground Structures (WP-037)

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community, LANDGATE/SLIP, SLIP/Landgate

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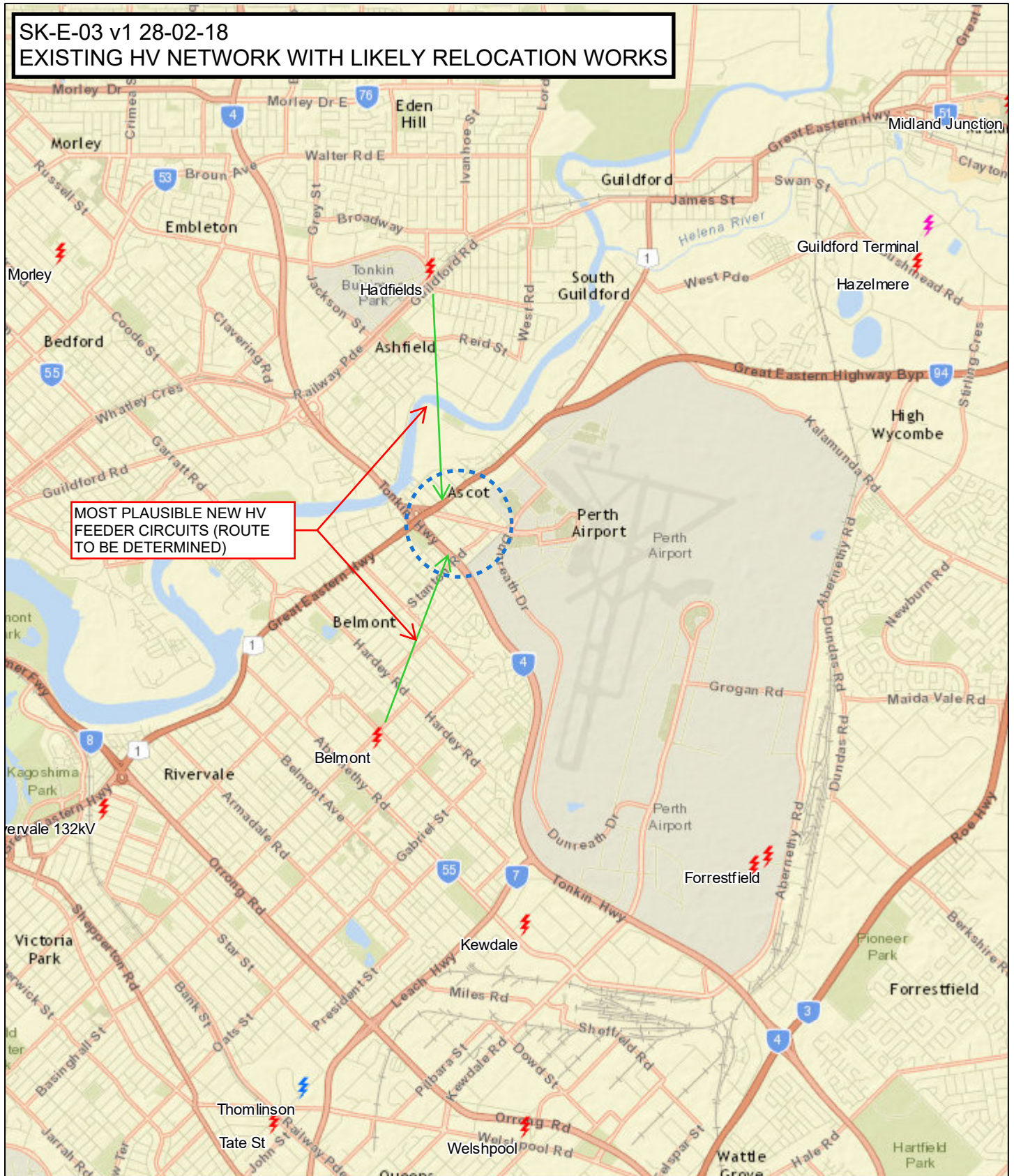
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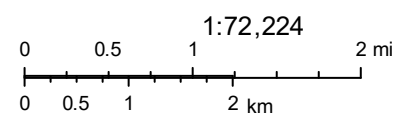
# NCMT - Zone Substations



2/28/2018, 12:27:20 PM

Existing Substations/Terminals/Power Stations and APR info : WP-007

-  Existing Western Power Substation
-  Current Non Western Power Substation
-  Current Western Power Terminal/Power Station



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

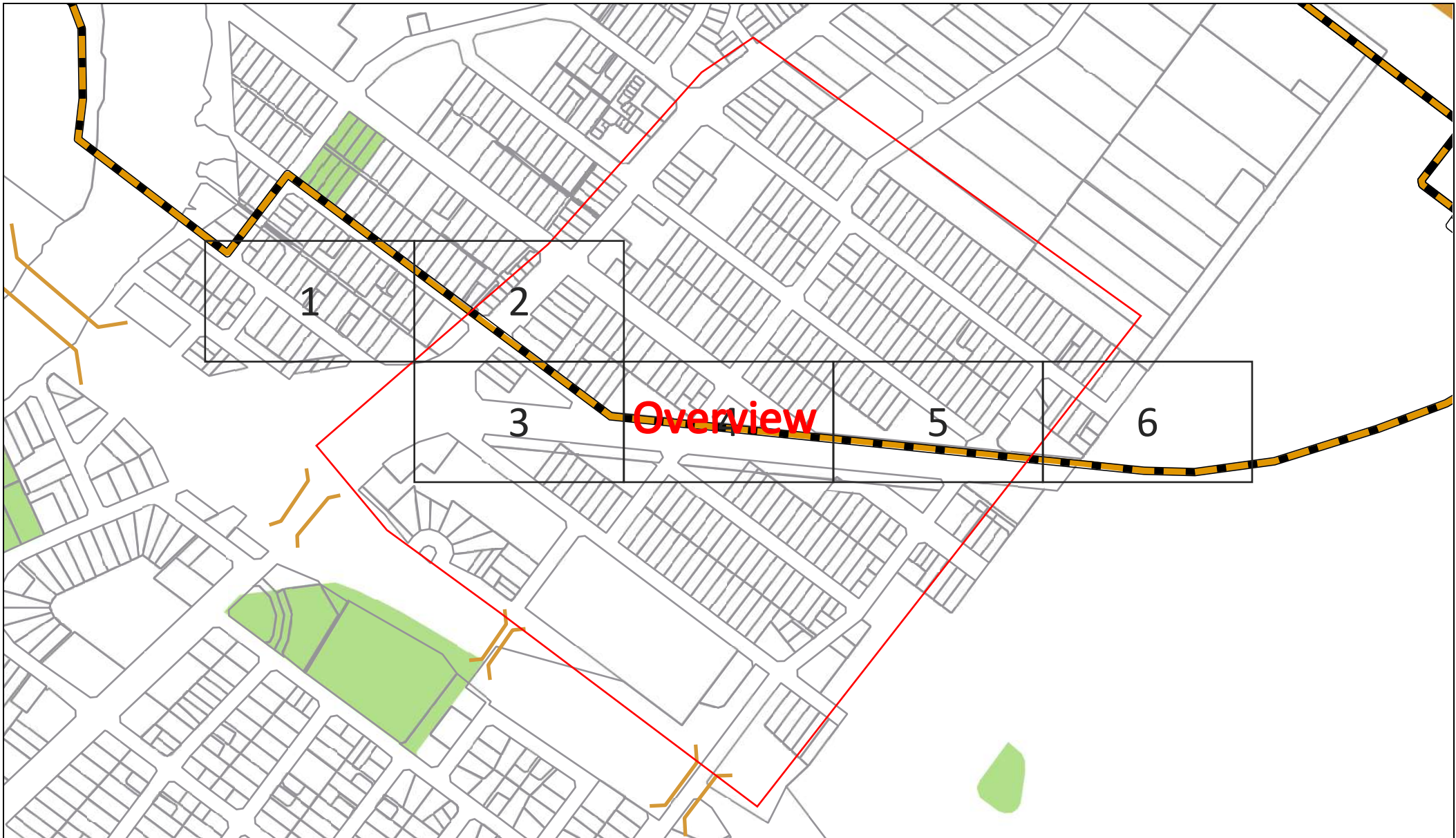
## **APPENDIX 2 – COMMUNICATIONS**











Sequence Number: 104329650

Date: 26/11/2020

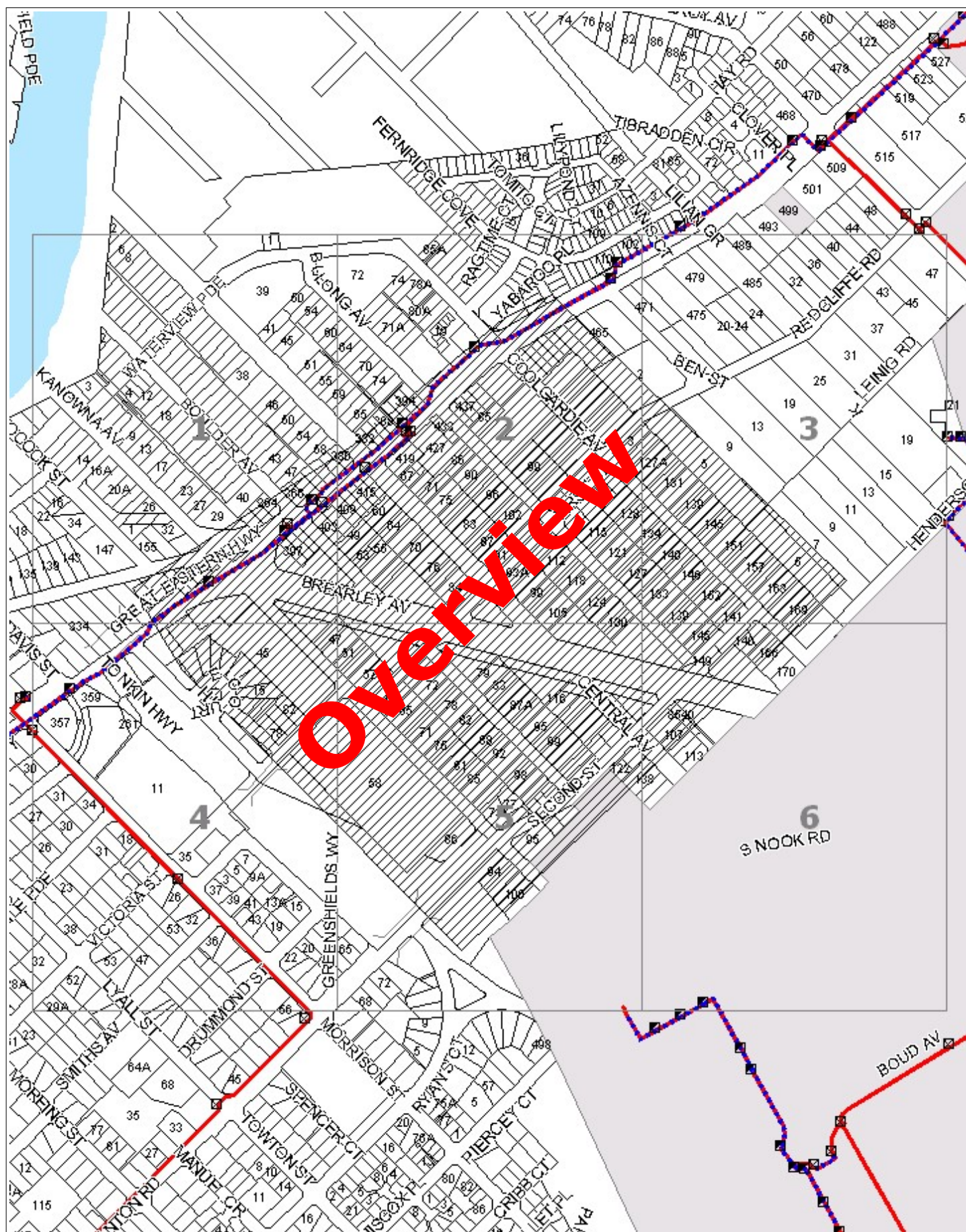
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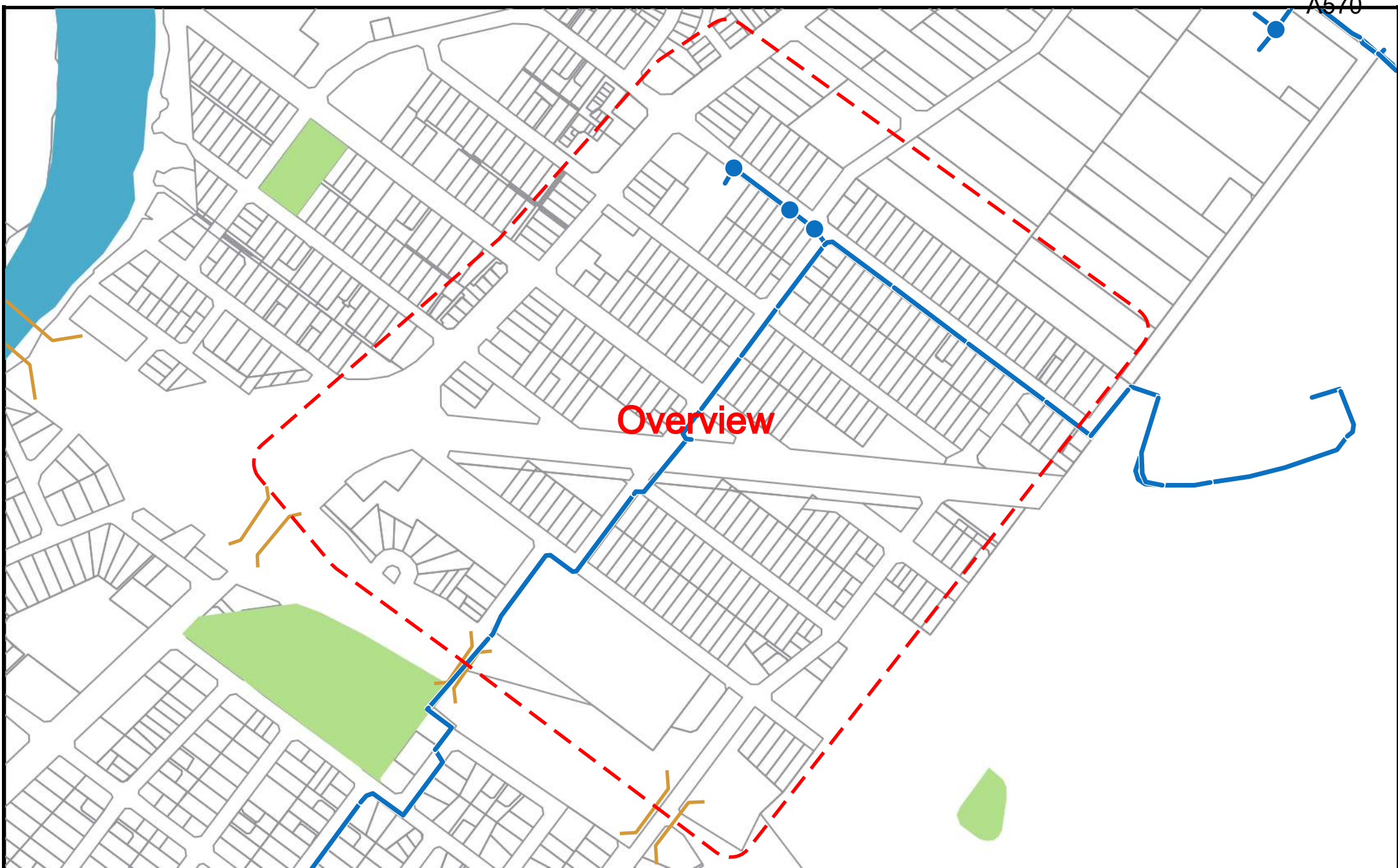
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Vocus Group Pit



Vocus Group Conduit

SCALE: 1:6267







