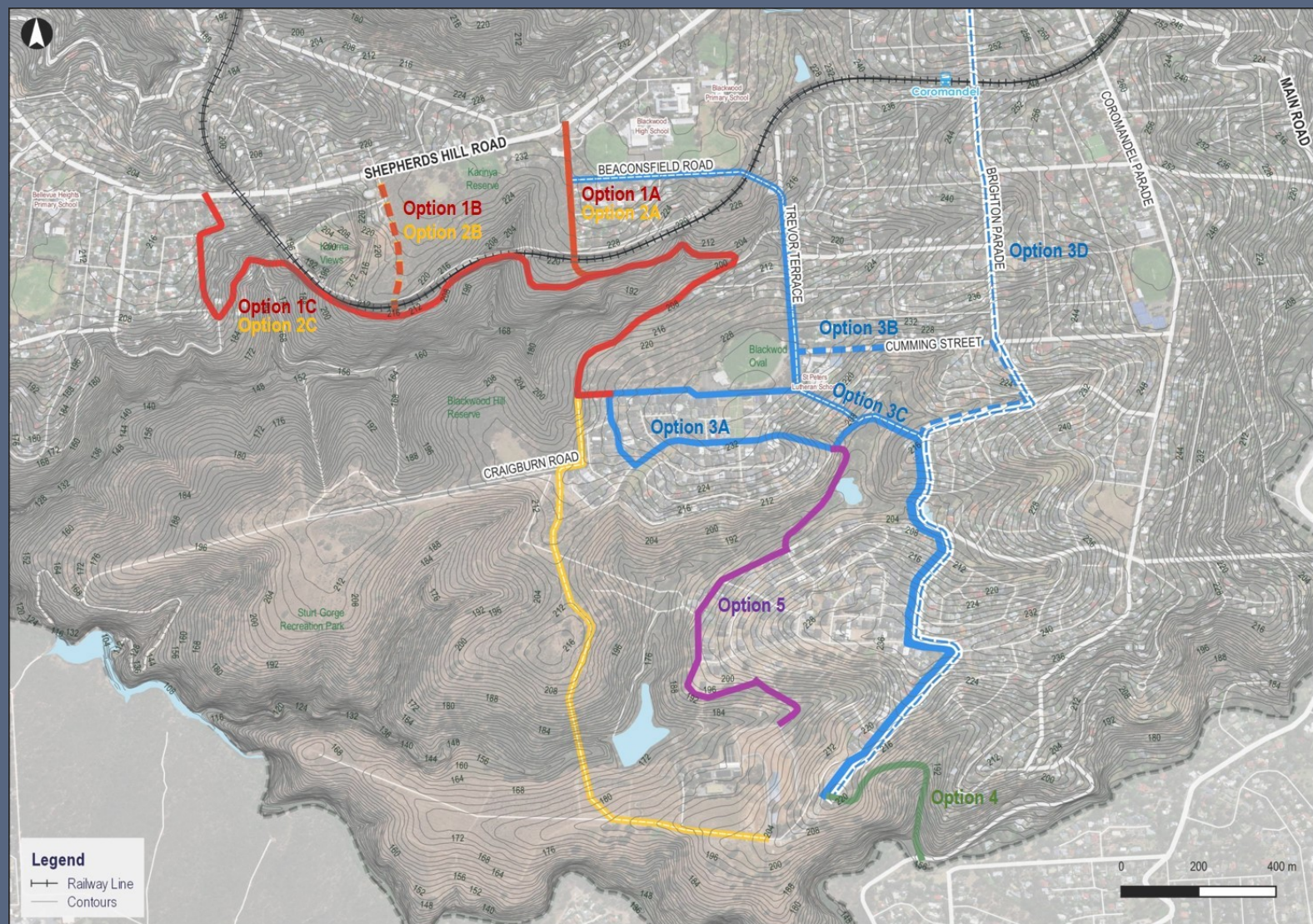


# Craigburn Farm Western Bypass Feasibility Study

Final Report

Western Bypass Road Options and Strategic Merit Test



Prepared by: GTA Consultants (SA) Pty Ltd for City of Mitcham and the Department of Planning, Transport and Infrastructure

on 12/07/19

Reference: S170360

Issue #: A

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### Quality Record

| Issue | Date     | Description | Prepared By           | Checked By  | Approved By | Signed                                                                                |
|-------|----------|-------------|-----------------------|-------------|-------------|---------------------------------------------------------------------------------------|
| A     | 12/07/19 | Final       | John Devney<br>Joy Yu | David Kwong | David Kwong |  |

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# EXECUTIVE SUMMARY

## Study Purpose and Objectives

The main purpose of this study was to assess the feasibility of a western bypass or link road connection for bushfire safety and traffic movement reasons using an evaluation framework developed using the Australian Transport Assessment and Planning (ATAP) Framework guidelines.

The key objective for a bypass or link road of Craighburn Farm is to provide safe egress for a mass evacuation of residents due to a bushfire event. In addition, the study investigated if major strategic routes or upgrades to existing road networks are sufficient to resolve the issues of bushfire risk and traffic congestion. The strategic objectives for the assessment of the high-order feasibility of the alignment options were to:

- Provide Craighburn Farm residents with safe egress to mitigate bushfire risks;
- Maximise improvement for local access and amenity for walking and cycling in the bush land;
- Maximise travel time benefits for Craighburn Farm residents to access Shepherds Hill Road;
- Minimise cost to Government (City of Mitcham, DPTI and Infrastructure Australia in the Australian Federal Government);
- Minimise impact on local streets in Craighburn Farm with through traffic; and
- Minimise environmental and heritage impacts of a new roadway.

## Constraints and Opportunities

The constraints and challenges for a western bypass or link road include:

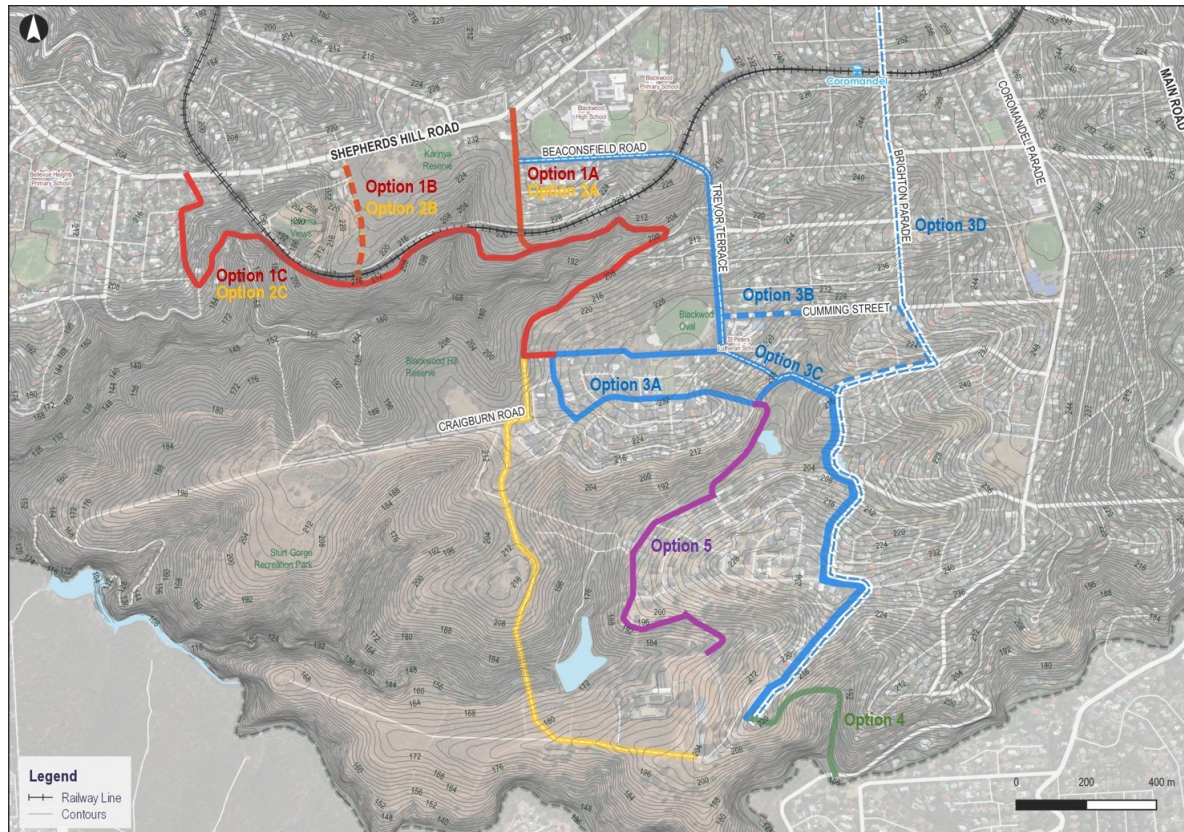
- Topography and water features restricting the geometric road requirements, including gradient and curvature;
- Bushfire risk and hazard areas, including parks, bushland, schools, residential estates and businesses;
- Geological issues and seismology with the location of previous earthquake activity and fault lines;
- Soil types that would limit or impact the road constructability and capital cost;
- Special reserves and parks for recreational purposes, including walking trails and mountain bike tracks;
- Heritage features, including European and indigenous built and cultural heritage areas; and
- Environmental protection requirements for special flora or fauna in the Blackwood Hill Reserve, Sturt Gorge Recreation Park or any other bushland or protected sites in the Craighburn Farm study area.

Opportunities for the bypass or link roads with connections from or within Craighburn Farm were also identified to provide a strategic transport route between Shepherds Hill Road and Murrays Hill Road west of the residential areas in Craighburn Farm so that through north-south traffic could avoid using Coromandel Parade and the Blackwood roundabout.

## Recommendations

A total of 12 alignment options were developed by considering the key study objectives and the physical, environmental and social constraints in and around the Craighburn Farm residential suburb. They are shown in Figure E.1.

**Figure E.1: Craighburn Farm Bypass Road Alignment Options**



A Strategic Merit Test was developed with the following ten assessment criteria to determine a short-list of alignment options in order of priority.

- Bushfire Emergency Egress
- Accessibility Improvements
- Impacts to Craighburn Farm Residents
- Impacts on Property and Trails
- Fire Risk to Human Life and Property
- Impacts on Bushland, Flora and Fauna
- Traffic Relief on Arterial Roads
- Road Infrastructure Costs
- Impacts during Construction
- Road Design Complexity and Constructability

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Options 1A, 1B, 1C and 2A, 2B and 2C were assessed to be not viable as a bypass road or bushfire emergency egress route of Craighburn Farm because they have:

- Significant capital costs to build and maintain it as a public roadway with the necessary bridges over the gullies, gorge and railway line and the length of new road infrastructure;
- Major social impacts on the bush trails for bush walkers and cyclists in the Blackwood Hill Reserve and the Sturt Gorge Recreation Park;
- Significant environmental impacts to the bushland, flora and fauna, in particular through the Bush for Life areas and in the Blackwood Hill Reserve and the Sturt Gorge Recreation Park;
- Impacts from additional traffic through the local streets of Craighburn Farm generating noise to residents; and
- Complex road designs and difficult road infrastructure to build.

The benefits for the residents in Craighburn Farm are generally low with:

- Limited reduction in safety risks as an emergency egress route and reduce fire risk to human life and property during a catastrophic fire event;
- Marginal or no improvement to accessibility for pedestrians, cyclists and to access public transport; and
- Limited traffic relief on the arterial roads with the low-density residential development in Craighburn Farm that can be accommodated mostly on the existing road network.

The bypass alignments for Option 2 (2A, 2B, 2C) are not likely to provide a strategic regional transport route between Black Road/Murrays Hill Road and Shepherds Hill Road to avoid the Blackwood roundabout because the two-lane roadway and indirectness of the roadway would not be attractive for non-local or traffic bypassing Blackwood.

Options 4 and 5 are also not recommended for further consideration because:

- Option 4 would impact the bushland and walking trails between Blackwood Park Boulevard and Murrays Hill Road
- Option 5 would create issues for the local residents by removing amenity in the local parks and allowing for more through traffic in local streets that can use the existing egress routes via Blackwood Park Boulevard, Fergusson Avenue and Grand Boulevard for a bushfire emergency route to Coromandel Parade.

Options 3A, 3B and 3C were also not considered viable as western bypass options for Craighburn Farm residents, as they connect within the existing residential estates using mostly existing local streets. Options 3A, 3B and 3C are not considered viable as they would require a new bridge over the railway line to Beaconsfield Road.

A safer route for the Craighburn Farm residents is the existing situation where they can exit via Grand Boulevard to Coromandel Parade to travel north to Shepherds Hill Road via the Blackwood roundabout or south to Murrays Hill Road and Black Road.

In conclusion, the emergency bushfire egress for Craighburn Farm residents, in particular west of Grand Boulevard and south of Fergusson Avenue, exists via Craighburn Road and Cumming Street or Grand Boulevard to Coromandel Parade. It is considered adequate for the size of the residential population and none of the alternative bushfire bypass emergency egress alignments are safer than the existing situation.

The only alignment option that the City of Mitcham may consider for further investigations is Option 3D with the opening of Star Lily Street to connect more directly with Brighton Parade. However, the residents of Star Lily Street and Brighton Parade would be impacted with additional traffic and noise in the street and loss of local amenity, and consequently it is not recommended for the City of Mitcham or the State Government to pursue a detailed feasibility study or business case for this road connection.

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## Glossary and Abbreviations

Abbreviations used in this document are defined as follows.

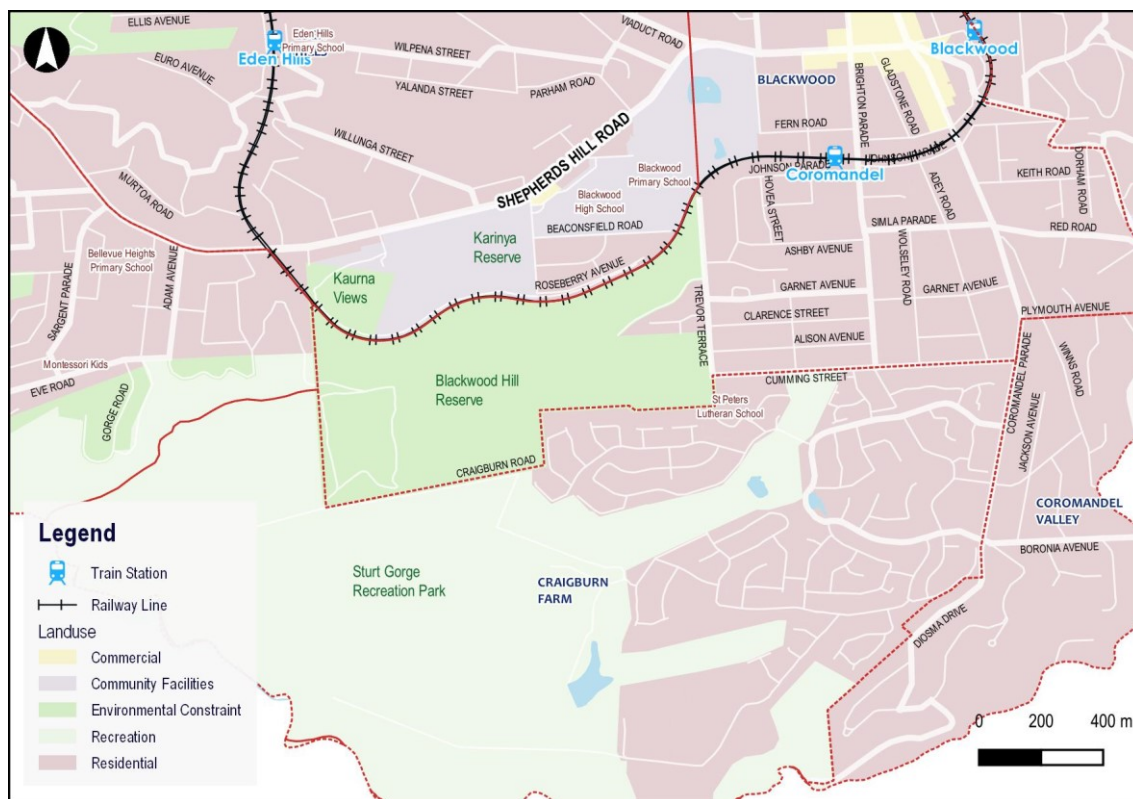
| Term         | Definition                                                                        |
|--------------|-----------------------------------------------------------------------------------|
| 30-Year Plan | 30-Year Plan for Greater Adelaide (updated in May 2017)                           |
| ABS          | Australian Bureau of Statistics, Australian Federal Government                    |
| BCR          | Benefit Cost Ratio                                                                |
| CBA          | Cost Benefit Analysis                                                             |
| CFS          | Country Fire Service, South Australia                                             |
| DEH          | Department of Environment and Heritage, South Australian Government               |
| DENR         | Department of Environment and Natural Resources, South Australian Government      |
| DEW          | Department of Environment and Water, South Australian Government                  |
| DPTI         | Department of Planning, Transport and Infrastructure, South Australian Government |
| FDS          | Fire Dynamics Simulator                                                           |
| FPO          | Fire Prevention Officer                                                           |
| ITLUP        | Integrated Transport and Land Use Plan, DPTI, July 2015.                          |
| MCA          | Multi-Criteria Analysis                                                           |
| NPV          | Net Present Value                                                                 |
| RMP          | Road Management Plan                                                              |

# 1. INTRODUCTION

## 1.1. Study Background

The Craighurn Farm residential area, also known as Blackwood Park, is located southwest of the Blackwood district centre, as shown in Figure 1.1. It is surrounded to the west by bushland and the Sturt Gorge Recreation Reserve that is considered of high risk for bushfires to occur. In the event of an emergency, residents have road egress to the east and north to Main Road and Shepherds Hill Road via Coromandel Parade and the Blackwood roundabout, north via Brighton Parade to access Shepherds Hill Road over the Belair railway line or south to Murrays Hill Road and Black Road.

Figure 1.1: Craighurn Farm Western Bypass Study Area



This bushfire risk issue was documented by concerns from the Sturt Country Fire Service (CFS) Group in the 2009 Bushfire Inquiry undertaken by the Parliament of South Australia Natural Resources Committee. They raised the following concerns for safe evacuation with the traffic congestion and geometric profile of the existing road network:

*"... if we have a major impacting fire on the area on a weekend when most of the 6,000 dwellings are occupied, and assuming that each dwelling has 1.5 vehicles, we could have more than 8,500 vehicles fleeing from an approaching front. Of the six exits from the district, you could reasonably expect less than half to be suitable for this purpose due to bushfire impacts. This situation will cause severe traffic congestion throughout the district and leave road users in some areas at extreme risk. This situation may be further complicated by the passage of a goods train through the area at the same time closing any of the three rail crossings, two of which are on the main transport routes restricting the traffic flow to the south. Limited vision for road users due to heavy smoke would be expected and the possibility of spot fires impacting on fleeing road users ahead of the fire front, due to the lack of strategic roadside vegetation clearance, would be of major concern."* (Pearce Submission 20/8/09 page 2)

Subsequent to the final report in 2011, a new connecting road along the western edge of the Craighburn Farm estate through State and Council reserves connecting Murrays Hill Road in Coromandel Valley to Northcote Road and Shepherds Hill Road was proposed. This western bypass is a potential solution to the traffic congestion in Blackwood and it would improve safety in the event of bushfire emergencies by providing an alternate route to Coromandel Parade.

This Western Bypass and/or link road would provide a north-south route through Coromandel Valley and Blackwood avoiding the narrow, winding sections of Coromandel Parade and Main Road with a direct connection to Shepherds Hill Road. It would also allow the western side of Craighburn Farm to have additional access/egress points to improve fire safety and amenity. The Blackwood, Coromandel and Craighburn Farm communities as well as some City of Onkaparinga residents would benefit from improved access through the new proposed road bypass. It would also provide traffic congestion relief for the residents of Craighburn Farm who currently must use Coromandel Parade and Main Road to access Shepherds Hill Road to connect to the western suburbs, South Road and the Southern Expressway via the Blackwood roundabout.

In the 2018/2019 State Budget, a feasibility study into the Craighburn Farm Western Bypass was funded through the Mitcham Hills Corridor Road Improvement Upgrades in a partnership project between the City of Mitcham (Council) and the Department of Planning, Transport and Infrastructure (DPTI).

### 1.2. Study Scope and Purpose

The main purpose of this study was to assess the feasibility of a Western Bypass or link road connection for bushfire safety and traffic movement reasons using an evaluation framework developed using the Australian Transport Assessment and Planning (ATAP) Framework guidelines. This assessment will be the first stage of a two-stage process. If a bypass or link road is considered viable, a more detailed concept and a project definition report with a full business case may be undertaken in a subsequent stage. This study will provide recommendations for a Go/No Go decision to move to concept design to be made in consultation with DPTI. Dependent on the outcome of the feasibility study, the documentation may form the basis for a submission under the Infrastructure Australia scheme.

### 1.3. Report Structure

The report comprises the following sections:

- **Section 1 Introduction** to explain the study background and purpose, scope of work and the report structure
- **Section 2 Planning Context** with an overview of the existing land use, demographics and transport system and a summary of the relevant planning documents and discussion of the goals, transport objectives and targets.
- **Section 3 Constraints and Opportunities** to determine the long list of alignment options. This includes the constraints mapping and the summary of the discussions from the stakeholder meetings.
- **Section 4 Western Bypass Alignment Options** to describe the development and short-listing of the bypass and road link options based on site inspections and the constraints and opportunities analysis.
- **Section 5 Strategic Merit Test** of the Bypass or Link Road Options using the Multi-Criteria Analysis (MCA) assessment that is based on the ATAP Evaluation Framework and guidelines. This includes a “fatal flaw” assessment, the MCA scoring of 12 bypass and link road alignment options.
- **Section 6 Conclusions and Recommendations** with the next steps for delivering a consultation and community engagement strategy and to prepare a full business case to obtain funding and planning approvals from the Federal, State and Local governments.
- **Appendix A Road Bypass and Link Road Alignment Options CAD Drawings**

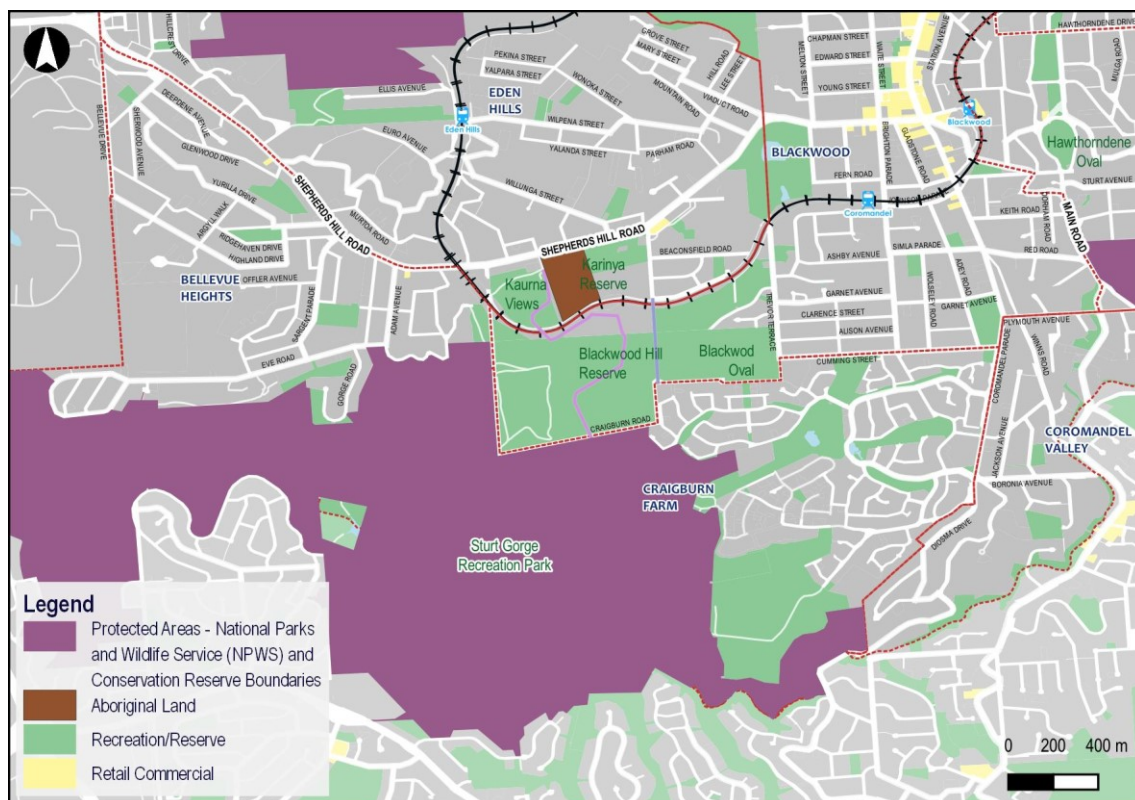
## 2. STRATEGIC PLANNING REVIEW

### 2.1. Existing Land Use, Demographics and Transport Network

#### 2.1.1. Land Use

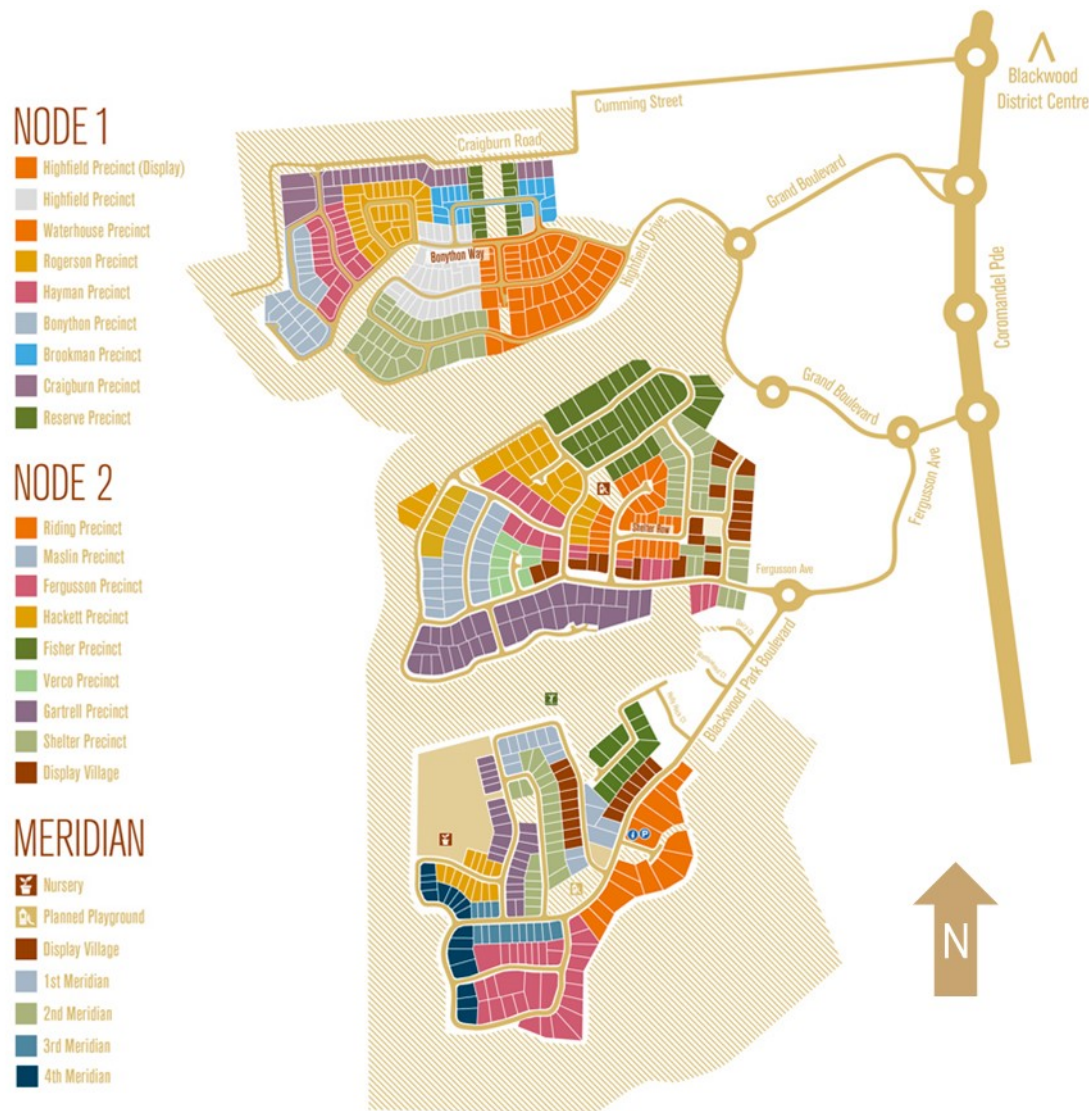
The land use in the Craighburn Farm study area comprises mostly recreational parks and bushland reserves to the north and west with the low-density residential subdivisions with schools and sports ovals in the eastern part west of Coromandel Parade as shown in Figure 2.1. Craighburn Farm adjoins the Sturt Gorge Recreation Park which includes a range of various walking and riding trails with views across Flagstaff Hill, Aberfoyle Park, Happy Valley to the coast. The native bushland has a diverse range of fauna in the park that wanders into Craighburn Farm, including kangaroos, koalas, and echidnas. Many waterfalls, creeks and gullies are also located throughout the area.

Figure 2.1: Land Use and Protected Areas in Parks in the Craighburn Farm Study Area



The Craighburn Farm residential area started as the estate of Blackwood Park that was first established in 1998. The estate consists of three distinct 'nodes' that have been developed incrementally from north to south with each node divided by tree-lined gullies and significant areas of open space. The newest 'node', known as "Meridian", is bordered by the Sturt River and Sturt Gorge Recreation Park and is shown in Figure 2.2.

Figure 2.2: Blackwood Park Residential Estate



Source: Meridian website, 2019.

The number of households and population in the three “nodes” of the Blackwood Park estate in 2016 and as per the development plan are shown in Table 2.1. These statistics show the ultimate proposed residential growth in Craighurn Farm compared to the number of households in 2016. In 2019, the Blackwood Park residential estate is about 80 per cent completed.

Table 2.1: Number of Households and Population in the Blackwood Park Estate

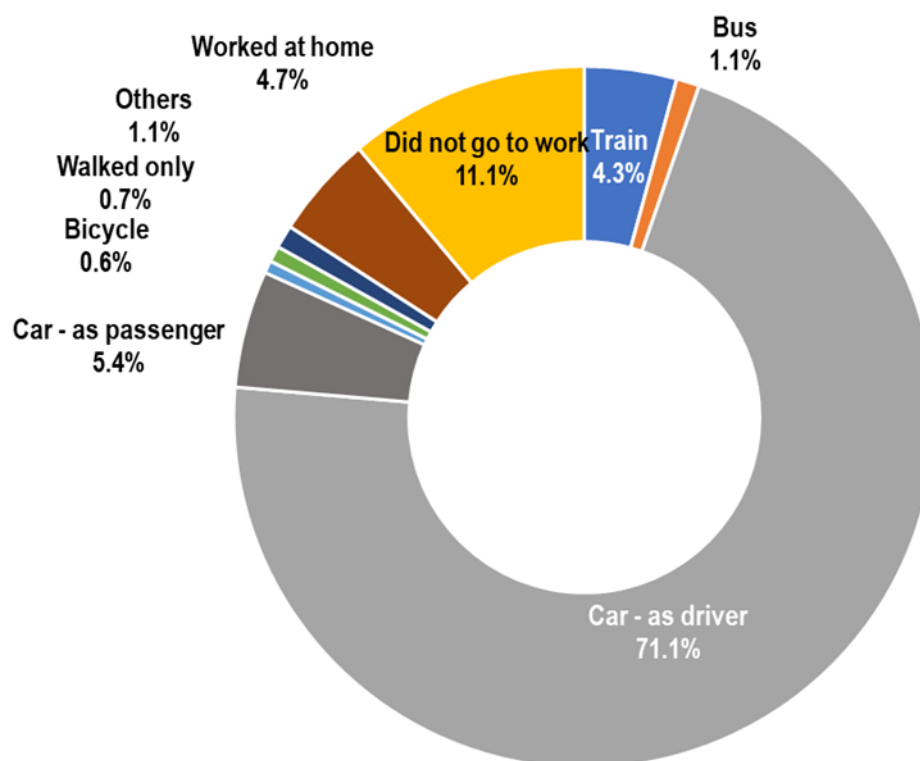
| Blackwood Park Sub-area | Census 2016 Number of Households from the 2016 Census | Number of Lots according to the Blackwood Park development plan |
|-------------------------|-------------------------------------------------------|-----------------------------------------------------------------|
| Node 1                  | 225                                                   | 233                                                             |
| Node 2                  | 91                                                    | 232                                                             |
| Node 3                  | 3                                                     | 174                                                             |

## 2.1.2. Demographic Overview

In 2016, Craigburn Farm had a population of 2,394 with 855 dwellings. This is an average of three persons per household. The residents are relatively well-educated with 34 per cent having a university qualification compared with 19 per cent of South Australians and 22 per cent of Australians in general. Most residents were born in Australia (73 per cent) with parents who were both born in Australia. The medium weekly income of households is almost double that of South Australian households in general. Housing in the suburb is almost exclusively large detached family homes that are owner-occupied.

The mode of travel to work for Craigburn Farm and Coromandel Valley residents from the 2016 census is shown in Figure 2.3. Public transport for work trips is only used by 5.4 per cent of the residents whereas over 76 per cent are using private vehicles. This shows that car trips are important for these residents and the public transport options by bus on Route 600 or via train from Coromandel station is only used by a small percentage of the residents.

**Figure 2.3: Mode of Travel to Work for Craigburn Farm – Coromandel Valley Residents**

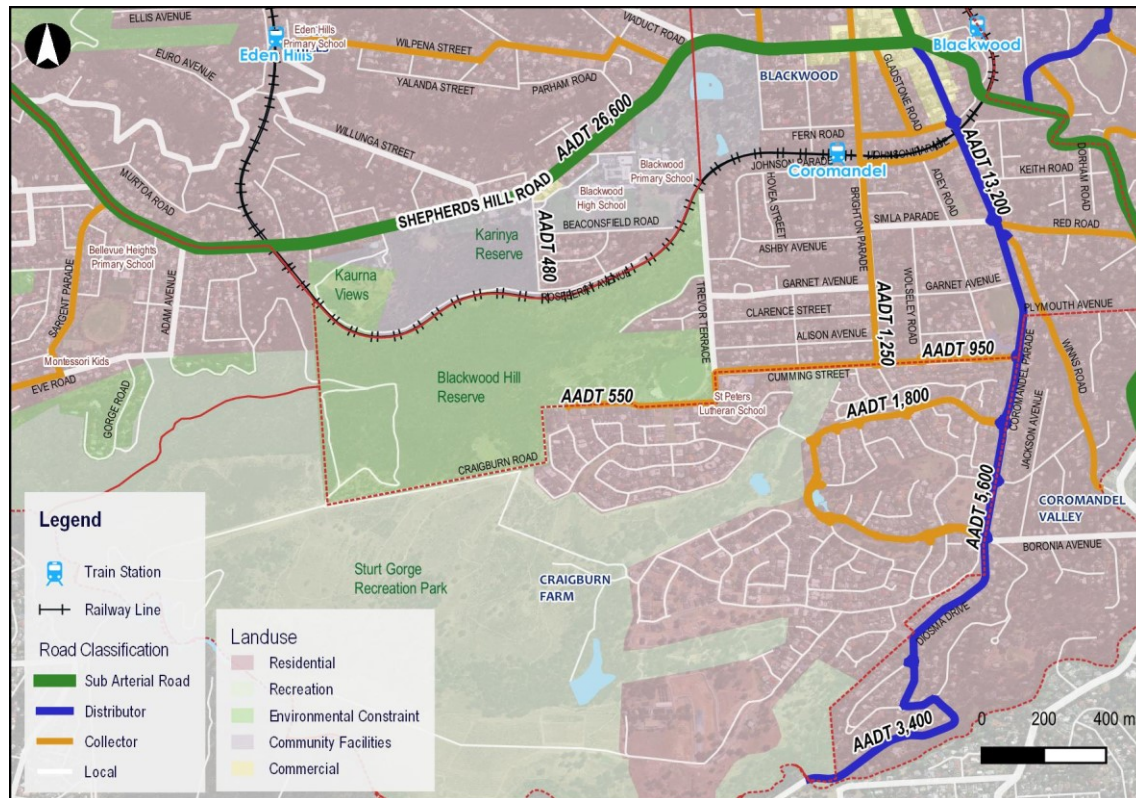


Source: Australian Bureau of Statistics (ABS) Census, 2016.

## 2.1.3. Road Network

Main Road, Shepherds Hill Road and Coromandel Parade are the main traffic routes from all areas south and west of the Blackwood business precinct, including Craighburn Farm, as shown in Figure 2.4. Cumming Street and Craighburn Road have daily traffic volumes less than 1,000 vehicles. Grand Boulevard has a daily traffic volume of about 1,800 vehicles.

**Figure 2.4: Road Hierarchy and Daily Traffic Volumes**



The key arterial roads in the study area are:

- Main Road that provides north-south access from Craighburn Farm and Blackwood to the Adelaide Plains and CBD.
- Shepherds Hill Road that provides access to the western suburbs, South Road and the Southern Expressway.

Both Main Road and Shepherds Hill Road are under the care, control and maintenance of DPTI.

Council manages Coromandel Parade, which is a Distributor Road from Craighburn Farm, the southern parts of Blackwood and parts of Coromandel Valley. It connects to Main Road and Shepherds Hill Road at the Blackwood roundabout that has recently been upgraded to improve traffic efficiency, especially during the peak periods.

The local road network in Craighburn Farm connects onto Grand Boulevard with connections to Coromandel Parade and also via Creswell Avenue at Watts Terrace. The remaining connection located to the north of the development is accessed via Hayman Retreat to Craighburn Road and subsequently Cumming Street to further distribute either eastbound onto Coromandel Parade or northbound to Shepherds Hill Road. Due to the topography of the area, these connecting roads are a fire risk hazard for evacuation in the event of a major fire or other natural disaster if they were to become blocked or obstructed. The emergency access for these residents is made worse if the emergency occurred during peak periods with the traffic congestion along Coromandel Parade, Shepherds Hill Road and Main Road particularly at the Blackwood roundabout. The other existing emergency egress routes are via Brighton Parade to access Shepherds Hill Road to north of Craighburn Farm past the Coromandel train station over the level crossing on the Belair railway line or to the south of Craighburn Farm via Grand Boulevard, Coromandel Parade and Murrays Hills Road to Black Road. No road access exists to the west of the Craighburn Farm residential estates.

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## 2.1.4. Public Transport

The Belair railway line and the interstate standard gauge line to Melbourne are shown with the local bus routes and stops in Figure 2.5. The railway line, especially with the long freight trains is a barrier for movement for a western bypass or link road and a risk during a bushfire for the residents of Craighburn Farm. The closest bus stops for Craighburn Farm residents are located along Grand Boulevard with Route 600 that connects Old Reynella to Bellevue Heights and Westfield Marion shopping centre via Shepherds Hill Road. The bus stops in Shepherds Hill Road that are north of the railway line and the hilly bushland terrain are not accessible from Craighburn Farm. However, a new link road may provide the more convenient walk access and a new cyclist connection to Shepherds Hill Road from the western part of Craighburn Farm over the railway line.

**Figure 2.5: Public Transport in the Craighburn Farm area**



## 2.2. Review of Relevant Strategic Planning

A review of the relevant background documents was undertaken with a summary of the following key documents:

- City of Mitcham Bushfire Prevention Plan 2018/2019
- City of Mitcham Spatial Vision Consultation Plan
- Bushfire Inquiry South Australian Evidence Final Report, Parliament of South Australia Natural Resources Committee, July 2011
- Road Management Plan (Short to Medium Term), Main Road (RN6452) (Belair Road to Shepherds Hill Road) and Shepherds Hill Road (RN6467) (Main Road to Seymour Street), DPTI, February 2015
- Sturt Gorge Recreation Management Plan, Department of Environment and Heritage, 2008
- City of Mitcham Draft Integrated Transport Plan, InfraPlan, 2017 (not a public document)
- City of Mitcham Draft Road Network Strategy, GTA Consultants, 2018 (not a public document)

## 2.2.1. City of Mitcham Bushfire Prevention Plan (2018/2019)

The City of Mitcham Bushfire Prevention Plan (2018/2019) is aimed to protect life and reduce the impact of bushfires on property and the environment within the City of Mitcham and to provide community bushfire protection whilst ensuring the principals of proper land management are taken into account.

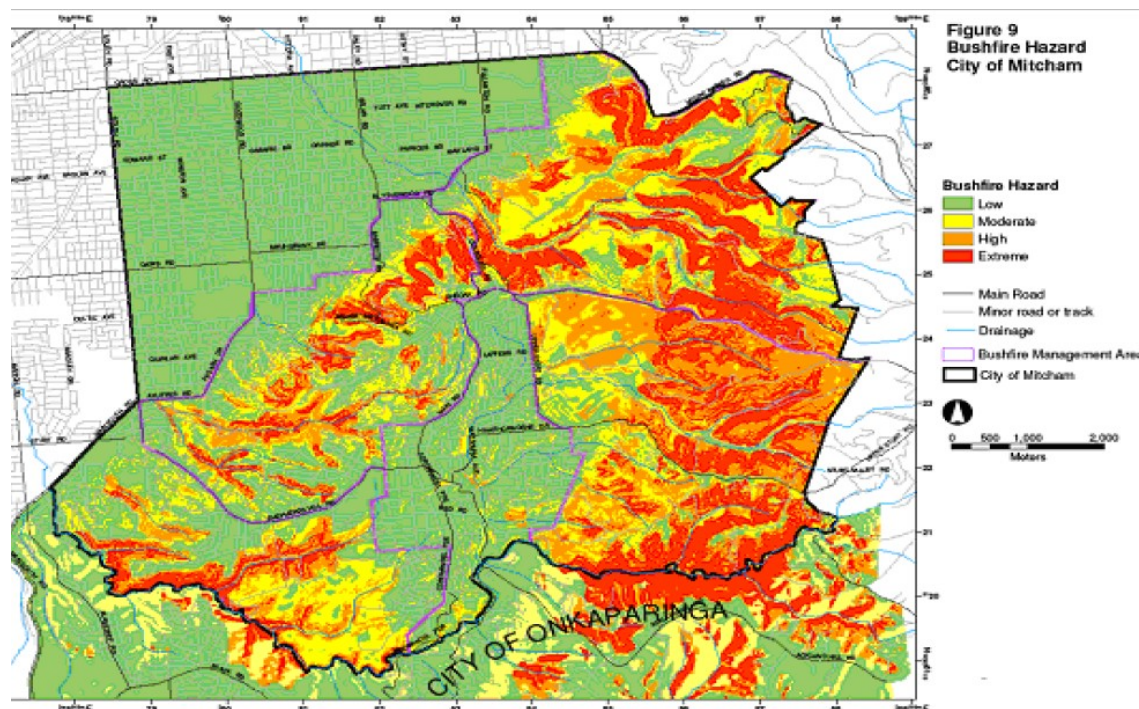
The plan provides information on the fire access tracks in Government Agencies Fire Liaison Committee (GAFLC) guidelines.

The Bushfire Management Plan also provides information on the classification of Fire Danger Season, the Fire Danger Index (FDI) and recommended action and potential impact for each FDI category.

The plan identified the study area to have high to very high fuel loads and high to extreme bushfire hazard ratings occurring in the Sturt Gorge Recreation Park and in the vicinity of the creek lines through Craighburn Farm, as shown in Figure 2.6.

The plan also includes maps showing threats of bushfire to Council assets, community assets, natural assets and capital assets. In summary, extreme to moderate bushfire threat exists at the southern part of the area, particularly due to very high fuel loads within Sturt Gorge Conservation Park. Residential development around Sturt Creek tributaries are at greater risk of fire, with creek vegetation providing a potential conduit for fire into this area.

**Figure 2.6: Bushfire Hazard City of Mitcham**



Source: Mitcham Bushfire Prevention Plan 2018-2019

## STRATEGIC PLANNING REVIEW

The program of works from the Bushfire Prevention Plan that are located in the reserves in the Craighurn Farm study area are listed in Table 2.2.

**Table 2.2: Program of works to upgrade Reserves within the Craighurn Farm Study Area**

| Asset Name<br>Responsible Agency                            | Asset Type        | Likelihood of fire impacting on the asset | Rating | Action                                                                                                                    | Task                                                                                                                         | Priority | Time Frame |
|-------------------------------------------------------------|-------------------|-------------------------------------------|--------|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------|------------|
| Karinya Reserve<br>City of Mitcham                          | Council reserve   | Medium                                    | Medium | Council Horticulture Officer to inspect after Fire Dynamics Simulator (FDS) and implement Management Plan for the reserve | Council Fire Prevention Officer (FPO) and Horticulture Officer to inspect prior to FDS and implement any works not concluded | Medium   | May –Nov   |
| Eden Hills Dump<br>City of Mitcham                          | Council Reserve   | Very High                                 | High   | Council Horticulture Officer to inspect after FDS and implement Management Plan for the reserve                           | Council FPO and Horticulture Officer to inspect prior to FDS and implement any works not concluded                           | High     | May –Nov   |
| Colebrook Reserve<br>Eden Hills<br>Aboriginal Lands Trust   | Heritage Reserve  | Very High                                 | High   | Lands Trust staff manage and maintain the reserve                                                                         | Council FPO inspects prior to FDS and advise the Trust of any works not concluded                                            | High     | May –Nov   |
| Sturt Gorge Reserve<br>Department for Environment and Water | Conservation Park | Very High                                 | High   | Department of Environment and Water (DEW) inspects after FDS and implement their management plan                          | Councils FPO to inspect prior to FDS and if necessary, advise DENR of any works to be completed                              | High     | May –Nov   |
| Blackwood Hill Oval<br>City of Mitcham                      | Council Reserve   | High                                      | High   | Council Horticulture Officer to inspect after FDS and implement Management Plan for the reserve                           | Council FPO and Horticulture Officer to inspect prior to FDS and implement any works not concluded                           | High     | May –Nov   |

Source: Mitcham Bushfire Prevention Plan 2018-2019

### 2.2.2. City of Mitcham Draft Spatial Vision Consultation Plan

In the draft Spatial Vision Consultation Plan, a possible Southern link road was identified west of Craighurn Farm as shown in Figure 2.7 and possible removal of rail freight along the Belair line.

**Figure 2.7: Possible Southern Link Road in the City of Mitcham Spatial Vision Consultation Plan**



Source: City of Mitcham Draft Spatial Vision Consultation Plan, 2018 modified by GTA.

## 2.2.3. Bushfire Inquiry South Australian Evidence Final Report, Parliament of South Australia Natural Resources Committee (2011)

The following comments were mentioned in the Bushfire Inquiry South Australian Evidence Final Report:

- The winding, narrow and heavily wooded Hills road network posing issues for bushfire response.
- Mass evacuation at the last minute was considered impossible due to low capacity of the roads
- Fire fight was made difficult due to poor access to many location

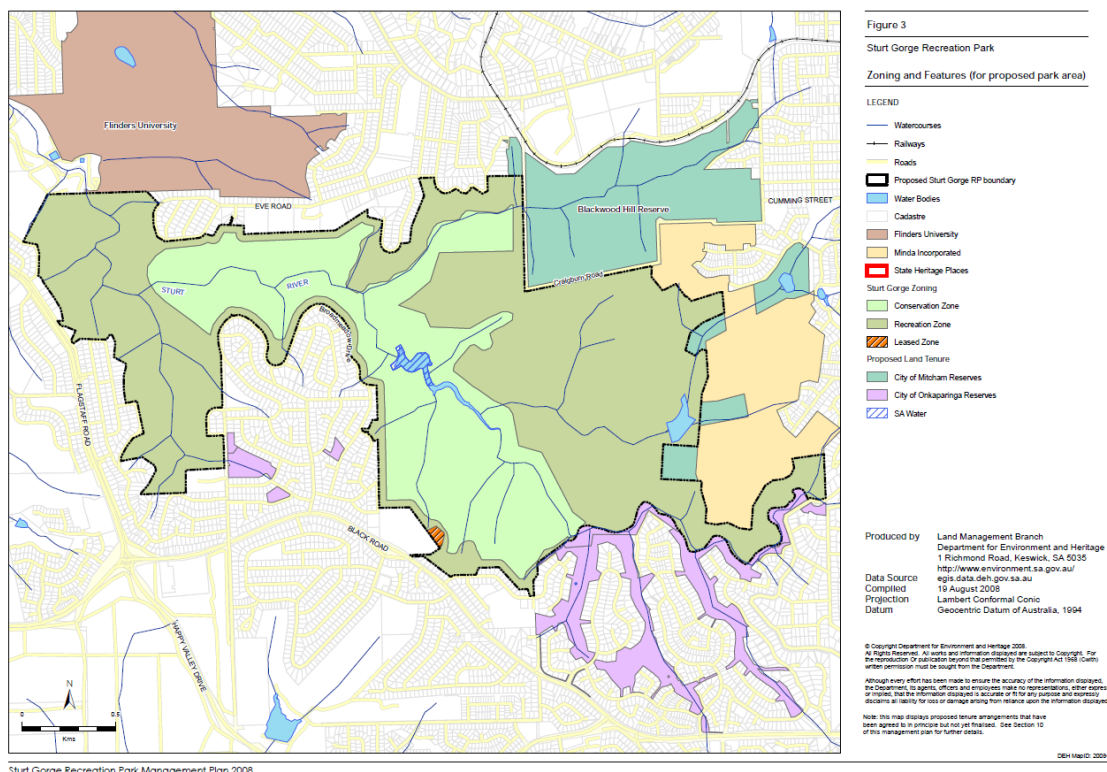
The following recommendations were made by the Committee:

- Clear communication to residents should be made regarding the constraints of the Hills road network with policy framed in such a way as to reduce the likelihood of dangerous last-minute mass evacuations
- Steps should be taken to improve the capacity of the road network during times of fire such as providing alternative escape routes where possible, reducing or preventing train movements on bushfire days, and strategically clearing roadside vegetation where appropriate.

## 2.2.4. Sturt Gorge Recreation Management Plan (2008)

The Sturt Gorge Recreation Management Plan was adopted on 1 December 2008 by the Department of Environment and Heritage (DEH) and was prepared pursuant to section 38 of the National Parks and Wildlife Act 1972. The zoning and features of the Sturt Gorge Recreation Park is shown in Figure 2.8. The eastern side of the reserve is within a Recreation Zone.

**Figure 2.8: Sturt Gorge Recreation Park Zoning and features**



Source: Sturt Gorge Recreation Park Management Plan, 2008.

The Plan identified that the three small areas of the former Craighorn Farm land have been identified by the City of Mitcham as land over which it wishes to have care and control to enable stormwater management and facilitate a land swap to achieve community recreation and open space areas within the development area.

The Plan states the following in the Public Utilities section:

*There is also a possibility that in the future, requests will be made to locate additional utility services in the park. It is impossible to canvass the range of possibilities in this management plan, but in general terms, DEH remains opposed to the location of additional infrastructure on parks except under very special circumstances. Protection of park values should be seen as the priority and reserves should not be taken as the easy option because they are public land and somewhat remote from residential areas.*

*Any proposal for new utility infrastructure should be reviewed in conjunction with the prevailing DEH policy. A community and environmental cost-benefit analysis should be mandatory before a decision is taken to locate infrastructure on reserve land. Provided that on balance a proposal is of positive community benefit and complies with DEH policy, a grant of approval may be deemed to accord with this management plan.*

## 2.2.5. Road Management Plan for Main Road and Shepherds Hill Road (2015)

An update to the Road Management Plan (RMP) for Main Road and Shepherds Hill Road was prepared by DPTI in February 2015 to the original RMP prepared in 2006. The intent of this revision is to review the progress of the implementation of the original recommendations made in the 2006 RMP, update the crash statistics to the most recent five-year period and re-assess and modify where appropriate any recommendations in the RMP. The study corridor comprised Main Road from Belair Road to the Blackwood Roundabout, and Shepherds Hill Road from the Blackwood Roundabout to Seymour Street, with the second section in the Craigburn Farm study area.

The most relevant site is located at the intersection of Shepherds Hill Road/Brighton Parade/Waite Parade where two potential treatments were proposed for the intersection of with a roundabout or traffic signals as shown in Figure 2.9.

**Figure 2.9: Potential Treatments for the Intersection of Shepherds Hill Road/Brighton Parade/Waite Avenue**



Roundabout that requires some property acquisition

Signalised intersection

A roundabout was considered to address the right angle/turn crashes at the intersection and provide greater priority for vehicle movements to and from the side roads. The treatment would slow vehicle speeds through the intersection, simplify vehicle movements, provide pedestrian walk-throughs on approaches to the roundabout and reduce travel time delays for vehicles exiting the side roads. Shepherds Hill Road traffic would be required to give way introducing travel time delays which are not considered excessive. A roundabout at this intersection would create a slower road environment between this intersection and the Blackwood Roundabout providing a safer environment for pedestrian movements. It would also be a gateway into the Blackwood commercial precinct for drivers approaching from the west. The roundabout would provide a safe alternative for commuter traffic currently using the Blackwood Roundabout or Gladstone Road to access residential dwellings south of Shepherds Hill Road. It would require considerable road works and some land acquisition attracting a high cost for implementation.

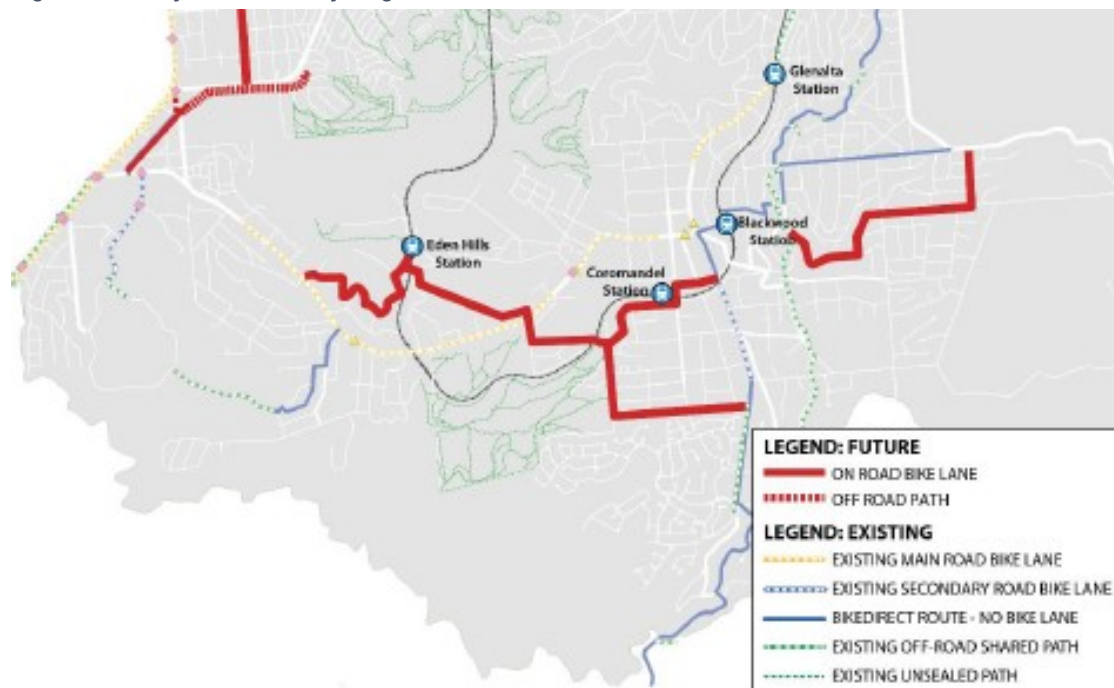
Traffic signals were also investigated to improve safety at the intersection by controlling conflicting traffic movements as well as improving access to and from the side roads. The existing PAC to the east would be retained for existing pedestrian desire lines and connectivity between retail facilities either side of Shepherds Hill Road. Traffic signals would require east and westbound vehicles on Shepherds Hill Road to stop introducing travel time delays for main road traffic. Traffic signals would increase the speed at which vehicles can negotiate the intersection in comparison to a roundabout resulting in increased vehicle speeds on approaches to the intersection and through the pedestrian precinct. This treatment would include pedestrian crossing facilities improving the pedestrian access at the intersection. However preliminary traffic analysis indicates traffic signals will result in additional delays and congestion along Shepherds Hill Road, with queues during the morning peak period extending from this intersection back to and through the Blackwood Roundabout. This treatment would require the removal of on-street parking along Brighton Parade, Waite Street and Shepherds Hill Road west of the intersection. Traffic signals would require road widening and land acquisition.

In 2019, as part of the Mitcham Hills Corridor Upgrade, DPTI and Council are in consideration of both options and a preferred option has not yet been determined.

## 2.2.6. City of Mitcham Draft Integrated Transport Plan (2017)

In the City of Mitcham Draft Integrated Transport Plan undertaken by Infraplan in 2017, a feasibility study for an alternate access route west of Craighburn Farm connecting to Shepherds Hill Road was recommended to provide bushfire emergency egress for Craighburn Farm residents. The Integrated Transport Plan also identified the cycling network plan for City of Mitcham shown in Figure 2.10.

Figure 2.10: City of Mitcham Cycling Network Plan

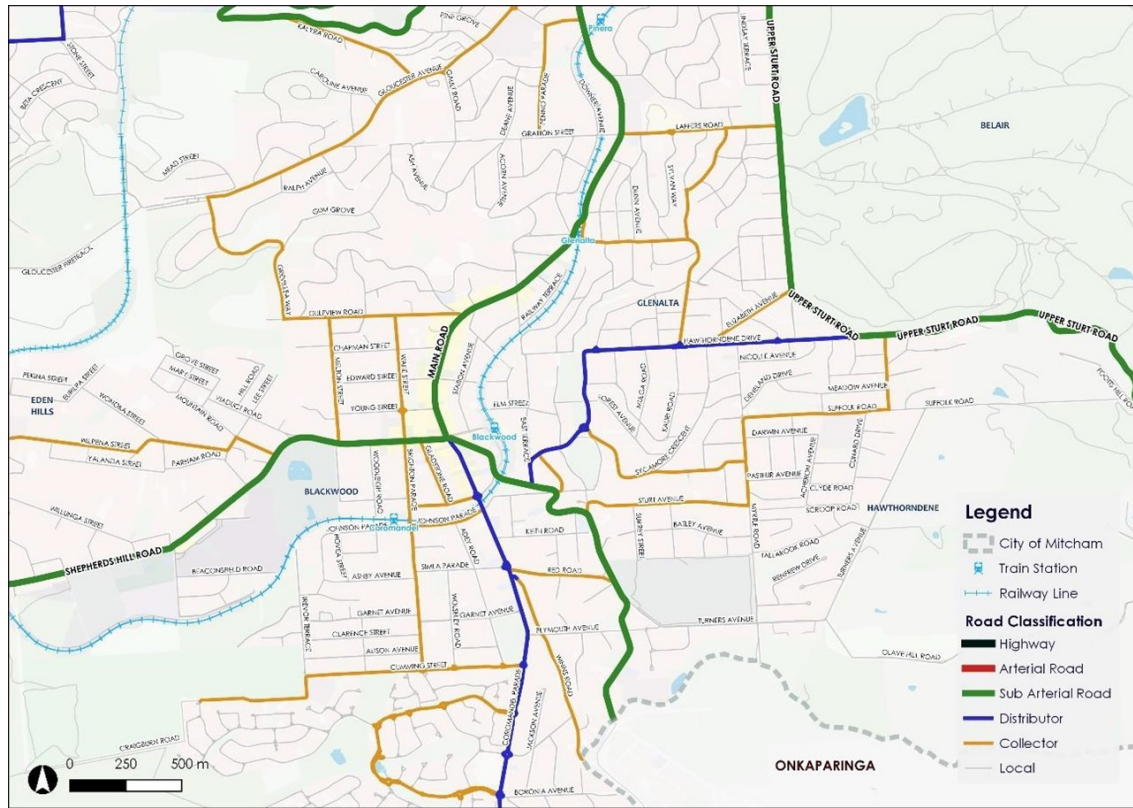


Source: InfraPlan, 2017.

## 2.2.7. City of Mitcham Road Network Strategy (2018)

The City of Mitcham Road Network Strategy was undertaken by GTA Consultants in 2018. The strategy reviewed the existing road hierarchy and proposed new road hierarchy based on the functionality and volumes of the roads. The proposed road network hierarchy for the Mitcham Hills is shown in Figure 2.11.

**Figure 2.11: Proposed Road Network Hierarchy for the Mitcham Hills**



### 2.2.8. Proposal for a train station at Bellevue Heights

The proposed Bellevue Heights station would be on a section of railway track in a cutting south of Shepherds Hill Road as shown in Figure 2.12. It would require a pedestrian overpass to access the station platform from both sides of the railway line. It would be located less than 950 m south of Eden Hills station and 2.1 km west of Coromandel station which is likely too close for another station on the Belair railway line. Furthermore, the walkable patronage catchment is very limited with the Blackwood Hill Reserve south of the railway line and most of the residential development located west of the railway line or north of Shepherds Hill Road. The access for cars and buses from Shepherds Hill Road to the station would impact on the traffic in the local area and along Shepherds Hill Road.

**Figure 2.12: Proposed Location for a Train Station at Bellevue Heights**



Source: Google maps modified by GTA.

DPTI currently has no plans or commitment for a new train station at this location on the Belair railway line.

## 2.3. Strategic Goals and Transport Objectives

In developing the goals and transport objectives to support the strategic rationale for the Craighburn Farm bypass or link road, the following policy documents were reviewed and considered for the strategic rationale for a road project:

- The 30-Year Plan for Greater Adelaide – 2017 Update, May 2017, DPTI.
- Road Management Plan Edition 2 (Short to Medium Term), February 2015, DPTI.
- The Integrated Transport and Land Use Plan, July 2015, DPTI.
- City of Mitcham Strategic Management Plan 2017-2027
- City of Mitcham Draft Integrated Transport Plan

The key objective for a bypass or link road of Craighburn Farm are to provide safe egress for a mass evacuation of residents due to a bushfire event. In addition, the study investigated if major strategic routes or upgrades to existing road networks are sufficient to resolve the issues of bushfire risk and traffic congestion.

Based on the study goals and strategic planning requirements for a western bypass or link road at Craighburn Farm, a set of objectives were developed for the assessment of the alignment options through discussions with the City of Mitcham and DPTI as given in Table 2.3.

**Table 2.3: Key Objectives to support the Craighburn Farm Western Bypass or Link Road Options**

| Objective | Objective Description                                                                                                 | Type of Objective |
|-----------|-----------------------------------------------------------------------------------------------------------------------|-------------------|
| A         | Provide Craighburn Farm residents with safe egress to mitigate bushfire risks                                         | Benefit           |
| B         | Maximise improvement for local access and amenity for walking and cycling in the bush land                            | Benefit           |
| C         | Maximise travel time benefits for Craighburn Farm residents to access Shepherds Hill Road                             | Benefit           |
| D         | Minimise cost to Government (City of Mitcham, DPTI and Infrastructure Australia in the Australian Federal Government) | Disbenefit        |
| E         | Minimise impact on local streets in Craighburn Farm with through traffic                                              | Disbenefit        |
| F         | Minimise environmental and heritage impacts of a new roadway                                                          | Disbenefit        |

## 3. CONSTRAINTS AND OPPORTUNITIES

The constraints and challenges for a western bypass or link road are shown in this section with a series of maps for the topography, seismology or earthquake prone areas, bushfire prone and designated safe refuge areas and recreational reserves. These constraints are shown with a series of GIS-based maps, such as:

- Topography and water features restricting the geometric road requirements, including gradient and curvature;
- Bushfire risk and hazard areas, including parks, bushland, schools, residential estates and businesses;
- Geological issues and seismology with the location of previous earthquake activity and fault lines;
- Soil types that would limit or impact the road constructability and capital cost;
- Special reserves and parks for recreational purposes, including walking trails and mountain bike tracks;
- Heritage features, including European and indigenous built and cultural heritage areas; and
- Environmental protection requirements for special flora or fauna in the Blackwood Hill Reserve, Sturt Gorge Recreation Park or any other bushland or protected sites in the Craighburn Farm study area.

Opportunities for the bypass or link roads with connections from or within Craighburn Farm are also identified.

### 3.1. Constraints

The land uses in Craighburn Farm are mostly residential and bushland or park with walking trails. However, the terrain is very hilly around Craighburn Farm as shown in Figure 3.1 with the contour lines and Figure 3.2 with the elevation model. This limits the opportunities for the western bypass or link road and affects the design, complexity and cost.

## CONSTRAINTS AND OPPORTUNITIES

Figure 3.1: Topographic Constraints in the Craighburn Farm Area

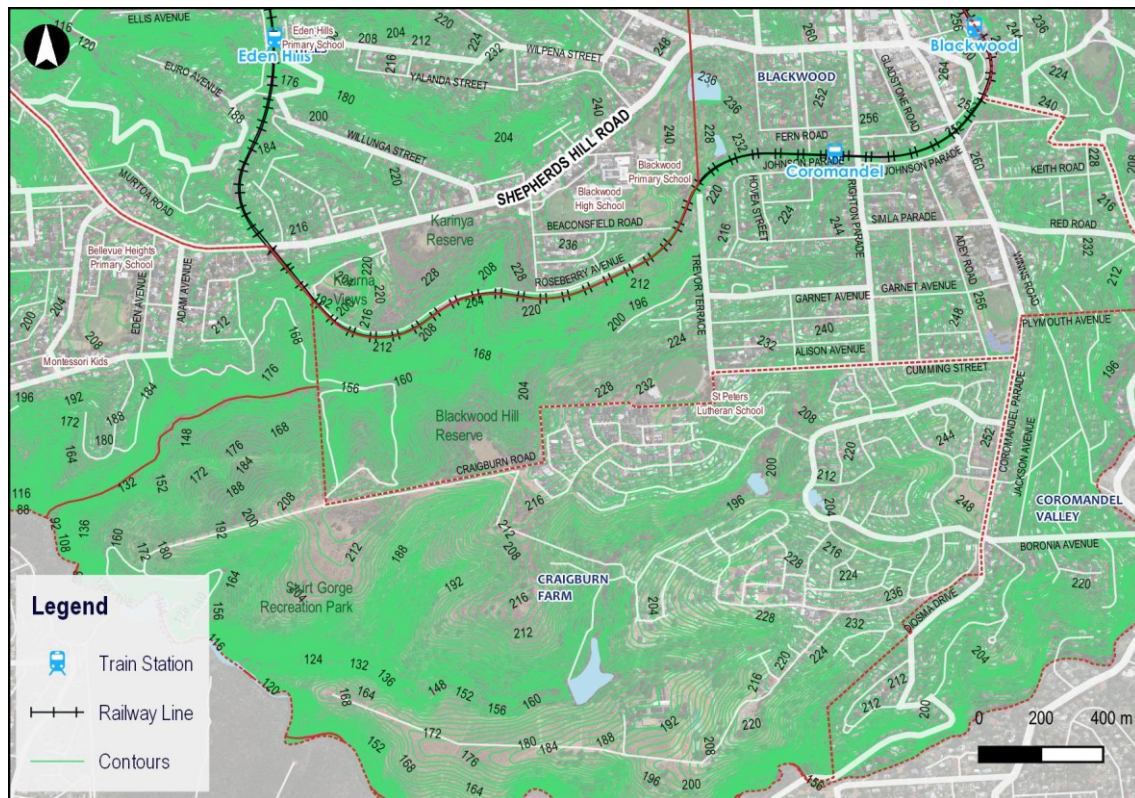


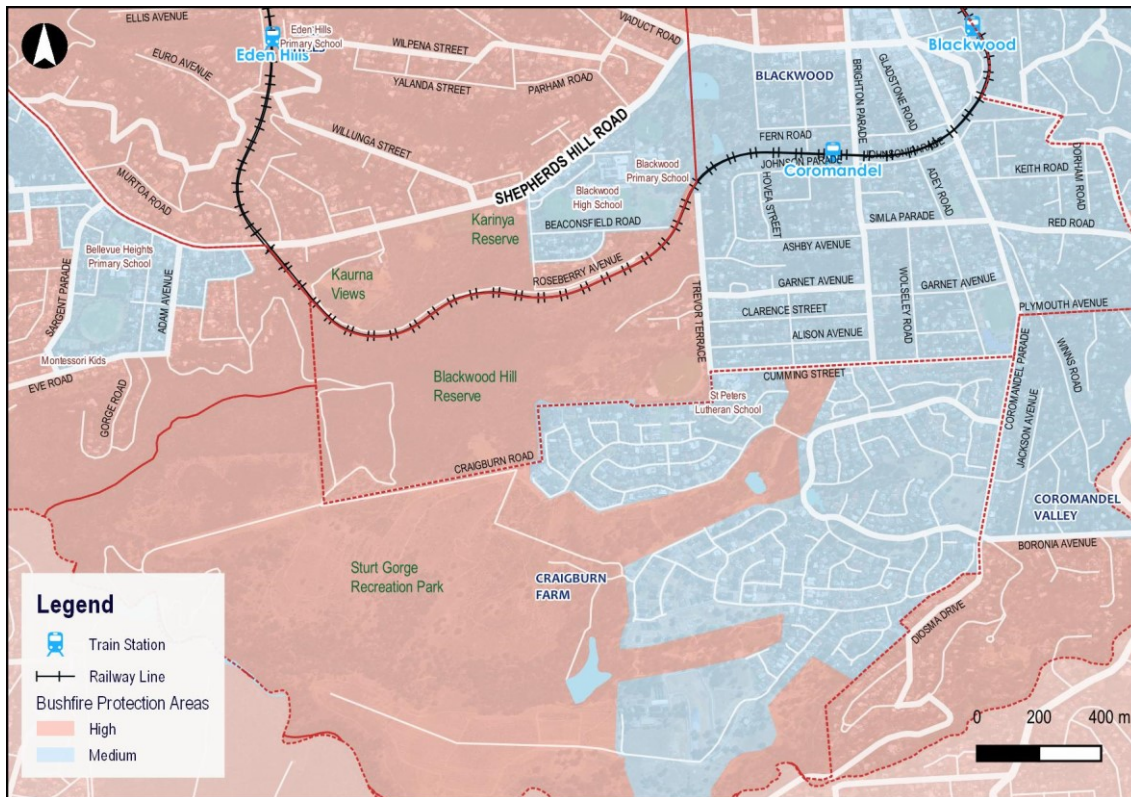
Figure 3.2: Elevation Model for Craighburn Farm



## 3.1.1. Bushfire Risks

The bushfire protection areas in the Mitcham Hills are shown in Figure 3.3 and they surround most of Craighburn Farm.

**Figure 3.3: Bushfire Protection Areas in the Mitcham Hills**



South Australia has three categories of bushfire protection areas depending on the level of risk from bushfires for general, medium and high bushfire risk. Craighburn Farm and the surrounding Mitcham Hills area are completely in the high-risk area. Therefore, it is subject to the bushfire-related planning and building requirements. These requirements are dependent on the level of bushfire risk determined for the site.

From the Mitcham Bushfire Prevention Plan 2018-2019, the Craighburn Farm area is in designated Area 4 which has:

- High to Very High fuel loads in the Sturt Gorge Recreation Park which is located immediately west of the Craighburn Farm residential estate.
- High to Extreme bushfire hazard ratings in the Sturt Gorge Recreation Park and along the creek lines through Craighburn Farm.
- Very High Council asset value for the Karinya Rotary Reserve and the reserves south of Shepherds Hill Road.
- Extreme value for community assets for the St Peters Lutheran and Blackwood High schools south of Shepherds Hill Road in Blackwood and Craighburn Farm respectively.
- Very High or High value nature asset for the Sturt Gorge Reserve between Shepherds Hill Road and Sturt River that extend along the tributary creeks throughout Craighburn Farm.
- High to Moderate capital asset values for the schools located south of Shepherds Hill Road and in Craighburn Farm.
- Extreme to High bushfire threat to Council assets in the Blackwood Hill Reserve and adjacent to the Karinya Rotary Park and the Mountbatten Reserve.

## CONSTRAINTS AND OPPORTUNITIES

The last resort refuges and bushfire safer places are shown in Figure 3.4 and Figure 3.5. During a bushfire emergency, the residents of Craighburn Farm only have the Blackwood Hill Oval as a last resort refuge. Safe access to Shepherds Hill Road and Main Road is only possible via Grand Boulevard and Coromandel Parade and this egress route could potentially be blocked during a catastrophic fire.

Figure 3.4: Last Resort Refuges and Bushfire Safer Places for the Mitcham Hills

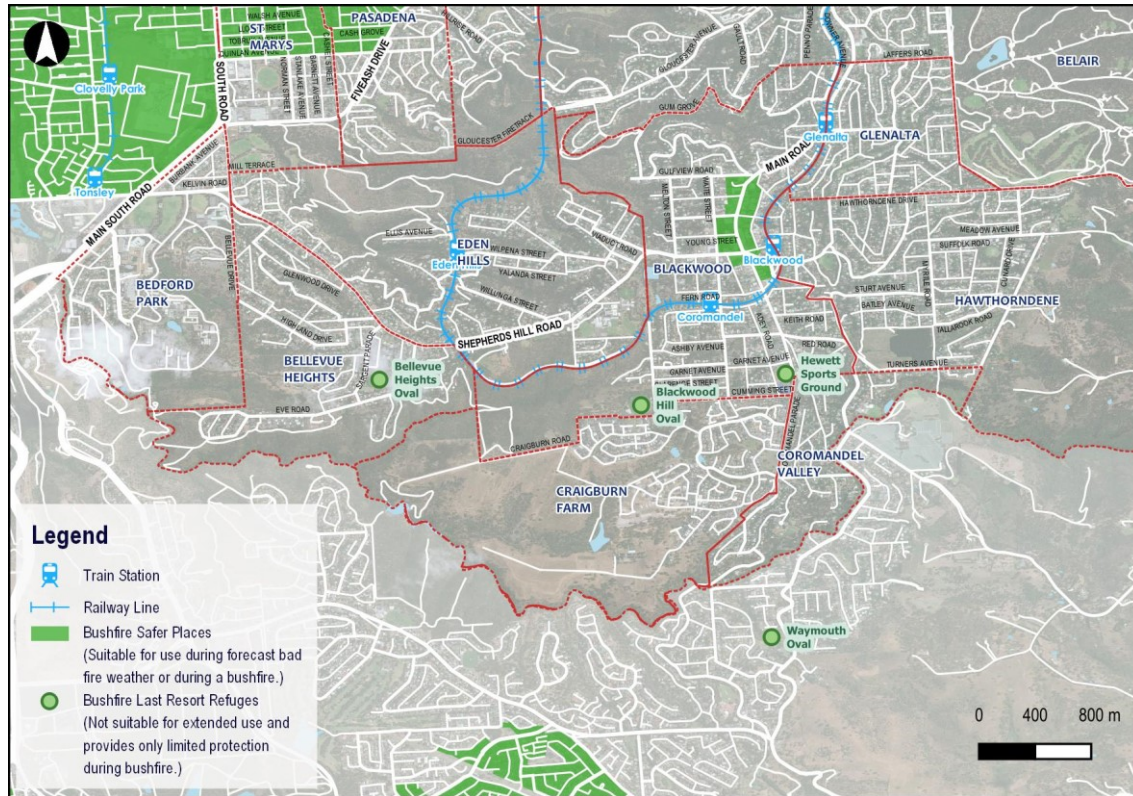
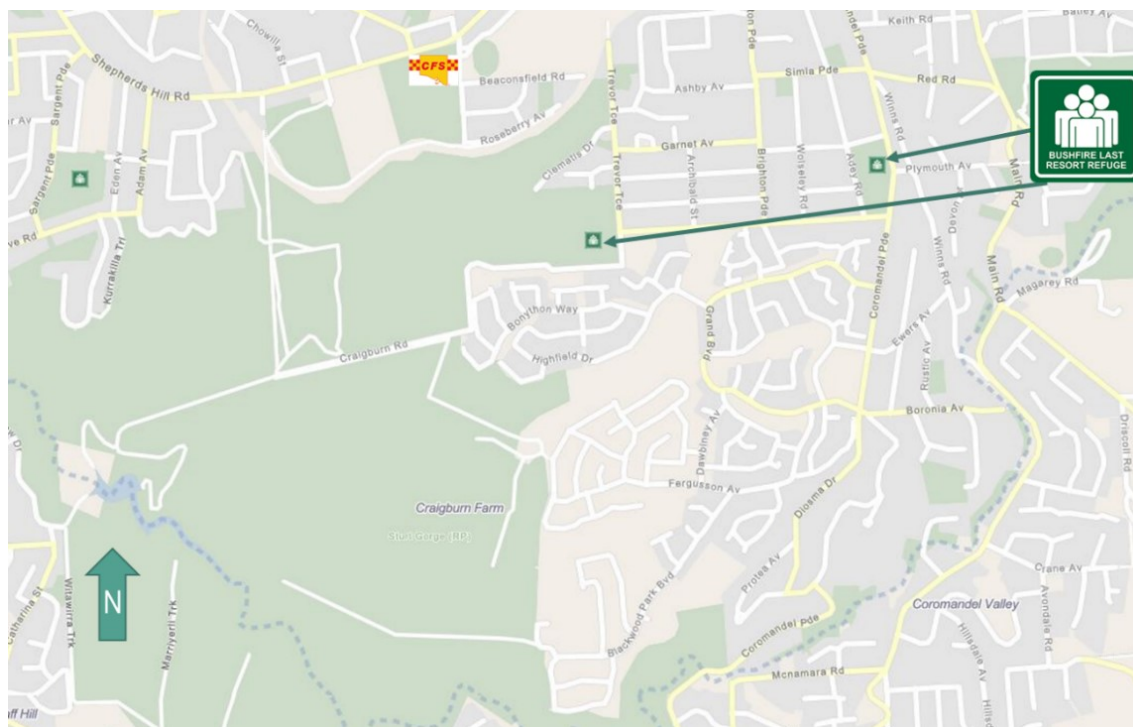


Figure 3.5: Bushfire Last Resort Refuge Areas for Craighburn Farm Residents

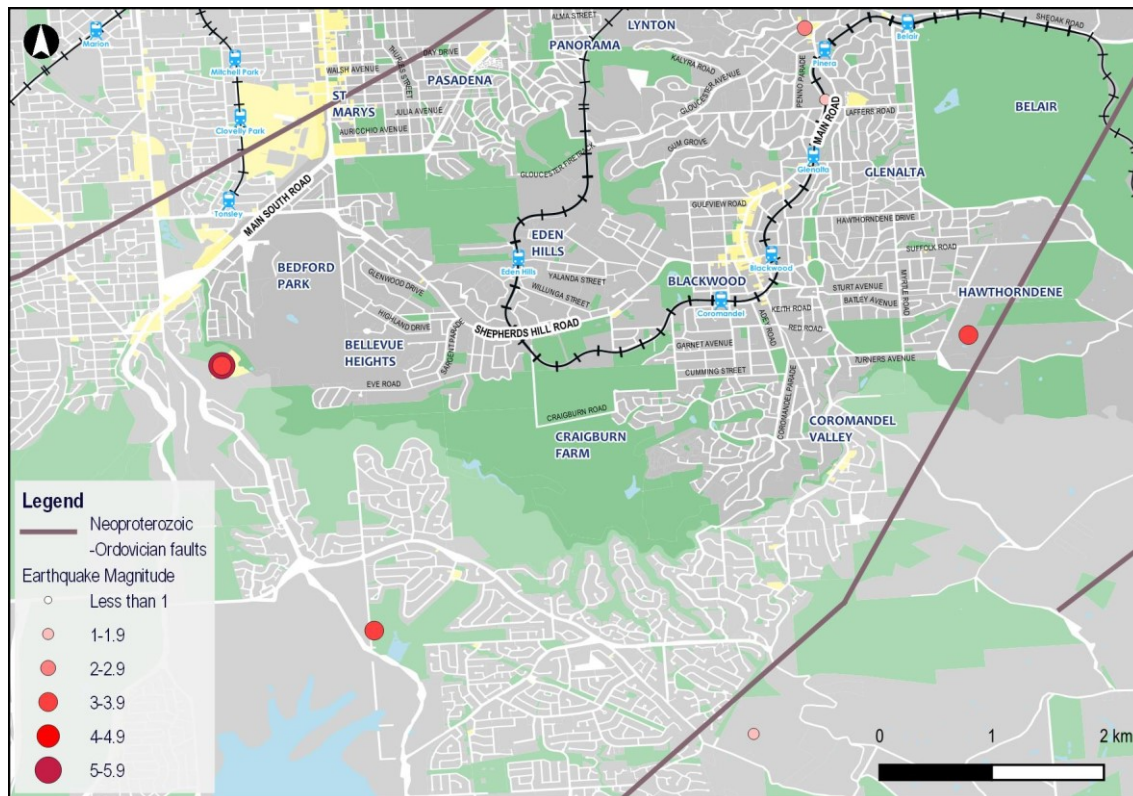


## 3.1.2. Geological Issues

The seismology data from the State Government were obtained to identify the earthquake records and fault lines in the area in the vicinity of the study area and are shown in Figure 3.6. Significant earthquakes have occurred in Belair, Hawthorndene, Flagstaff Hill and Darlington. Two major fault lines exist:

- in an east-west orientation between Seacliff and Pasadena under the Tonsley Innovation District and St Marys.
- in a north-south orientation between Reynella and Belair east of Coromandel Valley and under Hawthorndene.

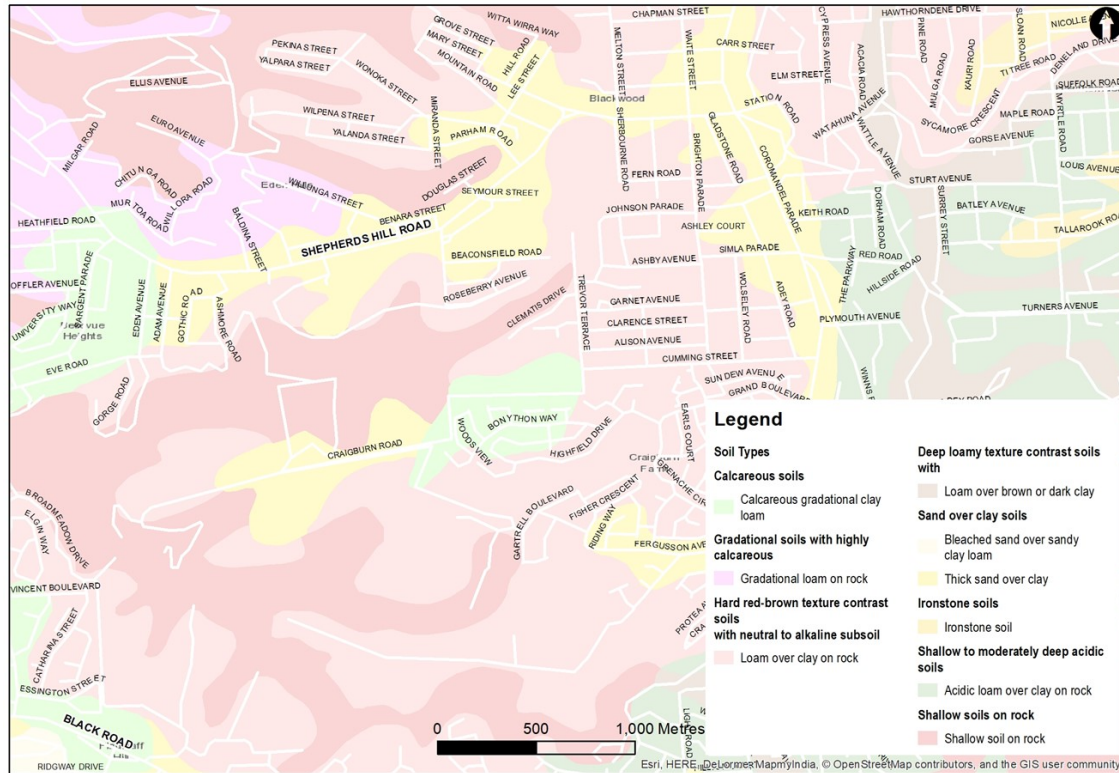
**Figure 3.6: Earthquakes and Fault Lines in the Craigburn Farm Area**



## 3.1.3. Soil Types

The soil types in the Craighburn Farm study area are shown in Figure 3.7. Most of the soil in the area where a western bypass road is under consideration is shallow soil or loam on rock. These soils on rock beds in the Sturt Gorge Recreation Park and the Blackwood Hill Reserve may likely make road construction with any significant cut-and-fill requirements difficult to build and more costly.

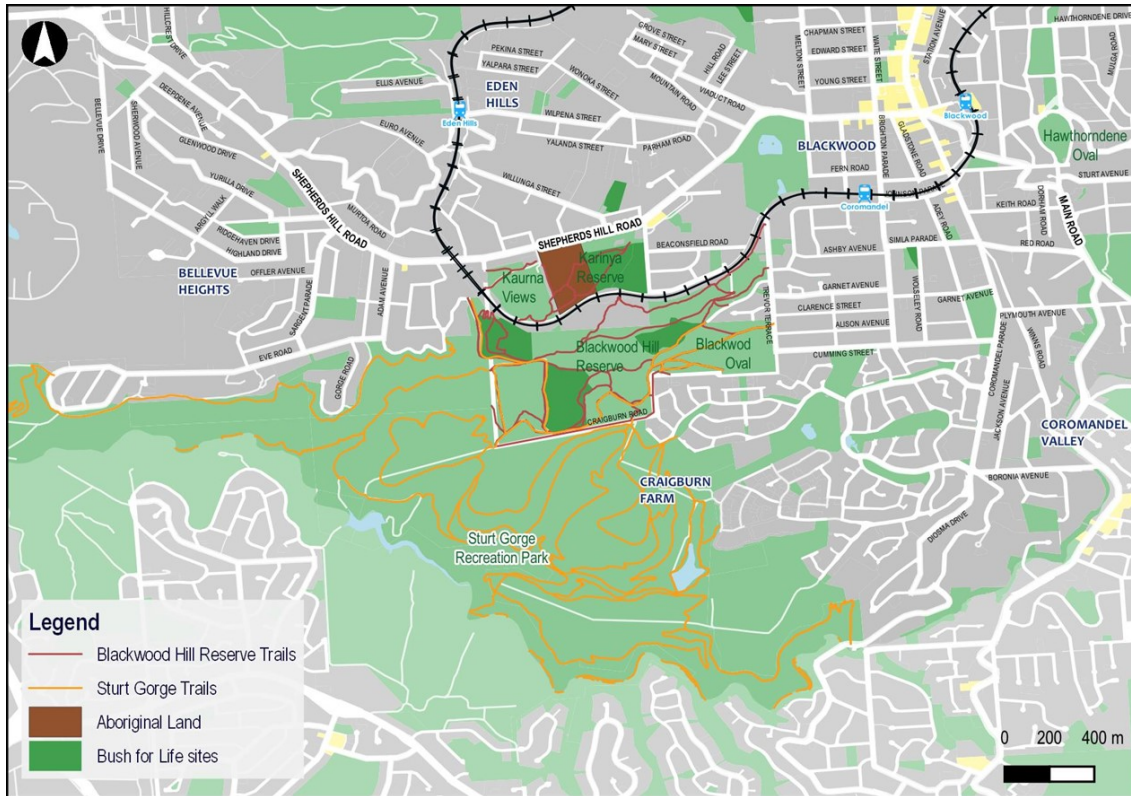
**Figure 3.7: Soil Types in the Craighburn Farm Area**



## 3.1.4. Walking and Cycling Trails in the Protected Reserves

The Blackwood Hill Reserve and the Sturt Gorge Recreation Park have significant social and recreation value for local and metropolitan residents with a myriad of trails through both bush land reserves as shown in Figure 3.8.

**Figure 3.8: Walking and Cycling Trails in Craigburn Farm and Bush for Life Sites**



Examples of the walking and mountain bike trails in the Blackwood Hill Reserve and the Sturt Gorge Recreation Park are shown in Figure 3.9.

**Figure 3.9: Walking and Bicycle Trails in the Blackwood Hill Reserve and Sturt Gorge Recreation Park**



Walking trail in the Blackwood Hill Reserve north of Craigburn Road



Mountain bike tracks in the Sturt Gorge Recreation Park south of Craigburn Road

## CONSTRAINTS AND OPPORTUNITIES

The bush trails for walking and mountain bike riding are shown in the Council and Blackwood Park developer brochures for the Blackwood Hill Reserve and the Sturt Gorge Recreation Park respectively in Figure 3.10 and Figure 3.11.

### Figure 3.10: Blackwood Hill Reserve Walking Trails



Source: City of Mitcham trails brochure.

**Figure 3.11: Walking and Mountain Bike Trails Brochure in the Sturt Gorge Recreation Park**



Source: Blackwood Park trails brochure.

## 3.2. Opportunities

Opportunities for the western bypass and link road connections exist with potential crossings of the railway line and between the existing residential estates in Craighburn Farm. Based on a site visit by the study team, the following locations were considered in the development of the road alignment options.

Connections over the railway line between Craighburn Road and the Blackwood Hill Reserve to Shepherds Hill Road may be possible at Colebrook Drive and Northcote Road as shown Figure 3.12.

**Figure 3.12: Opportunities to Connect over the Railway Line at Northcote Road and Colebrook Drive**



Railway line is located in a cutting between Colebrook Drive and Northcote Road where a new bridge could be built to connect the Blackwood Hill Reserve and Shepherds Hill Road



Looking north from the railway line to Northcote Road with the bushland on the westside and houses on the east side of the street

Further to the north-eastern end of the Blackwood Hill Reserve, a roadway bridge could be considered to connect Beaconsfield Road south of the Blackwood High School to Trevor Terrace on the south-eastern side of the railway line as shown in Figure 3.13.

**Figure 3.13: Beaconsfield Road Pedestrian Bridge over the Railway Line**



Existing pedestrian and cyclist only bridge over the railway line between Beaconsfield Road and Trevor Terrace



Footpath leading from the pedestrian bridge to Trevor Terrace between two existing house lots



Eastern end of Beaconsfield Road with gum trees which will be a constraint for any new roadway bridge

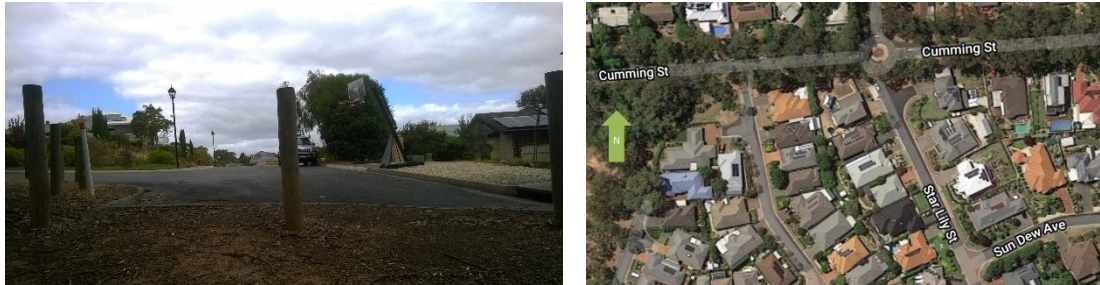


Looking east from the end of Beaconsfield Road

## CONSTRAINTS AND OPPORTUNITIES

The existing cul-de-sac at the northern end of Star Lily Street as shown in Figure 3.14 could be removed to provide more direct and faster link to Brighton Parade, especially during bushfire emergencies. However, this would attract more traffic in Star Lily Street and consequently create more noise and loss of local amenity for the residents in the street.

**Figure 3.14: Cul-de-sacs at the northern end of Verdelho Street and Star Lily Street south of Cumming Street**



In early 2019, the Blackwood Park residential estate is about 80 per cent completed with Nodes 1 and 2 completely established. Node 3 of the Meridian precinct is still under development with lots for sale as shown in Figure 3.15. The potential new road links between Nodes 1 and 2, and between Nodes 2 and 3 are shown on this Blackwood Park plan.

**Figure 3.15: Blackwood Park Residential Development Areas**



Source: Meridian development brochure modified by GTA, 2019.

## CONSTRAINTS AND OPPORTUNITIES

Potential opportunities to connect Nodes 1, 2 and 3 with additional connecting local access or link roads between Nodes 1 and 2, and Nodes 2 and 3 are shown in Figure 3.16 and Figure 3.17 respectively. Both of these link roads would impact the public open space, require the removal of trees and flora and need to cross small gullies.

Figure 3.16: Potential Local Street Connections between Nodes 1 and 2 in Craigburn Farm



Source: Google maps modified by GTA.

Figure 3.17: Potential Local Street Connections between Nodes 2 and 3 in Craigburn Farm



Source: Google maps modified by GTA.

## CONSTRAINTS AND OPPORTUNITIES

In order to provide an alternate emergency access for the residents in the Node 3 (Meridian) section of the new housing development of Blackwood Park, a potential road connection between Blackwood Park Boulevard in the southern part of Craighburn Farm to Murrays Hill Road/Coromandel Parade may be possible through the Horners Corners bushwalking trails of the Sturt Gorge Recreation Park, as shown in . It would provide a faster and safer egress than the existing route via Blackwood Park Boulevard, Fergusson Avenue and Grand Boulevard to access Coromandel Parade. However, it would sever the planned new housing estate east of Blackwood Park Boulevard and significantly impact the recreational walking routes through the Horners Corners area.

**Figure 3.18: Potential Connection Between Blackwood Park Boulevard and Murrays Hill Road**



Source: Google maps modified by GTA.

## 4. WESTERN BYPASS ALIGNMENT OPTIONS

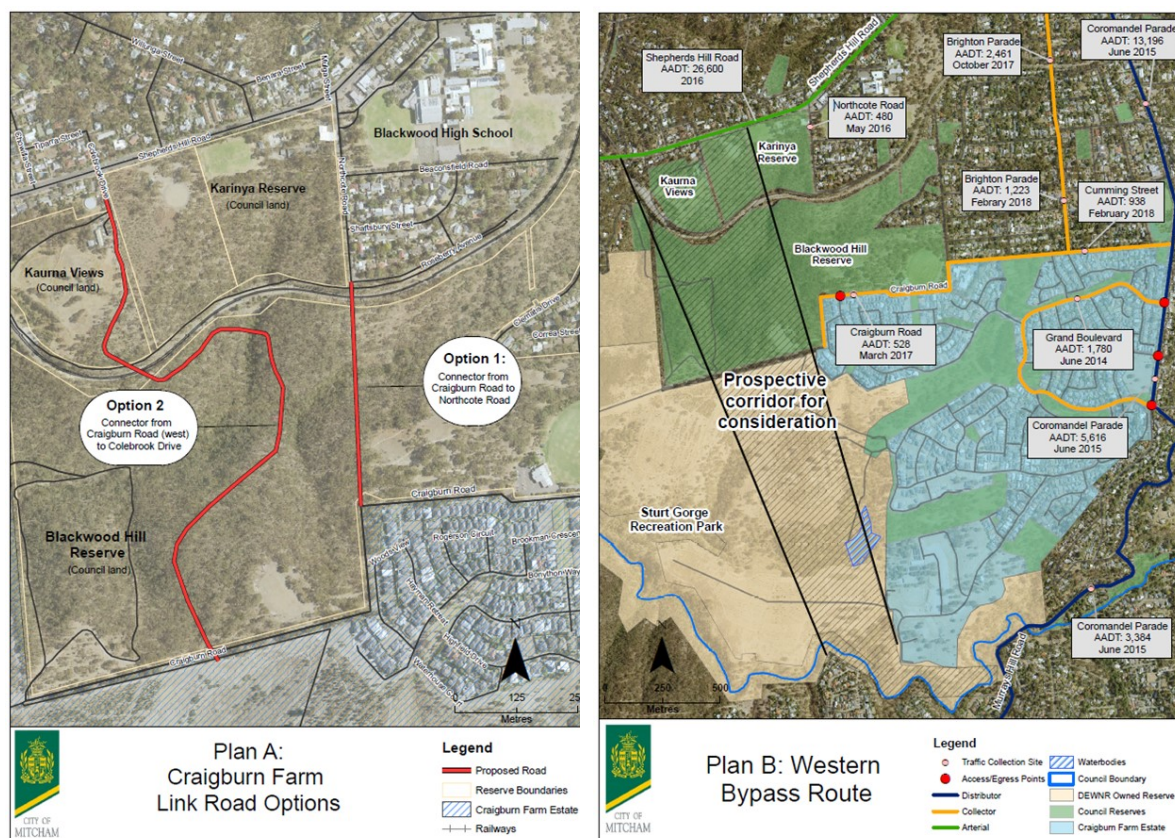
### 4.1. Bypass and Link Road Alignment Options

#### 4.1.1. Preliminary Road Alignment Options

Two stakeholder workshops were held during the feasibility study with representation from officers from the City of Mitcham and DPTI. The first workshop was held to develop the road alignment options and the second workshop was to discuss the findings of the Strategic Merit Test of the long list of options. The preliminary road options developed by the City of Mitcham, as shown in Figure 4.1, were considered as part of the assessment, namely:

- A link road that connects Craighburn Farm to Shepherds Hill Road that was developed and modified as Option 1.
- A new western bypass road along the western edge of the Craighburn Farm estate connecting Murrys Hill Road, Coromandel Valley in the south to Northcote Road and Shepherds Hill Road, Blackwood in the north and with possible links to the Craighburn Farm residential estate. This was the basis for Option 2.

Figure 4.1: Initial Bypass and Link Road Options from the City of Mitcham



Link Road options between Craighburn Road and Shepherds Hill Road

Corridor for the Western Bypass Road

## WESTERN BYPASS ALIGNMENT OPTIONS

The alignments for these two alignment options were developed further considering the typographic, physical, environmental and social constraints through the Blackwood Hill Reserve and the Sturt Gorge Recreation Park.

### 4.1.2. Bypass and Link Road Alignments Options

The western bypass and link road alignment options with a short description and length of these options are provided in and are shown on the overview plan in Table 4.1. These alignment options that were refined at Workshop #1 with the key stakeholders from the City of Mitcham and DPTI are shown in Figure 4.2.

**Table 4.1: Alignment Options for the Western Bypass and Link Roads in Craigburn Farm**

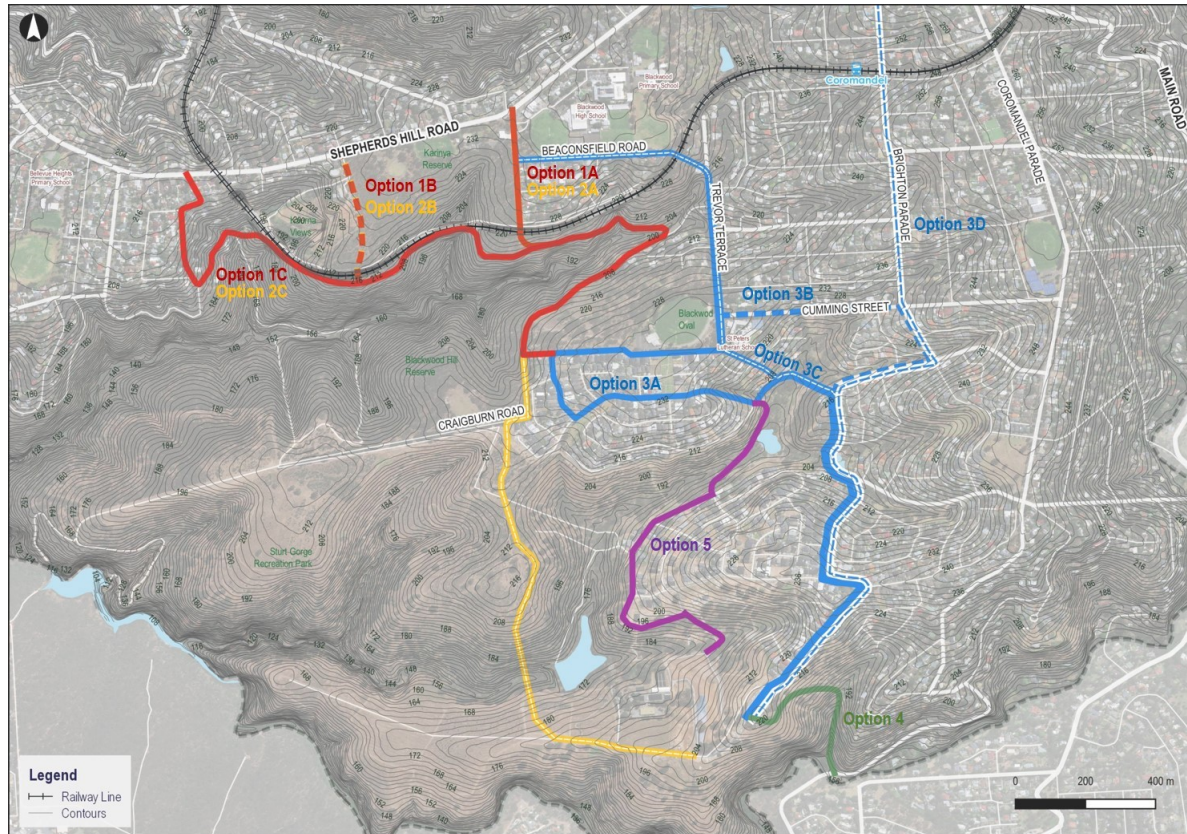
| Option | Option Name                                      | Option Description                                                                          |
|--------|--------------------------------------------------|---------------------------------------------------------------------------------------------|
| 1A     | Northcote Road connection                        | Connector from Craigburn Road to Northcote Road via Blackwood Hill Reserve                  |
| 1B     | Colebrook Drive connection                       | Connector from Craigburn Road to Colebrook Drive via Blackwood Hill Reserve                 |
| 1C     | Mountbatten Road connection                      | Connector from Craigburn Road to Mountbatten Road via Blackwood Hill Reserve                |
| 2A     | Blackwood Park to Northcote Road                 | Connector from Blackwood Park Boulevard to Northcote Rd via Sturt Gorge Recreation Park     |
| 2B     | Blackwood Park to Colebrook Drive                | Connector from Blackwood Park Boulevard to Colebrook Drive via Sturt Gorge Recreation Park  |
| 2C     | Blackwood Park to Mountbatten Road               | Connector from Blackwood Park Boulevard to Mountbatten Road via Sturt Gorge Recreation Park |
| 3A     | Beaconsfield Road connection via Craigburn Road  | Trevor Terrace to Beaconsfield Road from Craigburn Road                                     |
| 3B     | Beaconsfield Road connection via Cumming Street  | Trevor Terrace to Beaconsfield Road from Cumming Street and Star Lily Street                |
| 3C     | Beaconsfield Road connection via Lutheran School | Trevor Terrace to Beaconsfield Road via Lutheran School access                              |
| 3D     | Star Lily Street connection to Brighton Parade   | Connection from Creswell Avenue to Brighton Parade via Star Lily Street                     |
| 4      | Horners Corners connection                       | Blackwood Park Boulevard to Murrays Hill Road/Coromandel Parade via Horners Corners         |
| 5      | Blackwood Park Nodes 1, 2 and 3 connections      | Connections between Highfield Drive and Gartrell Boulevard and Symon Crescent               |

The bypass road was assumed to have a 50 km/h posted speed limit with a design application of 50 km/h plus 10 km/h for 60 km/h. This design speed assumption applies for all bypass and link road alignment options.

The function of these bypass and link road options are intended primarily for bushfire emergency egress, but they would allow for local traffic access at any time. A fire track type access road with a spray-sealed roadway was considered, but a thin bituminous sealed road was considered for this feasibility study to allow for all vehicle types, albeit with low volumes of traffic on these bypass or link roads. However, the assumption of a bituminous sealed road increases the capital cost to construct and the costs for the on-going road maintenance. This roadway treatment was assumed for all options.

## WESTERN BYPASS ALIGNMENT OPTIONS

Figure 4.2: Alignment Options for the Western Bypass and Link Roads in Craighurn Farm



## 4.1.3. Geometric design assumptions

A preliminary geometric design assessment for each of the alignment options was prepared based on the Austroads Guide to Road Design Part 3: Geometric Design (Austroads Part 3).

The basis of the preliminary geometric design is provided in the following reference tables from Austroads Part 3.

The effect of grade on vehicle types from Table 8.2 in Austroads Part 3 are given in Table 4.2.

**Table 4.2: Effect of Grade on Vehicle Type from Austroads**

| Grade<br>(percent) | Reduction in Vehicle Speed as compared to Flat Grade (percentage) |                                    |                      |                                                                                 |                                                                                                                                                              |
|--------------------|-------------------------------------------------------------------|------------------------------------|----------------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    | Uphill                                                            |                                    | Downhill             |                                                                                 | Road Type Suitability                                                                                                                                        |
|                    | Light Vehicle                                                     | Heavy Vehicle                      | Light Vehicle        | Heavy Vehicle                                                                   |                                                                                                                                                              |
| 0 to 3             | Minimal                                                           | Minimal                            | Minimal              | Minimal                                                                         | For use on all roads                                                                                                                                         |
| 3 to 6             | Minimal                                                           | Some reduction on high speed roads | Minimal              | Minimal                                                                         | For use on low-moderate speed roads including high traffic volume roads                                                                                      |
| 6 to 9             | Largely unaffected                                                | Significantly slower               | Minimal              | Minimal for straight alignment; substantial for winding alignment.              | For use on roads in mountainous terrain. Usually need to provide auxiliary lanes if high traffic volumes                                                     |
| 9 to 12            | Slower                                                            | Much slower                        | Slower               | Significantly slower for straight alignment; much slower for winding alignment. | Need to provide auxiliary lanes for moderate-high traffic volumes. Need to consider run-away vehicle facilities if proportion of commercial vehicles is high |
| 12 to 15           | 10 to 15 km/h slower                                              | 15 per cent maximum negotiable     | 10 to 15 km/h slower | Extremely slow                                                                  | Satisfactory on low volume roads with very few or no commercial vehicles                                                                                     |
| 15 to 33           | Very slow                                                         | Not negotiable                     | Very slow            | Not negotiable                                                                  | Only to be used in extreme cases and be of short lengths with no commercial vehicles                                                                         |

The general maximum grades from Table 8.3 in Austroads Part 3 are given in Table 4.3.

**Table 4.3: General Maximum Grades for Urban Roads from Austroads**

| Operating Speed (km/h) | Terrain Type (per cent grades) |         |                |
|------------------------|--------------------------------|---------|----------------|
|                        | Flat                           | Rolling | Mountainous    |
| <b>60</b>              | 6 to 8                         | 7 to 9  | 9 to 10        |
| <b>80</b>              | 4 to 6                         | 5 to 7  | 7 to 9         |
| <b>100</b>             | 3 to 5                         | 4 to 6  | 6 to 8         |
| <b>120</b>             | 3 to 5                         | 4 to 6  | Not applicable |
| <b>130</b>             | 3 to 5                         | 4 to 6  | Not applicable |

Note: Values closer to the lower figures should be aimed for on primary highways. Higher values may be warranted to suit local conditions. For unsealed surfaces, these values should be reduced by 1 per cent.

## WESTERN BYPASS ALIGNMENT OPTIONS

The desirable maximum lengths of grades from Table 8.4 in Austroads Part 3 are given in Table 4.4.

**Table 4.4: Desirable Maximum Lengths of Grades from Austroads**

| Grade (percentage) | Maximum Length of Road (m) |
|--------------------|----------------------------|
| 2 to 3             | 1,800                      |
| 3 to 4             | 900                        |
| 4 to 5             | 600                        |
| 5 to 6             | 450                        |
| > 6                | 300                        |

### 4.1.4. Geometric assessment of the bypass and link road alignment options

A high-level geometric assessment of the road alignment options is provided in this section with a more detailed assessment of the geometric issues and constraints for each option given in Section 4.2. This geometric assessment of the 12 bypass and link road alignment options is provided in Table 4.5. It is based on the following assumptions:

- The desired maximum grade for a 60 km/h road is therefore 10 per cent and grades greater than this will greatly reduce the speed of the vehicles and the type of vehicles that are able to utilise the road. Gradients of up to 12 per cent were tested for Options 3, 4 and 5. However, where these grades are exceeded, the length of the road can be increased to reduce the grade where possible. The maximum lengths of grades will also need to be considered for safety.
- In addition to the maximum grades and lengths of grades specified, Austroads provides maximum and minimum K-Values which have been adopted for the preliminary geometric design. K-values relate to sight distances over crests and through sag locations using formulae relating to the incoming and outgoing grades through the sag or crest, as well as the length of the transition. Higher than minimum K-values are desirable for both sags and crests. At sag locations most assessed areas achieved K-Values of 15 or greater, however the minimum achieved K-Value was 10. Similarly, at crests, most locations achieved K-Values greater than 15 however minimum K-Values of 10 was adopted.
- The lidar data was used at 2 m contours. The accuracy of this type of data is varied and a detailed survey would be required if any of these options are developed further.

**Table 4.5: Geometric Assessment of Road Alignment Options**

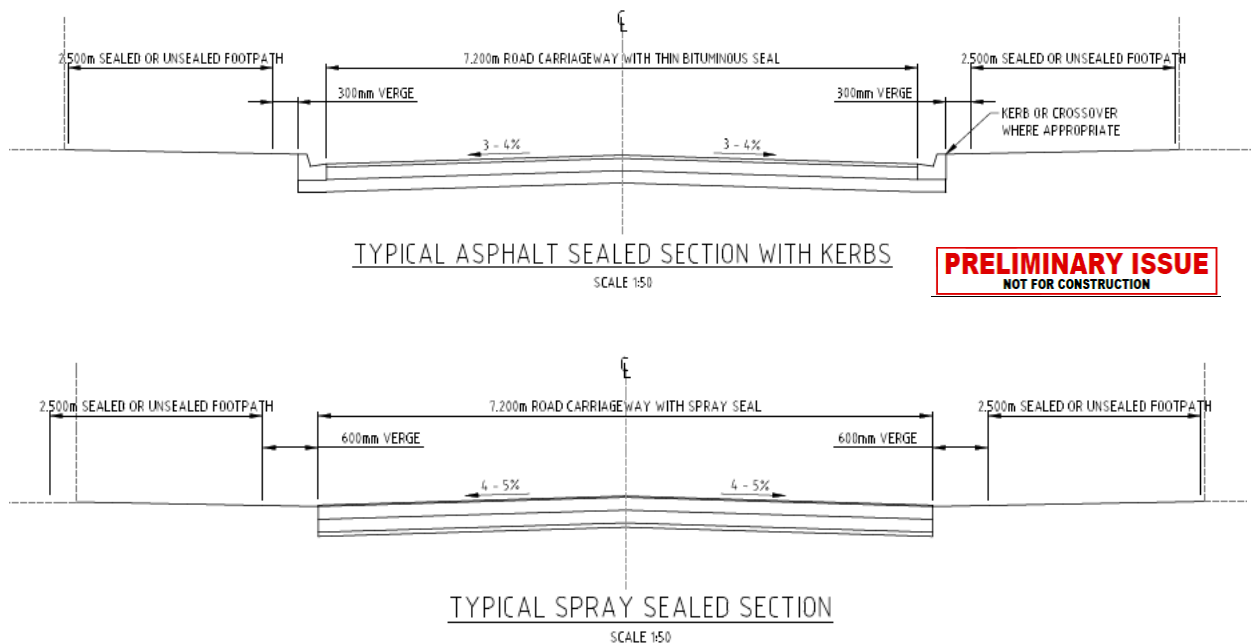
| Option | Option Description                 | Geometric Assessment                                                                                                                                                                                                                                                                 |
|--------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1A     | Northcote Road connection          | Preliminary geometric design complies to Austroads. 8 m elevated bridge over railway                                                                                                                                                                                                 |
| 1B     | Colebrook Drive connection         | Preliminary geometric design complies to Austroads. 11 m elevated bridge over railway. Up to 4 m of fill in non-bridge locations along the railway.                                                                                                                                  |
| 1C     | Mountbatten Road connection        | Preliminary geometric design complies to Austroads. Number of fill locations along the railway.                                                                                                                                                                                      |
| 2A     | Blackwood Park to Northcote Road   | Very difficult to achieve correct grades through Sturt Gorge area. 15 - 20 m high bridge unavoidable at 9 per cent, At a design grade of 12-13 per cent only reduces this by a little. It is similar to Option 1A north of Craighorn Road and Node 1 of the residential development. |
| 2B     | Blackwood Park to Colebrook Drive  | Very difficult to achieve correct grades through Sturt Gorge area. 15 - 20 m high bridge unavoidable at 9 per cent, 12-13 per cent only reduces this by a little. It is similar to Option 1B north Craighorn Road and Node 1 of the residential development.                         |
| 2C     | Blackwood Park to Mountbatten Road | Very difficult to achieve correct grades through Sturt Gorge area. 15 - 20 m high bridge unavoidable at 9 per cent, 12-13 per cent only reduces this by a little. It is similar to Option 1C north of Craighorn Road and Node 1 of the residential development.                      |

## WESTERN BYPASS ALIGNMENT OPTIONS

| Option | Option Description                               | Geometric Assessment                                                                                                                                                                                                                                                                                                                           |
|--------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3A     | Beaconsfield Road connection via Craighurn Road  | Geometric design over railway does not work with relation to Austroads within such a short distance to make up vertical grade. Shown as 15 per cent, but adequate clearance over railway is still not achieved. The suitability of the rest of the existing alignment has not been assessed.                                                   |
| 3B     | Beaconsfield Road connection via Cumming Street  | Geometric design over railway does not work with relation to Austroads within such a short distance to make up vertical grade. Shown as 15 per cent, but clearance over railway is still not achieved. Suitability of the rest of the existing alignment has not been assessed.                                                                |
| 3C     | Beaconsfield Road connection via Lutheran School | Geometric design over railway does not work with relation to Austroads within such a short distance to make up vertical grade. Shown as 15 per cent, but clearance over railway is still not achieved. Suitability of the rest of the existing alignment has not been assessed.                                                                |
| 3D     | Star Lily Street connection to Brighton Parade   | Suitability of existing alignment has not been assessed.                                                                                                                                                                                                                                                                                       |
| 4      | Horners Corners connection                       | The grade through this option is too steep (up to 13.5 per cent) and the length of this steep section is greater than the requirements of Austroads (450 m). A 4 m high bridge is to be constructed to meet vertical curve requirements. The road can be lengthened which may provide options to reduce the length and grade of the alignment. |
| 5      | Blackwood Park Nodes 1, 2 and 3 connections      | Preliminary geometric design complies to Austroads. Minor culvert bridges would be required to allow stormwater to flow under roads.                                                                                                                                                                                                           |

The road design for the Craighurn Farm western bypass or link road was assumed to be a sealed two-lane road with a width of 7.2 m and a posted speed limit of 50 km/h. Two indicative cross-sections for the roadway with an asphalt-sealed treatment with kerbs and a spray-sealed section with no kerbs is shown in Figure 4.3.

**Figure 4.3: Indicative Cross-section for the Craighurn Farm Western Bypass Road**



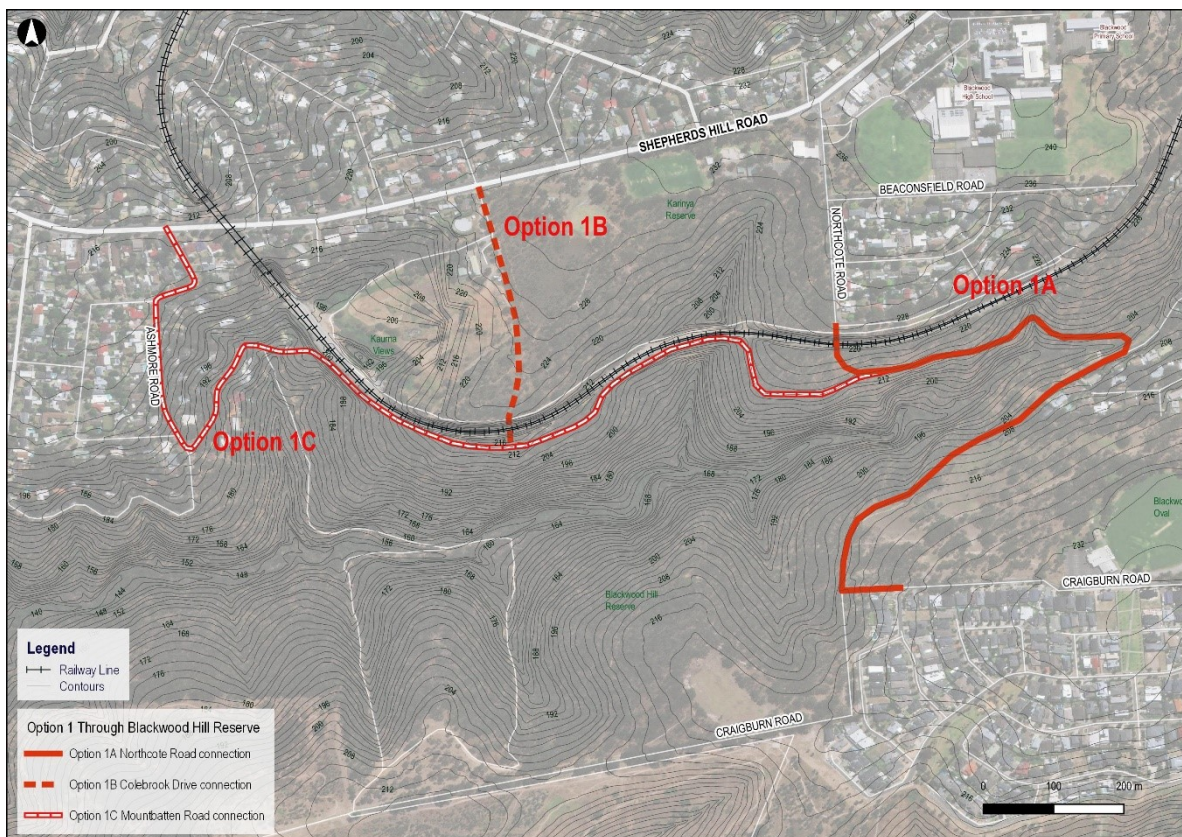
## 4.2. Alignments for the Bypass and Link Road Options

Strategic level alignment concept drawings were prepared for each of the short-listed bypass or link road alignment options and are included in Appendix O. These drawings only show the preliminary concept alignment plans for the short-listed alignment options for both the access and bypass links. These concept drawings exclude detailed vertical and horizontal design. For each alignment option the advantages and disadvantages are provided.

### 4.2.1. Options 1A, 1B and 1C between Craighurn Road and Shepherds Hills Road through the Blackwood Hill Reserve

Alignment options 1A, 1B and 1C between Craighurn Road and Shepherds Hill Road through the Blackwood Hill Reserve are shown in Figure 4.4. Options 1A and 1B require bridges over the railway line.

**Figure 4.4: Road Alignment Options 1A, 1B and 1C through the Blackwood Hill Reserve**



The advantages of these three alignment options are:

- A short bushfire emergency egress road around the eastern and northern end of the Blackwood Hill Reserve is provided with the benefits going to residents in Node 1 of the Craighurn Farm estate south of Craighurn Road, north of Highfield Drive and west of Grand Boulevard.
- Access for pedestrians and cyclists is improved from north of the railway line to the Blackwood Hill Reserve.
- Impacts on the Bush for Life land in the reserve are avoided by the alignment diverting around the eastern periphery of the Blackwood Hill Reserve.
- Construction impacts and capital costs are lower than in Options 2A, 2B and 2C that extend through the Sturt Gorge Recreation Park.

The disadvantages of these three alignment options are:

- The route through or around the Blackwood Hill Reserve does not reduce the bushfire emergency risk because residents from Node 1 of Craighburn Farm would exit via a bushfire prone area through the reserve. The Country Fire Service (CFS) would not support these options that would increase the risk to human life and property during a bushfire emergency. This was discussed by the CFS representative during Workshop #2.
- Additional traffic and noise will likely be generated through the local streets of Craighburn Farm to access this connection road via the Blackwood Hill Reserve which will affect the amenity, safety and noise for the residents.
- All options will require upgrades and potentially traffic signals at the intersections that connect to Shepherds Hill Road in order to manage the additional traffic and safety requirements, in particular, at Shepherds Hill Road with:
  - Northcote Road for Option 1A;
  - Colebrook Drive for Option 1B; and
  - Ashmore Road for Option 1C via Mountbatten Road.
- These options do not provide a strategic bypass route of Craighburn Farm and minimally reduce the traffic at the Blackwood roundabout. A new two-lane bypass roadway with the indirect route through the bushland would not be attractive for non-local or traffic bypassing Blackwood and it would continue to use the Blackwood roundabout.
- The road design is complex with the need for bridges over the railway line with Options 1A and 1B. The location of the bridge abutments will impact on bushland on the north and south side of the railway line and the houses in Northcote Road for Option 1A.
- The capital costs are high with the benefits not likely to justify with the indirect route likely only to be used by residents of Craighburn Farm and not used as a bypass route of the Blackwood roundabout.

## WESTERN BYPASS ALIGNMENT OPTIONS

### 4.2.2. Options 2A, 2B and 2C between Murrays Hill Road and Shepherds Hill Road

Alignment options 2A, 2B and 2C between Murrays Hill Road and Shepherds Hill Road via the Sturt Gorge Recreation Park and Blackwood Hill Reserve are shown in Figure 4.5. Options 2A and 2B require bridges over the railway line. These three options through the Sturt Gorge Recreation Park will require a major bridge structure over the steep valley west of Node 3 of the Blackwood Park estate.

**Figure 4.5: Road Alignment Options 2A, 2B and 2C through the Sturt Gorge Recreation Park**



The advantages of these three alignment options are:

- Provides bushfire emergency egress road through and around the Blackwood Hill Reserve for residents in Node 1 of the Craigburn Farm estate south of Craigburn Road, north of Highfield Drive and west of Grand Boulevard and through the Sturt Gorge Recreation Park for residents in Node 3 of the new Meridian residential development in Blackwood Park at the southern terminus of Blackwood Park Boulevard.
- Improves access for pedestrians and cyclists from north of the railway line to the Blackwood Hill Reserve.
- Improves access for pedestrians and mountain bike riders from the southern part of Blackwood Park to the trails in the Sturt Gorge Recreation Park.
- Impacts on the Bush for Life land in the reserve are avoided by the alignment around the eastern periphery of the Blackwood Hill Reserve.
- No properties would need to be acquired or purchased for these road options.

The disadvantages of these three alignment options are:

- The route through the Blackwood Hill Reserve and Sturt Gorge Recreation Park does not reduce the bushfire emergency risk because residents from the Craigburn Farm Node 1 (north near Craigburn Road) and Node 3 at the southern end of Blackwood Park Boulevard would need to exit via a bushfire prone area through the reserve and recreation park to the north to access Shepherds Hill Road. The Country Fire Service (CFS) would not

support these options that would increase the risk to human life and property during a bushfire emergency. This was discussed by the CFS representative during Workshop #2.

- Additional traffic and noise will likely be generated through the local streets of Craighburn Farm to access this connection road via the Blackwood Hill Reserve, Craighburn Road or via Blackwood Park Boulevard which will affect the amenity, safety and noise for the local residents, in particular in Nodes 1 and 3 of the residential estate.
- These options do not provide a strategic bypass route and would minimally reduce the traffic at the Blackwood roundabout. A new two-lane bypass roadway with the indirect route through the bushland would not be attractive for non-local or traffic bypassing Blackwood and it would continue to use the Blackwood roundabout.
- All options will require upgrades and potentially traffic signals at the intersections that connect to Shepherds Hill Road in order to manage the additional traffic and safety requirements, in particular, at Shepherds Hill Road with:
  - Northcote Road for Option 2A;
  - Colebrook Drive for Option 2B; and
  - Ashmore Road for Option 2C via Mountbatten Road.
- The road design is complex with the need for bridges over the railway line with Options 2A and 2B. The location of the bridge abutments will impact on bushland on the north and south side of the railway line and the houses in Northcote Road for Option 2A.
- The section of the road south of Craighburn Road for all three options will require significant high-level road bridges to be built over the Sturt Gorge through the Sturt Gorge Recreation Park with high capital costs, constructability challenges with the bridge abutments and footings, and major impacts to severance of the walking and mountain bike trails and the flora and fauna in the bushland park.
- The constructability of these road options would be difficult with access for heavy construction vehicles required to operate through the residential estates, impacting the amenity of the residents during the construction period.
- The capital costs for all options are very high with the benefits not likely justify with the indirect route likely only to be used by residents of Craighburn Farm and not used as a bypass route of the Blackwood roundabout.

## WESTERN BYPASS ALIGNMENT OPTIONS

### 4.2.3. Options 3A, 3B, 3C and 3D-through Craighburn Farm to Shepherds Hill Road via Beaconsfield Road or Brighton Parade

Alignment options 3A, 3B and 3C between Craighburn Farm (Node 1) and Shepherds Hill Road via Trevor Terrace and Beaconsfield Road or option 3D via Star Lily Street and Brighton Parade are shown in Figure 4.6. Options 3A, 3B and 3C require a new bridge over the railway line connecting Trevor Terrace to Beaconsfield Road with access to Shepherds Hill Road via Northcote Road. No new structures are required for Option 3D.

**Figure 4.6: Road Alignment Options 3A, 3B, 3C and 3D through Craighburn Farm**



The advantages of these alignment options are:

- A bushfire emergency egress route will be provided via a new road bridge between Trevor Terrace and Beaconsfield Road for Options 3A, 3B and 3C. This would improve access for residents in Nodes 1, 2 and 3 of Craighburn Farm via the internal street network to Trevor Terrace.
- Option 3D improves local access for residents from Nodes 2 and 3 of Craighburn Farm via a new link to Shepherds Hill Road along Star Lily Street to Brighton Parade as an alternative to Grand Boulevard and Coromandel Parade via the Blackwood roundabout.
- All options provide some potential traffic relief on the Blackwood roundabout with an alternative route connecting to Shepherds Hill Road.
- No impacts to pedestrian and mountain bike trails and minimal impacts to flora and fauna through the bushland except near the new road bridge connection to Beaconsfield Road for Options 3A, 3B and 3C.
- Relatively low capital cost for Option 3D via Star Lily Street and easier constructability than the other options.
- Except for the new bridge, the constructability of the options is much easier than the other options with the use of the existing local streets.

## WESTERN BYPASS ALIGNMENT OPTIONS

The disadvantages of these alignment options are:

- Up to two properties between the railway line and Trevor Terrace may need to be acquired or be impacted with severance issues for the new road and bridge over the railway line to Beaconsfield Road.
- Option 3C requires access through the Lutheran School that would need to be negotiated for a public road to be built between Trevor Terrace at Craigburn Road and Dunsford Street. This option would also generate more traffic along Dunsford Street which is currently a quiet cul-de-sac and therefore it would impact the amenity for the residents.
- More traffic would be generated along the local streets impacting the residents with concerns about noise, safety and amenity. Option 3A would have more traffic along Highfield Drive and Craigburn Road to access Trevor Terrace. Option 3C would introduce traffic on the western side of the Lutheran School to access Trevor Terrace. Options 3B and 3C would have more traffic along Star Lily Street that is currently a cul-de-sac.

### 4.2.4. Option 4 between Blackwood Park Boulevard and Murrays Hill Road

Alignment option 4 between Blackwood Park Boulevard in Craigburn Farm and Murrays Hill Road via Horners Corner is shown in Figure 4.7. When combined with Options 2A, 2B or 2C, it would provide a full bypass road of all three nodes of in the Craigburn Farm residential estate for emergency egress to the south to Black Road. No new structures are required for the Option 4 between Blackwood Park Boulevard and Murrays Hill Road.

**Figure 4.7: Road Alignment Option 4 through Horners Corners**



## WESTERN BYPASS ALIGNMENT OPTIONS

The advantages of this alignment option are:

- A shorter bushfire emergency route would be provided for the residents in Node 3 of Craighburn Farm or the southern part of Blackwood Park to the south to Murrays Hill Road and Black Road. They currently must exit via Blackwood Park Boulevard, Fergusson Avenue and Grand Boulevard to Coromandel Parade or Diosma Drive.
- The road would provide an improved access for residents of the southern part of Blackwood Park.

The disadvantages of this alignment option are:

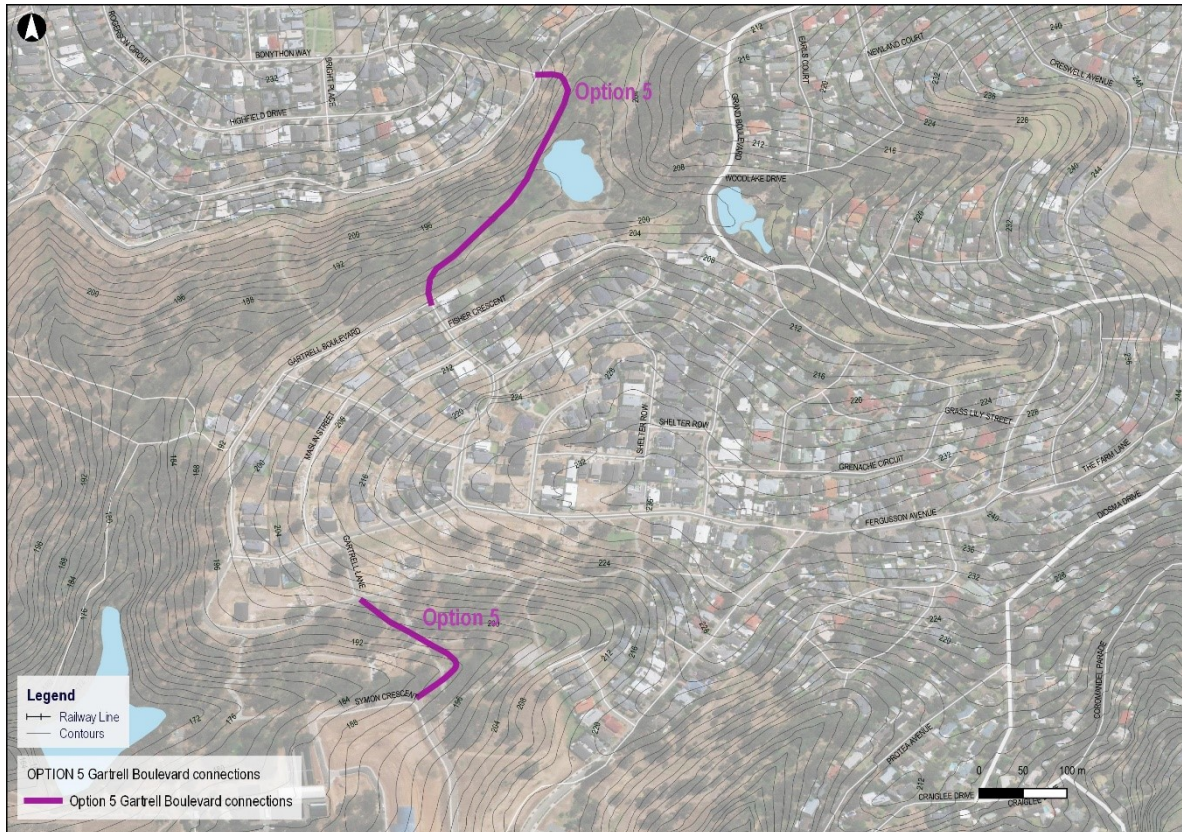
- The roadway would significantly impact on the bushwalking trails of Horners Corners within the Sturt Gorge Recreation Park.
- The new road would bisect the large lot estate east of Blackwood Park Boulevard that is always planned as part of the Meridian development.
- The new road would significantly remove native bushland and impact negatively on the flora and fauna in Horners Corners part of the Sturt
- The intersection of the new road through Horners Corners with Murrays Hill Road and Coromandel Parade with a T-junction or roundabout with impact the road safety and traffic efficiency along Murrays Hill Road and Coromandel Parade. This intersection would need approval from the DPTI traffic operations division.
- This option would be likely classified as a connector road that would be the responsibility for the City of Mitcham to build and provide the on-going asset maintenance.

## WESTERN BYPASS ALIGNMENT OPTIONS

### 4.2.5. Option 5 connecting Blackwood Park and Craighurn Farm

Alignment option 5 between Nodes 1, 2 and 3 in Craighurn Farm is shown in Figure 4.8. No new major structures are required for Option 5. However, culverts and drains will be necessary for drainage purposes for a new roadway to cross the lower terrain between the residential estates.

**Figure 4.8: Road Alignment Option 5 connecting Nodes 1, 2 and 3 in Craighurn Farm**



The advantages of this alignment option are:

- The road connectivity between Nodes 1 and 2, and Nodes 2 and 3 in the Craighurn Farm residential estates would be improved with shorter routes for some residents. However, other residents would have more traffic in their streets.
- These link roads have relatively low capital costs to build. However, they would be local streets for the City of Mitcham to maintain.

The disadvantages of this alignment option are:

- Limited benefits to residents for improved emergency egress during a major bushfire.
- More traffic would be generated along the local streets impacting the residents with concerns about noise, safety and amenity.
- The public open space and bushland between Nodes 1 and 2, Nodes 2 and 3 would be significantly impacted, including the community playgrounds.
- These link roads would be additional road assets for the City of Mitcham to maintain.

## 4.3. High Order Cost Estimates

High-order cost ranges were estimated to support the options to provide the assessment scoring for the Strategic Merit Test. The high-order road infrastructure costs assumed the following:

- Bridge over rail \$ 4 – 6 million
- Embankment works \$ 2 – 4 million
- Bridge culverts < \$ 1 million
- Brighton road upgrade \$ 1 – 2 million
- Property purchases \$ 1 – 2 million
- Significant bridges >\$ 50 million

The strategic cost estimates and assumptions are provided in Table 4.6. The costs for the estimate ranges are assumed to be in 2019 dollars and only include a high order estimate of the direct construction costs for the infrastructure to build the roadway, structures, drainage and necessary environmental remediation and construction traffic management. They exclude contract management, project management costs and escalation costs.

**Table 4.6: High Order Cost Estimates for the Road Alignment Options**

| Option | Option Description                               | Assumptions                                                                                                                                                                                                                                                                             | Cost (\$1M)   |
|--------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1A     | Northcote Road connection                        | One bridge over the railway line; 3 small culvert bridges over the valleys through the Blackwood Hill Reserve                                                                                                                                                                           | \$7 to \$9 M  |
| 1B     | Colebrook Drive connection                       | One bridge over the railway line; 4 small culvert bridges over the valleys through the Blackwood Hill Reserve; embankment works                                                                                                                                                         | \$9 to \$12 M |
| 1C     | Mountbatten Road connection                      | 5 small culvert bridges over the valleys through the Blackwood Hill Reserve; embankment works                                                                                                                                                                                           | \$4 to \$6 M  |
| 2A     | Blackwood Park to Northcote Road                 | One significant bridge (up to 25 m height) over the Sturt Gorge; One bridge over the railway line; 3 small culvert bridges over the valleys through the Blackwood Hill Reserve; other infrastructure                                                                                    | > \$50 M      |
| 2B     | Blackwood Park to Colebrook Drive                | One significant bridge (up to 25 m height) over the Sturt Gorge; One bridge over the railway line; 4 small culvert bridges over the valleys through the Blackwood Hill Reserve; other infrastructure                                                                                    | > \$50 M      |
| 2C     | Blackwood Park to Mountbatten Road               | One significant bridge (up to 25 m height) over the Sturt Gorge; 5 small culvert bridges over the valleys through the Blackwood Hill Reserve; other infrastructure                                                                                                                      | > \$50 M      |
| 3A     | Beaconsfield Road connection via Craighburn Road | One bridge over the railway line connecting Trevor Terrace to Beaconsfield Road; property purchases required next to Trevor Terrace; one culvert bridge over a valley                                                                                                                   | \$5 to \$7 M  |
| 3B     | Beaconsfield Road connection via Cumming Street  | One bridge over the railway line connecting to Beaconsfield Road; property purchases required; one culvert bridge over a valley; civil works connect through from Creswell Avenue at Grand Boulevard to Brighton Parade at Cumming Street with additional changes to the existing roads | \$5 to \$7 M  |
| 3C     | Beaconsfield Road connection via Lutheran School | One bridge over the railway line connecting to Beaconsfield Road; one culvert bridge over a valley; property purchases required; civil works at the Lutheran school                                                                                                                     | \$5 to \$7 M  |
| 3D     | Star Lily Street connection to Brighton Parade   | Civil works would connect through from Creswell Avenue at Grand Boulevard to Brighton Parade at Cumming Street with additional changes to the existing roads; One small culvert bridge over a valley                                                                                    | < \$2 M       |
| 4      | Horners Corners connection                       | One small culvert bridge over a valley with a creek; property purchases required east of Blackwood Park Boulevard                                                                                                                                                                       | \$2 to \$4 M  |
| 5      | Blackwood Park Node 1, 2 and 3 connections       | 3 small culvert bridges over valleys between the Blackwood Park estates                                                                                                                                                                                                                 | \$2 to \$4 M  |

## WESTERN BYPASS ALIGNMENT OPTIONS

The cost estimates were prepared by FMG Engineering in good faith and as a general guide only. Therefore, they are not to be used for any budgetary or funding commitments. These cost estimates rely on expressions of opinion based on only the portion of the market in which FMG Engineering operates. Assumptions made, while reasonable, may not be correct. These cost estimates are based on previous experience with similar contracted work and FMG Engineering accepts no responsibility for any losses incurred by clients who proceed on the basis of a cost estimate provided by us. No liability from this statement, negligence or otherwise is assumed by FMG Engineering, its subsidiaries, agents or employees for the contents of the cost estimate. Under no circumstances will FMG Engineering have any responsibility to any third party who may come into possession of this cost estimate. Before proceeding with any contract, a full current market costing should be sought from a licensed quantity surveyor or similarly qualified professional.

## 5. STRATEGIC MERIT TEST

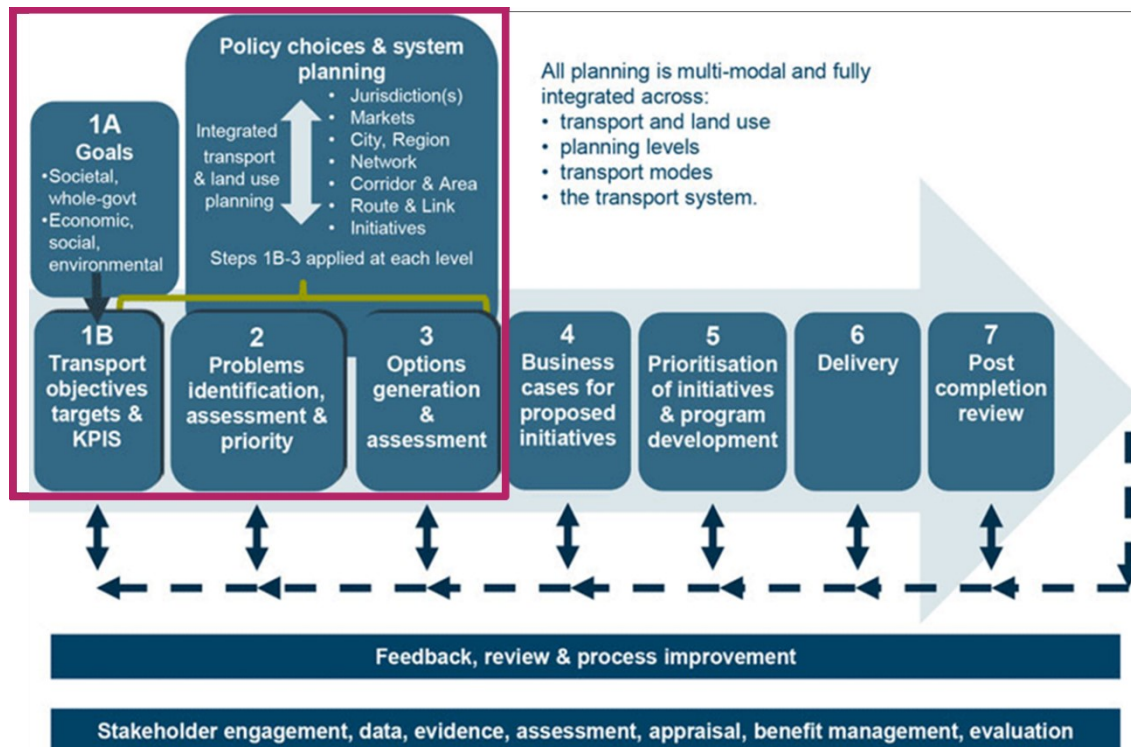
A Strategic Merit Test (SMT) was developed that considers how the proposed list of options meets the goals, objectives and strategic plans. The purpose of the SMT in option assessment is to check how well the identified options align with the economic, environmental and social goals and transport system objectives and approved strategies and policies. This enables an initial filtering of options before further assessment and development. It is intended to be an initial check for strategic merit that:

- Rules an option in or out at an early stage of the assessment process; and
- Identifies those options that should proceed to the next stage of appraisal, options that require further work and those that should be abandoned because they are inconsistent with the objectives and strategies.

### 5.1. Evaluation Framework

The Australian Transport Assessment and Planning (ATAP) framework as shown in Figure 5.1 was used to undertake the feasibility assessment for the Craigburn Farm Western Bypass/Link Road. For this feasibility study, only Steps 1A, 1B, 2 and 3 were undertaken. Steps 4 and 5 would be undertaken as part of a Stage 2 feasibility study if the bypass or link roads pass the Strategic Merit Test and are recommended for a detailed concept planning and business case, including more robust cost estimates. With the ATAP guidelines, weightings to the assessment criteria are typically not applied in the initial assessment, but only as part of a sensitivity analysis of the scores. The process involves narrowing down the list of options through a “filtering” process. Options should not be ruled out based on personal preferences, perceived political difficulties or in any way that precludes genuine consideration of certain options. Options should be judged purely on their merits and ruled out only on the basis that they do not address the problem in an efficient way.

Figure 5.1: ATAP Framework and Guidelines for Assessing Road Alignment Options



Source: ATPA Guidelines, 2018.

Based on the ATAP Framework and guidelines, the following steps were undertaken as part of the evaluation framework:

- Map the physical constraints to determine the potential roadway alignment options
- Determine a long list of potential road alignment options for the western bypass route of Craighburn Farm based on the constraints and opportunities analysis
- Conduct a "fatal flaw" assessment of the potential alignment options to filter out the options to develop a short list
- Develop and confirm the MCA assessment criteria based on a Triple Bottom Line approach
- Score the roadway alignment options for MCA criteria to determine a preferred option

### 5.1.1. Funding Application Requirements

If the Strategic Merit Test in Step 3 of the ATPM framework recommends a preferred options, the next steps are to proceed to Steps 4, 5, 6 and 7. This requires an approach to develop and prepare a full business case to support a funding application to other government agencies, such as Infrastructure Australia and the new State Government authority of Infrastructure South Australia, and will identify:

- the elements to be included in a business case,
- the strategic rationale for the proposed transport upgrades, and
- the typical economic evaluation criteria that would quantify the benefits, dis-benefits and costs for the project.

Based on the Assessment Framework published by Infrastructure Australia for funding applications, the key elements in the development of a business case for a transport infrastructure project are:

- **Strategic Context:** to provide the strategic context to support the project based on strategic planning policies and long-term goals and objectives
- **Problem Description:** to describe the problem to be addressed that includes issues for the transport system, urban development and demographic changes
- **Project Overview:** to succinctly describe the proposed transport project
- **Options Identification and Assessment:** to identify and assess the long list of options that were considered
- **Economic Evaluation:** to evaluate the benefits and costs in monetary terms based on financial and economic criteria
- **Deliverability:** to identify the level of difficulty and the risks to deliver the project.

The economic evaluation for a full business case of the preferred bypass or link road alignment would need to be in accordance with the following guidelines:

- Australian Transport Assessment and Planning Guidelines
- Infrastructure Australian Assessment Framework (March 2018)
- SA Department of Treasury and Finance, Guidelines for the evaluation of public sector initiatives.

The economic evaluation will provide the following measures of economic performance of the public transport infrastructure project:

- **Net Present Value (NPV):** the difference between the present value (PV) of total incremental benefits and the PV of the total incremental costs.
- **Benefit Cost Ratio (BCR):** ratio of the PV of total incremental benefits to the PV of total incremental costs.

A positive NPV implies that the incremental benefits of the project exceed the incremental costs in today's values. The BCR indicates the expected economic return on every dollar of investment.

A detailed Cost Benefit Analysis (CBA) should be the primary tool for undertaking a detailed appraisal of options that have passed through the first two stages of the assessment process. The detailed CBA should include:

- A robust and objective CBA supported by strong evidence
- Consideration of as many monetised benefits and costs as possible
- Consideration of non-monetised benefits and costs as well
- Consideration of the overall efficiency of an initiative (the combined scale of benefits compared to costs, usually expressed as a benefit cost ratio or BCR)
- Consideration of issues of risk and uncertainty (usually provided through sensitivity testing).
- Complementary information on the initiative's distributional (equity) impacts should be presented with the CBA.

## 5.1.2. Consultation and Community Engagement Strategy

If a preferred alignment is recommended from Strategic Merit Test, consultation and community engagement strategy will be required as part of the next steps in the ATAP assessment and approvals process. A framework for delivering a consultation, community engagement strategy and approvals by Federal, State and Local governments would include stakeholder consultation and community consultation for the following types of stakeholders who would benefit from, or be impacted by, the western bypass or link road around Craighburn Farm:

- The residents of Craighburn Farm or the Blackwood Park housing estate to minimise risk to human life and property damage.
- Users of the surrounding parklands in the Sturt Gorge Recreation Park.
- Government with minimal cost and delivery risk.
- Council that maintains the local streets and address the concerns of the residents for noise, safety and amenity.

## 5.1.3. Assessment Criteria

The assessment criteria are aligned with the goals, transport objectives and strategic planning in an assessment framework that uses a triple bottom line approach to identify economic, social and environmental benefits and impacts of each of the bypass or link road options. The assessment criteria for the evaluation framework with the criterion objectives and the quantitative value or assessment measure are given in Table 5.1. These assessment criteria were discussed with Council and DPTI stakeholders at Workshop #1 and was amended to suit the evaluation framework.

**Table 5.1: Assessment Criteria for the Strategic Merit Test**

| Number | Criterion Name                       | Criterion Objective                                                     | Triple Bottom Line Category | Quantitative Value or Assessment Measure                                                       | Proposed Weighting |
|--------|--------------------------------------|-------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------|--------------------|
| 1      | Bushfire Emergency Egress            | Maximise safe egress for residents during a bushfire emergency          | Social                      | Proportion of road lengths in bushfire high risk areas to bushfire safer places                | 15%                |
| 2      | Accessibility Improvements           | Maximise public transport patronage and active transport opportunities  | Social                      | Access to public transport, bush trails from north of railway line and bush trails from Node 3 | 5%                 |
| 3      | Impacts to Craighburn Farm Residents | Minimise impacts on residents from traffic and noise                    | Social                      | Number of houses in the residential estates along the new roadway                              | 10%                |
| 4      | Impacts on Property and Trails       | Minimise property acquisition and loss of use of walking/cycling trails | Social                      | Number of properties affected, and number of tracks and trails crossed or removed              | 10%                |

## STRATEGIC MERIT TEST

| Number | Criterion Name                              | Criterion Objective                                         | Triple Bottom Line Category | Quantitative Value or Assessment Measure                                                                                                                                              | Proposed Weighting |
|--------|---------------------------------------------|-------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| 5      | Fire Risk to Human Life and Property        | Minimise impacts to residents and property from fire damage | Environmental               | Length of roads through high risk bushfire protection area                                                                                                                            | 10%                |
| 6      | Impacts on Bushland, Flora and Fauna        | Minimise environmental impacts                              | Environmental               | Area of bushland to be cleared for new roads                                                                                                                                          | 10%                |
| 7      | Traffic Relief on Arterial Roads            | Minimise traffic impacts                                    | Economic                    | Amount of diverted traffic (daily) from Blackwood roundabout or Coromandel Parade (assuming 25% of traffic generated by residential developments along the road will use this bypass) | 15%                |
| 8      | Road Infrastructure Costs                   | Minimise cost                                               | Economic                    | Road infrastructure costs                                                                                                                                                             | 10%                |
| 9      | Impacts during Construction                 | Minimise cost                                               | Economic                    | Impact on train line, walking/cycling trails, traffic, noise and environmental impacts on creeks and vegetation                                                                       | 5%                 |
| 10     | Road Design Complexity and Constructability | Minimise cost                                               | Economic                    | Compliance to Austroads, bridge/embankments/culverts requirement                                                                                                                      | 10%                |

The following data and attributes were used in the scoring:

- Traffic and crash data (supplied by DPTI and Council)
- Road hierarchy and public transport infrastructure (railway line and bus stops)
- Existing potential infrastructure constraints
- Social and amenity impacts
- Environmental and heritage impacts
- Bushfire risk and management.

Based on the Evaluation Framework, a Strategic Merit Test of the bypass or link road alignment options was conducted with a quantitative or judgement score for each of the assessment criteria for each option. The criteria were scored by the specialists for each discipline relevant to the criterion objective. Where appropriate, quantitative values will be determined from the available data and GIS mapping analysis.

The quantitative scores as described in were measured for each bypass or link road alignment option. These values were translated into scores for each of the assessment criteria for the MCA in the Strategic Merit Test from 1 to 5 with 1 for the worst outcome to 5 for the best outcome as given in Table 5.2.

**Table 5.2: Scoring Values for the Multi-Criteria Analysis**

| Score Description | Best outcome (Very Good) | Second best outcome (Good) | Third best outcome (Neutral) | Second worst outcome (Poor) | Worst outcome (Very Poor) |
|-------------------|--------------------------|----------------------------|------------------------------|-----------------------------|---------------------------|
| Score Value       | ●5                       | ●4                         | ●3                           | ●2                          | ●1                        |

## 5.2. Scoring for the Multi-Criteria Analysis Assessment

### 5.2.1. Criterion 1 Bushfire Emergency Egress

Bushfire emergency egress assessment was measured as the proportion of road lengths to travel to bushfire safer places that are within the bushfire high risk areas. For each option, the lengths of roads for residents to travel to their nearest bushfire safer places were measured via the proposed new road option and via the most direct route along the existing roads. The lengths of the roads that are within the bushfire high risk areas were measured and the proportion of roads within the high-risk bushfire areas were calculated as percentages. The scores and measurement of Criterion 1 for each option are shown in Table 5.3.

The closest bushfire safer place for all options is the Blackwood Village Shopping Centre. The second closest bushfire safer place is Tonsley Innovation District except for Option 4, where it is closer to get to Black Road in Onkaparinga. Most proposed options will go through longer length of bushfire high risk areas compared to going through the existing roads. From the results, Option 3A, 3B, 3C, 3D, and 5 have the highest score as they are mostly using the existing road network which are currently not within the high-risk bushfire areas. Option 1, 2 and 4 all have large sections of road that will be going through the bushfire high risk areas.

**Table 5.3: Scores for Criterion 1 Bushfire Emergency Egress**

| Option | Proportion of road lengths in bushfire high risk areas to bushfire safer places                                                                                                                                                       | Score |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1A     | New option: 35% to Blackwood Village (1.2km out of 3.4km); 41% to Tonsley Innovation District (2.2km out of 5.4km)<br>Existing roads: 0% to Blackwood Village (0km out of 3km); 15% to Tonsley Innovation District (1km out of 6.6km) | ●3    |
| 1B     | New option: 58% to Blackwood Village (2.6km out of 4.5km); 47% to Tonsley Innovation District (2.6km out of 5.5km)<br>Existing roads: 0% to Blackwood Village (0km out of 3km); 15% to Tonsley Innovation District (1km out of 6.6km) | ●2    |
| 1C     | New option: 64% to Blackwood Village (3.5km out of 4.5km); 44% to Tonsley Innovation District (2.5km out of 5.7km)<br>Existing roads: 0% to Blackwood Village (0km out of 3km); 15% to Tonsley Innovation District (1km out of 6.6km) | ●2    |
| 2A     | New option: 50% to Blackwood Village (2.6km out of 5.2km); 50% to Tonsley Innovation District (3.6km out of 7.2km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 13% to Tonsley Innovation District (1km out of 8km) | ●2    |
| 2B     | New option: 63% to Blackwood Village (4km out of 6.3km); 55% to Tonsley Innovation District (4km out of 7.3km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 13% to Tonsley Innovation District (1km out of 8km)     | ●1    |
| 2C     | New option: 67% to Blackwood Village (4.9km out of 7.3km); 52% to Tonsley Innovation District (3.9km out of 7.5km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 13% to Tonsley Innovation District (1km out of 8km) | ●1    |
| 3A     | New option: 3% to Blackwood Village (0.2km out of 6.1km); 17% to Tonsley Innovation District (1.2km out of 7.2km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 13% to Tonsley Innovation District (1km out of 8km)  | ●5    |
| 3B     | New option: 2% to Blackwood Village (0.1km out of 5.5km); 17% to Tonsley Innovation District (1.1km out of 6.6km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 13% to Tonsley Innovation District (1km out of 8km)  | ●5    |
| 3C     | New option: 4% to Blackwood Village (0.2km out of 4.9km); 20% to Tonsley Innovation District (1.2km out of 6.0km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 13% to Tonsley Innovation District (1km out of 8km)  | ●5    |
| 3D     | New option: 0% to Blackwood Village (0km out of 3.2km); 14% to Tonsley Innovation District (1km out of 7.1km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 13% to Tonsley Innovation District (1km out of 8km)      | ●5    |
| 4      | New option: 51% to Blackwood Village (2km out of 3.8km); 64% to safer place on Black Road (2.5km out of 3.8km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 56% to safer place on Black Road (3.5km out of 6.2km)   | ●3    |
| 5      | New option: 16% to Blackwood Village (0.6km out of 3.8km); 17% to Tonsley Innovation District (1.6km out of 9.3km)<br>Existing roads: 0% to Blackwood Village (0km out of 3.8km); 13% to Tonsley Innovation District (1km out of 8km) | ●5    |

### 5.2.2. Criterion 2 Accessibility Improvements

The accessibility improvement criterion was measured by improvement of access to public transport, access to bush trails from north of railway line and access to bush trails from Node 3. The scores and measurement of Criterion 2 for each option are shown in Table 5.4.

A new bridge connection over the railway line is considered as an improvement for accessibility to the trails for residents north of the railway line who currently have no direct access to trails in Blackwood Hill Reserve.

Pedestrian accessibility to public transport is anticipated to have slight improvement or no improvement at all for all options. However, the new roads proposed in Option 1 and 2 will have the potential to introduce a new and more direct bus route for the Craighburn Farm residents.

**Table 5.4: Scores for Criterion 2 Accessibility Improvements**

| Option | Access to public transport, bush trails from north of railway line and bush trails from Node 3                                                                 | Score |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1A     | New bridge connection to bush trails for Northcote Road residents via bridge over railway line                                                                 | ●3    |
| 1B     | New bridge connection to Colebrook Drive                                                                                                                       | ●1    |
| 1C     | New walking connection to bush trails for Mountbatten Road residents                                                                                           | ●2    |
| 2A     | New bridge connection to bush trails for Northcote Road residents via bridge over railway line<br>Better walking access to bush trails for residents in Node 3 | ●5    |
| 2B     | New bridge connection to Colebrook Drive<br>Better walking access to bush trails for residents in Node 3                                                       | ●3    |
| 2C     | New walking connection to bush trails for Mountbatten Road residents<br>Better walking access to bush trails for residents in Node 3                           | ●4    |
| 3A     | No accessibility improvements to public transport or trails                                                                                                    | ●1    |
| 3B     | No accessibility improvements to public transport or trails                                                                                                    | ●1    |
| 3C     | Shorter walk access to public transport                                                                                                                        | ●1    |
| 3D     | No accessibility improvements to public transport or trails                                                                                                    | ●1    |
| 4      | Slight improvement on walking access to bus stops on Murrays Hill Road                                                                                         | ●1    |
| 5      | Slight improvement on walking access between Node 2 and Node 3                                                                                                 | ●1    |

### 5.2.3. Criterion 3 Impacts to Craighburn Farm Residents

The impacts to Craighburn Farm residents in terms of noise and odour is measured by the number of houses in the residential estates along the roadway. The scores and measurements of Criterion 3 for each option are shown in Table 5.5. Option 1A, 1B and 4 have the least number of houses along the proposed road options therefore scoring the highest number.

**Table 5.5: Scores for Criterion 3 Impacts to Craighburn Farm Residents**

| Option | Number of houses in the residential estates along the roadway | Score |
|--------|---------------------------------------------------------------|-------|
| 1A     | 60 houses                                                     | ●5    |
| 1B     | 27 houses                                                     | ●5    |
| 1C     | 81 houses                                                     | ●4    |
| 2A     | 271 houses                                                    | ●1    |

| Option | Number of houses in the residential estates along the roadway | Score |
|--------|---------------------------------------------------------------|-------|
| 2B     | 238 houses                                                    | ●2    |
| 2C     | 292 houses                                                    | ●1    |
| 3A     | 216 houses                                                    | ●2    |
| 3B     | 176 houses                                                    | ●3    |
| 3C     | 138 houses                                                    | ●3    |
| 3D     | 199 houses                                                    | ●2    |
| 4      | 11 houses                                                     | ●5    |
| 5      | 75 houses                                                     | ●4    |

## 5.2.4. Criterion 4 Impacts to Property and Trails

The measurement for Criterion 4 is based on the number of property acquisition and number of tracks and trails that will be dissected or removed. Property acquisition was assigned with a higher weighting than impact on bushland trails. The scores and measurements of Criterion 4 for each option are shown in Table 5.6.

Option 3A, 3B and 3C were assigned with a lower score as the connection between Beaconsfield Road and Trevor Terrace would require property acquisition of existing residential house. Option 3C would require additional land acquisition of the Lutheran School and impacting on the existing school car park.

**Table 5.6: Scores for Criterion 4 Impacts to Property and Trails**

| Option | Number of properties affected, and number of tracks and trails crossed or removed | Score |
|--------|-----------------------------------------------------------------------------------|-------|
| 1A     | No property acquisition required; 3 trails crossed                                | ●4    |
| 1B     | No property acquisition required; 4 trails crossed                                | ●3    |
| 1C     | No property acquisition required; 3 trails crossed                                | ●4    |
| 2A     | No property acquisition required; 9 trails crossed                                | ●2    |
| 2B     | No property acquisition required; 10 trails crossed                               | ●1    |
| 2C     | No property acquisition required; 9 trails crossed                                | ●2    |
| 3A     | 1 property acquisition required; 1 trail crossed                                  | ●3    |
| 3B     | 1 property acquisition required; 1 trail crossed                                  | ●3    |
| 3C     | 2 property acquisition required; 1 trail crossed                                  | ●1    |
| 3D     | No property acquisition required; 0 trails crossed                                | ●5    |
| 4      | No property acquisition required; 1 trail crossed                                 | ●4    |
| 5      | No property acquisition required; 0 trails crossed                                | ●5    |

## 5.2.5. Criterion 5 Fire Risk to Human Life and Property

Fire risk to human life and property is measured by length roads of each option that are within the high-risk bushfire protection area. The scores and measurements of Criterion 5 for each option are shown in Table 5.7.

Large sections of new roads in Option 1 and 2 will be through the Black Hill Reserve and Sturt Gorge Recreation Park which are within the high-risk bushfire protection area.

Table 5.7: Scores for Criterion 5 Fire Risk to Human Life and Property

| Option | Length of roads through high risk bushfire protection area | Score |
|--------|------------------------------------------------------------|-------|
| 1A     | 1,200 m                                                    | ●4    |
| 1B     | 2,100 m                                                    | ●3    |
| 1C     | 2,500 m                                                    | ●2    |
| 2A     | 2,600 m                                                    | ●2    |
| 2B     | 3,500 m                                                    | ●1    |
| 2C     | 3,900 m                                                    | ●1    |
| 3A     | 200 m                                                      | ●5    |
| 3B     | 100 m                                                      | ●5    |
| 3C     | 200 m                                                      | ●5    |
| 3D     | 0 m                                                        | ●5    |
| 4      | 450 m                                                      | ●5    |
| 5      | 600 m                                                      | ●5    |

#### 5.2.6. Criterion 6 Impacts on Bushland, Flora and Fauna

Impacts on bushland, flora and fauna were measured by the area of bushland to be cleared as a result of the new roads. A 20m buffer was measured along the new roads and the area of the buffer that is bushland is calculated. The scores and measurements of Criterion 6 for each option are shown in Table 5.8.

Option 1 and Option 2 will require a large amount of bushland and vegetations being cleared for the new roads to be built. Option 3, 4 and 5 require no or minimal amount of clearing.

Table 5.8: Scores for Criterion 6 Impacts on Bushland, Flora and Fauna

| Option | Area of bushland to be cleared for new roads  | Score |
|--------|-----------------------------------------------|-------|
| 1A     | 20,600 sq. m                                  | ●4    |
| 1B     | 40,600 sq. m                                  | ●3    |
| 1C     | 39,700 sq. m                                  | ●3    |
| 2A     | 51,400 sq. m                                  | ●2    |
| 2B     | 71,300 sq. m                                  | ●1    |
| 2C     | 70,500 sq. m                                  | ●1    |
| 3A     | 2,400 sq. m                                   | ●5    |
| 3B     | 2,700 sq. m                                   | ●5    |
| 3C     | 2,700 sq. m                                   | ●5    |
| 3D     | 0 with the entire route within the urban area | ●5    |
| 4      | 9,300 sq. m                                   | ●5    |
| 5      | 12,500 sq. m                                  | ●5    |

### 5.2.7. Criterion 7 Traffic Relief on Arterial Roads

Traffic relief on arterial roads is measured by the amount of diverted traffic from Blackwood Roundabout or Coromandel Parade each option creates. The number of houses in the catchment of the roads were totalled and the traffic generated by these residential developments were estimated. It was assumed that 25 per cent of the traffic generated by the residential developments in the catchment of each road option would use the option rather than Coromandel Parade or Blackwood roundabout. The scores and measurements of Criterion 7 for each option are shown in Table 5.9. From the calculation, Option 3 would divert the most amount of traffic from arterial roads, as the options have a larger catchment of residential dwellings. However, the traffic will be diverted onto Brighton Parade, which is a collector road with one traffic lane in each direction and a level crossing at the Belair line. Detailed modelling would be required to estimate the impact and the capacity of Brighton Parade.

**Table 5.9: Scores for Criterion 7 Traffic Relief on Arterial Roads**

| Option | Amount of diverted traffic (vehicles per day, vpd) from Blackwood roundabout or Coromandel Parade (assuming 25 per cent of traffic generated by residential developments along the road will use this bypass) | Score |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1A     | 600 vpd (diverting traffic from Node 1 to Shepherds Hill Road via new road and Northcote Road)                                                                                                                | ●2    |
| 1B     | 600 vpd (diverting traffic from Node 1 to Shepherds Hill Road via new road and Colebrook Drive)                                                                                                               | ●2    |
| 1C     | 600 vpd (diverting traffic from Node 1 to Shepherds Hill Road via new road and Ashmore Road)                                                                                                                  | ●2    |
| 2A     | 1,000 vpd (diverting traffic from Node 1 and Node 3 to Shepherds Hill Road via new road and Northcote Road)                                                                                                   | ●3    |
| 2B     | 1,000 vpd (diverting traffic from Node 1 and Node 3 to Shepherds Hill Road via new road and Colebrook Drive)                                                                                                  | ●3    |
| 2C     | 1,000 vpd (diverting traffic from Node 1 and Node 3 to Shepherds Hill Road via new road and Ashmore Road)                                                                                                     | ●3    |
| 3A     | 3,000 vpd (diverting traffic from most of Craighburn Farm to Shepherds Hill Road via Trevor Terrace, Beaconsfield Road and Northcote Road)                                                                    | ●5    |
| 3B     | 3,000 vpd (diverting to Shepherds Hill Road via Trevor Terrace, Beaconsfield Road and Northcote Road)                                                                                                         | ●5    |
| 3C     | 3,000 vpd (diverting to Shepherds Hill Road via Trevor Terrace, Beaconsfield Road and Northcote Road)                                                                                                         | ●5    |
| 3D     | 2,300 vpd (diverting to Brighton Parade)                                                                                                                                                                      | ●4    |
| 4      | 400 vpd (connection between node 3 and Murrays Hill Road)                                                                                                                                                     | ●1    |
| 5      | 0 (local connections between Node 2 and Node 3)                                                                                                                                                               | ●1    |

### 5.2.8. Criterion 8 Road Infrastructure Cost

The cost estimates were converted to a score from 1 to 5 as follows:

- < \$2 million Rating 5 ●5
- \$2 to 4 million Rating 4 ●4
- \$4 to 7 million Rating 3 ●3
- \$7 to 12 million Rating 2 ●2
- > \$12 million Rating 1 ●1

Road infrastructure costs are measured in ranges of millions depending on the structures required for each road alignment option. The scores for Criterion 8 are shown in Table 5.10.

Table 5.10: Scores for Criterion 8 Road Infrastructure Costs

| Option | Measure                                                                                                           | Score |
|--------|-------------------------------------------------------------------------------------------------------------------|-------|
| 1A     | \$ 7 – 9 million – Bridge over rail, small bridges over culverts                                                  | ●2    |
| 1B     | \$ 9 – 12 million – Bridge over rail, small bridges over culverts, embankment works                               | ●2    |
| 1C     | \$ 4 – 6 million – Embankment works, small bridges over culverts                                                  | ●3    |
| 2A     | > \$ 50 million – Significant bridge (up to 25 m height) and other small bridges and other infrastructure         | ●1    |
| 2B     | > \$ 50 million – Significant bridge (up to 25 m height and other small bridges and other infrastructure          | ●1    |
| 2C     | > \$ 50 million – Significant bridge (up to 25 m height) and other small bridges and other infrastructure         | ●1    |
| 3A     | \$ 5 – 7 million – Bridge over rail only, property purchases required                                             | ●3    |
| 3B     | \$ 5 – 7 million – Bridge over rail, property purchases required, civil works at school                           | ●3    |
| 3C     | \$ 5 – 7 million – Bridge over rail, property purchases required, civil works to punch through to Brighton Parade | ●3    |
| 3D     | < \$ 2 million – Civil works to punch through to Brighton Parade, possible upgrades to existing roads             | ●5    |
| 4      | \$ 2 – 4 million – Bridge over creek, property purchases required                                                 | ●4    |
| 5      | \$ 2 – 4 million – Small bridges over culverts required                                                           | ●4    |

### 5.2.9. Criterion 9 Impacts during construction

Impacts during construction include train line disruptions, impact on trails, increased noise and traffic due to construction and environmental impacts on creeks and vegetation. Each option is assessed against the potential impacts and the scores for each option is shown in Table 5.11.

Table 5.11: Scores for Criterion 9 Impacts during Construction

| Option | Measure                                                                                                                                                                                                                                     | Score |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1A     | Train line disruption during bridge construction, impact on walking / cycling trails, increased traffic in streets from construction traffic, increased noise due to construction, potential environmental impacts on creeks and vegetation | ●2    |
| 1B     | Train line disruption during bridge construction, impact on walking / cycling trails, increased traffic in streets from construction traffic, increased noise due to construction, potential environmental impacts on creeks and vegetation | ●2    |
| 1C     | Impact on walking / cycling trails, increased local traffic in streets from construction traffic, increased noise due to construction, potential environmental impacts on creeks and vegetation                                             | ●2    |
| 2A     | Train line disruption during bridge construction, significant impact on walking / cycling trails, increased noise due to construction, potential environmental impacts on creeks and vegetation                                             | ●1    |
| 2B     | Train line disruption during bridge construction, significant impact on walking / cycling trails, increased noise due to construction, potential environmental impacts on creeks and vegetation                                             | ●1    |
| 2C     | Significant impact on walking / cycling trails, increased noise due to construction, potential environmental impacts on creeks and vegetation                                                                                               | ●1    |
| 3A     | Train line disruption during bridge construction, increased traffic in streets from construction traffic, increased noise due to construction, minimal environmental impacts on creeks and vegetation                                       | ●2    |
| 3B     | Train line disruption during bridge construction, increased traffic in streets from construction traffic, increased noise due to construction, minimal environmental impacts on creeks and vegetation                                       | ●2    |

| Option | Measure                                                                                                                                                                                               | Score |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 3C     | Train line disruption during bridge construction, increased traffic in streets from construction traffic, increased noise due to construction, minimal environmental impacts on creeks and vegetation | ●2    |
| 3D     | Increased traffic in streets from construction traffic, increased noise due to construction, minimal environmental impacts on creeks and vegetation                                                   | ●5    |
| 4      | Impact on walking / cycling trails, increased noise due to construction, potential environmental impacts on creeks and vegetation                                                                     | ●3    |
| 5      | Impact on walking / cycling trails, increased noise due to construction, potential environmental impacts on creeks and vegetation                                                                     | ●3    |

## 5.2.10. Criterion 10 Design Complexity and Constructability

The structure requirement for each design is assessed against Austroads for design constructability. The scores for each option for Criterion 10 are shown in Table 5.12.

**Table 5.12: Scores for Criterion 10 Design Complexity and Constructability**

| Option | Measure                                                                                                                           | Score |
|--------|-----------------------------------------------------------------------------------------------------------------------------------|-------|
| 1A     | Can comply to Austroads, bridge design required                                                                                   | ●2    |
| 1B     | Can comply to Austroads, bridge design required, embankments to be designed, possible retaining structures                        | ●2    |
| 1C     | Can comply to Austroads, embankments to be designed, possible retaining structures                                                | ●2    |
| 2A     | Marginal with regards to Austroads, significant bridge design required                                                            | ●1    |
| 2B     | Marginal with regards to Austroads, significant bridge design required, embankments to be designed, possible retaining structures | ●1    |
| 2C     | Marginal with regards to Austroads, significant bridge design required, embankments to be designed, possible retaining structures | ●1    |
| 3A     | Does not comply with Austroads at bridge, too steep and too long and not enough clearance for train, bridge design required       | ●1    |
| 3B     | Does not comply with Austroads at bridge, too steep and too long and not enough clearance for train, bridge design required       | ●1    |
| 3C     | Does not comply with Austroads at bridge, too steep and too long and not enough clearance for train, bridge design required       | ●1    |
| 3D     | Roundabout design required, Road upgrades including potential revisions to kerbs, cross-section and signage                       | ●5    |
| 4      | Close to complying to Austroads, switchbacks may be required                                                                      | ●4    |
| 5      | Culvert bridge required, stormwater to be assessed                                                                                | ●3    |

## 5.3. Multi-Criteria Analysis Results

The results of the Multi-Criteria Analysis (MCA) assessment with the weightings assigned in Table 5.1 are given in Table 5.13.

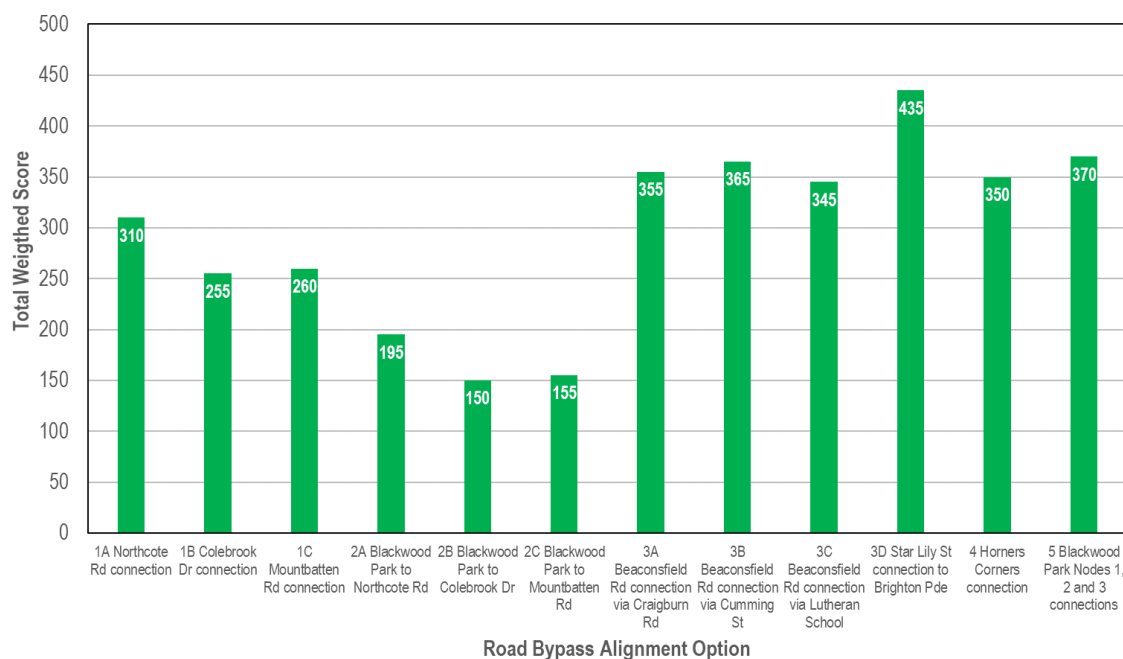
**Table 5.13: Ranking of the Road Alignment Options with Weighted Scores**

| Ranking | Option | Craigburn Farm Road Bypass Alignment Options     | Weighted Score | Percentage Score |
|---------|--------|--------------------------------------------------|----------------|------------------|
| 1       | 3D     | Star Lily Street connection to Brighton Parade   | 435            | 87%              |
| 2       | 3C     | Beaconsfield Road connection via Lutheran School | 370            | 74%              |
| 3       | 3B     | Beaconsfield Road connection via Cumming Street  | 365            | 73%              |
| 4       | 5      | Blackwood Park Nodes 1, 2 and 3 connections      | 355            | 71%              |

| Ranking | Option | Craigburn Farm Road Bypass Alignment Options    | Weighted Score | Percentage Score |
|---------|--------|-------------------------------------------------|----------------|------------------|
| 5       | 3A     | Beaconsfield Road connection via Craigburn Road | 350            | 70%              |
| 6       | 4      | Horners Corners connection                      | 345            | 69%              |
| 7       | 1A     | Northcote Road connection                       | 310            | 62%              |
| 8       | 1C     | Mountbatten Road connection                     | 260            | 52%              |
| 9       | 1B     | Colebrook Drive connection                      | 255            | 51%              |
| 10      | 2A     | Blackwood Park to Northcote Road                | 195            | 39%              |
| 11      | 2B     | Blackwood Park to Colebrook Drive               | 155            | 31%              |
| 12      | 2C     | Blackwood Park to Mountbatten Road              | 150            | 30%              |

The weighted criteria assessment scores out of 500 are shown in Figure 5.2.

**Figure 5.2: Multi-Criteria Analysis Results with the Weighted Assessment Scores**



A sensitivity test of the Multi-Criteria Analysis assessment with no weightings was undertaken with the results given in Table 5.14. Options 1 and 2 are still at the bottom of the ranking. Options 4 and 5 moved to ranking 2 and 3 over Options 3C and 3B. None of the options are clearly better than the others. The ATAP guidelines without and with the weightings did not significantly change the outcomes of the Strategic Merit Test with the western bypass Options 1A, 1B, 1C, 2A, 2B and 2C all at the bottom of the assessment scores and with Option 3D with the highest ranking followed the other Options 4, 5, 3A, 3B and 3C, however in a slightly different ranking order.

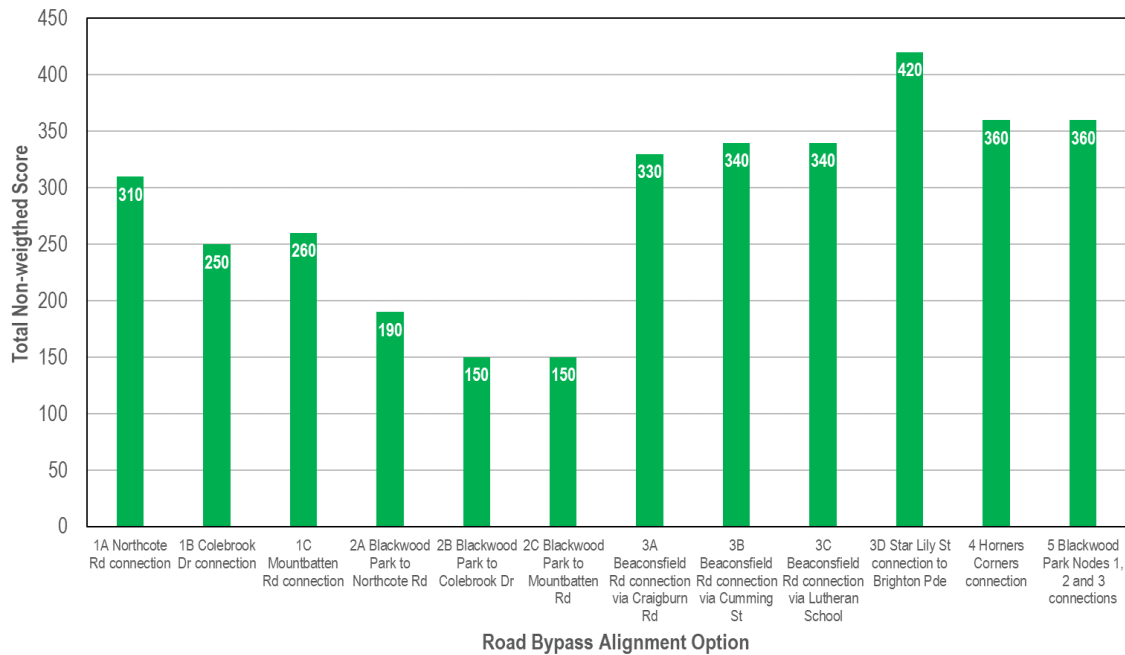
**Table 5.14: Ranking of the Road Alignment Options with Unweighted Scores**

| Ranking | Option | Craigburn Farm Road Bypass Alignment Options     | Unweighted Score | Percentage Score |
|---------|--------|--------------------------------------------------|------------------|------------------|
| 1       | 3D     | Star Lily Street connection to Brighton Parade   | 420              | 84%              |
| 2       | 4      | Horners Corners connection                       | 360              | 72%              |
| 3       | 5      | Blackwood Park Nodes 1, 2 and 3 connections      | 360              | 72%              |
| 4       | 3B     | Beaconsfield Road connection via Cumming Street  | 340              | 68%              |
| 5       | 3C     | Beaconsfield Road connection via Lutheran School | 340              | 68%              |
| 6       | 3A     | Beaconsfield Road connection via Craigburn Road  | 330              | 66%              |

| Ranking | Option | Craigburn Farm Road Bypass Alignment Options | Unweighted Score | Percentage Score |
|---------|--------|----------------------------------------------|------------------|------------------|
| 7       | 1A     | Northcote Road connection                    | 310              | 62%              |
| 8       | 1C     | Mountbatten Road connection                  | 260              | 52%              |
| 9       | 1B     | Colebrook Drive connection                   | 250              | 50%              |
| 10      | 2A     | Blackwood Park to Northcote Road             | 190              | 38%              |
| 11      | 2B     | Blackwood Park to Colebrook Drive            | 150              | 30%              |
| 12      | 2C     | Blackwood Park to Mountbatten Road           | 150              | 30%              |

The unweighted criteria assessment scores out of 500 are shown in Figure 5.3.

**Figure 5.3: Multi-Criteria Analysis Results with the Unweighted Assessment Scores**



## 6. CONCLUSIONS AND RECOMMENDATIONS

### 6.1. Key Findings and Conclusions

The constraints and challenges for a western bypass or link road of Craigburn Farm include:

- Topography and water features restricting the geometric road requirements, including gradient and curvature;
- Bushfire risk and hazard areas, including parks, bushland, schools, residential estates and businesses;
- Geological issues and seismology with the location of previous earthquake activity and fault lines;
- Soil types that would limit or impact the road constructability and capital cost;
- Special reserves and parks for recreational purposes, including walking trails and mountain bike tracks;
- Heritage features, including European and indigenous built and cultural heritage areas; and
- Environmental protection requirements for special flora or fauna in the Blackwood Hill Reserve, Sturt Gorge Recreation Park or any other bushland or protected sites in the Craigburn Farm study area.

Opportunities for the bypass or link roads with connections from or within Craigburn Farm were also identified to provide a strategic transport route between Shepherds Hill Road and Murrays Hill Road west of Craigburn Farm so that the through north-south traffic could avoid using Coromandel Parade and the Blackwood roundabout.

A total of 12 bypass or link road alignment options were developed to address the strategic objectives of the study. The key issues and risks for these alignment options are given in Table 6.1.

**Table 6.1: Key Issues and Risks with the Craigburn Farm Bypass and Link Road Alignment Options**

| Option | Craigburn Farm Road Bypass Alignment Options | Key Issues to consider                                                                                                                                                                                                                                                                                                                                                                                    |
|--------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1A     | Northcote Road connection                    | <ul style="list-style-type: none"> <li>• No benefits for bushfire emergency egress or as a strategic bypass route of Craigburn Farm and the Blackwood roundabout</li> <li>• High capital cost for bridge over railway line</li> <li>• High impact on bushland in the Blackwood Hill Reserve</li> </ul>                                                                                                    |
| 1B     | Colebrook Drive connection                   | <ul style="list-style-type: none"> <li>• No benefits for bushfire emergency egress or as a strategic bypass route of Craigburn Farm and the Blackwood roundabout</li> <li>• High capital cost for bridge over railway line</li> <li>• High impact on bushland in the Blackwood Hill Reserve</li> </ul>                                                                                                    |
| 1C     | Mountbatten Road connection                  | <ul style="list-style-type: none"> <li>• No benefits for bushfire emergency egress or as a strategic bypass route of Craigburn Farm and the Blackwood roundabout</li> <li>• High impact on bushland in the Blackwood Hill Reserve</li> </ul>                                                                                                                                                              |
| 2A     | Blackwood Park to Northcote Road             | <ul style="list-style-type: none"> <li>• No benefits for bushfire emergency egress or as a strategic bypass route of Craigburn Farm and the Blackwood roundabout</li> <li>• Very high cost with new bridges over the railway line and Sturt Gorge</li> <li>• High environmental impacts to flora and fauna and social impacts to trails with a roadway through the bushland reserves and parks</li> </ul> |
| 2B     | Blackwood Park to Colebrook Drive            | <ul style="list-style-type: none"> <li>• No benefits for bushfire emergency egress or as a strategic bypass route of Craigburn Farm and the Blackwood roundabout</li> <li>• Very high cost with new bridges over the railway line and Sturt Gorge</li> <li>• High environmental impacts to flora and fauna and social impacts to trails with a roadway through the bushland reserves and parks</li> </ul> |

## CONCLUSIONS AND RECOMMENDATIONS

| Option | Craigburn Farm Road Bypass Alignment Options     | Key Issues to consider                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2C     | Blackwood Park to Mountbatten Road               | <ul style="list-style-type: none"> <li>No benefits for bushfire emergency egress or as a strategic bypass route of Craigburn Farm and Blackwood roundabout</li> <li>Very high cost with new bridge over the Sturt Gorge</li> <li>High environmental impacts to flora and fauna and social impacts to trails with a roadway through the bushland reserves and parks</li> </ul>                                                                            |
| 3A     | Beaconsfield Road connection via Craigburn Road  | <ul style="list-style-type: none"> <li>Limited benefits for bushfire emergency egress or as a strategic bypass route to Shepherds Hill Road</li> <li>Impacts to amenity for residents with increased traffic in local streets</li> <li>Property, land and environmental impacts with new road bridge between Trevor Terrace and Beaconsfield Road</li> </ul>                                                                                             |
| 3B     | Beaconsfield Road connection via Cumming Street  | <ul style="list-style-type: none"> <li>Limited benefits for bushfire emergency egress or as a strategic bypass route to Shepherds Hill Road</li> <li>Impacts to amenity for residents with increased traffic in local streets</li> <li>Property, land and environmental impacts with new road bridge between Trevor Terrace and Beaconsfield Road</li> <li>Major traffic and local amenity and noise impacts to residents in Star Lily Street</li> </ul> |
| 3C     | Beaconsfield Road connection via Lutheran School | <ul style="list-style-type: none"> <li>Limited benefits for bushfire emergency egress or as a strategic bypass route to Shepherds Hill Road</li> <li>Impacts to amenity for residents with increased traffic in local streets</li> <li>Property, land and environmental impacts with new road bridge between Trevor Terrace and Beaconsfield Road</li> <li>Impacts on access along the western side of the Lutheran School</li> </ul>                    |
| 3D     | Star Lily Street connection to Brighton Parade   | <ul style="list-style-type: none"> <li>Limited benefits for bushfire emergency egress or as a strategic bypass route to Shepherds Hill Road</li> <li>Major traffic and local amenity and noise impacts to residents in Star Lily Street and along Brighton Parade</li> </ul>                                                                                                                                                                             |
| 4      | Horners Corners connection                       | <ul style="list-style-type: none"> <li>High environmental impacts to flora and fauna and social impacts to trails with a roadway through the Horners Corners bushland</li> </ul>                                                                                                                                                                                                                                                                         |
| 5      | Blackwood Park Nodes 1, 2 and 3 connections      | <ul style="list-style-type: none"> <li>Limited benefits for bushfire emergency egress or as a strategic bypass route around Craigburn Farm</li> <li>Impacts to amenity for residents with increased traffic in local streets</li> </ul>                                                                                                                                                                                                                  |

Options 1A, 1B, 1C and 2A, 2B and 2C were assessed to be not viable as a bypass road or bushfire emergency egress route of Craigburn Farm because they have:

- Significant capital costs to build and maintain it as a public roadway with the necessary bridges over the gullies, gorge and railway line and the length of new road infrastructure;
- Major social impacts on the bush trails for bush walkers and cyclists in the Blackwood Hill Reserve and the Sturt Gorge Recreation Park;
- Significant environmental impacts to the bushland, flora and fauna, in particular through the Bush for Life areas and in the Blackwood Hill Reserve and the Sturt Gorge Recreation Park;
- Impacts from additional traffic through the local streets of Craigburn Farm generating noise to residents; and
- Complex road designs and difficult road infrastructure to build.

The benefits for the residents in Craigburn Farm are generally low with:

- Limited reduction in safety risks as an emergency egress route and reduce fire risk to human life and property during a catastrophic fire event;
- Marginal or no improvement to accessibility for pedestrians, cyclists and to access public transport; and

## CONCLUSIONS AND RECOMMENDATIONS

- Limited traffic relief on the arterial roads with the low-density residential development in Craighburn Farm that can be accommodated mostly on the existing road network.

The bypass alignments for Option 2 (2A, 2B, 2C) are not likely to provide a strategic regional transport route between Black Road/Murrays Hill Road and Shepherds Hill Road to avoid the Blackwood roundabout because the two-lane roadway and indirectness of the roadway would not be attractive for non-local or traffic bypassing Blackwood.

Options 4 and 5 are also not recommended for further consideration because:

- Option 4 would impact the bushland and walking trails between Blackwood Park Boulevard and Murrays Hill Road
- Option 5 would create issues for the local residents by removing amenity in the local parks and allowing for more through traffic in local streets that can use the existing egress routes via Blackwood Park Boulevard, Fergusson Avenue and Grand Boulevard for a bushfire emergency route to Coromandel Parade.

Options 3A, 3B and 3C were also not considered viable as western bypass options for Craighburn Farm residents, as they connect within the existing residential estates using mostly existing local streets. Options 3A, 3B and 3C are not considered viable as they would require a new bridge over the railway line to Beaconsfield Road.

Option 3D with the opening of Star Lily Street to connect more directly with Brighton Parade is the last alternative alignment in the assessment. However, the residents of Star Lily Street and Brighton Parade would be impacted with additional traffic and noise in the street and loss of local amenity.

### 6.2. Recommendations

The results from the Strategic Merit Test indicate that a western bypass road of Craighburn Farm with Options 1A, 1B, 1C, 2A, 2B and 2C is not viable for the following reasons:

- the significant environmental impacts to the bushland flora and fauna habitats, recreational walking and cycling trails in the bushland reserves and recreation parks west of Craighburn Farm.
- the social impacts on additional traffic and noise for residents in Craighburn Farm.
- the high capital costs to build a new roadway with bridges are a major disbenefit for a road project that will be unlikely to function as a traffic bypass route of the Blackwood roundabout due to the indirect alignment to connect with Shepherds Hill Road.
- Finally, encouraging bushfire emergency egress via a road through the bushland west of Craighburn Farm may increase the risk to human life, instead of reducing it.

A safer route for the Craighburn Farm residents is the existing situation where they can exit via Grand Boulevard to Coromandel Parade to travel north to Shepherds Hill Road via the Blackwood roundabout or south to Murrays Hill Road and Black Road.

In conclusion, the emergency bushfire egress for Craighburn Farm residents, in particular west of Grand Boulevard and south of Fergusson Avenue, exists via Craighburn Road and Cumming Street or Grand Boulevard to Coromandel Parade. It is considered adequate for the size of the residential population and none of the alternative bushfire bypass emergency egress alignments are safer than the existing situation.

The only alignment option that the City of Mitcham may consider for further investigations is Option 3D with the opening of Star Lily Street to connect more directly with Brighton Parade. However, with the likely issues for the residents of Star Lily Street and Brighton Parade with additional traffic and loss of local amenity, it is not recommended for the City of Mitcham or the State Government to pursue a detailed feasibility study or business case for this road connection.

## 7. REFERENCES

### State

DEH, 2008. Sturt Gorge Recreation Management Plan, Department of Environment and Heritage, 2008

SA Government, 2011. *SA Strategic Plan, In a Great State*. South Australian Government, Adelaide, South Australia, 2011.

SA Government, 2011. Bushfire Inquiry South Australian Evidence Final Report, Parliament of South Australia Natural Resources Committee, July 2011.

DPTI, 2013. *The Integrated Transport and Land Use Plan – Goals and Objectives*, Department of Planning, Transport and Infrastructure, Adelaide, South Australia, October 2013.

DPTI, 2015. *The Integrated Transport and Land Use Plan – Technical Document*, Department of Planning, Transport and Infrastructure, Adelaide, South Australia, July 2015.

DPTI, 2015. *Road Management Plan (Short to Medium Term)*, Main Road (RN6452) (Belair Road to Shepherds Hill Road) and Shepherds Hill Road (RN6467) (Main Road to Seymour Street), Department of Planning, Transport and Infrastructure, Adelaide, South Australia, February 2015.

DPTI, 2017. *30-Year Plan for Greater Adelaide 2017 Update*. Department of Planning, Transport and Infrastructure, Adelaide, South Australia, 2017.

### City of Mitcham

CoM, 2017. City of Mitcham Strategic Management Plan 2017-2027.

CoM, 2018. City of Mitcham Bushfire Prevention Plan 2018/2019.

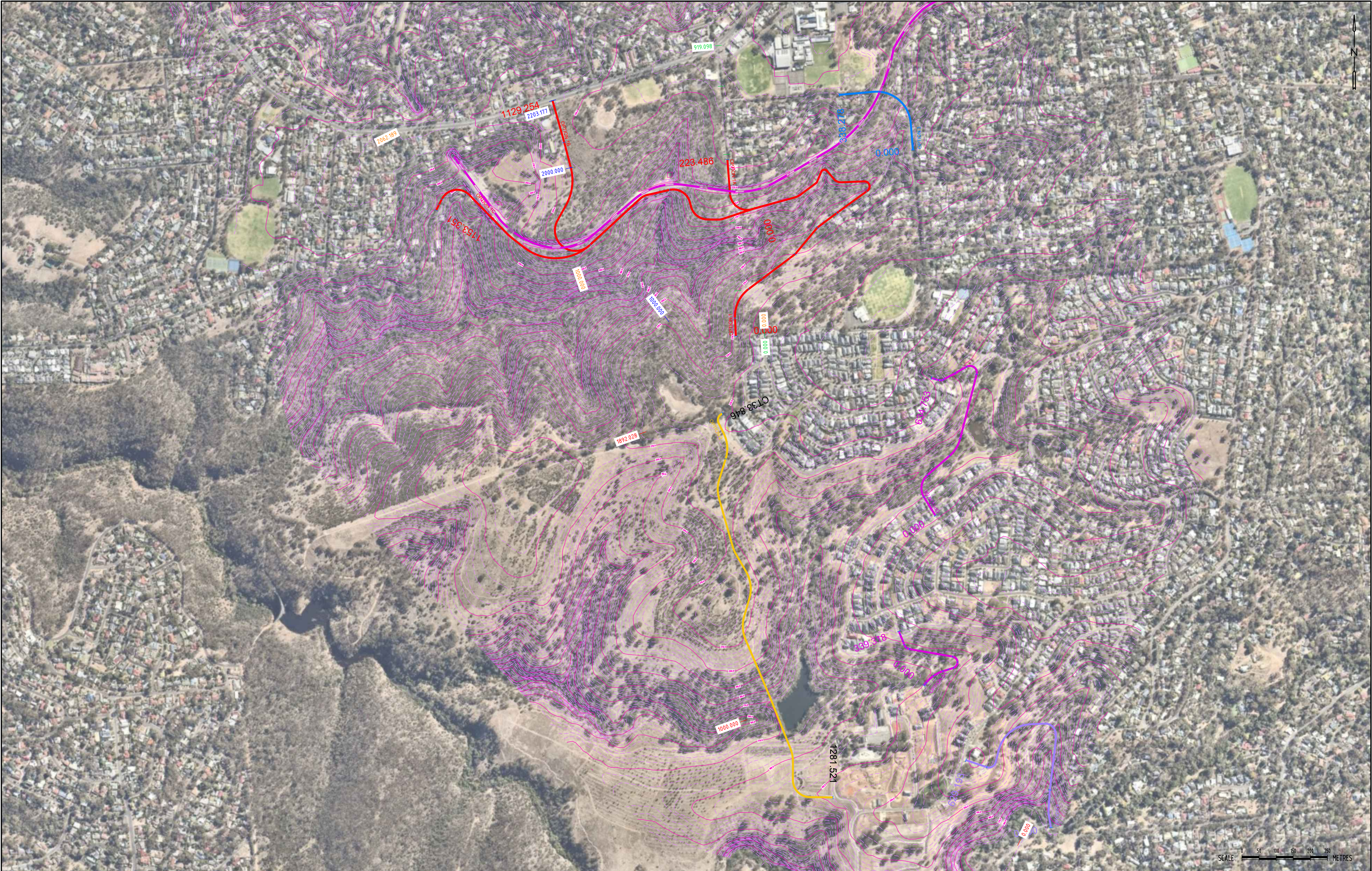
CoM, 2018, City of Mitcham Spatial Vision Consultation Plan.

CoM, 2017. City of Mitcham Draft Integrated Transport Plan, InfraPlan (not a public document).

CoM, 2018. City of Mitcham Draft Road Network Strategy, GTA Consultants, 2018 (not a public document).

# A. BYPASS AND LINK ROAD ALIGNMENT OPTIONS CAD DRAWINGS

A



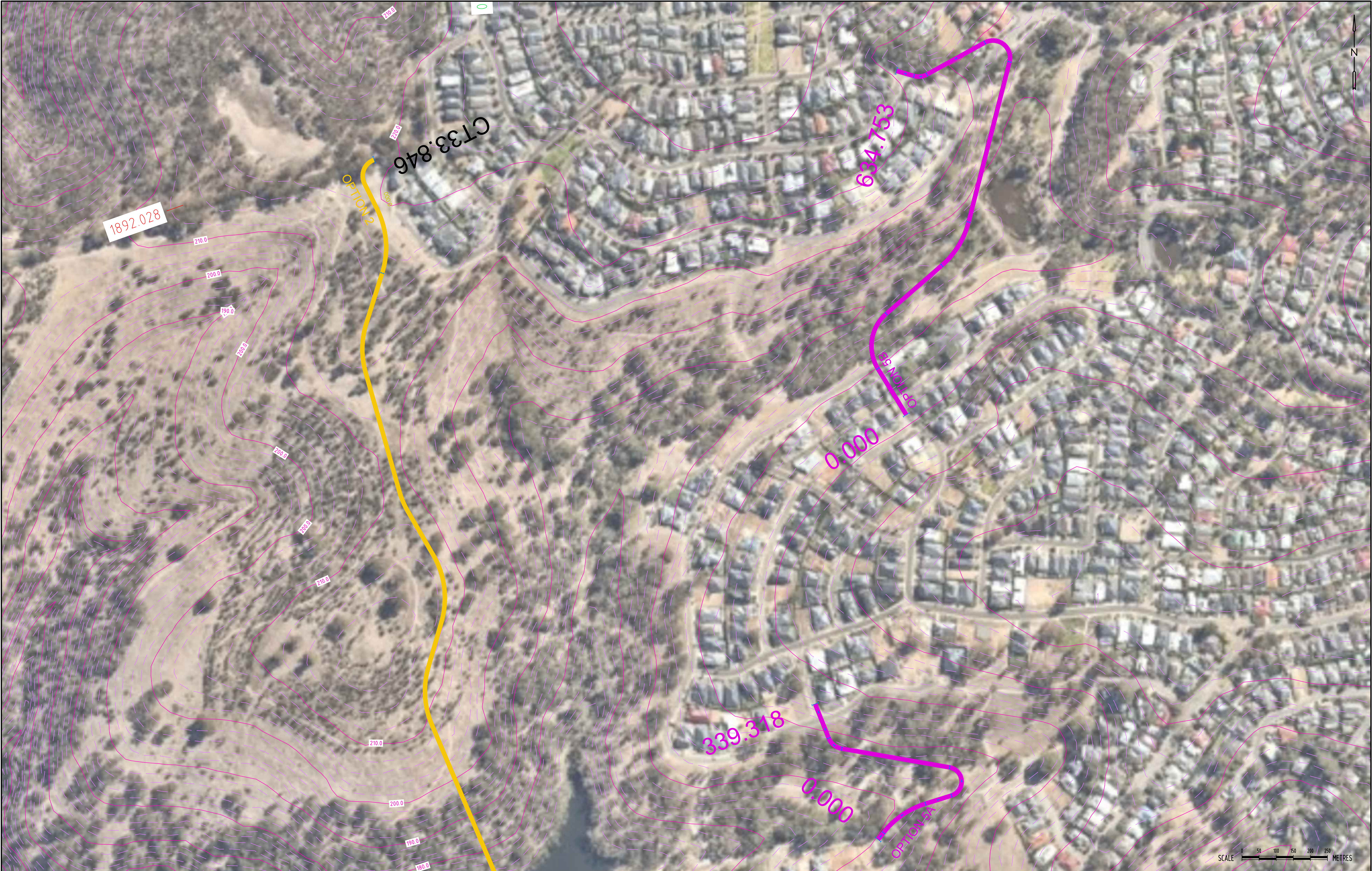
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|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|                     |             |  |  |                                                                                                                                                                                                                                                           |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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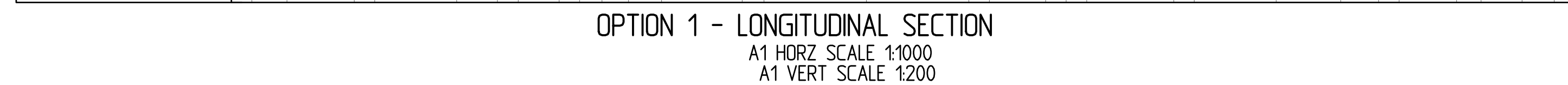


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| CLIENT<br>GTA Consultants                            |  |
| PROJECT TITLE<br>ACCESS ROAD OPTIONS                 |  |
| SITE ADDRESS<br>WESTERN BYPASS<br>CRAIGBURN FARM, SA |  |
| DRAWING TITLE<br>SITE PLAN - SHEET 3 OF 3            |  |

|                                    |                            |
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| DESIGNED<br>CC                     | DRAWN<br>CC                |
| CHECKED<br>GB                      | NO. OF SHEETS<br>5         |
| SCALE<br>1:5000 @ A1               | DATE STARTED<br>01.05.2019 |
| SITE ID & JOB No.<br>S44800-265455 | REV.                       |
| DRAWING No.<br>SK13                | B                          |



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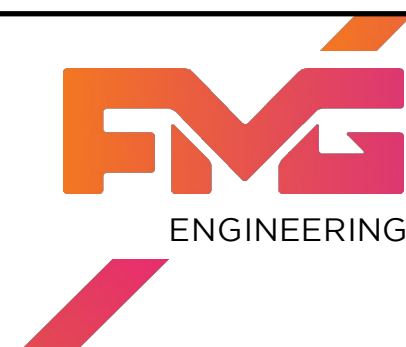
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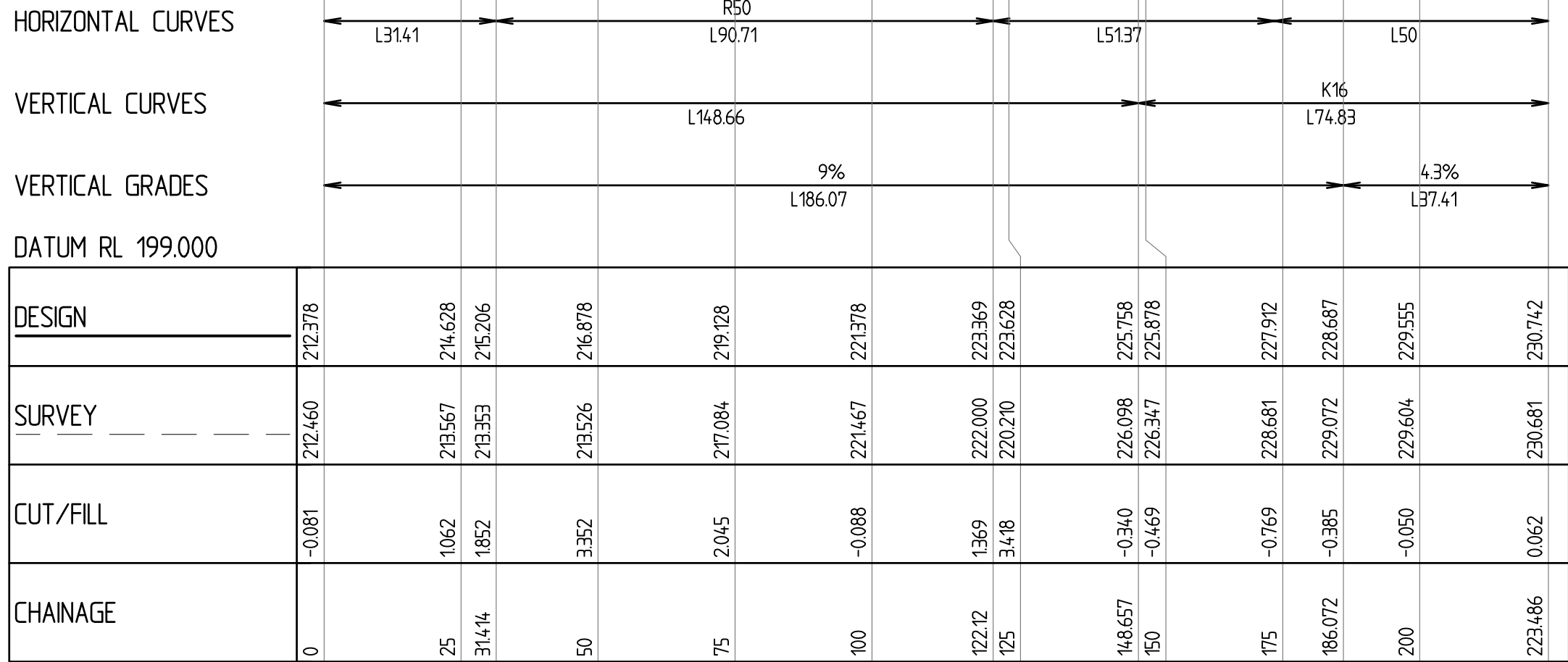
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| CLIENT            | GTA Consultants                                                                                                                          | DESIGNED           | CC           | DRAWN         | CC |
| PROJECT TITLE     | ACCESS ROAD OPTIONS<br><br>SITE ADDRESS<br>WESTERN BYPASS<br>CRAIGBURN FARM, SA<br><br>DRAWING TITLE<br>SOUTH LINK LONGITUDINAL SECTIONS | CHECKED            | GB           | No. OF SHEETS | 5  |
| SCALE             |                                                                                                                                          | 1:1000H 1:200V @A1 | DATE STARTED | 01.05.2019    |    |
| SITE ID & JOB No. |                                                                                                                                          | S44800-265455      |              | REV.          |    |
| DRAWING No.       |                                                                                                                                          | SK20               |              | B             |    |
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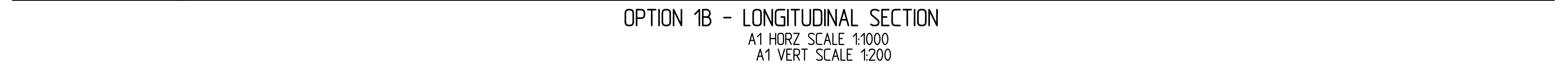
### LEGEND

PROPOSED

 POSSIBLE BRIDGE  
 POSSIBLE CULVERT



|                     |  |  |  |                                                                                                                                                                                                                                                           |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                           |  |  |  |                                                                                                                                                                                                                             |  |  |  |                                                                                                                                                                                                                                                                                                                                                                   |  |  |  |
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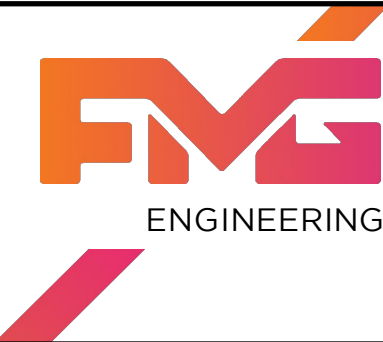
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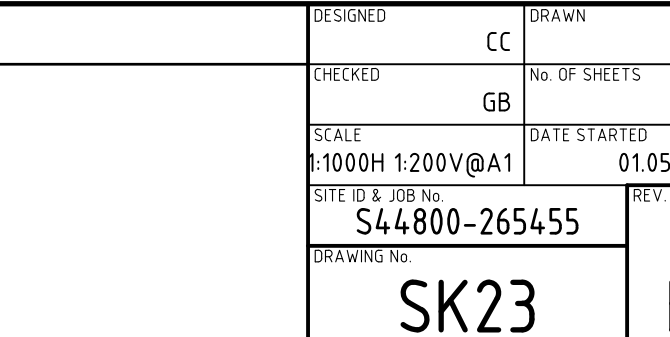
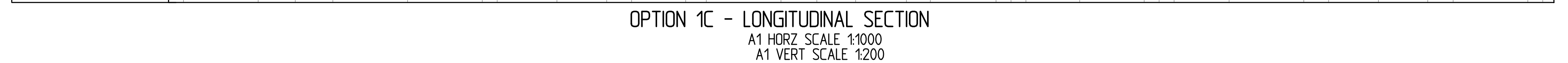
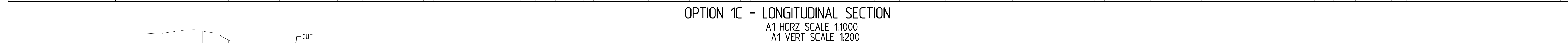
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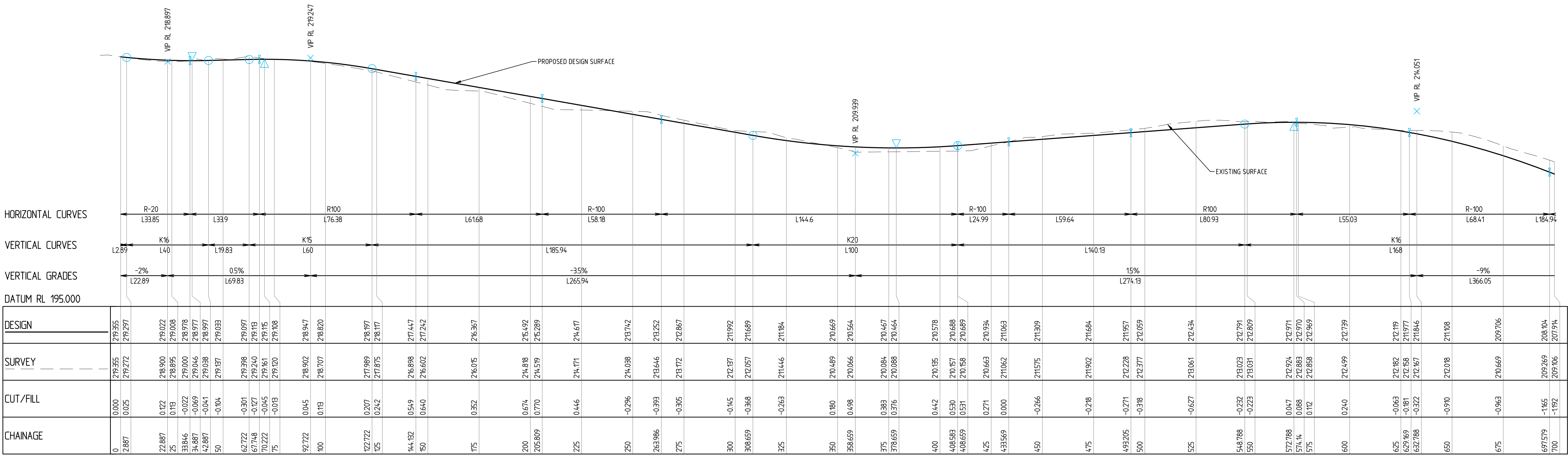


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| 1:1000H 1:200V@A1                  | 01.05.2019   |               |      |
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| SHEET TITLE | CLIENT<br>GTA Consultants                            |  | DESIGNED<br>CC                      |  | DRAWN<br>CC                |  |
|             | PROJECT TITLE<br>ACCESS ROAD OPTIONS                 |  | CHECKED<br>GB                       |  | No. OF SHEETS<br>5         |  |
|             | SITE ADDRESS<br>WESTERN BYPASS<br>CRAIGBURN FARM, SA |  | SCALE<br>1:1000H 1:200V@A1          |  | DATE STARTED<br>01.05.2019 |  |
|             | DRAWING TITLE<br>OPTION 1C                           |  | SITE ID & JOB No.<br>S44-800-265455 |  | REV.                       |  |
|             |                                                      |  | DRAWING No.<br>SK23                 |  | B                          |  |



OPTION 2 - LONGITUDINAL SECTION  
A1 HORZ SCALE 1:1000  
A1 VERT SCALE 1:200

**LEGEND**

**PROPOSED**

- POSSIBLE BRIDGE
- POSSIBLE CULVERT

SCALE: H 0 10 20 30 40 50 METRES  
V 0 2 4 6 8 10

|                     |  |  |  |                                                                                                                                                                                                                                                           |  |  |  |                                                                                                                                                 |  |  |  |                                                      |  |  |  |                                                                              |  |                            |  |      |  |
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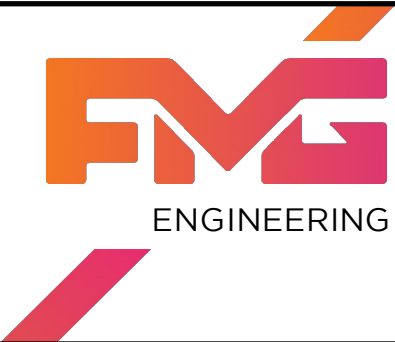
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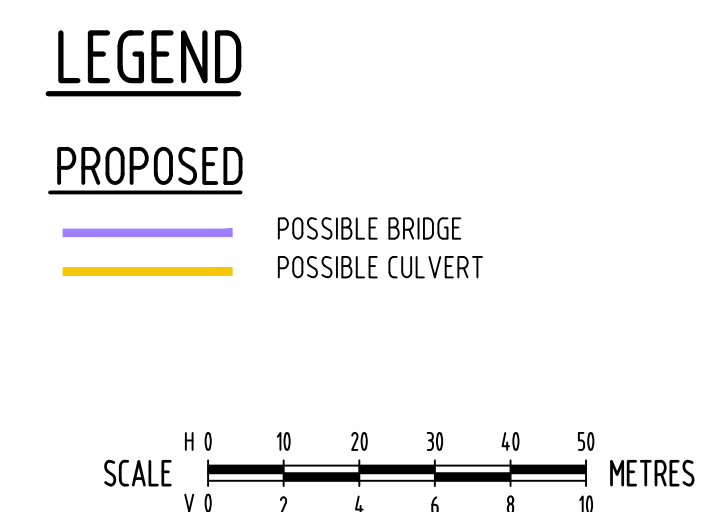
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| CLIENT        | GTA Consultants                      |
| PROJECT TITLE | ACCESS ROAD OPTIONS                  |
| SITE ADDRESS  | WESTERN BYPASS<br>CRAIGBURN FARM, SA |
| DRAWING TITLE | OPTION 2 - SHEET 2 OF                |

|                   |              |               |      |
|-------------------|--------------|---------------|------|
| DESIGNED          | CC           | DRAWN         | CC   |
| CHECKED           | GB           | No. OF SHEETS | 5    |
| SCALE             | DATE STARTED |               |      |
| 1:1000H 1:200V@A1 | 01.05.2019   |               |      |
| SITE ID & JOB No. |              |               | REV. |
| S44800-265455     |              |               |      |
| DRAWING No.       |              |               |      |
| SK25              |              |               | B    |



|                     |  |  |  |                                                                                                                                                                                                                                                                   |      |     |                                                                                                                                                                 |  |  |  |  |  |  |  |
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PROJECT TITLE  
**ACCESS ROAD OPTIONS**

SITE ADDRESS  
WESTERN BYPASS  
CRAIGBURN FARM, SA

DRAWING TITLE  
**OPTION 3**

DESIGNED  
CC

CHECKED  
GB

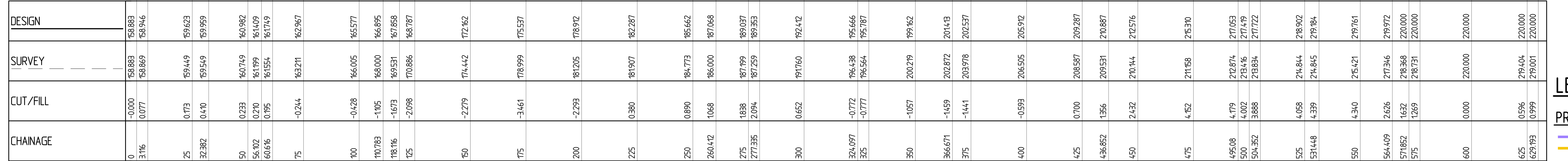
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SITE NO. / JOB NO.  
S44800-265455

DRAWING NO.  
SK26

DATE STARTED  
01.05.2019

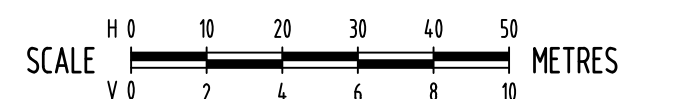
REV.  
B



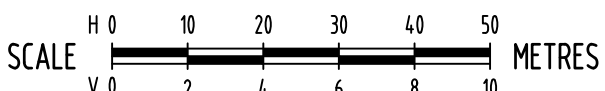
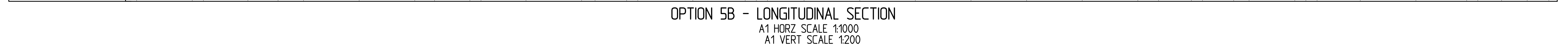
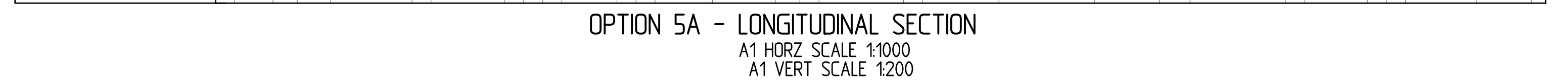
A1 HORZ SCALE 1:1000  
A1 VERT SCALE 1:200

PROPOSED

 POSSIBLE BRIDGE  
 POSSIBLE CULVERT



|                     |  |  |  |                                                                                                                                                                                                                                                           |  |  |  |                                                                                                                                                                                                                                                                                                                                                                                                                           |  |  |  |                                                                                                                                                                                                |  |  |  |                                                                                                                                                                                                                 |  |  |  |
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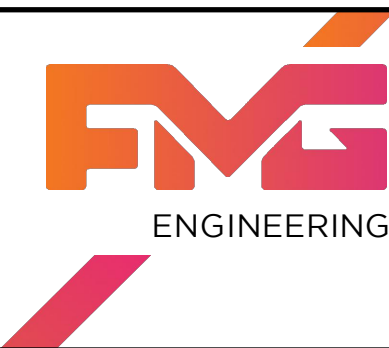
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| PROJECT TITLE<br>ACCESS ROAD OPTIONS                 |  | CHECKED                            | GB                         | No. OF SHEETS | 5  |
| SITE ADDRESS<br>WESTERN BYPASS<br>CRAIGBURN FARM, SA |  | SCALE<br>1:1000H 1200V@A1          | DATE STARTED<br>01.05.2019 |               |    |
| DRAWING TITLE<br>OPTION 5A AND 5B                    |  | SITE ID & JOB No.<br>S44800-265455 |                            | REV.          |    |
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