8.15 SAFE CYCLING CORRIDOR - INKERMAN ROAD

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Trim No: *22/1276145*

Attachments:
1. *Stage 2 Corridor Design Report* ⇩
2. *Option 1 Concept Design* ⇩
3. *Option 2 Concept Design* ⇩
4. *Independent Cycling Demand Estimate* ⇩
5. *Independent Emissions Analysis* ⇩
6. *Gender Impact Assessment* ⇩
7. *Independent Safe System Assessment* ⇩
8. *Independent Safety Review* ⇩
9. *Traffic Impact Assessment Report* ⇩
10. *Stage 1 Corridor Report* ⇩
11. *Inkerman Road Engagement Outcomes Report (Redacted)* ⇩
12. *CoPP and GECC Section 1 Report (Co-Design)* ⇩

EXECUTIVE SUMMARY

Two cycling corridor design options for the Inkerman Road corridor have been prepared and assessed:

- Option 1: One-way traffic with protected bi-directional bicycle lanes with parking on both sides (Attachment 2).
- Option 2: Two-way traffic with protected bi-directional bicycle lanes with parking on one side (Attachment 3).



Figure 1: Corridor Option 1

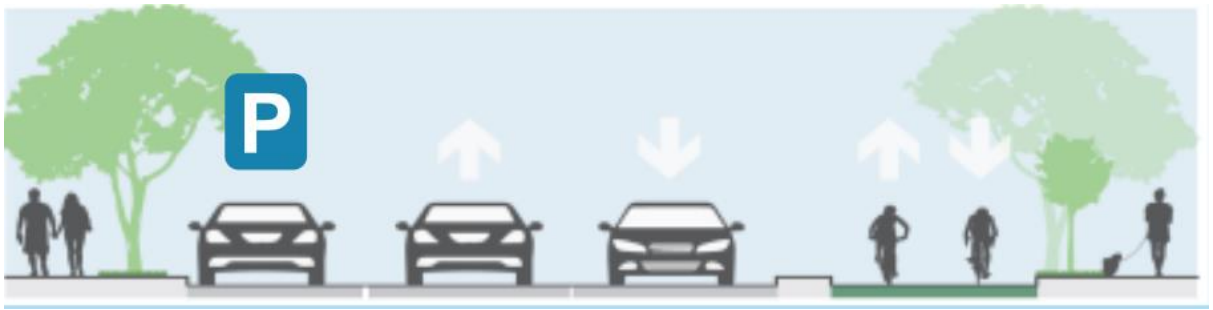


Figure 2: Corridor Option 2

Based on the criteria assessment undertaken for both designs, both Option 1 and Option 2 score better than the existing conditions. However, it should be noted that Option 1 to date has no in-principle support from the Department of Transport and would present a significant

approvals risk to proceed. Given this, Option 2 is considered to result in the best project outcome, however presents significant cost barriers.

The above design options have been prepared with the accompanying design report (Attachment 1) which details the design process of preparing the two Corridor Options.

The following assessments have been undertaken to determine the best and most feasible outcome for the corridor:

- Corridor Design Report – including an on-street car parking assessment (Attachment 1).
  This report details the design development process of preparing the two Corridor Options and details issues and responses relating to the key themes of safety, impact on the neighbourhood and feasibility of construction. It also includes an on-street car parking assessment, with the key findings:
    - Option 1 with one-way traffic will have less impact to on-street parking as parking is retained on both sides of the corridor (458 spaces, 80% parking retained)
    - Corridor Option 2, all on-street parking is lost on the south side of the road to retain two traffic lanes (267 spaces, 47% parking retained)

- An independent cycling demand estimate (Attachment 4)
  A cycling demand estimate study was undertaken to help predict the extent of cycling demand should the project be constructed. The report concluded that while "*estimating cycling demand is exceptionally difficult*" between 300-500 riders a day can be expected, with the likelihood that demand will fall towards the upper end of the range though the construction of protected bicycle lanes. This would represent a daily increase in cycling on Inkerman Road of between 84-207% on pre-pandemic (2019) levels.

  Based on comparable cycling projects, the report estimated that the proportion of riders using a new cycling project that would otherwise have driven a car would be expected to average around 6-8%.

- An independent emissions analysis (Attachment 5)
  An independent emissions analysis was undertaken to assess the environmental implications of the proposed cycling corridor options. The analysis considered the emissions saved by a modal shift from car and public transport trips to cycling, whilst accounting for the construction emissions for the project.

  Based on this analysis, installation of Option 1 or Option 2 would be environmentally beneficial over its life. It could contribute to reducing Glen Eira's total transport emissions by 0.01%, an impact that can be scaled up with further establishment of dedicated cycle paths and lanes as envisioned in the Integrated Transport Strategy (ITS).

- A Gender Impact Assessment (Attachment 6)
  The Gender Equality Act 2020 requires Glen Eira City Council to undertake a gender impact assessment for services that directly and significantly impact the public.
  A Gender Impact Assessment (GIA) was prepared to understand the impact the proposed design options (including maintaining existing conditions) would have on men, women and gender diverse people. The GIA determined that the overall gender impact of both design Options 1 and 2 was positive compared to existing conditions.

However, Option 1 is considered preferred of the two options given it retains more parking.

- An independent Safe System Assessment (Attachment 7)
  An early safety assessment was undertaken to ensure the design options were applying road safety principles that would improve the safety all for all road users and that they were appropriate to continue further design. Key findings were that both Option 1 and Option 2 were better aligned with an overall safer outcome for all road users, compared to the existing conditions.

- An independent Safety Review (Attachment 8)
  A more detailed safety assessment was undertaken on established concept designs to measure the overall improvement (or decline) in safety for the various road users when compared to existing conditions. Key findings were as follows:
    - Both design options result in a safer outcome for all road users combined compared to existing conditions.
    - Corridor Option 2 results in a safer bicycle and vehicle outcome compared to Corridor Option 1.
    - Corridor Option 2 outcomes for pedestrians were assessed as slightly poorer than Corridor Option 1 (but still better than existing) due to fewer raised pedestrian crossing opportunities.
    - Corridor Option 1 was assessed as having poorer safety outcomes for vehicles compared to existing conditions.

- A Traffic Network Impact Assessment (Attachment 9)
  To minimise the loss of on-street parking, officers explored the feasibility of altering Inkerman Road to be one-way for vehicle movements between Normanby Road and Orrong Road.

  The analysis concludes that a one-way option is very difficult to achieve due to the broader traffic distribution impacts across the road network, particularly impacts on trams on Balaclava Road. This is reflected in the absence of in-principle support from the DoT on any of the one-way options proposed for the Inkerman Road corridor. To proceed with this option would require the mitigation of these impacts and, as a result, carries a significant approval risk to proceed further.

  For Option 2, limited traffic modelling has been undertaken. It is however recognised that Option 2 may also displace some traffic demand due reduction of turn lanes at intersections and less efficient signal operations for traffic movement which would have a smaller pattern of impact on public transport performance in the surrounding area, albeit to a much lesser extent than Option 1.

  If Option 2 was to proceed to further detailed design, future modelling and assessment would need to be undertaken in consultation with DoT, with respect to wider network objectives and performance as opposed to in isolation as a traffic performance exercise. Following consideration of the design options, the DoT has given in-principle support to design Option 2.

- Independent costings for construction
  Cost estimates have been prepared for both corridor options. The total construction cost of the project is estimated at $14 million for either corridor option. While the total cost of actual works for either option is estimated at $6 million, given the volatility that

the building and construction industry has seen over the last two to three years, and uncontrollable cost escalations as a result of shortages of contractors, competition from major State projects, and disruption to supply chains as a result of COVID and war in the Ukraine, along with staging, traffic management, contingency and indirect costs, a cost contingency of 20% has been included to give a conservative estimate.

A more detailed summary and findings of each of the above assessments are included within this report, with each assessment report also attached for additional detail.

Additionally, the designs were informed via a co-design process with the following three key stakeholder groups:

- Community Reference Group (CRG)
- Strategic Transport Advisory Committee (STAC)
- Technical Advisory Group (TAG) (STAC, CRG, TAG)

This focused stakeholder engagement was undertaken to ensure that the development of the Corridor Plan reflects the community's values and priorities. Feedback and advice on potential issues and opportunities were used to inform the designs. More detail on how feedback was used to inform the design is summarised within this report and provided in the attached Engagement Outcomes Report (attachment 11), including design responses to each suggestion provided during the design workshops.

From the design, assessments, reviews and focused engagement undertaken, Option 2 demonstrates that a safe strategic cycling corridor can be achieved and is presented as the preferred design for the purpose of community consultation.

A decision to proceed to community consultation acknowledges the financial commitment required to deliver the project. The decision to proceed to construction would come through a further resolution of Council, following community consultation. It is recommended that no further design work or community consultation commence without a commitment to fund the project.

RECOMMENDATION

That Council:

1. Adopts Option 2 (Attachment 3) as the preferred corridor design for the purpose of community consultation, once the following pre-conditions have been met:

    a) Funding to deliver the project is confirmed through Council's future budget allocation process.
    b) The City of Port Phillip resolves to proceed to wider community engagement on its section of Inkerman Road / Street.

2. No further design work and/or community consultation is to commence until pre-condition a) and b) have been met.
3. Informs community and stakeholders of Council's resolution.

BACKGROUND

The population of Glen Eira is projected to increase by approximately 30,000 people by 2036, meaning around 20,880 more cars on our roads if current usage and ownership rates continue.

To address this, Council adopted a multi-faceted *Integrated Transport Strategy* in 2018 to find ways of encouraging the community to use different modes of transport other than driving, for the benefit of all.

One action in the *Strategy* is to conduct a *pilot* for a safe cycling route. The aim is to provide a safer alternative for those who wish to ride.

The *Integrated Transport Strategy* identified Inkerman Road as a potential key cycling corridor with strategic opportunity, being 11km from the CBD and linking the bicycle path under the Dandenong elevated rail line (Djerring trail). This was further strengthened with the proposal from the State Government to construct a separated bicycle lane on St Kilda Road (northwards from Carlisle Street). The route also aligns with the City of Port Phillip's identification of Inkerman Street as a proposed cycling corridor in its *Integrated Transport Strategy* — enabling a fully connected corridor.

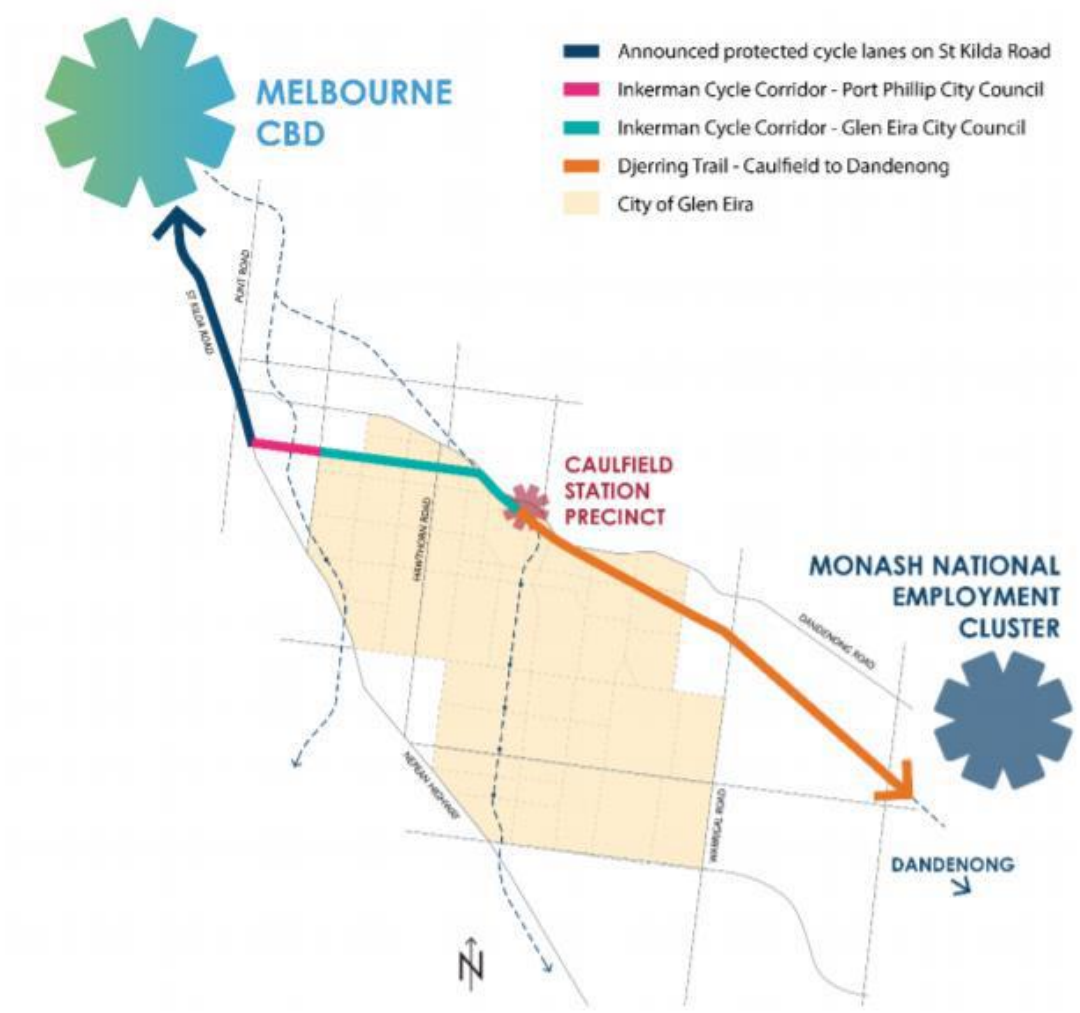


Figure 1: Inkerman Road Safe Cycling Corridor Network

After engagement with the community in early 2019, Council expanded its analysis to consider a route along Dandenong Road and routes that also involved Alma Road. A *Corridor Assessment Report* was developed that included four different route options for the safe cycling corridor. This report was released for community feedback over a six-week period.

After considering community feedback, the *Corridor Assessment Report* and an *Assessment of Routes* report, Council endorsed the following resolution at the Ordinary Council Meeting on 17 December 2019:

That Council

- *selects the Inkerman Road route as the preferred route for detailed design and exploration; and*
- *will receive a further report at the conclusion of the development of the Corridor Plan. The report will contain details of a functional layout, indicative costings, and outline how community concerns have been able to be addressed through the design process. No construction will occur without a further resolution of the Council.*

Following this resolution, officers worked with key stakeholders and established a Community Reference Group (CRG) to identify priority road scenarios to be further explored in the development of a Corridor Plan.

There are numerous road scenario designs that can incorporate a bike lane. These designs are dependent on several factors including road width, road type, speed and surrounding land uses. Chapter 3 of the corridor assessment report outlines the road designs that can incorporate a bike lane that could fit within the road corridor. In addition, a commitment was made that scenarios which require the removal of all parking or impacts on existing nature strips including the removal of a significant number of trees, are not considered.

This has ruled out several common bike lane designs including the 'Copenhagen bike lane' design, which provides protected bike lanes on each side of the road. However, this particular design does not fit within the confined road corridor and does not provide for the retention of some on-street parking.



Figure 2: Road Scenarios not considered for Inkerman Road - Corridor Assessment Report (page 68)

The Stage 1 report (Attachment 10) assessed five different 'Road Scenarios' which could be applied along the Inkerman Road corridor. All five options were considered through a design appraisal and stakeholder community engagement.

Considering the above, further consultation with the CRG and Council's STAC was then undertaken to determine which two corridor options should be further explored via designs of functional layout plans. A summary of this consultation is contained in the Engagement Summary report (Attachment 11). Based on this consultation and with consideration of what road designs would most likely be achievable (from feasibility, cost, and impact to the community perspective), the following two corridor options proceeded to concept design:



Figure 3: Corridor Option 1

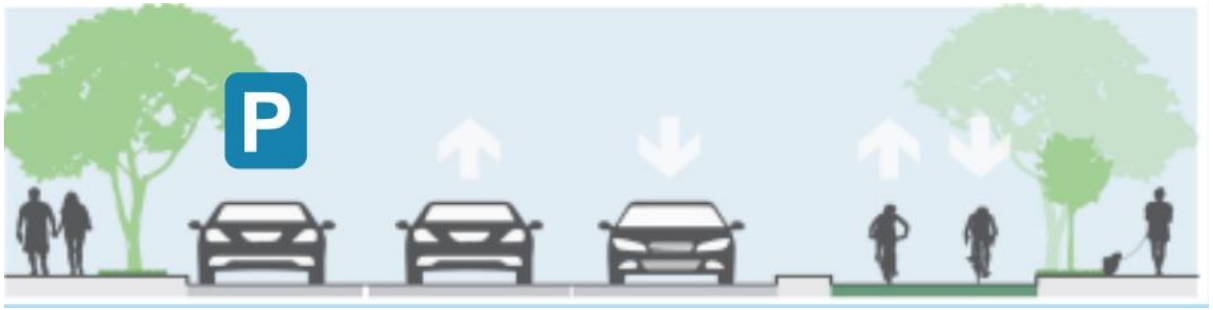


Figure 4: Corridor Option 2

Both the above road scenarios fit the kerb-to-kerb alignment of Inkerman Road (noting that the most constrained section of the corridor in Glen Eira is only 12m in width). They avoid the loss of significant trees and also retain 47-80% of on-street car parking, (depending on design option).

However, from April 2020, due to the impact of the COVID-19 pandemic and the inability to consult with the CRG and wider community, further consultation and final development of functional layout plans were put on hold. Due to the significant delay and re-prioritisation of Council's strategic resource plan to prioritise COVID recovery, a report was put to Council on 27 April 2021. Its purpose was to seek Council's consideration of whether to proceed with the design process for the project. Council endorsed the following resolution:

That Council:

1. *proceeds with the detailed design for the Inkerman Road Safe Cycling Corridor project as outlined in the 17 December 2019 Council resolution;*
2. *requests officers consult with the Community Reference Group and Technical*

Reference Group to assist in developing a preferred corridor design;

3. *requests Officers explore how best to address community concerns regarding parking, safety, accessibility and amenity where possible through the detailed design process;*
4. *requests the tabling of a further report on the preferred corridor design for Council consideration, including indicative costings and how community concerns were able to be addressed through the design process. No construction will occur without a further resolution of the Council.*

The following section of this report details the development of two designs for the Inkerman Road Safe Cycling Corridor and explores their impact on parking, safety, accessibility, and amenity.

ISSUES AND DISCUSSION

Design Process Summary:

The development of the Inkerman Road Corridor designs has been led by Council officers and assisted by engineering design consultants Arup, with continued input and support of a Community Reference Group (CRG), Technical Advisory Group (CRG), and Strategic Transport Advisory Group (STAC).

The process of developing co-designed corridor options has included iterative feedback loops over time. The aim has been to develop an understanding of relative performance with key stakeholder groups, and an appreciation for the differences between them. Local input has been sought to both optimise the design (for example, understanding community needs for crossing points) as well as understanding concerns over how each option would affect the street environment and the end user.

This process has culminated in two corridor designs that can be presented to Council to seek a decision on proceeding further with the project or otherwise.

A summary of the design process undertaken is outlined below:

1.1. Identification of Priority Road Scenarios

A desktop review of all background data and reports prepared to date was undertaken to assess and prioritise the different road scenario design options to implement a Safe Cycling Corridor on Inkerman Road.

This analysis focused on the three criteria identified in the Corridor Assessment Report to provide a safe environment for cyclists, minimise impacts on the neighbourhood and being feasible for construction.

Five road scenario design options were identified that would fit within the existing kerb to kerb width of the road and would retain car parking on at least one side of the road.

These road scenarios were presented to the CRG, STAC and TAG for discussion. A further one-way road scenario was added for consideration following the meeting with the CRG. A summary of this consultation is contained in the engagement outcomes report (Attachment 11).

Additionally, officers met with local traders along Inkerman Road to discuss the scenarios and how each would affect them.

1.2 Preliminary Draft Corridor Plan

These two corridor design options have proceeded to concept design:

- Option 1: One-way traffic with protected bi-directional bicycle lanes with parking on both sides (Attachment 2).
- Option 2: Two-way traffic with protected bi-directional bicycle lanes with parking on one side (Attachment 3).

The designs prepared for each option allowed officers to assess impacts on on-street parking, identify opportunities to reinstate on-street parking, and identify opportunities for activation/place-making spaces along the corridor to improve the local street amenity.

The draft corridor designs were presented to the CRG and STAC to seek feedback on the impact on the neighbourhood, safety, and feasibility. The draft corridor designs were reviewed on a technical basis by the TAG. A summary of this consultation is contained in the engagement outcomes report (Attachment 11).

Feedback from these meetings was considered in refining the draft Corridor Plans (Attachment 11).

1.3 Technical analysis of the draft Corridor Plans

The draft Corridor Plans were provided to various technical experts to undertake assessments of different aspects of the corridor plan to guarantee that they comply with relevant standards, are feasible for implementation, and achieve Council's strategic goals. These assessments include:

- Corridor Design Report – including an on-street car parking assessment.
- An independent Cycling Demand Estimate
- An independent Emissions Analysis
- Gender Impact Assessment
- Safe System Assessment
- An independent Safety Assessment
- Traffic Impact Assessment; and
- Independent costings for construction

The following section of this report will detail the outcome of these assessments.

Design Options

As detailed above, the two corridor options that progressed to full corridor concept design were:

- Option 1: One-way traffic with protected bi-directional bicycle lanes with parking on both sides
- Option 2: Two-way traffic with protected bi-directional bicycle lanes with parking on one side

The bi-directional bicycle lane is on the south side of Inkerman Road in both options as there are fewer vehicle crossovers and side streets, meaning less cycling conflict points overall.

This is largely attributable to Caulfield Park, and by keeping the facility on the south side across the entire corridor maintains continuity.

In Option 2, parking is provided on the opposite side of the bicycle path, to maximise sight lines and reduce car door conflicts. This results in parking being available on the same side

as residential premises alongside Caulfield Park, and other key places on the north side such as the Caulfield Hebrew Congregation and Lenny's store.

These 2 corridor options were considered to have the best possible chance to succeed and be accepted by Council and DoT.

Design Assessments

The development of these two corridor designs has allowed officers to assess the designs based on three key themes including safety, impact to neighbourhood, and feasibility. Several reports have been prepared to address key questions of these themes.

These assessments include:

- A Corridor Design Report – including an on-street car parking assessment (attachment 1).
- An independent Cycling Demand Estimate (attachment 4).
- An independent Emissions Analysis (attachment 5).
- A Gender Impact Assessment (attachment 6).
- An independent Safe System Assessment (attachment 7)
- An independent Safety Assessment (attachment 8)
- A Traffic Network Impact Assessment (attachment 9)
- Independent costings for construction

The following section of this report will detail the outcome of these assessments for the purpose of illustrating key differences between the options.

Corridor Design Report

A Corridor Design Report has been prepared which details the design development process of preparing the two Corridor Options. The report (attachment 1) outlines key design features for each option, these include:

- Pedestrian crossings (design and locations)
- Design speeds (40km/h)
- Location of bike lane
- Land widths and buffers
- Side road treatments
- Driveway access
- Separation to traffic at mid-block locations
- Traffic signal operation / bicycle signals
- Intersection treatments
- Normanby Road tram stop interface
- Signage and line-marking
- Waste collection and emergency access

The report also details issues and responses relating to the key themes of safety, impact on the neighbourhood, and feasibility of construction.

Car parking assessment

The Design Report includes a car parking assessment (attachment 1). To inform the assessment, existing parking demand was surveyed by OneMileGrid on Friday 24 May, Saturday 25 May and Tuesday 28 May 2019. The peak occupancy over the day for each section was recorded, with the busiest day Friday 24 May used to calculate utilisation (demand/supply) to represent the worst-case parking scenario. Figure 5 illustrates the existing parking supply and Figure 6 illustrates the parking utilisation documented on Friday 24 May.



Figure 5: Existing Parking Supply



Figure 6: Parking Utilisation

The future car parking supply for each Corridor Option is shown in Figures 7 and 8. In some instances, a small increase in parking is shown due to reduction of keep clear lengths and extension of parking areas closer to intersecting streets, largely enabled by reducing the corridor speed to 40km/h (this is reflected in the below diagram with some sections being over 100% in future car parking supply, as more parking then the existing supply is added).

Parking impacts to sections 1 and 5 are identical for both Corridor Options. Corridor Option 1 with one-way traffic will have less impact to on-street parking in sections 2-4 as parking is retained on both sides of the traffic lane (overall 458 spaces, 80% parking retained). For Corridor Option 2, all on-street parking is lost on the south side of the road to retain two traffic lanes (overall 267 spaces, 47% retained).



Figure 7: Option 1 Future Car Parking Supply (# of spaces and % retained)



Figure 8: Option 2 Future Car Parking Supply (# of spaces and % retained)

The predicted difference between the demand and future supply of on-street supply for each option is illustrated in Figure 9 and Figure 10. A positive number indicates that future supply continues to exceed demand given there is currently some spare capacity. A negative number indicates a shortfall of parking. Sections with negative values could experience parking overspill, with some demand migrating into adjacent side streets.



Figure 9: Option 1 Difference between future parking supply and existing peak demand



Figure 10: Option 2 Difference between future parking supply and existing peak demand

The analysis presented in Figure 9 and Figure 10 above assumed no change in parking behaviour. However, it is expected that some mode shift change in travel behaviours (including increased uptake of on-site parking) could occur over time and have a downwards effect on the existing parking demands.

Table 1 presents the potential changes to parking along the corridor for each option. A conservative approach has been adopted for the Corridor Plan, generally assuming existing no stopping extents. However, in future design stages, sight distance assessments could be carried out with a view to adding more parking.

	Option 1		Option 2	
Section	**Change to available parking**	**Excess (+)/shortfall (-) of parking spaces based on peak demand**	**Change to available parking**	**Excess (+)/shortfall (-) of parking spaces based on peak demand**
Hotham St – Orrong Rd	-100	-63	-100	-63

Orrong Rd – Kooyong Rd	-1	+43	-56	-12
Kooyong Rd – Hawthorn Rd	-5	+8	-45	-32
Hawthorn Rd – Normanby Rd	+12	+83	-84	-13
Normanby Rd (Inkerman Rd – Balaclava – Smith St)	-17	N/A	-17	N/A
Overall	**-111**	**+71**	**-302**	**-120**

Table 1: Parking by section of Corridor for each option

Option 1 results in a far reduced impact (and in some sections a positive addition) to on-street parking than option 2. However, the car parking assessment notes for both options, that given the shortfall of parking demand could be spread across a number of different side roads, the total impact of this dispersion would need to be assessed at any further design stage.

Cycling Demand Estimate

A cycling demand estimate study was undertaken (attachment 4) to help predict the extent of cycling demand should the project be constructed. The study was conducted in conjunction with the City of Port Phillip (CoPP) and broken into two sections, west of Hotham Street (CoPP section) and east of Hotham Street (Glen Eira section).

Two empirical methods were used to estimate the likely magnitude of cycling demand should the project be constructed:

1. Comparison method: analysis of observed counts from similar cycling projects in Victoria, Queensland and Western Australia.
2. Uplift factors: current demand along Inkerman Street is expanded by uplift factors derived from intercept surveys of bicycle riders at completed cycling projects across Australia.

The comparison method suggested demand could be around 900 riders on an average weekday, while the uplift method suggested demand closer to 500 riders per day towards the (busier) western end of Inkerman Street to the west of Hotham Street. Currently, the average daily cycling volume of the Glen Eira section of Inkerman Road is 163 riders.

In terms of the Glen Eira section, the demand estimate concluded that while "*estimating cycling demand is exceptionally difficult*" a range of between 300-500 riders a day can be expected, with the likelihood that demand will fall towards the upper end of the range though the construction of protected bicycle lanes (compared to un-protected buffered bicycle lanes) and if complementary actions such as high-quality connections to the Djerring Trail and St Kilda Road are incorporated. This would represent a daily increase in cycling on Inkerman Road of between 84-207% on pre-pandemic (2019) levels.

Based on comparable cycling projects, the report estimated that the proportion of riders using a new cycling project that would otherwise have driven a car would be expected to average around 6-8%.

Environmental Assessment

An independent Emissions Analysis was undertaken (attachment 5) to assess the environmental implications of the proposed cycling corridor options.

The analysis considered the emissions saved by a modal shift from car and public transport trips to cycling, whilst accounting for the construction emissions of a kerbside barrier between the bike path and the vehicular traffic.

The results of the emissions analysis on the proposed cycle path for Glen Eira City Council are presented in Table 5. This indicates that the installation of the path would reduce emissions by 15 t CO2-e per year, offsetting all embodied emissions from its construction in just over three years. As road construction elements typically have a life expectancy of over 20 years, this will result in net emissions savings of over 250 t CO2e.

Emissions	Quantity
Emissions saved per week	290 kg CO2-e
Emissions saved per year	15 t CO2-e
Embodied emissions of barrier construction	48 t CO2-e

Table 5: Emissions analysis results

Based on this analysis, installation of Option 1 or Option 2 would be environmentally beneficial over its life. It could contribute to reducing Glen Eira's total transport emissions by 0.01%, an impact that can be scaled up with further establishment of dedicated cycle paths and lanes as envisioned in the ITS.

Gender Impact Assessment

The Gender Equality Act 2020 requires Glen Eira City Council to undertake a gender impact assessment for services that directly and significantly impact the public.

A Gender Impact Assessment (GIA) (attachment 6) was prepared to understand the impact the proposed design options (including maintaining existing conditions) would have on men, women and gender diverse people. The GIA determined that the overall gender impact of both design options 1 and 2 is positive compared to existing conditions. However, Option 1 is considered preferred of the 2 options given it retains more parking.

Overall introducing a safe cycling facility along Inkerman Road is considered beneficial to gender equity. Women are more likely to feel unsafe cycling on a road without cycling infrastructure than men. Introducing separated cycling facility will increase opportunities for women to engage in cycling.

The evidence within GIA concludes that Option 1 is considered the preferred option from a gender impact perspective. This is because it provides a separated cycling facility and maintains more parking than Option 2. The GIA details that women may be more negatively impacted by parking loss if this means they need to walk further from their vehicles to their homes or place they are visiting (due to safety concerns, particularly at night). This can also be applied to the elderly and those with a disability. Additionally, the GIA notes that historically there has been a correlation with gender and care giving roles, which means women may also be more impacted by having to park further away for example, if they are travelling with young children, prams, buggies and groceries. However, both Option 1 and Option 2 are considered to have a positive gender impact outcome compared to existing conditions. A program to monitor and evaluate the outcome will be prepared if the project proceeds to detailed design and construction.

Corridor Safety Assessments

Early Safe System Assessment (SSA)

A Safe System Assessment (SSA) is a tool that has been developed to provide a measure of the extent to which a road infrastructure project aligns with Safe System principles which have the ultimate objective of eliminating fatal and serious injuries from crashes on the road network. An SSA is carried out by a specialist, independent and qualified team that considers each of the core components of the Safe System.

An SSA was undertaken on the two design options at an early stage in the design process and compared against the existing conditions to ensure the design options were applying road safety principles that would improve the safety all for all road users and that they were appropriate to continue further design.

The Safe System Matrix score is the sum of scores determined for seven major crash types for each of the options, summarised in the table below, noting the lower the score, the better alignment with Safe System principles. We aim to move Towards Zero.

	Option	Safe System Alignment Score
	Existing Conditions	192.5 / 448
	Design Option 1 	106.5 / 448
	Design Option 2 	112.5 / 448

Table 2: Safe System Assessment Alignment Score

The results show that both design options are better aligned with Safe System principles, compared to the existing conditions. This is primarily attributed to the dedicated bi-directional cycle path along the entire route (which significantly improves cyclist safety) and the reduced 40km/h speed limit (which reduces the likelihood and severity of all crash types) along the entire route. In addition, the proposed activation spaces along Inkerman Road improve pedestrian safety (by providing priority or low speed crossing points) and act as traffic calming along the route.

Design Option 1 has a better (lower) score than Design Option 2 because of the one-way traffic arrangement along the length of Inkerman Road, which results in fewer conflict points along the route. As a result, Design Option 1 has the best alignment with Safe System principles, followed by Design Option 2. The existing conditions has the highest overall SSA score and is therefore the least aligned with Safe System principles.

A number of ideas for consideration were included in the Safe System Assessment that would bring the project closer Towards Zero. They are listed in the attached SSA report (attachment 7) and were considered during further refinements to the design options.

Safety Assessment

Following the development of a complete set of draft concept designs, an independent Safety Review was commissioned. The intent of this assessment is to provide a relatively high-level safety review of the proposed corridor options to measure the overall improvement (or decline) in safety for the various road users when compared to existing conditions. This

assessment serves to determine whether the safety benefits justify alteration to the existing corridor. The assessment is not a detailed Road Safety Audit, this would be required at the next stage of the design if the project is to proceed.

While a more detailed coverage of safety risks is produced in the attached independent safety report (attachment 8), a summary of the main differentiators between the two options as well as key risk sources and mitigation is provided below:

- Comparative Assessment

This assessment ranks the safety outcome for the various road users for each proposed corridor option and existing conditions. The key findings are shown below:

- Both options result in a safer outcome for all road users combined compared to existing conditions.
- Corridor Option 2 results in a safer bicycle and vehicle outcome compared to Corridor Option 1.
- Corridor Option 2 outcomes for pedestrians were assessed as slightly poorer than Corridor Option 1 due to fewer raised pedestrian crossing opportunities.
- Corridor Option 1 was assessed as having poorer safety outcomes for vehicles compared to existing conditions.

User	Existing Conditions	Design Option 1	Design Option 2
Cyclists	3	2	1
Pedestrians	3	1	2
Vehicles	2	3	1
OVERALL ASSESSMENT	3	2	1

Table 3: User Safety Ranking Comparison

- Detailed design issues

A number of recommendations were made in the safety review for items that will be developed or detailed if the project proceeds to the next design stage. While some are valid, there is limited value in detailing these before detailed design, or before a single preferred option is identified. These issues include aspects such as:

- Hook turn pavement markings.
- Bicycle head start boxes.
- Exact stop line locations.
- Green pavement extents.
- Relative width of the separator kerb vs. the bicycle path.
- Minor changes to separation kerb extents adjacent wombat crossings.
- Bicycle lanterns for north-south cycling movements.

- Conflict points - property access

The Independent Safety Review found that for both design Option 1 and 2, due to the bi-directional bicycle lane, there are expected risks for cyclists given the high number of intersecting driveway crossovers on the south side of Inkerman Road, largely applicable to westbound cyclists as departing vehicles may not expect a cyclist to arrive from this direction.

To address this the design includes the provision of bicycle line markings and surface treatments at the crossovers which serves to advise the presence of bicycle lanes. With the report concluding, "*nonetheless, the prevailing issue is the unexpected arrival of a bicycle in the eastbound direction. As a primarily residential area, it is anticipated long-term residents will quickly adapt to the proposed design, and the risk associated with this item will reduce over time*".

The independent Safety Review found that Option 2 was more favourable than Option 1 in safety terms due to the absence of car parking adjacent the bicycle lane, which improves sightlines between property access points and path users.

- Conflict points - passenger car doors

Option 1 presents a unique risk scenario of car dooring conflict with other motor vehicles, where parallel parking is on the right-hand side of the one-way carriageway.

While the number of occurrences of car door opening into the traffic lane will be much lower on the passenger side, given the seat is occupied far less, the unfamiliar nature of a 'passenger side' traffic conflict may increase crash risk.

To mitigate this risk, the proposed design adopts a 0.5m buffer between the edge of the traffic and the edge of the car parking bays. While this doesn't replace the need to look for oncoming traffic, it would mean that a partially opened car door is less likely to result in a crash

Where parallel parking is on the right side, the driver side door will open head on into possible bicycle traffic. This scenario is mitigated by a separation strip.

- Conflict points - side roads

The Normanby Road underpass to Dandenong Road was identified as an existing risk and one that will be continued with the bike lane design. For the purpose of the Corridor Plan, the design has assumed that Council would not be in a position to propose new traffic signals at this location. A raised side road treatment is assumed to be provided, however the standard of treatment that can be achieved is limited by the existing retaining structures of the rail over bridge.

It has been noted that this area becomes particularly congested during peak times, and historically has experienced a number of vehicle-to-vehicle crashes.

It is therefore, recommended both within the Design Report and the independent Safety Review, that if the project is to proceed to a further detailed design stage, this intersection be subject to further design consideration and review, including considering options for signalisation with the Department of Transport.

Design Option 1. One-way Traffic Assessment

As one of two design options, officers have explored the feasibility of altering Inkerman Road to be one-way for vehicle movements between Normanby Road and Orrong Road as part of the Safe Cycle Corridor Project (attachment 9). The one-way concept is being considered to

accommodate a two-way off-road cycle path along Inkerman Road and maximise the amount of on-street parking retained.

The three one-way vehicle movement options that have been tested for feasibility are as follows:

- Model Option 1: Inkerman Road to be one-way westbound between Orrong Road and Normanby Road
- Model Option 2: Inkerman Road to be one-way eastbound between Orrong Road and Normanby Road
- Model Option 3: Inkerman Road to be one-way eastbound between Hawthorn Road and Normanby Road (along the frontage of Caulfield Park).



Figure 11: One-way traffic assessment options.

Model Options 1 and 2 explore one-way options up to Orrong Road as this is the beginning of the shared section of Inkerman Road with the City of Port Phillip. Port Phillip has also resolved to consider three separated cycling designs for Inkerman Road/Street, however, none are to be one-way.

To analyse the impacts of these options, turning movement counts and origin-destination surveys were undertaken in late November 2021. The data was further interrogated and used to undertake traffic analysis at key intersections. As part of the analysis undertaken, existing surveyed traffic volumes at various intersections were factored up to cater for the 'design hour' (a VicRoads guideline in traffic modelling which adjusts traffic volumes from a 'regular day' to the '30th busiest hour' on that road for the year), as well as account for 10 years population and travel growth before analysing road configuration options for Inkerman Road.

Of considerable change was model Options 1 and 2's impact on alternative routes. By making Inkerman Road one-way, traffic will be redistributed to the intersections along Alma Road and Balaclava Road and therefore will result in increased turning movements at these intersections. Based on the anticipated increase in traffic along Balaclava Road between Normanby Road and Chapel Street, model Option 1 is predicted to increase the tram travel time in the eastbound direction by 2 minutes 51 seconds during the School Pick-Up Peak whereas model Option 2 will increase the tram travel time in the eastbound direction by 3 minutes 53 seconds in the AM Commuter Peak.

Model Option 3 presents the least distribution to a road network that is expected to experience growth into the future and has the least impact on the operation of the tram routes along Balaclava Road when compared to the other options. The worst-case delay for trams was modelled at 54 seconds, which could be reduced, or even nullified with network improvements to that route enacted by Council.

Importantly to note, as subsequent updates have been made to the design since this modelling work was undertaken, the impacts at intersections may have slightly changed, and if a one-way option was to proceed as the preferred corridor design option that further traffic modelling would be required.

To date, no in-principle support has been received from the DoT on any of the one-way options proposed for the Inkerman Road corridor. This reflects the challenges associated with broader road network implications due to displacing traffic toward Balaclava Road and subsequent tram delays associated with this option. To proceed with this option would require the mitigation of these impacts and as a result, carries a significant approval risk.

Design Option 2 - Traffic Assessment.

As this option is limited in changes to the operation of traffic (as it retains two-way traffic flow), compared to a one-way option, limited traffic modelling for this option has been undertaken to understand traffic performance at this early stage of design. Detailed operational modelling to ascertain optimal signal operations and quantify the impact to traffic performance has not been undertaken and is not typically recommended for a project of this nature, if at all, until there is a narrower definition of the preferred design solution.

Any further traffic assessment needs to consider the range of users apart from vehicles that will be impacted by the construction of the Inkerman Road SCC. Considerations of mode shift and traffic redistribution would need to be incorporated to ascertain the impact to traffic performance with any degree of certainty. The exercise to achieve this can become a large and comprehensive modelling process.

Notwithstanding, using the *Inkerman Road Traffic Network Impact Assessment* (attachment 9) ‘existing future conditions’ as a base case, it is evident that there will also be some impact to traffic capacity under Option 2.

It should also be recognised that Option 2 may also displace some traffic demand due reduction of turn lanes at intersections and less efficient signal operations for traffic movement which would have a smaller pattern of impact on public transport performance in the surrounding area, albeit to a much lesser extent then Option 1.

If this option was to proceed to further detailed design future modelling and assessment would need to be undertaken in consultation with DoT, with respect to wider network objectives and performance as opposed to in isolation as a traffic performance exercise.

Following consideration of the design options, the DoT has given in-principle support to this option (design Option 2), while recognising, if the design was to proceed to detailed design, that further work would be required to minimise the impacts to all road users (including trams) through further intersection design and signal phasing.

Estimated Costings

Cost estimates have been prepared for both corridor options. Table 4 summarises the costs for each option. It should be noted that a significant portion of the total costs presented below related to indirect costs and contingency costs. As such, it is expected that the ‘total construction including escalation’ costs present a conservative estimate. Noting this, a

staged cost plan was also prepared for both options. It was estimated that this would result in an increase in costs of 20% for each stage.

Items	Option 1	Option 2
Section 1: Hotham St to Orrong Road	$1,579,628	$1,953,583
Section 2: Orrong Road to Kooyong Road	$1,392,252	$981,726
Section 3: Kooyong Rd to Hawthorn Road	$925,075	$779,624
Section 4: Hawthorn Road to Normanby Road	$1,088,612	$894,404
Section 5: Normanby Road	$625,207	$891,207
EO for night shift work	$841,616	$825,082
Direct Cost Total	**$6,452,390**	**$6,325,626**
Direct Field Costs	$2,645,480	$2,593,506
Indirect On Cost (e.g. owners outgoings cost and agency consultant charges)	$454,894	445,956
Contingency Risk 20% (+ 12-month cost escalation)	$4,757,277	$4,663,815
Total Construction Including Escalation	**$14,310,040**	**$14,028,903**

Table 4: Summary of Cost Estimate

In addition to the cost estimate presented in Table 4. Cost plans were also developed for both options if cheaper materials could be used. However, it was noted that there was limited opportunity to construct the cycling corridor using cheaper materials and the estimated cost reduction was 5%. In addition, a number of costs such as design, traffic management, project management, intersection changes and contingency would be the same cost regardless of the types of materials. The use of cheaper materials may also result in reduced safety outcomes and the requirement for an updated safety assessment.

More information on Council's financial capacity to accommodate this project and the broader financial impacts associated is contained in the '*financial, resource, risk and asset management implications'* section of this report.

External Funding Opportunities

This project would likely be suitable for state government grant programs. However, to apply for grants, typically detailed design and community consultation would need to be completed to demonstrate that the project could be constructed if external state government funding was provided.

Stakeholder feedback

Targeted stakeholder engagement was embedded in the project via three stakeholder groups. The purpose of the engagement was to ensure that the development of the Corridor Plan reflects the community's values and priorities and to seek feedback and advice on potential issues and opportunities to inform the designs.

The stakeholder groups involved were:

Community Reference Group (CRG)

A group made up of local community members, whose purpose was to represent diverse community views in providing advice and input on the Safe Cycling Corridor Project.

Convened in an advisory role, with no decision-making capacity. Meetings were independently chaired.

Technical Advisory Group (TAG)

A group that included technical experts from road management authorities and key stakeholders including; the Department of Transport, Major Road Projects Victoria, Yarra Trams, Bicycle Network and City of Port Phillip.

The group was made up of members with decision-making roles independent of Council.

Strategic Transport Advisory Committee (STAC)

A group consisting of Councillors and community members. The group is a formal Committee of Council with a reviewing and recommending capacity for strategic transport projects.

Group	Meeting	Purpose / Outcome
CRG	17/02/2020	Individual meetings were held for each stakeholder group to discuss previous community engagement findings, research and information, and prioritise corridor designs and help determine the feasibility of these before moving to design. Stakeholder group members also provided comments on preferred road scenario options.
TAG	20/02/2020	
STAC	20/02/2020	
CRG	16/02/2022	Re-introducing community members to the project and providing them with an update on the status of the project since meeting in 2020.
CRG	28/04/2022	To discuss and gather each groups feedback on draft Corridor Plans and parking opportunities. OneMileGrid (OMG) presented the findings from the traffic report.
STAC	02/05/2022	
TAG	05/05/2022	
CRG	08/08/2022	To discuss and get group feedback on a draft independent safety report and discuss and get feedback on the approach to engaging the wider community on draft Corridor Plan.
STAC	Scheduled for 04/08/2022	Meeting was cancelled. However, written feedback on the Independent Safety Review was sought and provided.
TAG	12/09/2022	To discuss and get group feedback on a draft independent safety report and refine technical aspects of the corridor design options.

Table 6: Stakeholder engagement outcomes summary

For more detail, an Engagement Outcomes Report with accompanying minutes for each meeting is attached to this report (attachment 11).

City of Port Phillip

On 5 May 2021, the City of Port Phillip (CoPP) endorsed a recommendation to proceed with preparing three concept plans for its section of the Inkerman Street / Road corridor.

CoPP officers are working through the approval process with DoT to ensure impacts for all road users are minimised. Given this work is still ongoing, it is now anticipated the CoPP designs will be presented to their Council in February 2023 seeking a decision to proceed to community consultation on a preferred design, or otherwise.

Glen Eira Council officers have been working closely with the CoPP officers to align project timeframes and design outcomes across the corridor. The section of corridor within the CoPP boundary (between St Kilda Road and Hotham Street) is wide enough for a uni-directional cycling corridor (i.e. bike lanes on both sides of the road) and has the capacity to provide parking on at least one side of the street.

Subsequently, the three concept plans for the CoPP section of the Inkerman Street / Road corridor all include a uni-directional cycling corridor and have the capacity to provide parking on at least one side of the street.

Approval risks for all concepts remain around the intersection with St Kilda Road, with CoPP officers working with the DoT to mitigate the impacts to all road users. Given this work is still ongoing, it is now anticipated the CoPP designs will be presented to their Council in February 2023 seeking a decision to proceed to community consultation on a preferred design, or otherwise.

A broader risk concerns the possibility that the CoPP determines not to proceed with an Inkerman Street / Road cycling corridor. To mitigate this risk, any resolution Glen Eira Council may make to proceed to wider consultation on the Glen Eira section of the Inkerman Road corridor can be tied to a similar successful resolution from the CoPP.

If a decision is made by both Councils to proceed to further community consultation, a draft community engagement report has been prepared which proposes that consultation on the full corridor occur in tandem with the CoPP, commencing March 2023.

Shared Section

Inkerman Road between Hotham Street and Orrong Road is shared between the GECC and the CoPP and is wide enough to accommodate uni-directional protected bike lanes and retain car parking on at least one side. Due to the CoPP resolution to not consider a bi-directional cycleway, GECC officers confirmed that they were comfortable in proceeding on preferred designs for uni-directional bike lane in the shared section between Hotham Street and Orrong Road.

Due to the constrained width of this section, parking can only be retained on one side of the street. Subsequently, there is only a design option available that allows a protected facility comprising uni-directional bike lanes with parking on one side. Any option that Council decides on east of Orrong Road can tie into this design. Further detail is provided in the shared section co-design report (attachment 12)

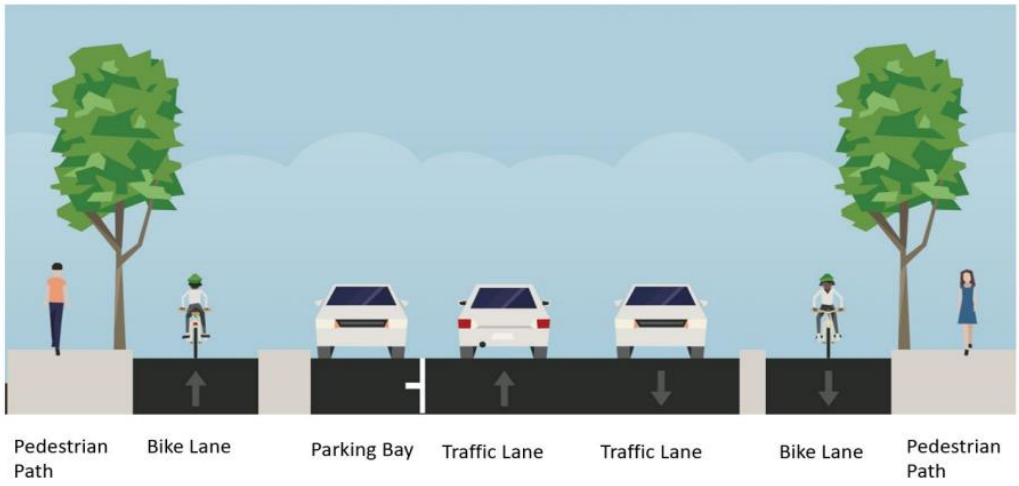


Figure 12: Shared Section Inkerman Road (between Hotham Street and Orrong Road) uni-directional protected bike lanes with parking on one side of the street.

Department of Transport (DoT)

The DoT is an essential partner in the design and any future delivery of a cycling corridor for Inkerman Road. While Glen Eira is the road management authority, responsible for the management and maintenance of Inkerman Road and most of Normanby Road (DoT is the road management authority for a small section of Normanby Road between Balaclava Road and Smith Street), the DoT is an approval authority for any major changes to the network including traffic signal changes at intersections.

The DoT has been involved in the development of both design options through the TAG, providing technical assistance on design consideration and offering in principle agreement on a future reduced 40km/h speed limit on Inkerman Road, noting any speed limit change in Victoria requires ministerial approval and the viability of obtaining this agreement will need to be reconfirmed in future design stages.

Following consideration of the design options, the DoT (Movement and Safety – Inner East team) has given in-principle support to the two-way option on Inkerman Road (option 2), while recognising, if the design was to proceed to detailed design, that further work would be required to minimise the impacts to all road users (including trams) through intersection design refinement and signal phasing.

To date, no in-principle support has been given on any of the one-way options (option 1) proposed for the Inkerman Road corridor. This reflects the challenges associated with broader road network implications due to displacing traffic toward Balaclava Road and subsequent tram delays associated with this option. To proceed with this option would require the mitigation of these impacts and as a result, carries a significant approval risk.

Summary of Options

Based on the technical design and the independent reviews the key differences between the existing condition of the corridor and the two corridor options are summarised below.

Maintaining Existing Conditions

Maintaining the existing corridor results in the worst overall outcome for safety in both the SSA and the Safety Review with both reports stating that a separated cycling facility and lower speeds would improve the safety for all modes. This option also scored the lowest in

the GIA because research indicates that women are significantly less likely to ride on a non-separated cycling facility.

Maintaining the existing conditions would make no material impact on both lowering community emissions and reducing future car use and associated issues of traffic and parking congestion. If current travel patterns continue, these impacts would only be further exacerbated. However, this option has the best outcome for on-street car parking, as it would maintain all existing parking.

Corridor Option 1:



Figure 1: Corridor Option 1

For Corridor Option 1, a significant differentiator is the ability to retain a greater supply of car parking. This requires an inherent trade-off of a one-way system with less direct access and circulation to/from Inkerman Road with one-way traffic. A side-effect of the prevalence of parking on both sides is that it can act as a potential barrier to sight-lines between modes at driveway crossings, limiting the degree of safety benefits achieved. In other areas of the design however, such as side-roads, the safety outcome is enhanced with a greater degree of pedestrian and cyclist priority achieved at raised side-road treatments. These treatments would come at some expense and may involve other risks such as underground services being affected to a larger degree during construction.

Option 1 is generally considered to have a greater impact to the look and feel of the streetscape. The visually tighter streetscape and side-road treatments offer landscape design opportunities, and may result in a slower paced environment, as well as offering a more local street character with less through-traffic.

The change to a one-way corridor has a broader road network implications and carries a significant approval risk, in particular due to displacing traffic toward Balaclava Road and subsequent tram delays if not mitigated.

Corridor Option 2

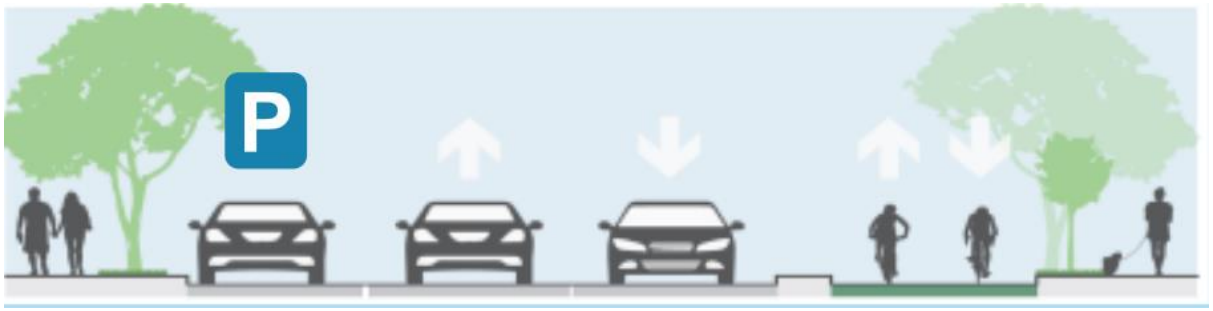


Figure 2: Corridor Option 2

For Option 2, parking is only retained on one side of the road. On-street parking would be retained at key destinations on the north such as Lenny's store and the Caulfield Hebrew Congregation. While an overall parking deficit of around 120 spaces would result, given the

prevalence of side streets in the corridor this deficit may be absorbed, particularly if there is a shift in parking behaviours, such as increased uptake of on-site parking or mode shift. The total impact of this dispersion would need to be assessed at any further design stage.

The limited parking under Option 2 has a resultant safety benefit in that parking would not obstruct line of sight to bike riders at driveways. A limiting factor to the safety improvements achieved is the limiting priority at side roads, given that there is insufficient space to achieve 'raised' side road priority treatment outside of Section 1.

In Option 2, retaining two-way function of Inkerman Road as a priority over car parking supply, implies a higher through-traffic function. At some intersections, reducing flaring of approaches and changes to signal phasing may require mitigation via right turn bans in some locations to give more space and time to cyclists.

Multi-criteria Analysis

The two Corridor Options have been analysed and tested against a range of criteria with findings presented within this report. Table 7 below provides an assessment of the corridors against each criteria item. The values of the scores are as follows:

- 1 = Strongly beneficial
- 2 = Somewhat beneficial
- 3 = Not beneficial
- 4 = Not achieved

Criteria	Existing	Option 1	Option 2
Safe System Assessment	3	1	2
Independent Safety Assessment	3	2	1
Parking Assessment	1	2	3
Gender Impact Assessment	3	1	2
Environmental Assessment	3	2	2
Cycling Demand Assessment	3	1	1
DoT Approval	N/A	4	1
Total Score ***lower number = more beneficial**	**16**	**13**	**12**

Table 7: Multicriteria analysis

Based on the multicriteria assessment presented in Table 7, both Option 1 and Option 2 score better than the 'existing – do nothing' option which scored 16, compared to both Option 1 and 2 which scored 13 & 12. It should be noted that Option 1 scored '4' for DoT approval because to date, no in-principle support has been given on any of the one-way options (option 1) proposed for the Inkerman Road corridor. Given this, Option 2 is more likely to result in a successful project outcome and is the preferred corridor option to proceed to wider engagement.

Outstanding matters for the next design stage

Following any decision to proceed with a preferred design option, the following matters will need to be addressed:

- Ministerial approval to reduce design speed to 40km/h
- Safety improvements at the Normanby Road underpass to Dandenong Highway
- Consultation with service providers on underground utilities
- Consultation with residents and property owners as part of public consultation
- Detailed Design
- Road Safety Audit on any Detailed Design
- Liaise with DoT to confirm the design interface and staging of delivery of Normanby Road tram stop upgrade
- Liaise with DoT to minimise the impacts to all road users (including trams) through intersection design refinement and signal phasing.

Alternate Consideration of Next Steps

Based on the extensive analysis provided in this report, out of the three options considered (maintain existing conditions, Option 1, and Option 2), Option 2 provides the best outcome, not just strategically to reduce car dependency and help Glen Eira reach its transport and environmental targets (a 50:50 mode share, and zero net community emissions by 2030), but also in terms of safety outcomes for all road users and feasibility of construction.

However, it needs to be recognised that no option is perfect. Option 2 will by nature impact the availability and supply of on-street parking on Inkerman Road by utilising the limited public road space available to provide a safe cycling facility. While impacts to parking have been deliberately considered and minimised throughout the design process to achieve equitable use for all road users, best practice design to provide a safer cycling experience requires the trade-off of reduced on-street public parking on Inkerman Road.

Additionally, the merit of the project needs to be considered against the broader financial capacity to accommodate the project. To undertake the project would take a full re-prioritisation and realignment of both Council's Long-Term Financial Plan, and 10-year Capital Works Program.

Given the above, four alternate way-forward scenarios are presented below:

1) **Option 2 – the preferred corridor design (Council funded)**

   Option 2 is the preferred corridor design. Option 2 demonstrates that a safe strategic cycling corridor can be achieved and is presented as the preferred design for the purpose of community consultation.

   A decision to proceed to community consultation acknowledges the financial commitment required to deliver the project. The decision to proceed to construction would come through a further resolution of Council following community consultation. It is recommended that no further design work or community consultation commence without a commitment to fund the project.

2) **Option 2 – the preferred corridor design (advocacy for external funding)**

If it is determined that the Inkerman Safe Cycling Corridor is a strategic priority for Council to deliver, however, the financial impact is too great, Council can determine to advocate to State & Federal Governments seeking an allocation of up to $14 million to support Council to fund the project, or entirely fund the project.

Given that no assurances could be given that the project could be delivered unless successful in obtaining entire or supported funding, no consultation should occur until a report is brought back to Council confirming a successful outcome in funding re-allocation.

3) Design refinement (less impact) of Option 2

If it is determined that cost of the project, and the impacts of the project (on the neighbourhood, amenity and public on-street car parking loss), outweigh the other benefits of the Inkerman Safe Cycling Corridor, Council can develop a reduced impact option to seek safety improvements for all road users of the Inkerman Road corridor.

Safety improvements for all road users can be sought by reducing the speed of Inkerman Road to 40km and looking at where safer cycling opportunities can be gained, through non-physically separated treatments and safer intersection treatments.

While the outcome of this option cannot be expected to be as beneficial for safety, cycling demand (and transition of vehicle trips to cycling trips), and the associated environmental outcome compared to Option 2, it is expected that a reduced impact option can still achieve safety benefits for all road users including cyclists, as compared to the existing road environment.

This option would reconfirm Council's commitment to safe cycling and its role in helping to achieve the ITS goal of a 50/50 mode split.

4) Do nothing

Council can determine not to proceed with the project.

CLIMATE EMERGENCY RESPONSE STRATEGY IMPLICATIONS

Council has committed to a carbon emission reduction target of zero net emissions for corporate emissions by 2025 and zero net community emissions by 2030.

Action 6.2.4 in Our Climate Emergency Response Strategy 2021-2025 | Dhumbali Wurrungi-biik Parbin-ata is "through implementation of the Integrated Transport Strategy, rapidly increase the quantity and quality of walking and cycling paths along major transport routes".

Supporting and transitioning trips to cycling, will be essential to transition to zero community emissions by 2030. In order to encourage people to cycle, it is essential for investment in cycling infrastructure that is safe, convenient and direct.

This project alone is expected to reduce Glen Eira's total transport emissions by 0.01%, an impact that can be scaled up with further establishment of dedicated cycle paths and lanes as envisioned in the ITS.

FINANCIAL, RESOURCE, RISK AND ASSET MANAGEMENT IMPLICATIONS

Early cost estimates for the construction of a separated cycling facility were provided to Council during its meeting of 27 April 2021. This estimated it would cost $9.5 million to construct the project using permanent materials.

Following further development of the project through the preparation of concept designs, more detailed cost estimates have been undertaken. The total construction costs of the project are now estimated to be at $14 million for both corridor Option 1 and Option 2. The increase in cost estimates is largely due to the volatility that the building and construction industry has seen over the last 2 to 3 years, and uncontrollable cost escalations as a result of shortages of contractors, competition from major State projects, and disruption to supply chains as a result of COVID and war in the Ukraine. This is seeking upwards pressure of 10-20% on tender prices, when compared to initial quantity surveyor estimations. Furthermore, there are additional challenges with contractors attempting to amend contracts to include renegotiation options on the basis of unforeseen risks.

It is recognised that the capital cost to implement a safe cycling corridor on the Inkerman Road corridor is significant and Council's financial capacity to accommodate the project estimate is currently limited.

Since this project is not contained in Council's Long Term Financial Plan, to undertake the project would take a full re-prioritisation and realignment of both Council's Long Term Financial Plan, and 10-year Capital Works Program. The cycling corridor will need to be considered against Council's broader strategic pipeline of work, Council Plan commitments, other Council strategies and plans and Council's financial capacity to include a project of this magnitude and nature. The implications on other capital works projects would need to be considered.

While the project would likely be suitable for State Government grant programs, to apply for grants, detailed design and community consultation would need to be completed to demonstrate that the project could be constructed. Given the unknown nature of possible future grants, this should not be relied upon for any commitment to deliver this project, rather treated as an offset on the project cost if successful.

A further risk concerns pushing detailed design and construction back beyond a phased implementation timeframe. While the project estimate of $14 million includes provision for cost escalation and 20% of the total cost for contingency risks, these risks are significantly escalated by pushing the project back.

Currently, officers estimate that the project can be delivered within the project estimate of $14 million under the following timeframe:

2022/23 – consultation

2023/24 – consultation / commence detailed design - $400,000

2024/25 – complete detailed design - $400,000

2025/26 – construction stage 1 - $4,400,000

2026/27 – construction stage 2 - $4,400,000

2027-28 – construction stage 3 - $4,400,000

If the work schedule was to increase in time, this would result in increased costs and higher impacts to the community during the construction period.

It is noted that the option to maintain the corridor in its existing form has no cost (other than existing maintenance) to Council.

POLICY AND LEGISLATIVE IMPLICATIONS

This project is part of the implementation of Council's Integrated Transport Strategy 2018-2031. Future delivery of this project will also support the delivery of Council's Our Climate Emergency Response Strategy 2021-2025 | Dhumbali Wurrungi-biik Parbin-ata.

COMMUNICATION AND ENGAGEMENT

Focused stakeholder engagement was undertaken to ensure that the development of the Corridor Plan reflects the community's values and priorities. Feedback and advice on potential issues and opportunities were used to inform the designs. More detail on how feedback was used to inform the design is provided in the Engagement Outcomes Report (attachment 11), including design responses to each suggestion provided during the design workshops.

If a decision is made to proceed to further community consultation (on the basis contained in the officer recommendation), a draft community engagement plan will be finalised.

LINK TO COUNCIL PLAN

Strategic Direction 3: A liveable and well planned city
Our planning aims to balance population growth with enhancing the unique character and heritage of our city

OFFICER DECLARATION OF CONFLICT OF INTEREST

No officers involved in the preparation of this report have any general or material conflict interest in this matter.

CONCLUSION

Based on the analysis provided in this report, out of the three options considered (maintain existing conditions, Option 1, and Option 2), Option 2 provides the best outcome, not just strategically to reduce car dependency and help Glen Eira reach its transport and environmental targets (a 50:50 mode share, and zero net community emissions by 2030), but also in terms of safety outcomes for all road users and feasibility of construction.

However, it needs to be recognised that no option is perfect. Option 2 will by nature impact the availability and supply of on-street parking on Inkerman Road by utilising the limited road space available to provide a safe cycling facility. While impacts to parking have been deliberately considered and minimised throughout the design process to achieve equitable use for all road users, best practice design to provide a safer cycling experience requires the trade-off of reduced on-street parking on Inkerman Road.

Additionally, the merit of the project needs to be considered against the broader financial capacity to accommodate the project. To undertake the project would take a full re-prioritisation and realignment of both Council's Long-Term Financial Plan, and 10-year Capital Works Program.

From the design, assessments, reviews and focused engagement undertaken, Option 2 demonstrates that a safe strategic cycling corridor can be achieved and is presented as the preferred design for the purpose of community consultation.

A decision to proceed to community consultation acknowledges the financial commitment required to deliver the project. The decision to proceed to construction would come through a further resolution of Council following community consultation. It is recommended that no further design work or community consultation commence without a commitment to fund the project.



Inkerman Road Corridor Plan

Safe Cycling Corridor: Stage 2 Design Report

11 October 2022

1 | Introduction

An outline of the project background, strategic context, and the development process of the Corridor Plan.

ARUP

Introduction

ARUP

Context

Glen Eira City Council (GECC) engaged Arup in January 2020 to commence development of a Corridor Plan for Inkerman Road, Glen Eira City Council's (GECC) first Safe Cycling Corridor. Inkerman Road was identified as the Safe Cycling Corridor as part of Glen Eira's Integrated Transport Strategy. A subsequent assessment of routes conducted by GECC reconfirmed Inkerman Road as the main east-west Strategic Cycling Corridor (SCC), and identified as a 'C2' (second highest significance) cycling corridor according the Department of Transport Movement and Place Framework.

Arup initially prepared a Stage 1 Report providing exploration and appraisal of five 'Road Scenarios' (i.e. cross sections) for how a safe cycling route could be achieved on Inkerman Road.

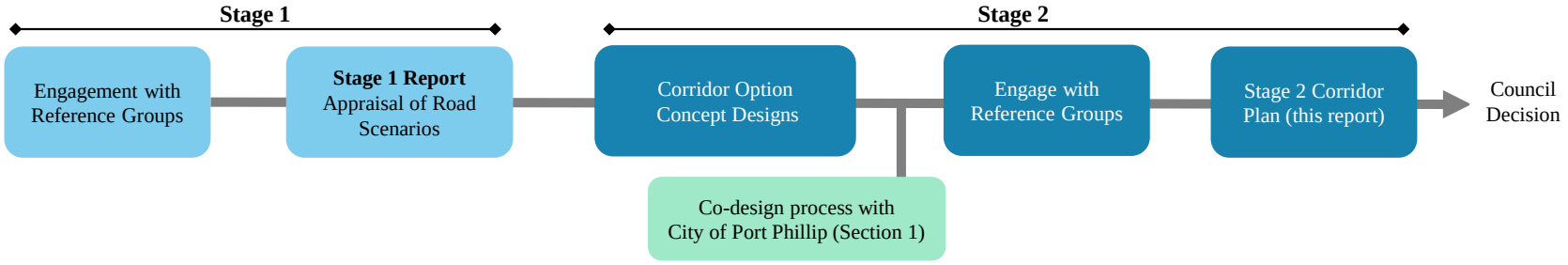
The Stage 1 report also provides the strategic context for the project, key constraints, and design assumptions. The Stage 1 report was delivered to Council on 14 February 2020. Based on feedback received from Council's Community Reference Group (CRG), Strategic Transport Advisory Committee (STAC), Technical Advisory Group (TAG) and local traders following the Stage 1 report, it was determined toit was determined to proceed with two shortlisted options, with Arup to prepare designs for each. These design options are herein referred to as Corridor Option 1 and Corridor Option 2.

Arup briefly commenced Stage 2 of the Corridor Plan, partially preparing two preliminary designs. In April 2020, the project was put on an extended hold due to the COVID 19 pandemic, due to challenges for representative in traffic data collection as well as impacting the consultation process. Design investigations briefly recommended in late 2020, when GECC and City of Port Phillip (CoPP) embarked on a Co-Design process for the shared section between Hotham Road and Orrong Road, which was a 'third' option that is now incorporated as part of both the Corridor Options.

Purpose of this report

The purpose of this Stage 2 report is to explain the design development process of the preparing the two Corridor Options as selected by GECC for a Safe Cycling Corridor along Inkerman Road. This report should be read in conjunction with the preceding Stage 1 report which provides an appraisal of all options considered, and can be supplemented by earlier reports that justify the selection of Inkerman Road as a priority bicycle route.

This report outlines key design features for each option, considering issues such as safety, neighbourhood, and feasibility of construction. This report should be read in conjunction with the concept layout plans produced by Arup.

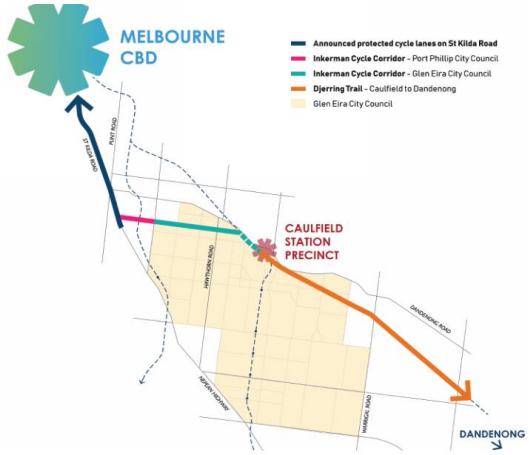


Strategic Context

ARUP

Inkerman Road as a strategic cycling link

Inkerman Road will form a key strategic cycling corridor connecting Melbourne City with the Djerring Trail between Caulfield and Dandenong to provide safe, connected and protected bicycle facilities between central Melbourne and the south-eastern suburbs. Along with proposed on-road bicycle lanes on St Kilda Road, GECC's Inkerman Road SCC project will complete the currently missing link for this continuous link. In addition to the sections of Inkerman Road discussed in this report, City of Port Phillip (CoPP) are similarly considering development of a protected bicycle facility for the section of Inkerman Road between Hotham Street and St Kilda Road.



Policy context

The project is aligned with clause 18 of the Victorian Planning Scheme which prescribes for the provision of a safe, integrated and sustainable transport system.

Similarly, GECC's Integrated Transport Strategy (ITS) 2018 – 2031 outlines a key goal for an increased share of active and sustainable modes of transport in response to growing traffic congestion and parking challenges. GECC's vision for 2031 signifies a change in transport policy and planning for Glen Eira to support and deliver for alternative modes of transport to the car.

Enabling active transport

The SCC project will play an important role in encouraging and enabling mode shift to active modes, particularly for inexperienced and vulnerable users who are unwilling or unable to make use of existing on-road cycling infrastructure.

Achieving this mode switch is an essential aspect of Glen Eira's mode share target of 50:50 car and non-car trips by 2031 outlined in the ITS. The benefits of the project and expected mode shift are not contained only to people cycling, with reduction in travel times and congestion, improved public health, decline in parking issues and wider economic savings also expected.

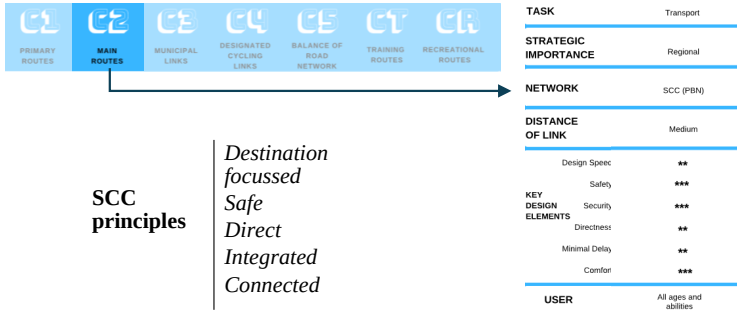
Furthermore, the project can support GECC's broader sustainability and climate change action goals and aspirations by enabling the switch to lower emission active transport and micro-mobility options.

Project origin and significance

Inkerman Road was selected as the preferred corridor to pilot the design, development and delivery of GECC's first Safe Cycling Corridor in the Safe Cycling Corridor Pilot Corridor Assessment completed by GECC in September 2019.

This corridor assessment was a response to broader planning work undertaken by the Department of Transport (DoT) that foreshadowed a strategic cycling route through Glen Eira to link the CBD with Dandenong. Inkerman Road was identified as the preferred route through Glen Eira to achieve this strategic cycling link.

As the first Safe Cycling Corridor, the design and development process for this project is being used as a pilot to refine the process for the delivery of further Safe Cycling Corridors to support GECC's transport vision.



SCC principles

Destination focussed
Safe
Direct
Integrated
Connected

A Street For All Ages and Abilities

ARUP

Towards a more inclusive transport system

The Inkerman Road Safe Cycling Corridor is for people of all ages and abilities.

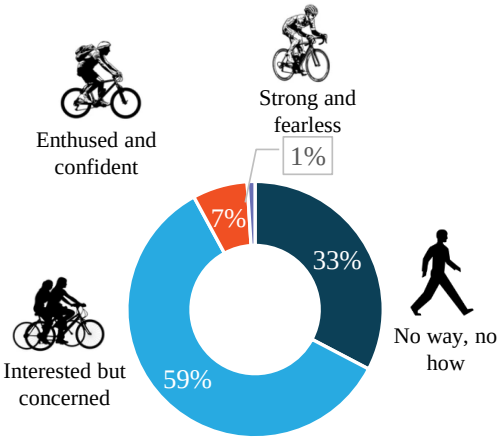
The road rules in Australia require people cycling to use dedicated facilities where provided and avoid footpaths. However, on Inkerman Road the existing provision of narrow painted lanes on Inkerman Road does not provide the separation and protection to encourage people who are interested but concerned about their safety to cycle.

Designing for all user types offers an opportunity to shift away from less sustainable modes and towards cycling or other micro-mobility options. The barriers that the "interested but concerned" group (see Geller's cyclist types to the right) face can be addressed with provision of safe and separated cycling infrastructure, to reduce the stress of sharing road space with vehicles and interactions with parked cars. The Inkerman Safe Cycling Corridor aims to address the existing road environment barriers to encourage greater uptake of cycling in the interested but concerned group. Equally, the project will be a 'whole of street' project, exploring opportunities for and improved walking environment and placemaking.

Futureproofing for e-mobility

E-mobility devices have made cycling and other forms of micro-mobility more accessible to people who were previously unable or unwilling to cycle for various reasons, such as the elderly or mobility impaired. Combined with the impacts of the COVID-19 pandemic and increased localised activity, there has been a significant increase in new people cycling and e-mobility users on the streets of Melbourne.

It is estimated there are approximately 100,000 e-scooters already in ownership within greater Melbourne (The Age, June 2022) while Bicycle Industries Australia reports e-bike sales doubling year on year between 2017-2020. This rapid proliferation highlights the momentum that is building for safe and protected facilities to shift trips away from vehicles. While various levels of government continue to consider regulation of these devices, there is equally a need to provide reasonable personal safety, separation and protection from vehicle traffic. Bicycle lanes offer a way of achieving this and limiting use of footpaths. Accommodating e-modes will continue to be a consideration for councils and road authorities, ensuring they are adequately provided for without compromising the function and safety of other transport network users.



Geller's classification of cyclist types is a useful method to conceptualise and understand the proportions of cyclist types that typically exist in a population. Geller's four typologies were based on survey data from Portland, Oregon in 2006, becoming a common method of understanding attitudes and barriers toward cycling held by different groups within a population.

Strong and fearless will cycle regardless of the presence of bicycle lanes and special facilities.

Enthused and confident people are similarly comfortable on roads, but would prefer separated facilities if available.

Interested but concerned people would like to cycle but only where safe and separated facilities with a low level of stress are provided.

No way, no how will not cycle regardless of the conditions.

Corridor Plan Development

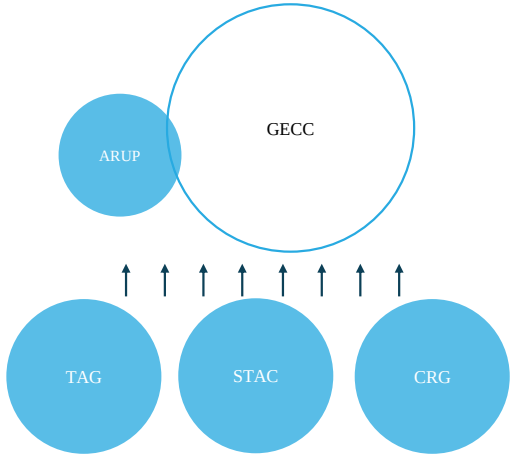
ARUP

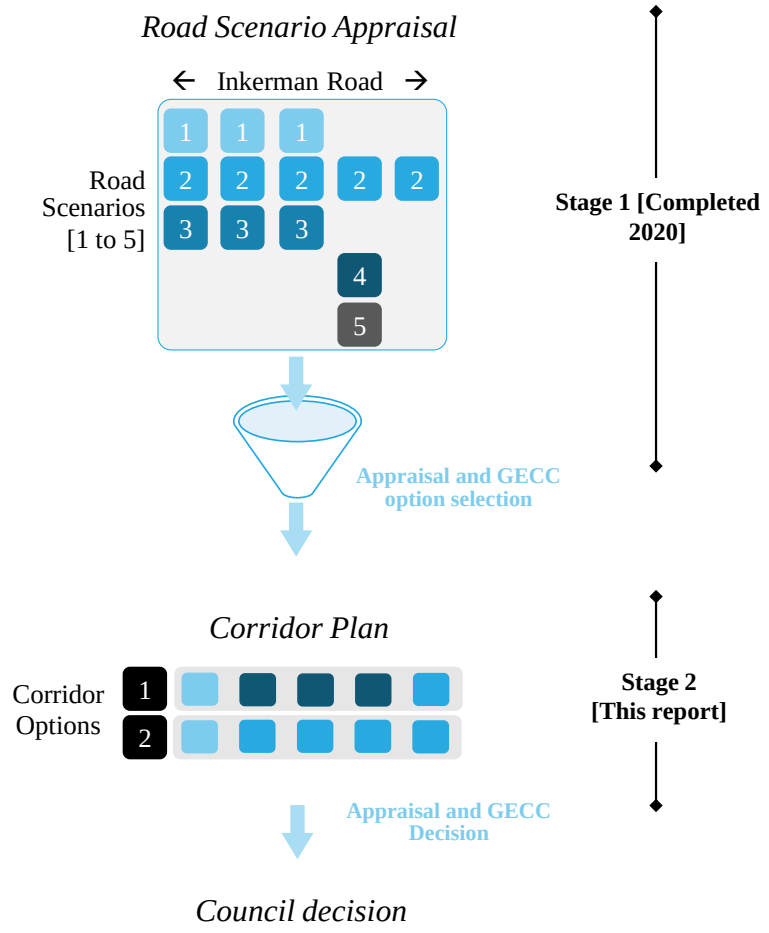
Stage 2 development process

The Stage 2 development of the Inkerman Road has been led by GECC with continued input and support of Community Reference Group (CRG), Technical Advisory Group (CRG), and Strategic Transport Advisory Group (STAC).

The purpose of Stage 2 is to build on the previous assessment and the GECC decisions for the preferred 'Road Scenarios'. The process of developing co-designed Corridor Options has included iterative feedback loops over time. The aim has been to develop an understanding of relative performance with key stakeholder groups, and an appreciation for the differences between them. Local input has been sought to both optimise the design (for example, understanding community needs for crossing points) as well as understanding concerns over how each option would affect the street environment and the end user.

Stage 2 culminates in two concepts that can be taken forward to Council to make a decision on proceeding further with the project into delivery.





Corridor Plan Development

ARUP

Standards and guidelines

The Stage 1 Report lists the key reference documents that more generally support the Inkerman Road Safe Cycling Corridor Pilot project and its history of planning. Collectively, those documents justify the selection of Inkerman Road as the preferred Strategic Cycling Corridor, and establish the Road Scenarios considered in previous stages.

This Stage 2 Report focuses on design development, and takes guidance from the following documents to produce designs for the Inkerman Road Corridor Plan:

- VicRoads Supplement to Austroads Guide to Road Design (AGRD) Part 4a (2017)
- VicRoads Supplement to AS1742.9 (2015)
- VicRoads Strategic Cycling Corridor Design Guidelines (2016)
- VicRoads Speed Zone Guidelines (2017)
- VicRoads Guidance on Treating Bicycle Car Dooring Collisions (2016)
- Austroads Guide to Traffic Management (AGTM) Part 10: Traffic Control and Communication Devices (2019)
- Austroads Guide to Road Design (AGRD) Part 4 Intersections and Crossings: General (2017)
- AS1742.9:2018 Manual of Uniform Traffic Devices
- AS2890.5:1993 On Street Car Parking
- Cycling Aspects of Austroads Guides (2017)
- Infrastructure - Tram Stop Platform Design, Yarra Trams CE-021-ST-0012 (March 2020)

Reference documents

In developing the Corridor Plan, reference has been made to the following:

- Glen Eira Parking Policy 2020
- Glen Eira Integrated Transport Strategy 2018-2031
- Glen Eira City Council Safe Cycling Corridor Pilot, Assessments Of Routes (GECC, November 2019)
- Assessment of Routes, 2019 (GTA)
- Caulfield Village Whole of Land Material Integrated Transport Plan (GTA 2017)
- Caulfield Village Stage 7-8 (31 Station Street) endorsed plans (June 2020)
- Caulfield Major Activity Centre Structure Plan (GECC, September 2022)
- GTA design drawings for the tram stop
- Feature and level surveys provided by GECC
- Austraffic survey data (various)

2 | Corridor Options

Defining the Corridor Options and the functionality provided for end users.

ARUP

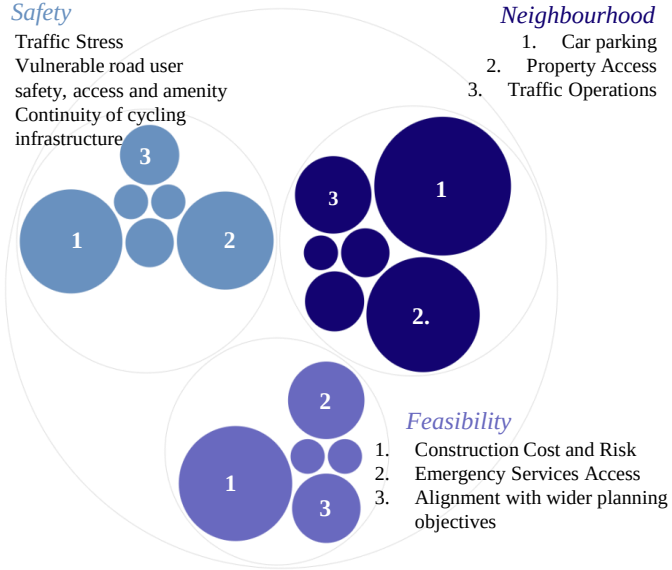
Corridor Options

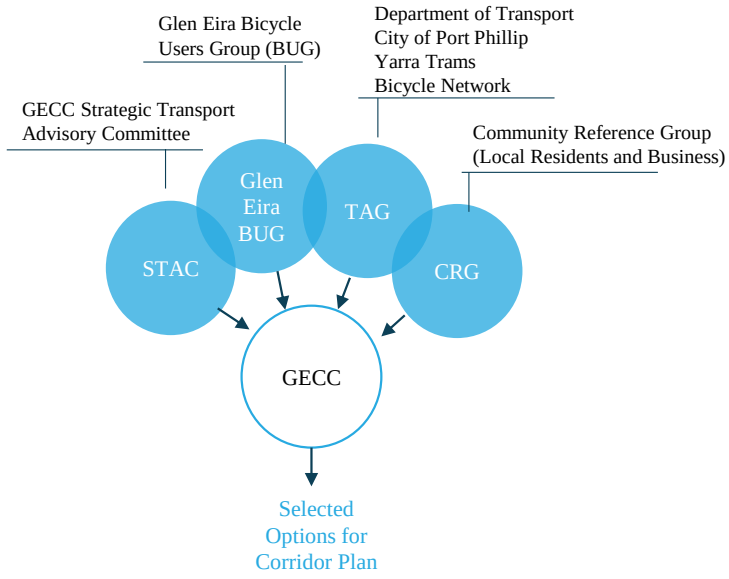
ARUP

Reference group input to the design process

As outlined in the introduction to the Stage 2 design development process, stakeholder and community engagement has informed the options development, appraisal and design process. To inform the design process, input from the CRG was initially sought at the inception of the project on 17 February 2020, alignment with the completion of Stage 1 appraisal. Community members were encouraged to participate in a 'dot democracy' exercise. This involved the CRG voting against the most important criteria based on the same set of criteria adopted by Arup in Stage 1 appraisal across the three categories of Safety, Neighbourhood and Feasibility. The three top-ranked themes are displayed below, with the size of the circle broadly indicative of their relative importance. A similar exercise was carried out with the Technical Reference Group during Stage 2, to identify any concerns, questions or opportunities with the evolving design options presented in Stage 2.

The Corridor Plan options taken forwards as part of this Stage 2 report were ultimately determined with input and feedback from a number of stakeholder groups shown below. The decision was based on both technical advice and community input. A key factor that influenced the decision making process included the ability to retain the most parking whilst also providing a safe and continuous route for cycling. Parking was identified as the top priority of the Community Reference Group.





Corridor Options

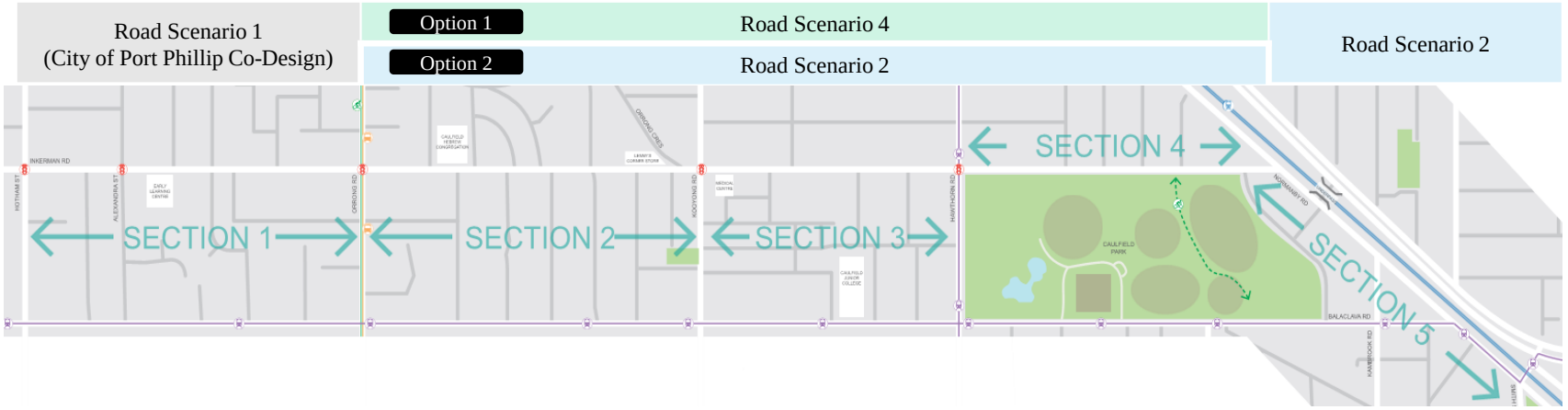
ARUP

Deciding on the Corridor Options

As part of the Stage 1 report, Arup assessed five different 'Road Scenarios' which could be applied along Inkerman Road. Using this appraisal and as an outcome of the stakeholder and community engagement led by GECC, Arup was instructed that the Corridor Plan should proceed using the combination of Road Scenarios 2 and Road Scenario 4 following Stage 1 (shown below).

In Section 1, City of Phillip required one-way protected lanes given the wider road reserve, noting that the corridor narrows to the east. On this basis, a Co-Design process with City of Port Phillip further considered the merit of 'Road Scenario 1', culminating in the development of the design now included as part of the Corridor Plan. The key design features of each Option are further detailed on the following page.





Corridor Options

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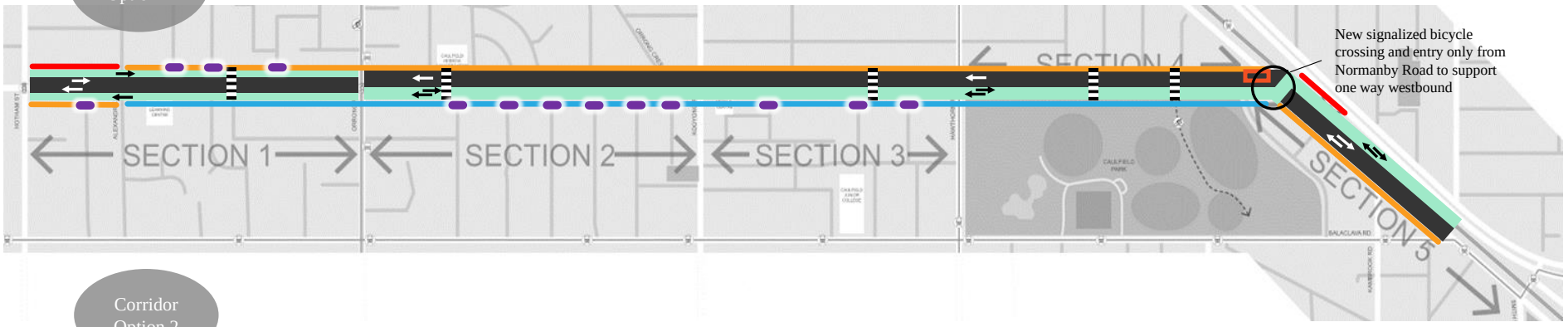
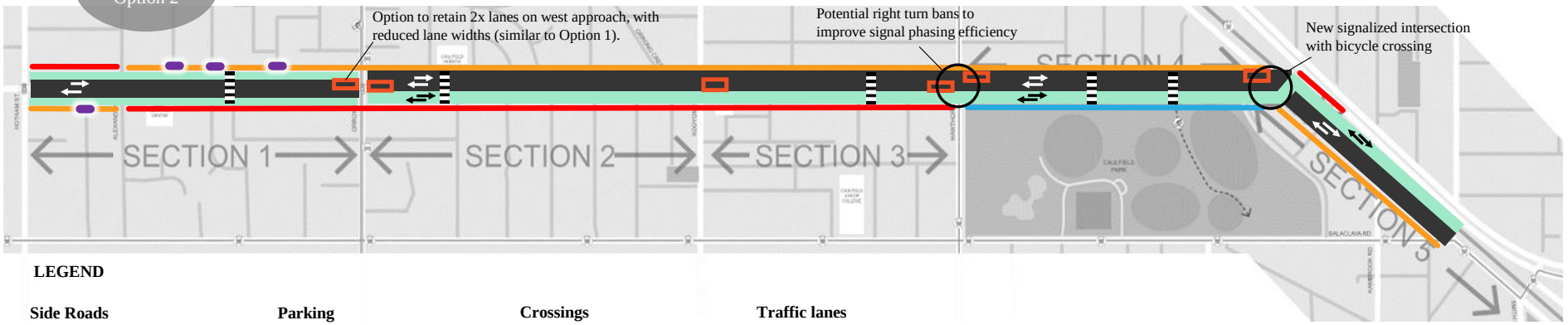
Key design features

Corridor Option 1



Corridor Option 2



LEGEND

Side Roads
- Pedestrian and Bicycle Priority Treatment (refer to page 19 for details)

Parking
- Minimal or no parking removed
- Some parking removed
- All parking removed

Crossings
- Pedestrian priority crossing

Traffic lanes
- Traffic lane
- Bike lane
- Through-traffic and turning traffic lanes consolidated (reduced number of lanes at intersection approach)

Corridor Options

ARUP

Deciding on the Corridor Options

Why is a major change to one-way being considered?

The initial options for Stage 1 investigations only considered a one-way street adjacent Caulfield Park. However, at the Community Reference Group on 17 February 2020, the comment was made to consider a one-way street more broadly, given the ability to retain more on-street car parking. On this basis, GECC decided that a one-way option for Sections 1 to 3 of Inkerman Road could be considered in Stage 2.

Upon commencement of the Corridor Option design process in March-April 2020, no commitment was made regarding the directionality of one-way flow. Rather, the design sought to develop a 'feasible base case' nominally showing westbound traffic flow. In April 2022, a report was delivered by One Mile Grid carried out traffic modelling exploring different flow directionality options and the network impacts of a one-way operation of Inkerman Road. Refer to the modelling report for further details.

Why is the bi-directional path on the south side in both options?

The bi-directional bicycle lane is on the south side of Inkerman Road in both options as there are fewer vehicle crossovers and side-streets, meaning less cycling conflict points overall. This is largely attributable to Caulfield Park, and by keeping the facility on the south side across the entire corridor maintains continuity. In Option 2, parking is provided on the opposite side of the bicycle path, to maximise sight lines and reduce car door conflicts. This results in parking being available on the same side as residential activity alongside Caulfield Park, and other key places on the north side such as the Caulfield Hebrew Congregation and Lenny's store.

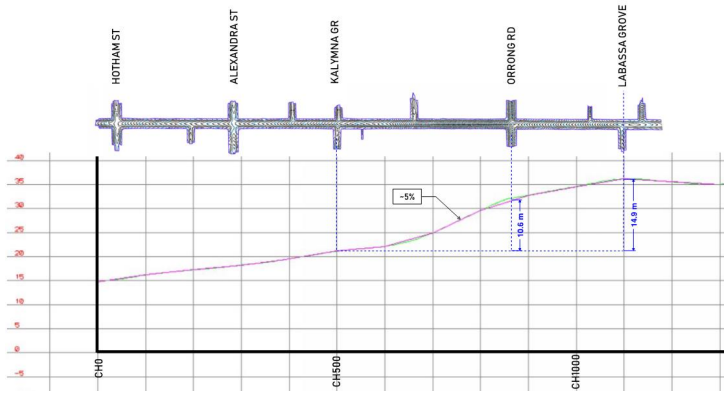


Above: Caulfield Park facing north

Why does the parking change sides in Section 1?

The parking locations were co-developed in workshops between Glen Eira City Council and the City of Port Phillip. Key reasons for the proposed design included:

- Putting parking on the north side, east of Alexandra Street means that parking is adjacent to the uphill direction of people cycling. The reduced speed of cyclists in turn reduces severity and likelihood of crashes with vehicles turning in/out of driveways, and provides clearer sight lines in the downhill direction.
- The downhill direction enhances the ability of people cycling to achieve 'equitable speed' and blend with traffic and may result in less conflict with left-turning vehicles entering side roads.
- Parking can be more optimally located to serve land uses including a childcare (south side, west of Alexandra) and a medical clinic (north side, east of Alexandra) which does not have off-street car parking.



Above: The vertical road profile of Inkerman Rd falls steeply westbound, particularly between Orrong Road and Kalymna Gr and was a key stakeholder concern for people cycling and parking conflicts.

Corridor Options

ARUP

Deciding on the Corridor Options

Why is the bike path against the rail corridor along Normanby?

At the eastern end of Inkerman Road, the bicycle path crosses onto the northeast side of Normanby Road.

Locating the bicycle path against the rail corridor means that car parking can be on the opposite side of the road, where it is more readily accessible by residents. Bicycle riders will also benefit from avoiding any interactions with vehicles entering driveways.

At the north end of Normanby Road, the bicycle path will occupy the space where existing indented car parking is provided. It is expected that some resurfacing works will be needed. As the path heads south, it must cross the underpass and road that connects to Dandenong Road. For the purpose of the Corridor Plan, GECC has assumed that Council would not be in a position to propose new traffic signals at this location. A raised side road treatment is assumed to be provided, however the standard of treatment that can be achieved is limited by the existing retaining structures of the rail over-bridge.

It has been noted that this area becomes particularly congested during peak times, and historically has experienced a number of vehicle to vehicle crashes. It is therefore recommended that further consultation occur considering options for signalisation with the Department of Transport.

Further to the southeast, the bicycle path would also pass the Normanby Road tram stop on a less active frontage, which may provide some benefits for minimising conflicts with pedestrians accessing the tram stop. This outcome is consistent with the draft Caulfield Major Activity Centre Structure plan – Village East Precinct Plan (see bottom right). The design interface at the tram stop is further explained later in this report.

The draft Structure Plan (right) nominates an initiative of "*connecting the Strategic Cycling Corridor through the core of the Centre along Normanby Road through continuous, safe infrastructure within the existing street cross sections*". It is understood that this bicycle connection is expected to continue to the southeast, before connecting into future facilities north-south along Queens Avenue.



Normanby Road, looking southeast



Caulfield Major Activity Centre Structure Plan (GECC) – Village East Precinct

Pedestrian Crossings

ARUP

Crossing location considerations

Pedestrian crossing locations (diagram below) were informed by the Community Reference Group from a list of options. The initial options were developed with consideration of the following:

- Proximity to key land uses (e.g Caulfield Hebrew Congregation)
- Desire lines to public transport stops including Malvern Station and tram stops along Balaclava Road

Raised pedestrian crossing

Raised pedestrian crossings (known colloquially as wombat crossings) are a pedestrian priority treatment incorporating a road hump. Wombat crossings are suitable for low speed environments, particularly to support pedestrian movement in activity centres or along key pedestrian desire lines. The incorporation of a road hump ensures vehicles reduce their speed on approach, clearly demarcating pedestrian priority over vehicles.

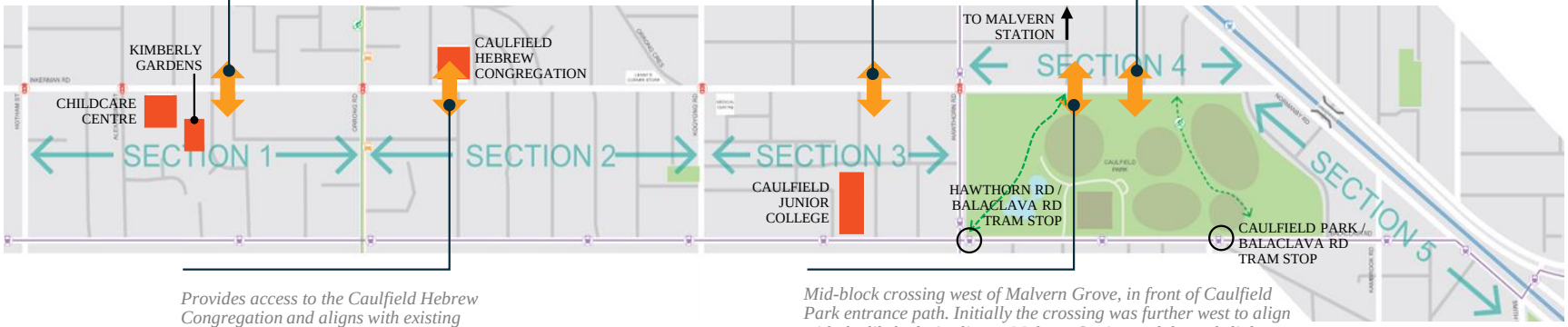


Example of raised pedestrian crossing at Wellington Road / Keele Street intersection, Collingwood.

Crossing provides access to childcare centre and Kimberly Gardens on south side of Inkerman Road. Also links desire line along Sidwell Avenue to connect with Balaclava Rd tram stop further south.

Mid-block crossing location between Kooyong Road and Hawthorn Road. Facilitates connection to Caulfield Junior College South of Inkerman Road and provides link on desire line to the Elmhurst Road / Balaclava Road tram stop.

Mid-block crossing location between Hawthorn Road and Normanby Road. Aligns with proposed cycling route (GECC ITS, 2018) through Caulfield Park. Provides link for pedestrian desire line to Caulfield Park / Balaclava Road tram stop.



Provides access to the Caulfield Hebrew Congregation and aligns with existing entrance to the Congregation. This wombat crossing replaces the existing pedestrian refuge island at this location.

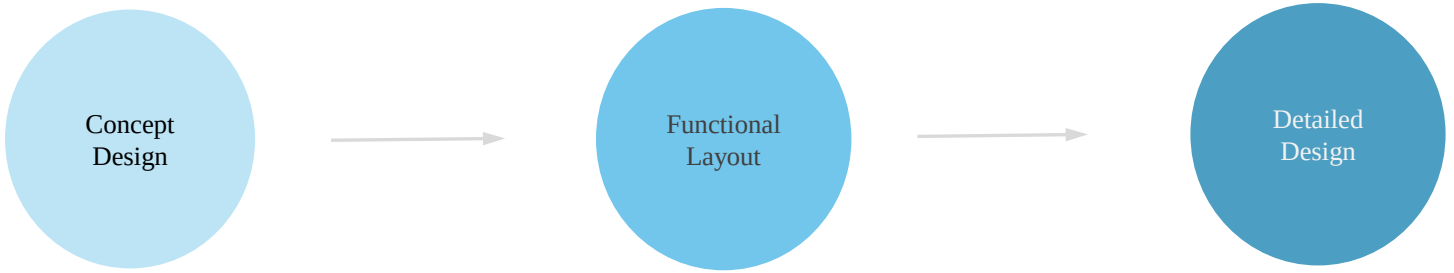
Mid-block crossing west of Malvern Grove, in front of Caulfield Park entrance path. Initially the crossing was further west to align with the likely desire line to Malvern Station and through-link to the Hawthorn Road / Balaclava Road tram stop and Hawthorn Road shops, however was modified based on CRG feedback.

Corridor Options

ARUP

Design stages | How progressed are the Corridor Option designs?

The co-design process of the Corridor Plan has been carried out with a level of detail that allows stakeholder input and feedback as the designs evolve. While certain details are needed for informed decision making, other elements of design are not appropriate to be developed until such as time that there is a single 'preferred' design solution. The design drawings produced by Arup under this engagement are considered to sit between what would be considered a 'Concept Design' and 'Functional Layout'. Discussion below provides context to this Corridor Plan and should be read in conjunction with the list of recommendations noted in Chapter 6.



Stage 1 & 2 Corridor Plan

- High level of community engagement and options. Flexibility for options and variants to be tested
- This stage helps to understand the scope and provides enough input to allow traffic modelling of strategic issues for comparative purposes, and stakeholder discussions.
- By the end of Concept Design, most key design features are well defined and 'space-proofed'.
- The design should not progress beyond Concept Design stage until the directionality of any one-way systems has been fully confirmed.

Partially complete at end of Stage 2

- Less reliance on 'typical' or 'general arrangement' details. Designs are proven with rigour and geometric detail (i.e. full suite of vehicle swept path analysis and sight distance checks, not yet completed as part of this package).
- High level impacts to civil construction / services issues and environmental features are identified. Third party approvals process to commence.
- A suite of signage and line marking is identified. Only the Council endorsed design should proceed to full details of signage and line marking in detailed design.
- The designs may be supported by modelling or other traffic studies where relevant. This requires directionality of traffic flow to be confirmed.

Future Stage: Pending Council resolution

- Design is resolved in 3D design detail, all impacts to civil services and grading addressed.
- Detailed signage and line marking has been addressed
- Relevant authority and asset owners consulted and approvals obtained where required
- This stage of design requires further resolution from council
- Outputs of this design phase taken to market for construction

3 | Design Basis

An outline of the technical basis of design and specific features of the Corridor Options.

ARUP

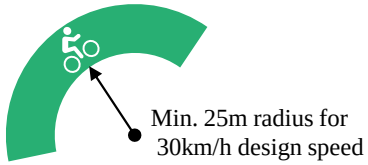
Design Basis

ARUP

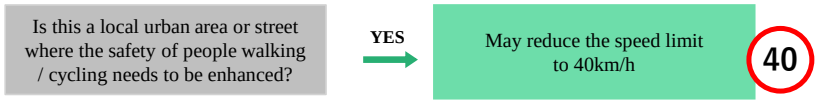
Design speeds

Traffic Speed
To reduce the risk of death or serious injury when a pedestrian or person cycling is involved in a crash, the posted and design speed will be lowered to 40km/h for both Options in line with VicRoads guidelines (VicRoads TEM Vol 3: Speed Zoning Guidelines 2017). The Department of Transport has provided in principle agreement to the adoption of lower speed limits for corridor for the purpose of the design. In some cases, the reduced speed environment is considered necessary to support the adoption of geometric minimums used in the road design.

Cycling Speed
The potential speed for cycling informs the allowable radius for the bike lane to 'bend' in and out at intersecting side roads for managing conflicts with traffic. Contemporary guidance requires that a speed of up to 30km/h be considered, which translates to a minimum curve radius of 25m.



VicRoads TEM Vol 3: Design Guidance for strategically important cycling corridors (2016)



Section of flow-chart reproduced from Figure 6 of VicRoads Speed Zoning Guidelines (2017).
VicRoads TEM Vol 3: Speed Zoning Guidelines (2017)

Road hierarchy & design vehicles

The size of 'design vehicle' is important in considering street functionality but can also have a significant impact on achieving a lower speed and calmed street environment, particularly for walking and cycling.

Currently, Inkerman Road is defined as a 'Link Road' in the Glen Eira roads register and Road Management Plan (RMP) and understood to be considered a Collector Road by Council officers. The use of 'link road' by GECC RMP translates to an 'Urban Arterial Road' under definitions used in Austroads and would translate into onerous design requirements which much of the existing infrastructure does not meet. Initial swept path assessments indicate that even the existing intersection geometry would not cater for the sizes of vehicles that would be typically be recommended to be accommodated under the Austroads design guidelines.

This project seeks to reduce traffic speeds, enhance local living, encourage walking, and provide residential access and reducing through-traffic movement function. For design purposes, Inkerman Road is expected to be classified as a lower order local or collector road.

The design development to date adopts this approach and accepts that in some instances with existing infrastructure constraints, some infrequent larger vehicle movements (waste, deliveries) may be impacted such as tracking over kerbs, breach of lane discipline or isolated localised mounting of the kerb. In general, signalised intersections in Option 1 accommodate up to a 12.5m single unit truck as design vehicle. In Option 2, at some locations the centre-line of the corridor results in only an 8.8m service vehicle being accomodated as a design vehicle.

As a principle, given the predominately residential nature of access along the road and unsignalised side-streets, it would be preferred that the design adopt smaller 'design vehicles' (i.e. regular use vehicles) and agree on the use of 'checking vehicles' as appropriate through subsequent stages of design development. In Option 1, time-based parking restrictions or refinement of parking extents may be required to accommodate larger vehicle movements, including for waste vehicle turning out of side roads given the tight road profile. These will need to be assessed in subsequent design phases which may include onsite testing, localised modifications to car parking or roadside furniture, or an access strategy that includes limitations on particular larger heavy vehicle movements in some constrained locations.

Design Basis

ARUP

Lane widths and buffers

Minimum lane width requirements for both vehicular and bicycle traffic have been taken from Austroads, Australian Standards and various VicRoads supplements in determining both the minimum and desirable standards.

It is noted that GECC has developed their own preferred design rules which fall within the desirable dimensions, the only exception being the adoption of a narrower than desirable 0.8m separator between bicycle lane and vehicle traffic.

Minimum requirement: the absolute minimum acceptable, and
Desirable standard: the preferred or ideal provision for a given design element

Measure	Parallel parking	Bicycle path (two-way)	Separator kerb	Traffic lane
Minimum Requirement	2.1m [+0.5m traffic lane clearance]	2.5m	0.6m [1]	3.0m
Desirable Standard	2.3m [+0.5m traffic lane clearance]	3.0m – 4.0m	1.0m	3.5m

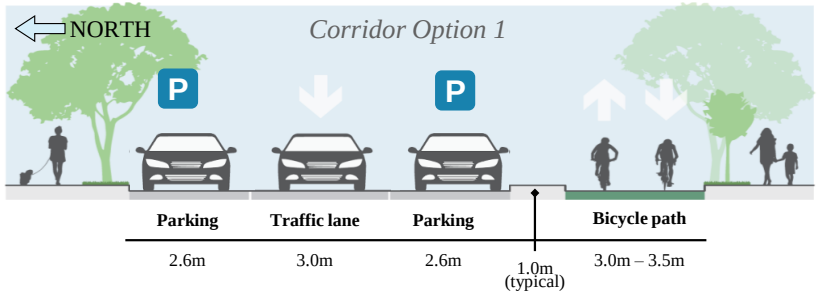
[1] Whilst not referenced in any relevant design standards, a 300mm wide separation kerb is generally accepted where the bicycle lane is directly adjacent to traffic and there is no risk of car-dooring. Glen Eira preferred is 0.8m
[2] With protected lanes, 2m between face of kerb is recommended to enable comfortable passing opportunities (Austroads)

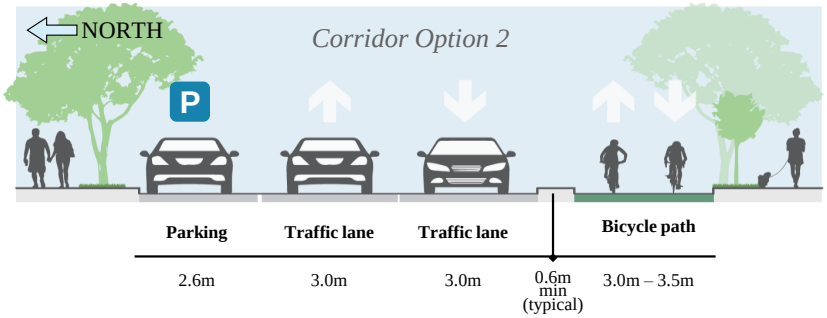
The requirement for a 0.5m buffer between on-street car parking and the traffic lane was removed in low-speed environments as part of the 2020 update to the Australian Standards for On-street Car Parking, following the development of the design basis of this project.

Typical cross section dimensions

The proposed designs generally satisfy the desirable design criteria, with the exceptions being:

- Parking lane adopts minimum 2.6m, which includes a 0.5m car door opening buffer#.
- Traffic lanes are adopted as 3.0m wide. This complies with VicRoads standards which suggest 3.0m as being suitable for a local road. Traffic lanes could potentially be further narrowed as part of detailed design to encourage lower speeds or at constrained locations.
- Separator kerb is generally 0.6m minimum width where adjacent to traffic lanes or 1.0m where adjacent to the bicycle path. In some cases, there will be opportunities for trading of the width of the bicycle path to create a wider buffer if needed. Alternatively, the width of the car parking lane could be reduced.





Design Basis

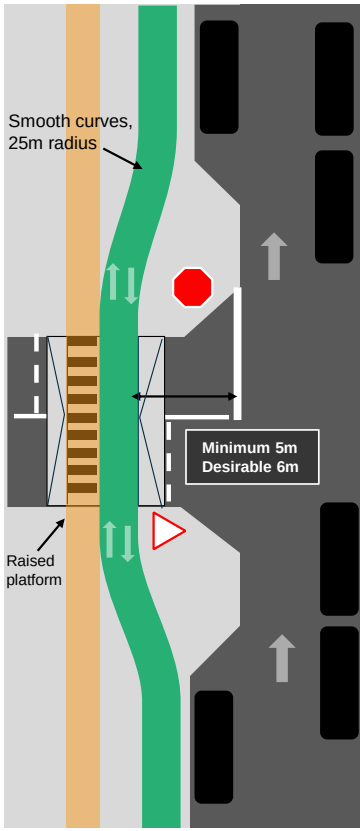
ARUP

Side road treatments

Raised (typical for Option 1)

Option proposes a 'raised' side road typology, where the bicycle lane runs next to the footpath on a raised platform, with walking and cycling having priority over the side street traffic in both directions. This treatment improves safety and amenity for vulnerable road users, and benefits people walking and cycling, by improving visibility between users. Ramping is provided to moderate vehicle speeds, and provides a visual cue to draw attention to a change in traffic conditions with at the crossing.

A slight 'bend-out' creates a holding length (typically around 5m) both to/from Inkerman Road. On entry, this serves to mitigate the risk of rear end collisions by reducing the need for vehicles exiting Inkerman Road to stop unexpectedly on the major road to give way to people cycling. It is important that sufficient space between the bicycle lane and vehicle traffic on Inkerman Road is kept free from visual obstructions to ensure visibility of people cycling by drivers depending on the negotiation speed for cornering.

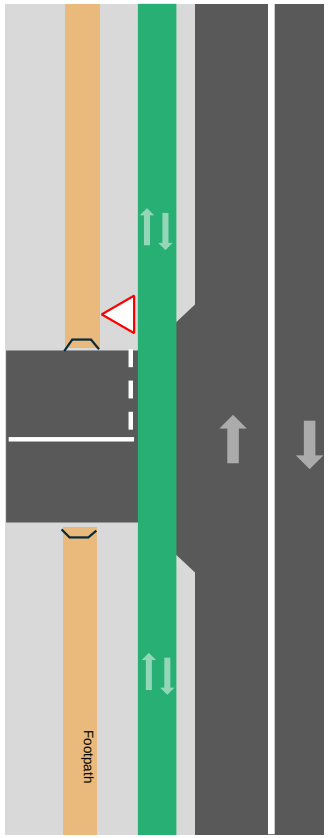


Raised crossing treatment [Corridor Option 1, and Section 1 for Corridor Option 2]

Straight (typical for Option 2)

Option 2 consists of a 'straight' side road treatment for all side roads except those in Section 1 where a raised treatment is able to be achieved. A straight treatment maintains visibility between traffic on the major road and people on the bicycle path and pedestrian crossing where there is limited space for a 'bent-out' treatment.

In contrast with the raised side road treatment, there is typically less width available where the straight treatment has been adopted. This means that vehicles entering side streets from Inkerman Road will have to stop and block traffic on Inkerman Road to give way to people walking and cycling across the side street. This may slightly increase the risk of rear-end collisions as vehicles will be stopping on Inkerman Road however this is somewhat mitigated by the future low-speed and one-lane nature where this treatment is adopted, with clear lines of sight. This treatment also increases the cognitive load when searching for a gap to exit, unfamiliar drivers may not be expecting people cycling to approach 'near side' from the left.



Straight crossing treatment [Typical for Corridor Option 2, outside of Section 1]

Design Basis

ARUP

Driveway access

Vehicular access has been considered to inform how closely parking is permitted adjacent to driveways. A 'swept path' assessment has been carried out for a 99th percentile passenger vehicle ('B99') as shown below. This demonstrates how much space is needed for both entering and exiting a 3m wide driveway. These tests show the 'worst case' scenario, being in Section 1 where the available road width for manoeuvring is narrowest. The swept paths demonstrate a range between 2-4m offset being generally sufficient for vehicles to access driveways safely, with only marginal overlap of clearance lines into the marked corner of the bay.

It is also noted that the verge width along the south side of Inkerman Road is generally wide enough for vehicles exiting driveways to reverse up to the point of having a view to approaching cyclists, before crossing the bicycle lane. This is described in more detail on slide 47. Crossovers to commercial premises or driveways with off-street car parks, would be reviewed on a case-by-case basis at detailed design, so that any particular needs are considered.

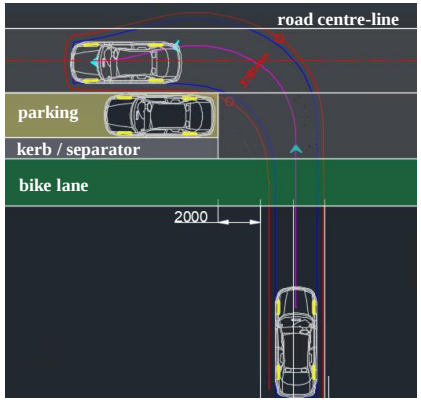
Adopted parking offset to crossovers

The table to the right shows the adopted 'approach side' offsets (i.e. before the driveway) and 'departure side' offsets (i.e. after the driveway). A different design basis is adopted for each council area, which reflects local preferences of the managing road authorities. These offsets have been developed following a review of the theoretical sight distance (including 'gap sight distance' and 'cyclist stopping sight distance' in addition to the noted manoeuvrability considerations. In broad terms, this results in up to one car parking space being removed for each driveway.

Preferred offsets from crossover to car parking.

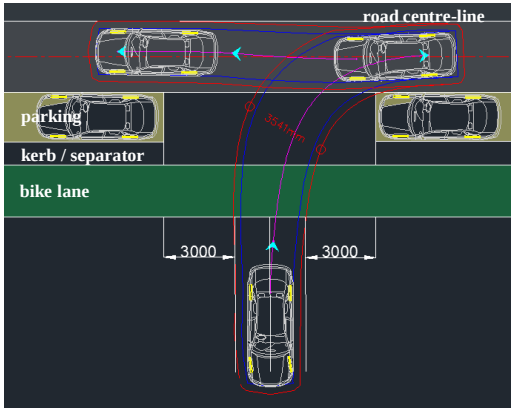
Council area	Approach side offset (m)	Departure side offset (m)
CoPP (Section 1 north side)	4m	2m
GECC	3m	3m

Left out of driveway



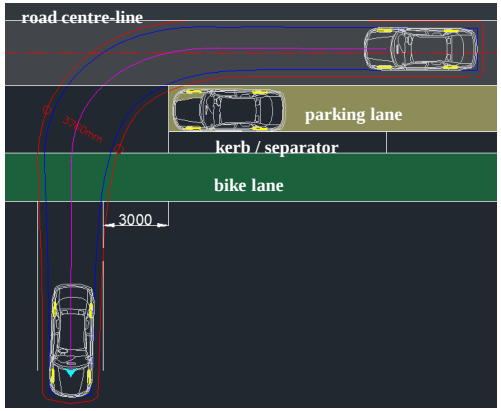
On exiting driveways, vehicles may need to cross the centreline slightly when exiting, unless vehicles leave a gap at the rear of the parking space.

Reverse out of driveway



When reversing out of driveways, vehicles have maintained lane discipline and not crossed the centre line.

Left in to driveway



Vehicles can enter driveways with ease when a 3m offset to parking spaces.

Design Basis

ARUP

Separation to traffic at mid-block locations

The Corridor Plans include a nominal buffer zone where physical separation devices would be provided between people cycling and motor vehicles.

While a specific traffic control device has not been specified, for spatial design purposes it has been assumed that a full height kerb would be provided, however semi-mountable kerbs may also be considered on a case-by-case basis, such as adjacent particular driveways or at side-road intersections. Semi-mountable kerbs can provide greater flexibility to allow for occasional larger vehicles access into local streets.

The choice of physical separation devices is ultimately a matter for detailed design, and could involve a combination of:

- **Separation kerb:** The most common type of separation, typically achieved with concrete or in some cases bluestone kerb and with concrete or asphalt infill. Various kerb profiles are possible, however should generally create a 'barrier' on the side of traffic.
- **Bolt-down products:** These kerbs can reduce the amount of physical reconstruction of asphalt required in the carriageway. Some may be installed temporarily or as a trial, and replaced incrementally. Replacement may occur over time as part of ongoing capital works budgets, or at such a time that the wearing course is due for replacement. This product may offer some advantages where there are constructability challenges due to underground services that limit excavation.
- **Bollards or other intermittent devices**: As an alternative to continuous kerbing, a line marked buffer could be combined with intermittent traffic control devices such as bollards. These devices, and in particular frangible bollards, can be prone to damage from impact, sometimes intentional, increasing the need for maintenance.

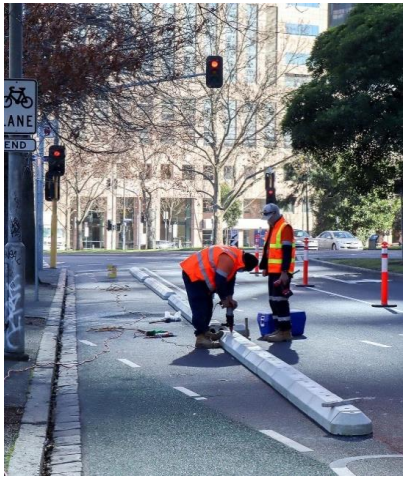
Examples are shown to the right. Naturally, regardless of the type of separation, breaks in physical separation are required adjacent driveways. In such cases, the physical separation device would give way to a line marking buffer zone.



Above: Bluestone kerb separator with asphalt infill, adjacent parking (City of Melbourne)



Right: Chevron separation strip with frangible bollards and 'blister' kerbs (Barcelona)



Above: City of Melbourne contractors installing bolt-down bicycle lane separators



Right: Bolt-down kerbing islands to prevent traffic from entering wide bicycle path (Carlton, Victoria)

Design Basis

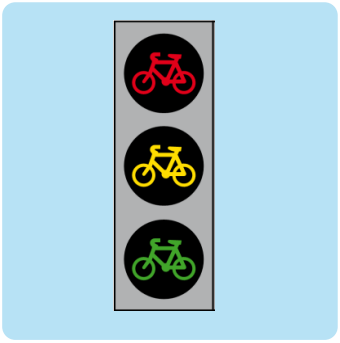
ARUP

Separation in time: bicycle signals

Creating a low-stress cycling experience relies not just physical separation at mid-block locations, but also separation in time those cycling movements which could create unsafe conflict with motor vehicle movements. Bicycle signals allow different user movements to be managed. In certain conditions, there will be a greater need to control bicycle and vehicular movements,

Bike signals (or bicycle lanterns) are proposed to be provided at all signalised intersections. These provide improved ability to manage conflicts between people cycling and turning vehicles. Specifically, bike lanterns allow a 'head start' to be provided for people cycling at intersections. In some cases, a fully separate bicycle phase could allow a green light to be provided to allow people cycling to proceed safely, then terminate, before the vehicle turning movement is allowed to begin. This higher order signal priority for people cycling would typically require a dedicated turning lane, to prevent blocking through-traffic in the same direction.

The inclusion of bicycle crossing lights legitimises priority for people cycling over left-turn vehicles if both of the signals are green, as outlined in Road Rule 62(1)(b).



Three aspect bicycle lanterns (AS 1742.14:2004)

The detailed functionality and extent of bicycle signal priority and green time allocation will ultimately depend on a number of factors, including network co-ordination, impact on traffic congestion and turning movement demands. For example, signal timing trade-offs between the Inkerman Road corridor and competing north-south corridors would need to be evaluated, and priorities allocated in accordance with network classifications as per the Department of Transport Movement and Place framework.

These matters would be further considered with more detailed modelling as part of next stage of design. Signal programming at intersections is ultimately determined by the Department of Transport (VicRoads), and further consultation will be required as part of functional layout development and detailed design to ensure that the design is compatible with the intended network operations.



Right: Example of a group of people cycling through a green bicycle light, ahead of vehicular traffic which remains on a red.

Design Basis

ARUP

Separation to traffic through intersections

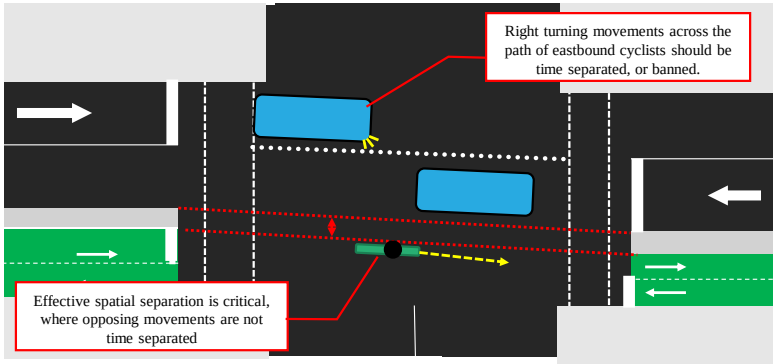
At intersections

Time-separated cycling movements should be the first priority. However, this may not always be achieved due to competing objectives such as the impact on modelled traffic performance which will influence the operational traffic signal design. In such cases, it would be important that a detailed review of spatial separation is achieved between bicycle riders and opposing traffic movements. Given the road space re-allocation along the corridor, traffic and bicycle lanes on either side of the signalised intersection may not be perfectly aligned. In such cases, a combination of raised retroreflective pavement markers, guide line markings inclusive of audio tactile line marking should be considered in conjunction with other pavement markings to highlight the conflict zone.

For the purpose of the Corridor Options, the minimum buffer widths at mid-blocks have been maintained through intersections. As part of future design stages, depending on the development of traffic signalling arrangements there may be a need to review and optimise a more generous buffer width for the comfort of people cycling and motorists alike.



Above: Example of a two-way bicycle path through an intersection. In the image to the left, a green left turn arrow is displayed while the people cycling movements are held on red. Similarly, in the right image, a red right turn arrow is displayed during the bicycle green phase. The side-road also offers space for a physical separator in the median, however this is will not be viable in most cases along Inkerman Road.



Below: Illustration of changing alignment across an intersection which increases the need for effective separation between people cycling and oncoming traffic.

Design Basis

ARUP

Traffic signal operation

In most if not all cases, changes to signal phasing of intersections will be required. This is both for incorporating bicycle signals, as well as to deliver the safest and most efficient phase operation following the removal of the reconfiguration of turn lanes.

General signal phasing assumptions are understood to have been adopted by One Mile Grid for the purposes of a comparative assessment between the two concept options focusing on the wider network impacts, and can be seen in that report. The detailed signal operation at intersections may be subject to further modelling.

Key concepts are illustrated by way of example, where traffic signal phasing would be modified under the proposed designs. Three key areas include:

1. Managing turning conflicts across the bicycle path for optimal safety outcomes.
2. Facilitating entry and exit movements to intersecting corridors
3. Managing transitions, such as where Inkerman Road meets Normanby Road.

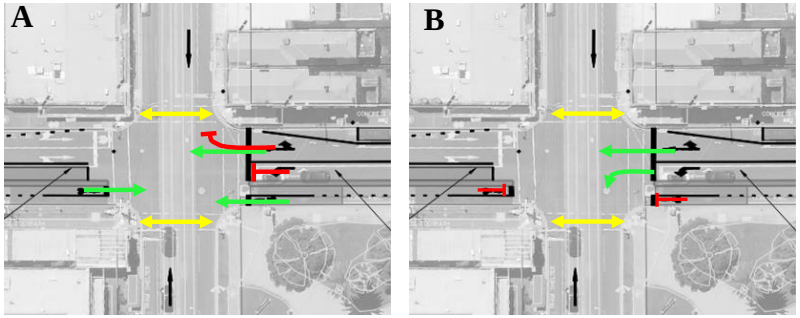
A 'dedicated bicycle phase' or 'fully controlled bicycle phase' is the highest order of signal priority for people cycling; a green bicycle lantern allows cycles to proceed safely through an intersection, terminating before the vehicle movement begins.

Typically, a dedicated bicycle phase would require a turning lane, which allows through-traffic to continue at the same time as people cycling. In some cases, only a 'head start' is provided, before motor vehicles are allowed to 'filter' through gaps in any through-moving bicycles.

Managing conflicts between right turning vehicles and people cycling is a critical consideration for Option 2 and may require consideration of right turn bans from the west and particularly if a right turn lane cannot be provided. The impact of 'split phasing', where the east and west vehicle approaches run in separate phases, could also be considered as part of further operational modelling. While typically less efficient from a traffic movement perspective it would allow retention of access.

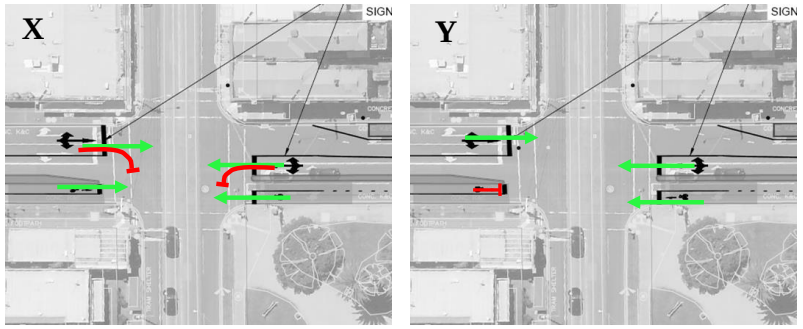
For Option 1 as designed, this conflict is avoided given that one-way traffic is westbound, there would be no right turns occurring across the bike path on the south side.

Example 1: A 'dedicated bicycle phase' for Option 1 (Inkerman Rd / Hawthorn Rd)



In Phase A, vehicle left turns are held. Vehicle through movements are unopposed, while vehicle right turns are allowed to 'filter' across pedestrians (potential pedestrian head start).

Example 2: A 'bicycle head-start' and 'filtered' turns in Option 2 (Inkerman Rd / Hawthorn Rd)



In a two-way option, right turn bans are recommended to improve efficiency, given the impact that turning vehicles could have on traffic capacity in a single lane approach. This would be particularly beneficial from the west approach, which is unsafe for filtering across eastbound bicycles.

Design Basis

ARUP

Traffic signal operation (cont.)

Cyclist entry and exit movements

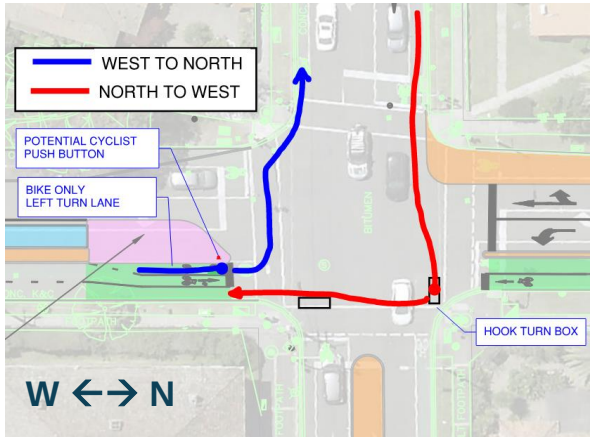
The primary north-south cycling route connecting into Inkerman Road is Kooyong Road, which currently has on-road cycling lanes.

Bicycle movements around the intersection are accomodated through a combination of the following:

- Hook turn storage boxes, and
- Existing pedestrian crossings retrofitted with bicycle lanterns to legalise cycling movements (shared crossings).

In reality there is a range of cycling abilities and confidence levels meaning there is no 'one size fits all' for how people cycling may prefer to connect between routes. For example, people who are confident cycling will choose to share the road and use turn lanes, however it is not best practice to rely on all users to do so.

In the examples below, two potential options are given of how a bicycle user could comfortably enter or exit Inkerman Road onto the intersecting cycling facilities on Kooyong Road.



Example of how a user would navigate between Inkerman Road and an intersecting cycling corridor

Exiting Inkerman Rd (west to North)
On arrival, eastbound bicycles would prop in the turn lane and utilise the push-button. When the north-south phase is called, they can use the shared use crossing to navigate toward the existing on-road bicycle lane.

Entering Inkerman Rd North to West
Bicycles perform a standard hook turn.



An example of a bicycle turning facility with a push-button.

Design Basis

ARUP

Traffic signal operation (cont.)

Managing transitions

Transitions are an important aspect of cycling corridors as they affect the continuity of the network. Transitions can affect ease of navigation and wayfinding and if poorly managed, can be stressful for people to navigate. There are two key transition points along the corridor, at Orrong Road and Normanby Road.

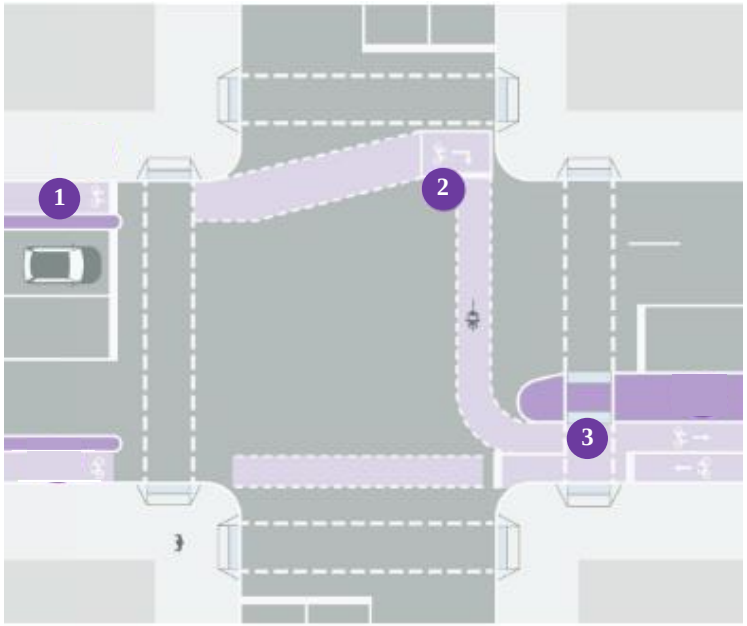
Inkerman Road / Orrong Rd

The transition at Inkerman Rd/ Orrong Rd where the eastbound facility changes from an eastbound protected lane on the north side, to a bidirectional path on the south side.

This transition is treated with a bicycle hook-turn; a treatment recognised within the DoT Cycling Design Guide (refer inset). Unlike a regular hook turn a line-marked box is provided off to the side, in this case the line marking of the bicycle path would channelise all people cycling toward the hook turn storage area.

The sequence of operation would be as follows, assuming an eastbound cyclist arrives on a red:

1. A cyclist is held at the stop line on red (see #1 inset) . When the west approach commences, only vehicular traffic is initially given a green light, whilst cyclists remain held on red. Running bicycles after east-west traffic would avoid the potential for conflicts between queued cyclists and turning vehicles.
2. The vehicular phase is cut-off early, potentially with a red left turn arrow. Then, the bicycle green begins and cyclists proceed to the next hook turn storage (see #2 inset).
3. Cyclists are released with a southbound bicycle head-start phase, allowing the approach to be cleared before the vehicle phase commences. Ideally, the cyclist phase would be separated from the eastern leg pedestrian crossing (see #3 inset), however some overlap map be required. In the case that the green pedestrian walk phase has commenced, cyclists would be required to yield to any pedestrians on the crossing.



Illustrative excerpt reproduced in part from the DoT Cycling Design Guide showing a bicycle transition. Alternatives were considered, including an 'approach side crossing', a protected intersection, or a mid-block crossings, however were not considered as suitable or viable.

Design Basis

ARUP

Traffic signal operation (cont.)

The second location for **managing transitions** is the **Inkerman Road/Normanby Rd** intersection, where the bi-directional path changes orientation to run parallel to the rail corridor.

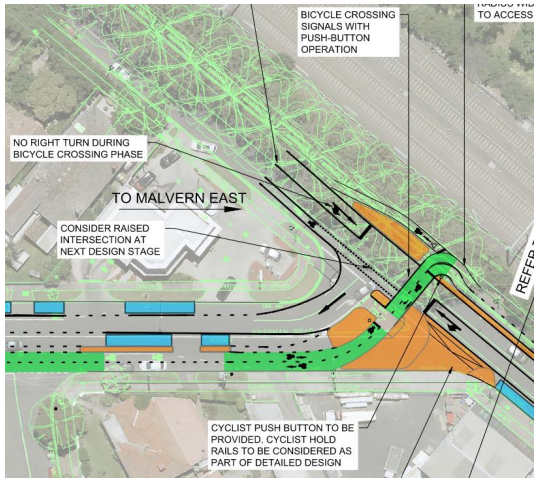
In both design options, a signalised 'bicycle only' crossing point is proposed given there are no pedestrian facilities on the northeast side of Normanby Road. There would be slight variations between options described below.

For **Option 1**, the bicycle crossing would be designed in a similar manner to a pedestrian operated signals . There would be no signal control for pedestrians crossing Inkerman Road. To cross Normanby Road, a push-button would be installed near the bicycle stop line to activate the crossing from either side. This would minimise any unnecessary stopping of traffic. Bicycle detector loops could be installed in the pavement to supplement the operation of the signals, for example to extend the green phase time for a platoon of people cycling, or terminate the phase early once all bicycles have passed. The signals would operate with only two traffic phases; one phase for the bicycle crossing, and a second phase for Normanby Road traffic. During the bicycle crossing phase, the right turn into Normanby Road would be held on red. The stop line on this approach has been set at a location further in advance of the crossing than is typically adopted for this reason. This was a recommendations of the independent safety review, and serves to mitigate conflicts between bicycles turning on the crossing to travel in the heading northwest and turning vehicles.

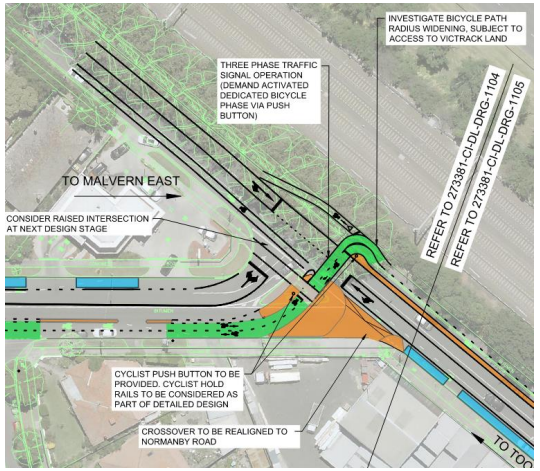
For **Option 2**, three traffic signal phases are required. The additional phase would serve the eastbound movement exiting Inkerman Road. This requires that a signalised pedestrian crossing be provided on Inkerman Road. Right turns from the Normanby Road into Inkerman Road would be required to filter across pedestrians on the pedestrian crossing, which could be provided with a head-start to manage these conflicts.

In both options, it is recommended that a raised intersection be considered as part of future design stages. This may require further investigation of levels and drainage particularly on This has also been recommended by DoT.

An alternative for an unsignalised bicycle priority crossing was reviewed and not considered suitable. Austroads identifies that such treatments can be suitable for low volume roads, however should generally be located away from intersecting roads, in a local traffic area, and that the priority assigned be consistent with that observed elsewhere along the road. The nature of Normanby Road more broadly is characterised by signal controlled intersections, with Normanby Road traffic otherwise being allocated priority.



Option 1 – Push-button bicycle crossing



Option 2 – Three phase intersection with bicycle crossing

Design Basis

ARUP

Normanby Road tram stop interface

There is a long history associated with the redevelopment of tram stop 56 at the corner of Normanby Road and Smith Street, Caulfield. This site is the most easterly point of the Corridor Plan, with the bookend being immediately west of the Smith Street underpass.

It is understood that a Section 173 agreement was entered into as part of the conditions of consent for the Caulfield Village redevelopment, part of which is nearing completion at the tram stop frontage. This provides a contribution of funds towards a future tram stop upgrade. As part of initial transport report prepared by GTA consultants in 2017, design concepts did not consider the needs of people cycling. In more recent times, a better understanding of the precinct movement needs has emerged. The current Caulfield Major Activity Centre Structure Plan reflects this location as part of the strategic cycling link between Inkerman Road and the Djerring Trail, with the facility alongside the rail corridor.

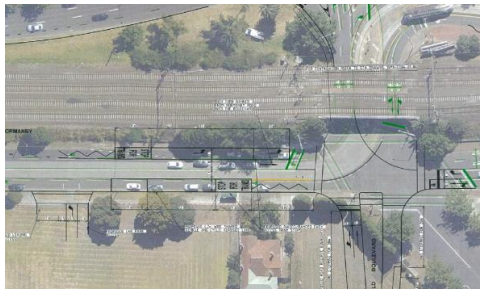
The ‘Option 3’ design shown bottom right is reflective of the Caulfield Major Activity Centre Structure Plan, and provides the starting point for the Corridor Plan.

In developing the Corridor Plans, minor changes have been made to the Option 3 concept to improve safety and tram performance, including the following:

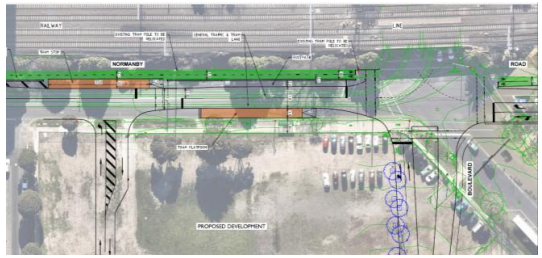
- Inclusion of a dedicated left turn lane from the west approach, to improve tram progression and reliability (based on consultation with Yarra Trams).
- The path alignment shifted marginally south, to provide an offset between the existing Victrack retaining wall and the bicycle operating area. This verge will be required to host electrical/tram poles, and traffic signal pedestals, as well as providing more space to achieve DDA compliance kerb ramps at the northwest corner of the intersection.
- A change from a bi-directional bicycle path to a Shared Use Path, for space efficiency purposes and as a potential means for simplifying the staging of delivery.
- Narrowing of the verge on the south side, along with other geometric changes.

It is understood that the Department of Transport will lead the design process for the tram stop. Notwithstanding the amendments considered by Arup, there remain some complexity both in terms of operational planning, design and staging of delivery. Challenges include:

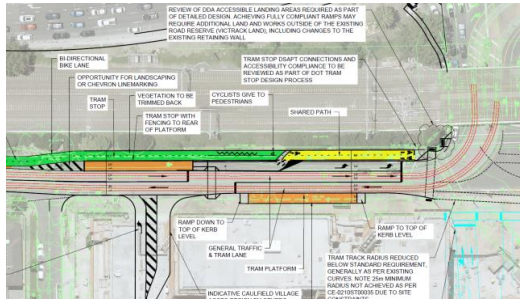
- Resolving accessibility requirements based on interpretation of the Disability Standards for Accessible Public Transport (DSAPT).
- Understanding traffic performance and operations, including co-ordination of signal phasing to mitigate ‘see-through’ effects due to the very close spacing between the intersection and tram stop pedestrian signals.
- Determining the additional signal phase implications of turning trams, and separation from traffic.
- Geometric design criteria, including existing non-compliant tram track curves, and the proposed traffic lateral shifts through intersections adopted in the designs by others.



Above: Initial drawings for an ‘easy access platform’ accessible tram stop (GTA, 2017)



Above: ‘Option 3’ tram stop drawings provided by the Department of Transport (GTA, 2020).



Above: Arup Corridor Plan Concept

Design Basis

ARUP

Signage and line-marking

Typical suite of products

Signage and line-marking on Inkerman Road and side streets will be altered to ensure the safe integration of the protected bi-directional facility with the road network. Signs and lines drawings will be part of the detailed design process for road infrastructure with the *AS/NZS 1742.9 Manual of Uniform Traffic Devices* standard used to determine appropriate provision. Potential new signage and line-marking is shown below:

Give way priority at side-roads

The interaction of side streets with the bi-directional facility and Inkerman Road forms a potential conflict area to be managed. Clear signage and line-marking is integral to ensure that bicycles and vehicles both understand how to use the road space in a safe manner. The diagram to the right outlines potential placement of signage to improve safety and short descriptions of vehicle operations and use of the intersection.

a



b



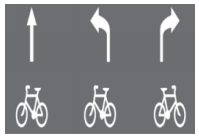
c



d



e



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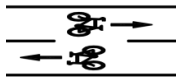
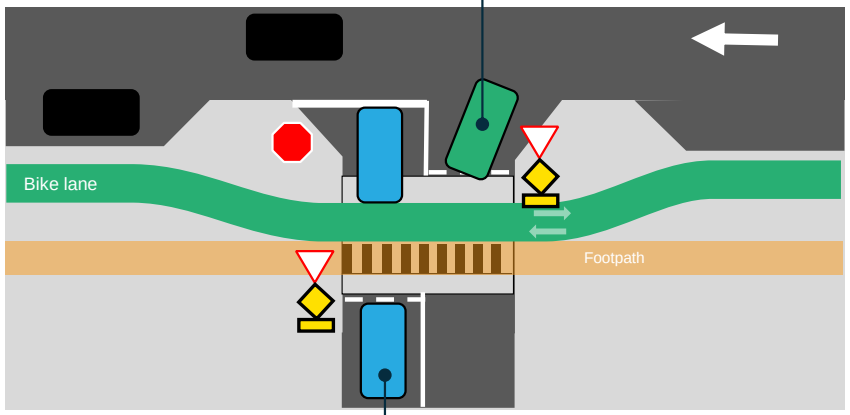


As a motorist enters a side street from Inkerman Road, they will see 'Give Way' to bicycles and pedestrians signage near the base of a shallow ramp (b and c on left) adjacent the give-way line, before looking for oncoming pedestrians/bicycles then crossing.



Vehicles approaching from the side street will be required to give way to bicycles and pedestrians before crossing the raised bicycle lane and footpath. These vehicles will be required to stop again following the raised treatment before entering Inkerman Road.

Design Basis

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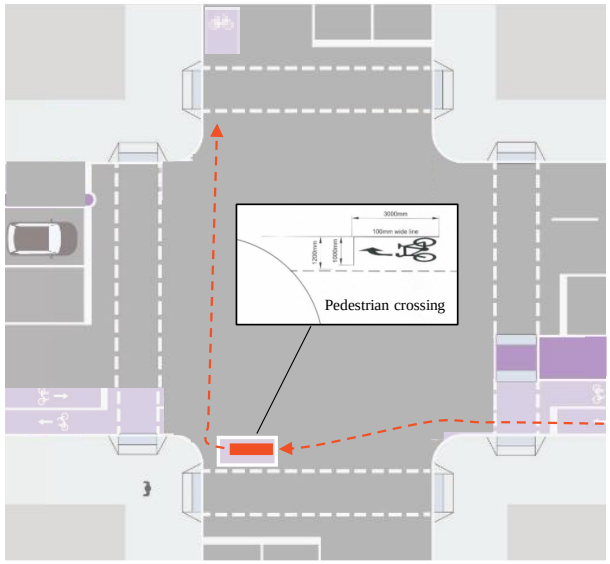
Signage and line marking

Bicycle hook turns

Hook turns will be provided at signalised intersections to facilitate bicycles turning right across traffic lanes. Operation of the hook turn is described in detail on slide 26. Bicycle hook turns can be performed at any intersection according to the road rules without formal line marking however formal line marking can ensure bicycles store in an appropriate area. Hook turn storage line marking (shown in diagram below) was considered appropriate considering Inkerman Road's designation as a C2 strategic cycling corridor to improve on the legibility and usability of the facility for people cycling of all ability.



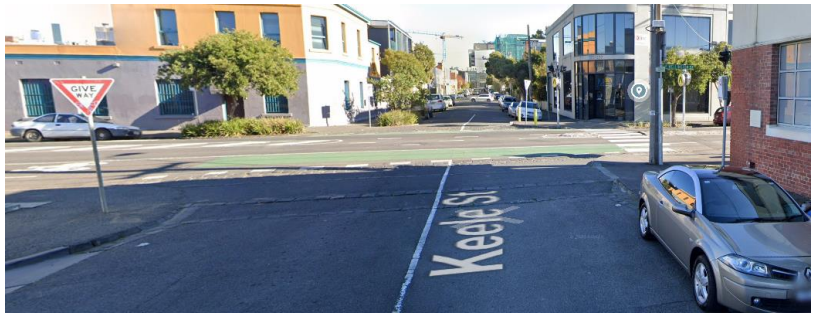
Example signalised bicycle hook turn operation.

Contrasting pavement

Green paint is used to indicate locations vehicles are crossing over the bicycle facility at unsignalized intersections and private driveways. The green paint will be in the field of view for both drivers and people cycling to indicate a point where vehicle and bicycle traffic streams are crossing. This serves as a demarcation that the space is allocated to the bicycle facility and vehicles should avoid stopping and storing on the bicycle lane where possible. Where green paint is used at driveways, reversing vehicles may not be able to see the road surface however in these instances it can still serve as a warning to approaching bicycles. Other supporting treatments would be recommended for Option 2, such as approach pavement markers and zig-zag line marking to reinforce the need to look left for approaching bikes.

On-street parking

The boundary between the parking and traffic lane can be line-marked in several different ways. Current designs show the edge of the traffic lane line marked only without a line marked boundary for on-street parking spaces . This encourages vehicles to stay within traffic lanes without excessively formalising and marking on-street parking spaces. There has been some buffer allowed within the parking lane to allow for doors opening however it would still be expected that parked cars are cognisant of traffic before swinging open parked car doors.



Example of contrasting road paint across intersecting side streets to demarcate bicycle lane at Keele Street / Wellington Street, Collingwood. Source: Streetview

4 | Assessment

Assessing how the Corridor Options perform against the initial appraisal criteria including Safety, Neighbourhood, and Feasibility.

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Assessment Approach

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Consultation criteria

Overview

Three themes have been used throughout the Stage 1 appraisal and consultation process. These themes included safety, neighbourhood, and feasibility. The assessment approach for Stage 2 extends the use of the three key themes, for the purpose of illustrating key differences between the options.

Safety

The corridor plan should provide a safe transport system for all, and enable people of all ages and abilities to ride a bicycle. It should be easy to understand, manage conflicts with intersecting driveways and streets, and should not negatively impact the safety of other vulnerable road users (elderly, children, people with disabilities).

- Conflict points: Separation type, intersection movements,
- Level of traffic stress: bicycle lane width, and width, intersections, traffic speed and volumes.
- Continuity of cycling facility
- Ease of use: wayfinding at entry and exit points.
- Vulnerable road user safety, access and amenity
- Interaction with roadside hazards
- Crash risk.

Neighbourhood

The corridor plan should provide connectivity to key land uses and destinations, limit the impact to property access, traffic operations, public transport and the streetscape. It should strike a balance with other community needs (i.e. car parking), and support broader streetscape opportunities where possible.

- Car parking
- Property access
- Public transport - access to and operation of public transport
- Traffic operations: congestion, changes to turn restrictions
- Streetscape - visual appeal of streetscape (street furniture, trees, surfaces)

Feasibility

The corridor plan be deliverable, meeting relevant best-practice design standards, permit reasonable waste collection processes, street cleaning operations and emergency services access, align with objectives of local and state authorities, and be of reasonable cost to construct.

- Alignment with stakeholder network and planning objectives
- Waste and street cleaning operations
- Emergency services
- Construction cost and risk



The themes of safety, neighbourhood and feasibility were used throughout the design and consultation process.

The same criteria have been used as a reporting framework, to identify key differences between Option 1 and Option 2, along with discussion on any impacts and how they might be managed.

4.1 | Safety Assessment

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Road Safety Process

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Safety assessments

Safety reviews and audits are a core part of the design process, often occurring at key milestones. The reviewer will often challenge the design assumptions and suggest alternatives. In developing the Corridor Plan, two independent safety reviews were carried out, as outlined below:

Safe Systems Assessment

A Safe Systems Assessment was commissioned by GECC in October 2020, with Arup providing a designer response shortly thereafter. Key outcomes of the SSA included that:

Both design options were considered better aligned with Safe System principles, compared to the existing conditions. The existing conditions scored 192.5, whilst Option 1 was 106.5 and Option 2 scored 112.5 (a lower score is better).

The one-way option had a better (lower) score than Option 2 because it was considered to result in fewer conflict points along the route.

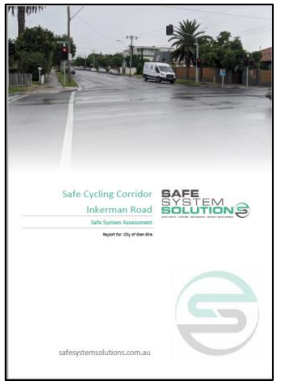
The report and findings returned to Arup for response on 18 July 2022. A response to the audit was provided and shared with the CRG on 8 August 2022 however the SSA did not prompt any major design changes.

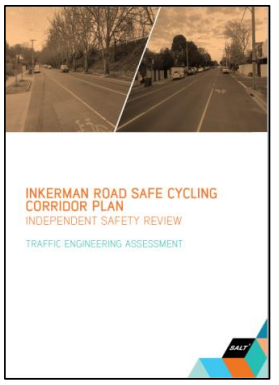
Independent Safety Review

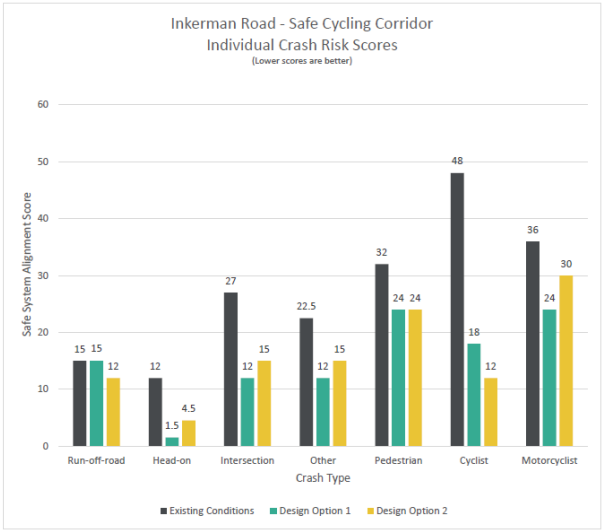
Following development of the full draft concept designs, an Independent Safety Review was commissioned by GECC in June 2022. Upon receipt, Arup classified the significance of issues as either minor, moderate or major; before a response was proposed. Most of the issues were considered minor or moderate in significance.

For the purpose of the design, findings fell into one of three categories below:

- **Downstream design development** matters, which do not materially affect the concept layout and are appropriate to be further developed at the next stage of design.
- **Design changes,** where several recommendations of the safety reviewer were accepted for amendment as part of the Corridor Plan process.
- **Design review.** In some cases, recommendations with a moderate impact on functionality or cost have been reviewed, however ultimately did not change the views of the designer for this stage. In some cases, optimisation or exploration of alternatives may be revisited once a preferred design solution is adopted.







Summary of the Safe Systems Assessment

Safety Considerations

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Safety summary

While a more detailed coverage of safety risks is produced in the independent safety report, a summary of the main differentiators between the two options as well as key risk sources and mitigation is provided below.

Comparative Assessment

The key findings are shown below:

- Both options result in a safer outcome for all road users aggregate compared to existing conditions.
- Corridor Option 2 results in a safer bicycle and vehicle outcome compared to Corridor Option 1. Outcomes for pedestrians were assessed as slightly poorer than Corridor Option 1 due to fewer raised pedestrian crossing opportunities.
- Corridor Option 1 was assessed as having poorer safety outcomes for vehicles compared to existing conditions.

User	Existing Conditions	Design Option 1	Design Option 2
Cyclists	3	2	1
Pedestrians	3	1	2
Vehicles	2	3	1
OVERALL ASSESSMENT	3	2	1

SALT safety rankings based on the Draft Arup Corridor Designs (June 2022). A ranking of 1 indicates it is the safest option.

Detailed design issues

A number of recommendations were made in the safety review for items that will be developed or detailed at the next design stage. While some are valid, there is limited value in detailing these before detailed design, or before a single preferred option is identified. These issues include aspects such as:

- Hook turn pavement markings.
- Bicycle head-start boxes.
- Exact stop line locations.
- Green pavement extents.
- Relative width of the separator kerb vs. the bicycle path.
- Minor changes to separation kerb extents adjacent wombat crossings.
- Bicycle lanterns for north-south cycling movements.

Conflict points – property access

The Independent Safety Review found that Option 2 was favourable in safety terms due to the absence of car parking adjacent the bicycle lane, which improves sightlines between property access points and path users.

Conflict points – passenger car doors

Option 1 presents unique risk scenario of car dooring conflict with other motor vehicles, where parallel parking is on the right hand side of the one-way carriageway.

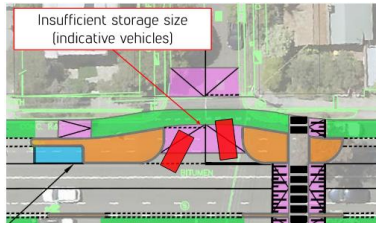
While the number of occurrences of car door opening into the traffic lane will be much lower on the passenger side, given the seat occupied far less, the unfamiliar nature of a 'passenger-side' traffic conflict may increase crash risk.

To mitigate this risk, the proposed design adopts a 0.5m buffer between the edge of the traffic and the edge of the car parking bays. While this doesn't replace the need to look for oncoming traffic, it would mean that a partially opened car door is less likely to result in a crash.

Where parallel parking is on the right side, the driver side door will open head-on into possible bicycle traffic. This scenario is mitigated by separation strip.

Conflict points – side roads

A recommendation was made to reconsider the geometry of the 'raised side road treatments', given in some cases the desirable length of propping zone is less than the desirable dimension to cater for the largest common car (99th percentile vehicle). No change has been made, given that average sized vehicles will not block the path. The suggestion to realign the bicycle path risks creating further safety issues and may dilute priority for vulnerable road users including pedestrians, which is a priority for the SCC. Notwithstanding, small adjustments can be considered in detailed design to optimise storage.



Excerpt of SALT report

Safety Considerations

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Safety summary

Level of traffic stress

The 'level of traffic stress' experienced by a bicycle rider when travelling along Inkerman Road is effectively a function of a number of geometric and contextual factors such as traffic volumes/speed and heavy vehicles. The most notable difference in stress factors between Options 1 and 2 are:

- degree of separation to traffic,
- interactions with car parking,
- interactions with property access points.

At mid-block locations, the car parking in Option 1 provides a sense of physical barrier between the bicycle path and moving traffic. However, it also introduces other stress factors such as passenger car-dooring risk and also impedes sight lines for vehicles turning into driveways. On the balance, Option 2 was considered safer by the independent reviewer for these reasons. However, we note that the individual experiences and perceptions of safety may differ depending on the level of cycling confidence and ability.

Parking proximity to driveways

The conflict between vehicles entering driveways and bicycle riders was identified as a key risk source by the safety reviewer, due to the potential for parking to block sight lines. Specifically, the safety review noted that a:

- A left-turn movement may not be able to perceive a person cycling until the turning movement has commenced, and
- A vehicle stopping on entry to a side road may overhang into the traffic lane, increasing likelihood of 'rear end' crashes.

The design recognises there are trade-offs in balancing local parking needs and property access. However, the design options provide high quality protection for cycling movements that specifically consider the risks of separation, buffering to car parking and reasonable sight lines at property entrances. Ultimately the design must balance unobstructed sight lines against user behaviour and compliance expectations for how close people will park to driveways.

For context, the road rules state that left-turning vehicles have priority over people cycling *once the turning movement has commenced.*

In most cases, motorists will have intermittent visibility to people cycling on approach when travelling in the same direction, allowing a car driver to modulate their speed and yield for the bicycle rider.

In responding to the safety review, it was noted that the design basis was developed with due consideration to sight distance metrics including:

- **Cyclist stopping sight distance:** A person cycling's ability to stop, having seen a vehicle crossing the path (note: people cycling must give way to a vehicle turning left if it has indicated intention to do so). Guidelines show that a bicycle rider travelling at 25km/h on flat terrain, would need to observe the impending conflict and brake 20m ahead, to avoid a collision situation.

- **Gap sight distance:** A measure of a drivers' ability to see an oncoming bicycle, in order to select accept safe gap to cross (assuming they have propped in a 'courtesy gap' situation near to the bike lane – refer inset). It is noted that the achieved gap sight distance of 12.5m to 17.5m would allow enough motorist perception time to cross when people cycling are travelling at low to moderate speeds.

Lastly, while rear-end crash risk when entering driveways is a somewhat relevant consideration, it is mitigated by the reduced speed environment along Inkerman Road.

Example of Gap sight distance achieved with 3m offset

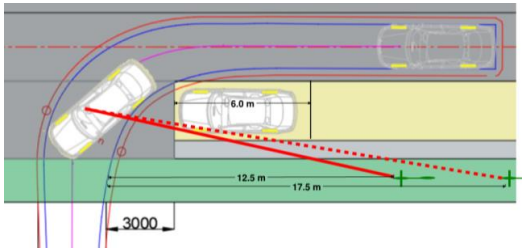

Table of gap times corresponding with varying cycling speeds, at the distances noted

Bicycle Speed	Sight line clear of vehicle (12.5m)	Sight line over bonnet (17.5m)
Key	———	·····
15km/h	3.0 sec	4.2 sec
20km/h	2.3 sec	3.2 sec
25km/h	1.8 sec	2.5 sec

Accessibility

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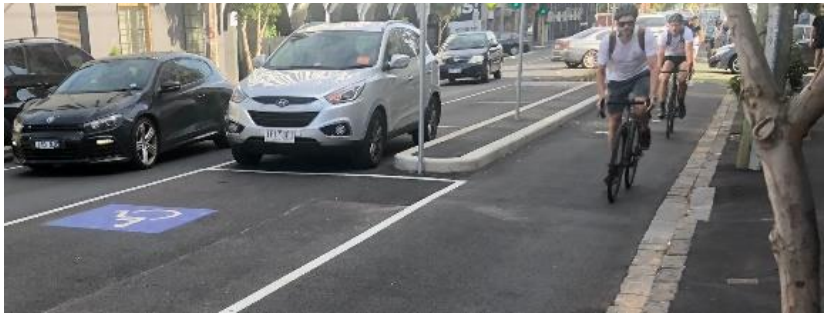
People with disabilities

When considering parking adjacent bicycle paths, accessible parking spaces can be provided by:

- providing breaks in the raised separator kerb beside the accessible space; and,
- providing a pram ramp from the bicycle lane onto the footpath that is designed in accordance with Australian Standards.

It is understood that current GECC policies do not provide formalised parking for people with disabilities for residential purposes.

However, a similar degree of accessible parking could be achieved through the means expressed above. The existing accessible parking provision on Inkerman Road is limited to areas adjacent commercial land uses, and is located in side streets where possible. This arrangement is expected to be maintained.



DDA parking space adjacent protected bicycle lanes on Wellington St, Collingwood

4.2 | Neighbourhood Assessment

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Neighbourhood Assessment

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The importance of parking to residents

A key theme of the consultation process has been that parking is a significant issue for residents and visitors. Parking can be particularly important for women, children, the elderly and mobility impaired. For these users, access to opportunities, security, safety and quality of journey may be more dependent on the ability to park within a reasonable proximity to the final destination. Historically in Glen Eira and on Inkerman Road, residents have enjoyed a high level of unrestricted access to on-street car parking.

Glen Eira is facing increasing pressures to on-street parking with a rapidly growing population and limited public road space. The allocation of this road space is the responsibility of GECC and often requires a balance of the movement, parking and amenity needs. GECC's Parking Policy reports an increasing quantity and intensity of community complaints regarding parking, with parking facilities becoming the third most important area for service provision improvement in 2019 (source: GECC Parking Policy 2020).

The Inkerman Road Safe Cycling Corridor project will by nature impact the availability and supply of some on-street parking in Inkerman Road by utilising the limited road space available to provide a safe cycling facility. Best practice design and separation of vehicles and people cycling to provide a safer cycling experience requires the trade-off of reduced on-street parking on Inkerman Road. Impacts to parking have been deliberately considered and minimised throughout the design process to achieve equitable use for all road users.



Glen Eira growth to 2031

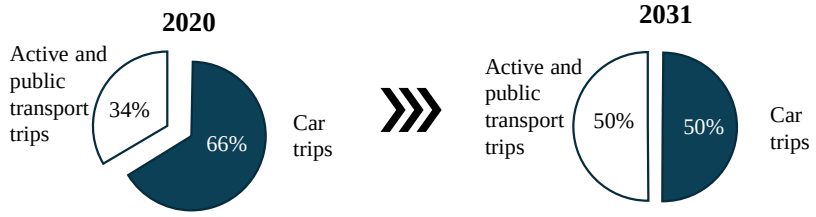
Source: GECC Integrated Transport Strategy 2018 - 2031

Glen Eira Parking Policy

GECC's Parking Policy published in 2020 outlines Council's approach to equitably address increasing demands for parking while managing traffic congestion. It acknowledges that the traditional approach of predicting parking demand and providing infrastructure to meet all demand is not working, and will continue to come under pressure from the growing residential, visiting and employment population. The policy signifies a shift away from this 'predict and provide' approach toward a focus on ensuring equitable access to parking for those dependent on on-street parking.

The Parking Policy is one of several policies that support the delivery of GECC's 15-year Integrated Transport Strategy (ITS). GECC recognises in Principle 4 of the ITS that "Parking will continue to play an important role and complement our transport system." The policy provides a mandate for innovative parking initiatives, parking restrictions, and changes to the Residential Parking Permit System Policy.

Another consideration of parking demand management is GECC's mode shift target of 50:50 car and non-car mode shares by 2031. Cars currently account for 66% of trips within Glen Eira, requiring a reduction of 16% over the next 9 years. The provision of Inkerman Road SCC will improve safety and opportunities for active transport within the local community and offers a step change toward lower car usage and parking demand more broadly.



Source: GECC Integrated Transport Strategy 2018 - 2031

Neighbourhood Assessment

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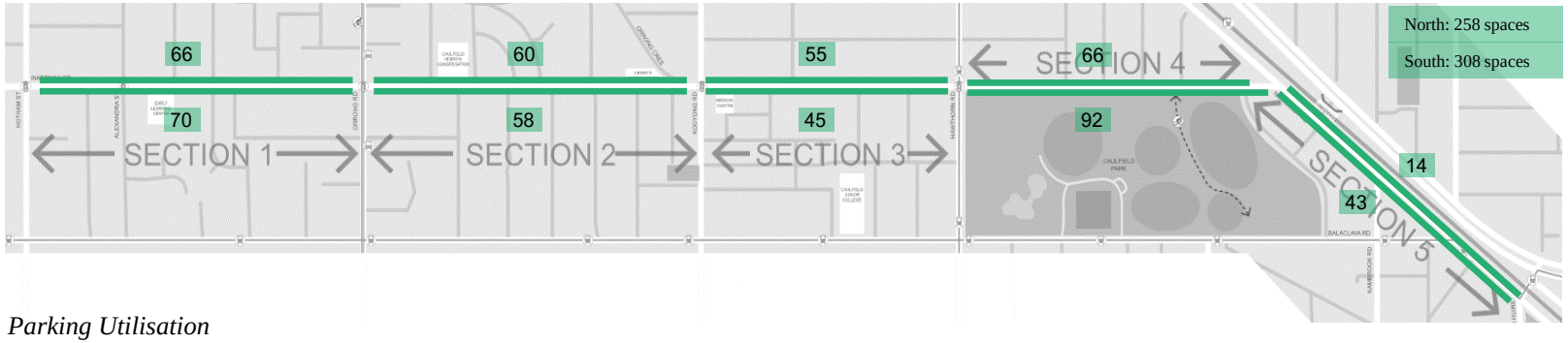
Car parking assessment: existing conditions

Parking along Inkerman Road is mostly on-street, unrestricted parallel parking. The number of existing parking spaces has been determined by measuring available on-street parking space using a feature survey as well as aerial imagery. It is noted that individual bays are not line marked, so there a degree of interpretation required, and the approach shown to the right has generally been used. Existing parking demand was surveyed by OneMileGrid on Friday 24 May, Saturday 25 May and Tuesday 28 May 2019. The peak occupancy over the day for each section was reported, with the busiest day Friday 24 May used to calculate utilisation (demand/supply) to represent the worst case parking scenario.

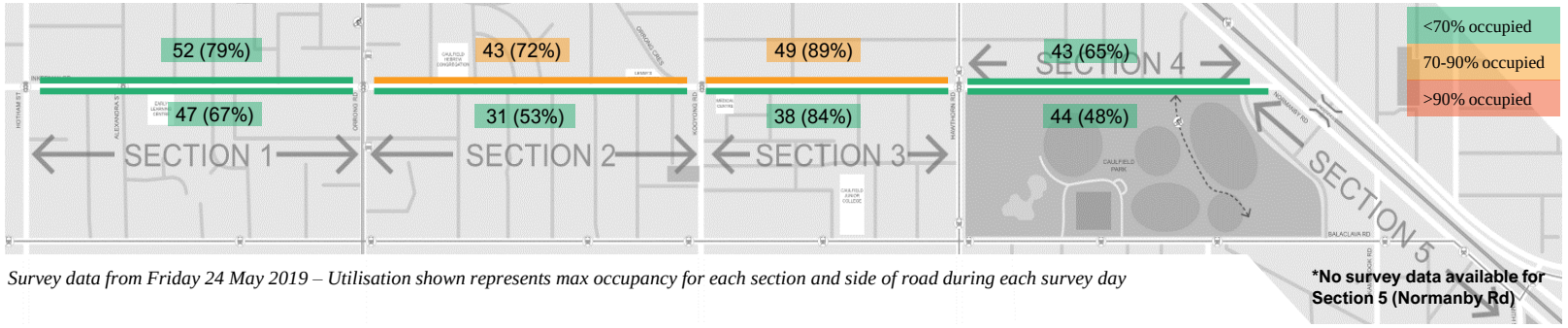
Assumed dimensions for determining number of parking spaces:

Type of space	Length	Description
End space (unobstructed)	5.0m	Easier parallel park maneuver due to no parking on one end.
Intermediate space (obstructed)	6.0m	Parallel park maneuver required.

Parking Supply



Parking Utilisation



Survey data from Friday 24 May 2019 – Utilisation shown represents max occupancy for each section and side of road during each survey day

Neighbourhood Assessment

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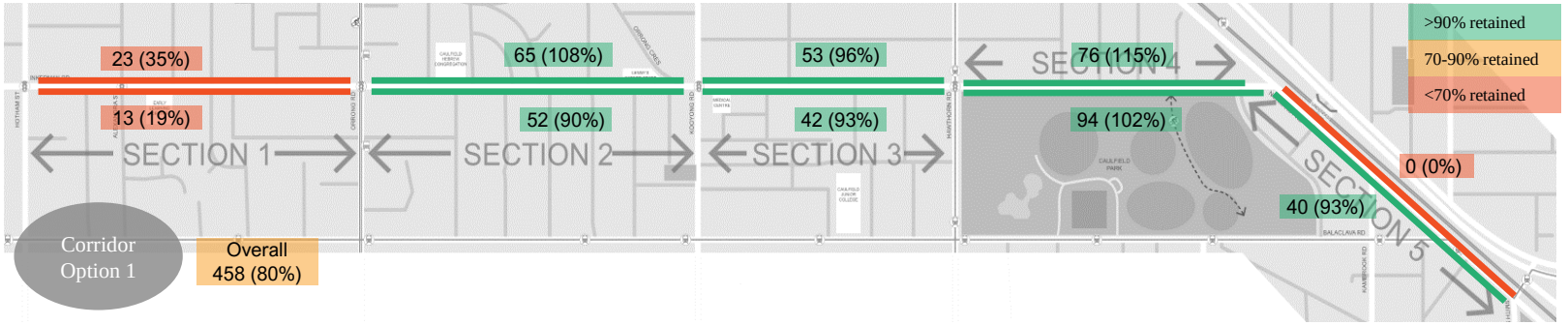
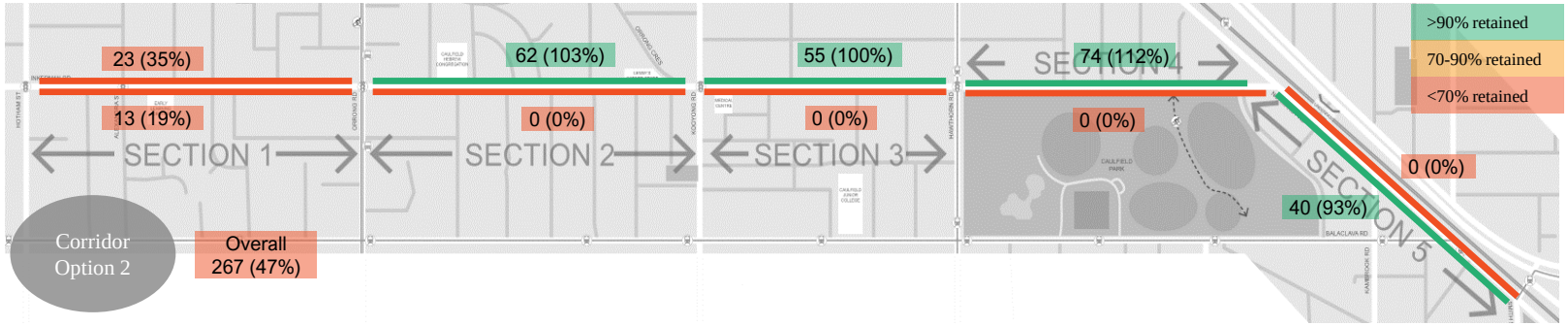
Car parking assessment: future parking supply

The cycling corridor car parking supply for each Corridor Option is shown below. The same assumptions for determining the existing supply have been used to determine future supply. In some instances, a small increase in parking supply is shown due to reduction of keep clear lengths and extension of parking areas closer to intersecting streets.

Parking impact to sections 1 and 5 are identical for both Corridor Options. Corridor Option 1 with one-way traffic will have less impact to on-street parking in sections 2-4 as parking is retained on both sides of the traffic lane. For Corridor Option 2, all on-street parking is lost on the south side of the road to retain two traffic lanes.

Future Car Parking Supply (# of spaces and % retained)





Neighbourhood Assessment

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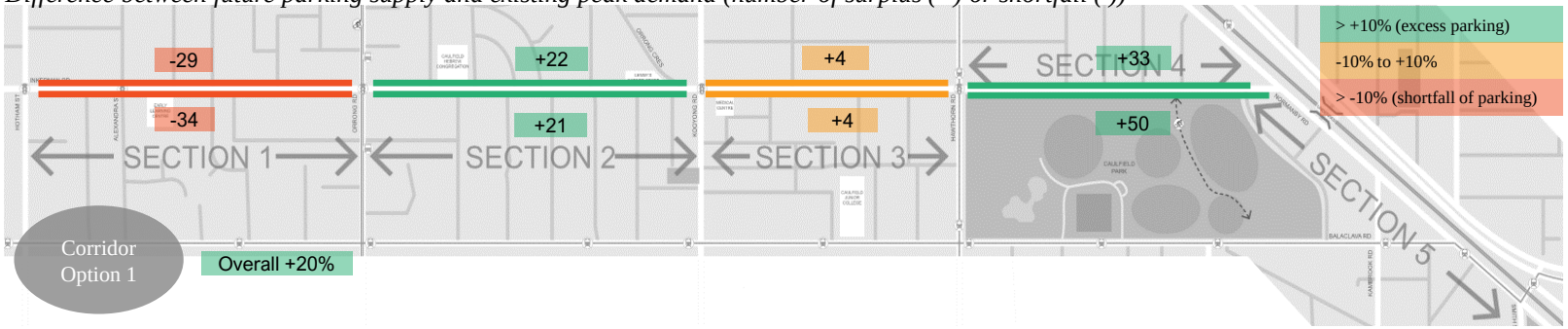
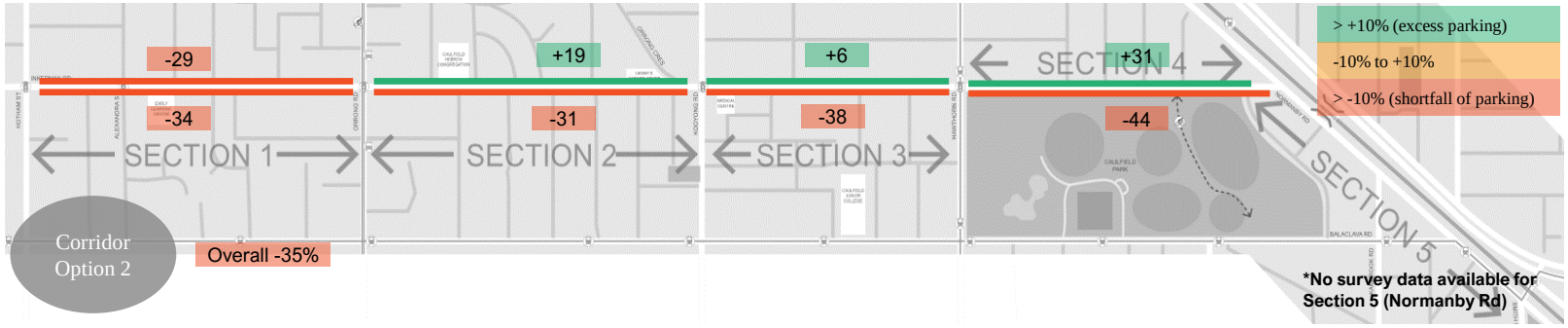
Car parking assessment: parking impacts and shortfall

The predicted difference between the demand and future supply of on-street supply for each option is shown below. A positive number indicates that future supply continues to exceed demand given there is currently some spare capacity. A negative number indicates a shortfall of parking. Sections with negative values could experience parking overspill, with some demand migrating into adjacent side streets or unoccupied driveways/garages.

It is noted that there is a high prevalence of on-street parking on Inkerman Road as it is unrestricted and highly available at present. This analysis assumes no change in parking behaviour. However, it is expected that some mode shift and change in travel behaviours (including increase uptake of on-site parking) could occur over time and have a downwards effect on the existing parking demands, in line with GECC's parking policy and vision for the future.

Difference between future parking supply and existing peak demand (number of surplus (+) or shortfall (-))





Neighbourhood Assessment

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Summary of parking impacts

Parking absorption of the surrounding area

Any shortfall of demands on Inkerman Road are expected to be absorbed into surrounding side roads, as well as the potential increase in utilisation of off-street residential car parking (i.e. garages or driveways).

Car parking surveys have not been carried out in all side roads to estimate the absorption potential for any overspill demands following the removal of car parking. However, given that these demands could be spread across a number of different side roads, the impact on any given street is not expected to be significant considering the number of side streets connecting to Inkerman Road.

Parking supply offsets

A review of surrounding residential streets has been carried out to understand opportunities for increase on-street parking supply. In all cases except for Alexandra Street and Orrong Crescent, there is a limited ability to implement angled car parking.

As noted previously, a small increase in parking supply is achieved in some areas where there is a reduction of 'no stopping' distances at side-roads.

The existing extent of no stopping adjacent intersections in some cases is large and exceeds the typical statutory requirements (10m adjacent unsignalised side roads).

This may have been appropriate in the past, given that Inkerman Road has been a 60km/h road, in order to maximise sight distances, or could represent site-specific factors. However, the proposed design actively seeks to reduce speeds through a combination of road narrowing, raised wombat crossings, and a reduction of the posted limit to 40km/hr.

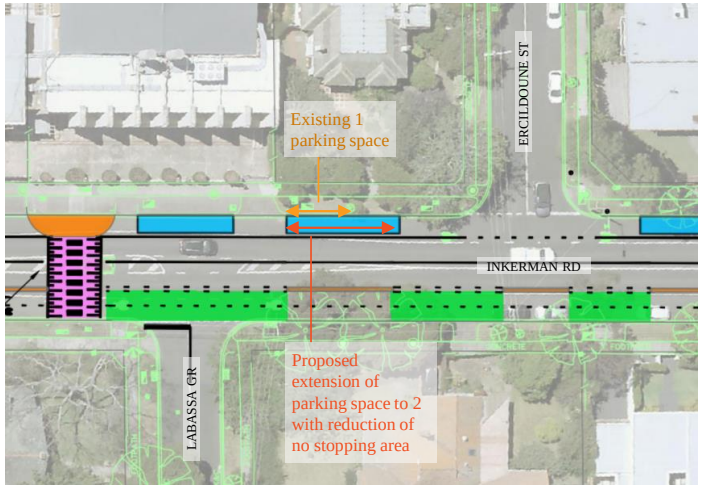
On the above basis, there may be opportunities for further increases in parking supply on the north side of Inkerman Road by allowing parking to occur closer to side roads, while still maintaining the applicable 10m offset.

A conservative approach has been adopted for the Corridor Plan, generally assuming existing no stopping extents.

In future design stages, sight distance assessments could be carried out with a view to adding more parking. It should be noted that design standards do not typically require parking areas to be outside of sight lines checks, which only deal with permanent fixed objects. A review of vegetation may also be required and trimming carried out to preserve sight distance rather than relying on no stopping zones.

	Option 1		Option 2	
Section	**Change to available parking**	**Excess (+)/shortfall (-) of parking spaces based on peak demand**	**Change to available parking**	**Excess/shortfall of parking spaces based on peak demand**
1	-100	-63	-100	-63
2	-1	+43	-56	-12
3	-5	+8	-45	-32
4	+12	+83	-84	-13
5	-17	-	-17	-
Overall	-111	+71*	-302	-120*

*Sections 1-4 only, no parking survey available for Section 5



Example of location where no stopping area can be reduced

Neighbourhood Assessment

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Parking management

There are several policy and parking management levers to be considered for the safe and efficient management of the Inkerman Road SCC. Some of these are existing GECC policies which may need to be revisited with the new context of the facility upon its completion:

Parking permit schemes

Section 4.5 of the current GECC Parking Policy (2020) stipulates that when there is a significant loss of on-street parking, remaining spaces will be prioritised for surrounding residents through parking restrictions such as "permit only" zones. The management and eligibility for parking permits is dependent on several conditions outlined in the Glen Eira Residential Parking Permit System Policy and may need to be revisited to manage loss of on-street parking on Inkerman Road.

Policy for new developments

Parking requirements for new developments can be adjusted to ensure that the design intent and safety considerations that informed the Inkerman SCC are not compromised by inadequate development. Considerations include requirements for parking provision off-street and requirements for forward-in / forward-out movements to be accommodated within property boundaries amongst others.

Design guidelines

Recommendations and guidelines for urban design and neighbourhood character can be updated to improve the interface with the Inkerman Road SCC over time. Considerations include fence height restrictions to improve sight lines from driveways adjacent to the facility, recommendations for clear zones and intersections to improve sight lines with intersecting side streets and minimum offsets for on-street parking spaces to driveways amongst others.

Loading zones

Loading zones in side streets can be used to manage hazardous situations with stopping vehicles on Inkerman Road following the construction of the SCC. Commercial and delivery vehicles are typically larger and may present increased risk with pedestrians and people cycling due to blind spots with the stipulation of loading zones away from the bicycle facility suggested to mitigate risk.

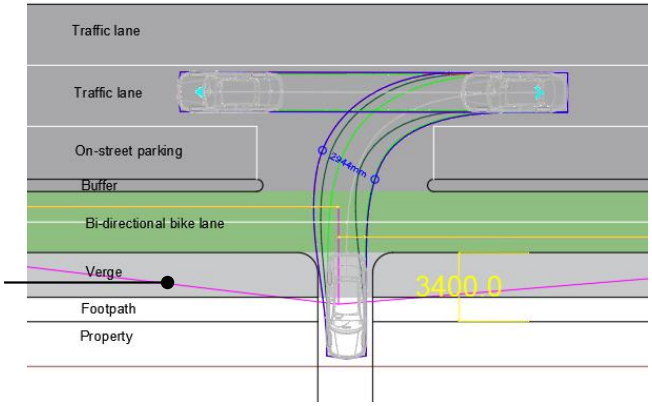
Reversing out of driveways

An issue raised through the Community Reference Group was the ability for drivers to safely reverse out of their driveways. Concerns were raised that there is a risk of motorists having a poor line of sight when reversing out of their driveway, and less operating space before their vehicle projects into the bicycle path.

The existing nature strip and footpath dimensions along the south side of Inkerman were reviewed, and found to average approximately 3.4m. For design purposes, the drivers eye position is generally considered to be 2.5m from the front of the vehicle. Most cars are less than 4.9m and only 1% are longer than 5.2m. On that basis, drivers will generally be able to obtain a line of sight through the verge without any fencing obstructing their view.

The diagram below shows a vehicle propped clear of the bicycle path. From this location, it can be seen that the driver would have around 1m of reversing space in which to establish sight to approaching bicycles. Actual sight distance will be a case by case situation for each private driveway as there are other factors to consider such as fence height, trees or other obstacles in the verge and varying depth of verge along Inkerman Road. This check represents a conservative assumption for a high fence that drivers cannot see through and the average depth of verge for Inkerman Road.

Sight-line are shown in purple based on the drivers eye position. This allows drivers to see approaching bicycles over 40m away from the conflict point. Cyclist safe stopping distance at 30km/h speed is 32.5m in dry conditions and 43.6m in wet conditions.



Neighbourhood Assessment

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Impact on traffic performance

Limited traffic modelling has been undertaken to understand traffic performance at this early stage of design. Detailed operational modelling to ascertain optimal signal operations and quantify the impact to traffic performance has not been undertaken, and is not typically recommended for a project of this nature, if at all, until there is a narrower definition of the preferred design solution.

Any further traffic assessment needs to consider the range of users apart from vehicles that will be impacted by the construction of the Inkerman Road SCC. Considerations of mode shift and traffic redistribution would need to be incorporated to ascertain the impact to traffic performance with any degree of certainty. The exercise to achieve this can become a large and comprehensive modelling process.

On a strategic level, the GECC ITS highlights the importance of promoting active travel and reducing vehicle trips in response to the local population and demand growth challenges to 2031. Considering Inkerman Road is designated a C2 cycling corridor, Inkerman Road in its existing state is underperforming relative to its objective and importance. To elevate its performance and meet the strategic intent requires a change to the priority given to traffic movement both along and across the competing corridors. In this context, there would be diminished value to be gained from a comprehensive modelling study.

Notwithstanding, what has been carried out at this stage is a comparative assessment by onemilegrid titled *Inkerman Road SCC - Project Traffic Network Impact Assessment* (March 2022). This assessment primarily focused on Option 1 and different permutations of the direction of traffic flow, suggesting the impacts will be more significant due to re-routing of demands related to the introduction of one-way sections. Naturally, it identifies that of the options tested, limiting one-way flow to Section 4 only (adjacent Caulfield Park) would cause the least tram delay to the Balaclava Road.

There will also be some impact to traffic capacity under Option 2 particularly as a result of the reduced flaring of intersection approaches. Future modelling and assessment would need to be undertaken in consultation with DoT, with respect to wider network objectives and performance as opposed to in isolation as a traffic performance exercise.

Impact on public transport

The analysis undertaken by One Mile Grid presents a view for Option 1 that traffic currently using Inkerman Road would be largely displaced onto the immediate network including Balaclava Road, where the tram route is shared with traffic rather than operating within a dedicated right of way. Naturally, this increase in demand would have a potential to create delays to trams, if unmitigated.

While noting the risk of impacts on Balaclava Road, it is possible that traffic demand could be displaced much more broadly than anticipated by the modelling. Further, the modelling does not recognise the cumulative impact that mode shift and increasing cycling uptake could have on broader network demands. It should also be recognised that Option 2, while not modelled, may also displace some traffic demand due reduction of turn lanes at intersections and less efficient signal operations for traffic movement which would have a similar pattern of impact on public transport performance in the surrounding area albeit to a much lesser extent.



Neighbourhood Assessment

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Local area Traffic impacts of one way traffic

For Corridor Option 1, the alteration of traffic to one-way only westbound may induce increase in the use of local streets to access locations on Inkerman Road for vehicles approaching from the west. GECC's Integrated Transport Strategy 2018-2031 and Street Design Guidelines (August 2022 Draft) detail examples of traffic calming strategies that may be applied to mitigate the risks associated with increased use of local streets and redirect traffic to the arterial road network. Introduction of traffic calming measures in these streets also align with GECC's Integrated Transport Strategy that outlines intentions to introduce traffic calming to local streets to achieve the objective of creating child friendly neighbourhoods.

Section 2 (Orrong Road to Kooyong Road)

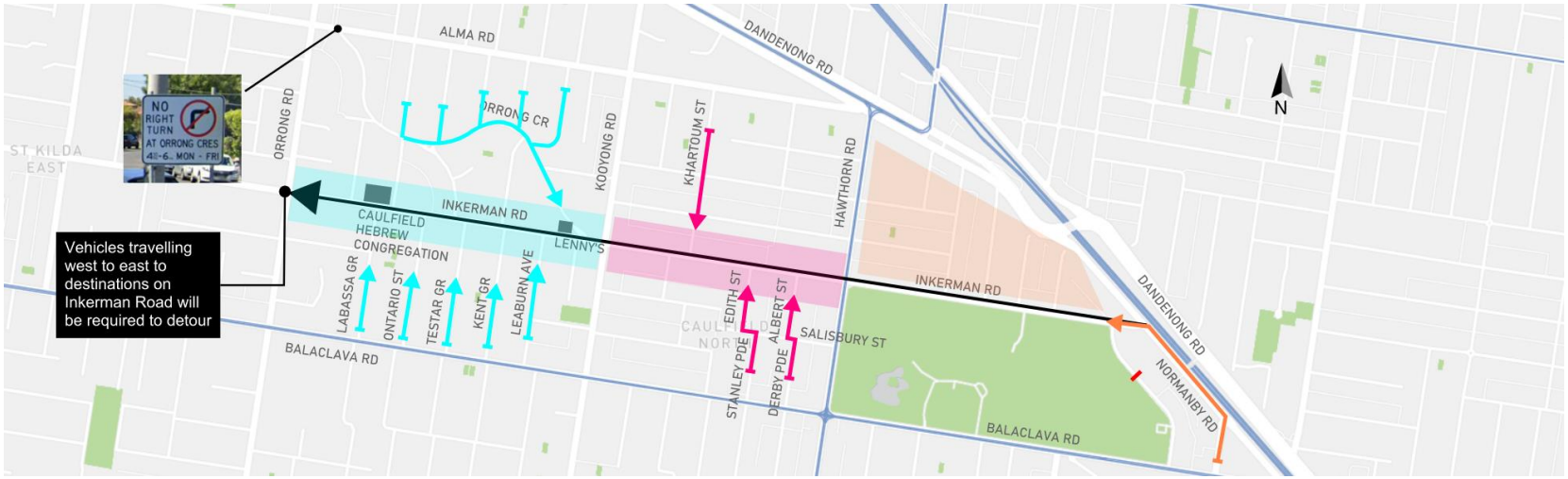
On the north side of Inkerman Road, Orrong Crescent is likely to be used for through movements as it provides both north-south and west-east connectivity. The Orrong Crescent intersection with Alma Road contains a 'no right turn' during peak times restriction currently, however local streets further east may also be used to access Orrong Crescent onto Inkerman Road.
On the south side, there are several streets that provide direct through connection from Balaclava Road to Inkerman Road that may be used for through traffic .

Section 3 (Kooyong Road to Hawthorn Road)

Khartoum Street is a likely candidate for prioritised traffic calming if Inkerman Road is altered to one-way traffic. This street is the only north-south through connection for this section of Inkerman Road and is likely to attract through traffic. South of Inkerman Road, Stanley Parade/Edith Street and Derby Parade/Albert Street are likely local streets that may be used to access Inkerman Road from Balaclava Road.

Section 4 (Hawthorn Road to Normanby Avenue)

North of Inkerman Road, local streets are unlikely to be used for through traffic as the local streets in this section cannot be accessed by right turn from Dandenong Road. South of Inkerman Road, Park Crescent is currently truncated mid-way preventing through movements. Normanby Road is the only other access to Inkerman Road and would not require traffic calming as it serves a movement purpose as opposed to a local residential street.



Inkerman Road Corridor Plan 46

Neighbourhood Assessment

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Placemaking

Both options, and particularly the one-way traffic option could provide opportunities for urban design activation and placemaking. Activation places would be general points of interest or locations nearby the proposed pedestrian crossings, where some further road space could be converted for other purposes. This could include seating places to gather, street trees for aesthetic and shelter/cooling benefits, or integrated as part of a water sensitive urban design feature. Other treatments such as the shared zone adjacent Caulfield Park (bottom left) would provide a major improvement to the identify of the street and place, and generating a sense of improved cross-corridor freedom of movement for pedestrians and traffic calming.

The example initiatives to the right have been developed by GECC's urban design team. These opportunities have not been incorporated within the corridor designs or parking analysis, however could be readily integrated, in some cases with a loss of some further parking.

Examples of Urban Design Placemaking Opportunities (Source: GECC)









4.3 | Feasibility Assessment

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Feasibility Assessment

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Alignment with network planning objectives

Strategic Cycling Corridor

The design approach for Inkerman Road is well aligned with the objectives of a C2 Strategic Cycling Corridor, providing a safe, direct, connected and integrated facility.

The re-allocation of road space on the corridor to prioritise active transport and micromobility at the expense of traffic speeds or parking supply on a 'C2' cycling corridor is considered to be well aligned with the Department of Transport's Movement and Place framework. The Inkerman Road corridor has the second highest significance for cycling, and by comparison has the second lowest importance 'general traffic rating' of 'GT4'.

In terms of the key trade-offs between Options 1 and 2, the choice is effectively between more on-street car parking (Option 1) or better vehicle circulation (Option 2). The impacts on car parking supply are considered under 'neighbourhood', as those changes will primarily impact on an individual and local level.

The broader network planning objectives should also be considered, noting that both options could potentially impact tram performance.

Two areas of potential impacts outside the Inkerman Road corridor include:

- Tram travel times and service reliability along Balaclava Road, due to the affects of displaced demand from Inkerman Road onto parallel east-west routes (further discussed on page 49), and
- Potential local impacts on tram function north-south along Hawthorn Road, as a result of traffic signal operation changes at the Inkerman Road/Hawthorn Road intersection.

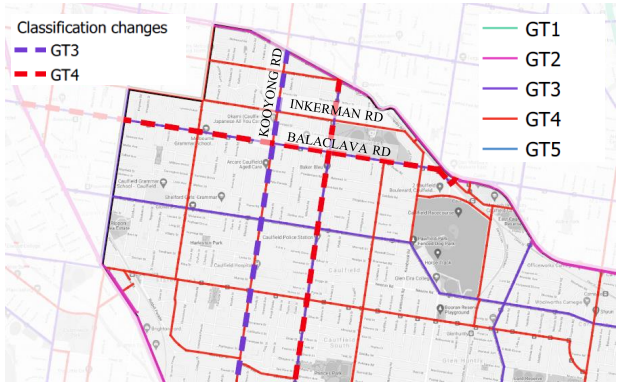
Active transport demand

One query arising in community consultation was regarding how many people might use the proposed facility, in order to quantify the 'return on investment'. Predicting overall mode shift and uptake of usage is a very challenging process as it will depend on a variety of factors including the level of safety that it provides. The increase in demand is likely to come from a number of sources including re-routing, new people cycling of a greater variety of ages and ability, and general population growth, both within and in the vicinity of Glen Eira.

A study by CDM Research was completed to attempt to estimate the magnitude of bicycle demand for the project (Technical Note by CDM dated 16 August 2022). It acknowledged the exceptionally difficult nature of modelling bicycle demand, however estimated a range of 500-900 bicycles per day could use the Corridor - two to three times higher than in 2019, in addition to additional e-mobility users, especially e-scooters and e-skateboards. A wide range of factors will contribute to future demand, including the relative attractiveness of cycling with measures such as parking management will increase the likelihood of actual future demand toward the upper margin of estimates.

It is noted that the GECC ITS contains many of the complementary actions suggested by CDM in tandem with the introduction of Safe Cycling Streets to achieve its mode shift targets.

The design process has proceeded without a set assumption on the number of bicycle riders. Notwithstanding, unlike the design of major roads or highways, the design of active travel facilities is less strictly defined in terms of demand vs. capacity; and is more concerned level of comfort, convenience, health and wellbeing. In addition, many benefits are tied to social and environmental outcomes as well as productivity of the overall transport system.



General traffic (GT) classifications under Movement and Place. GT1 is the highest priority for traffic, whilst GT5 is the lowest priority. Inkerman Road is currently allocated a GT4 classification. Balaclava Road has recently been changed to a GT4, and Kooyong Road to a GT3.

Feasibility Assessment

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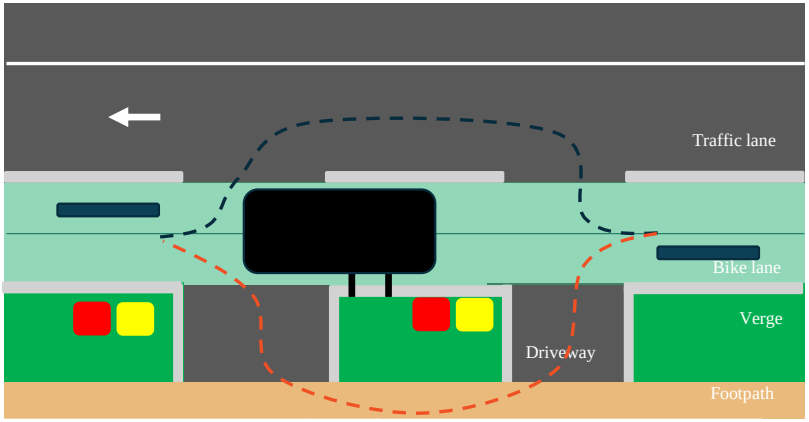
Servicing and emergency access

Section 1
(protected one way bike lanes)

For kerbside rubbish collection (once a week), GECC contractors have indicated that a minimum 3.5m road width is required on the bicycle lane side of Inkerman Road for side-arm loaded waste collection. An effective 3.5m width will be achieved based on formal lane widths plus part of the unoccupied width of the 2.6m parking lanes. Two person crews will transfer bins across the path and separator kerb.

Option 1 (One-way)

Under Option 1 (one-way traffic), side-loading waste collection will need to be modified in order to carry out rubbish collection on the north side of the road. It would be expected that a change to rear-loading waste collection would be needed. There would be limited impacts on the residents. This model may be more efficient for contractors, given that the crew could service both sides of the road at once.



Legend

Detour via road

Detour using driveways and footpath

Option 2 (Two-way)

For Option 2, rubbish collection could continue a side-arm loading collection process, with vehicles travelling within the bi-directional bicycle facility. It is understood that collection occurs once weekly on weekdays and typically outside of peak commuter hours, early in the morning.

Safety risk to people cycling is considered manageable due to the low speed nature of rubbish collection, and expectation that existing safety controls such as appropriate warning lights on rubbish trucks will remain as existing or be enhanced as needed. Waste collection should be scheduled for quiet times to minimise conflicts, as some awareness of people cycling will be required when collections are occurring. Any infrequent people cycling using the facility during waste collection hours may be required to detour around rubbish trucks if they happen to use the facility while rubbish collection is occurring (as shown to the left). This can occur via the breaks in the separator for driveway access and the traffic lane. Less confident people cycling may choose to dismount and make use of driveways and footpaths instead of the traffic lane.

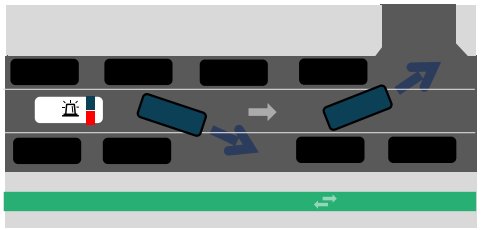
Street Cleaning

For street cleaning, street sweeping vehicles would be able to service the path from within the bi-directional bicycle lane, given the street cleaners 2m width + 1.25m brush extension. New arrangements may be required in Section 1.

Emergency Access

A suitable level of resilience needs to be available as part of the road design to enable vehicles to give way for passing emergency vehicles. In both options, vehicles can manoeuvre into available parking spaces or driveways to allow emergency vehicles to overtake (see figure below). All roads are subject to congestion which can affect emergency vehicles. At this stage, it is unclear which option would be susceptible to a higher degree of access delay.

Option 1 emergency vehicle access scenario



5 | Summary

A summary of the key differences between Corridor Options 1 and 2 and possible next steps.

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Summary of Assessment

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The Corridor Options have been developed through a technical design process. They have been assessed through independent reviews focusing on traffic and safety performance, as well as via community and stakeholder consultation process. Based primarily on the technical design and reviews carried out by Arup, the key differences are summarised below.

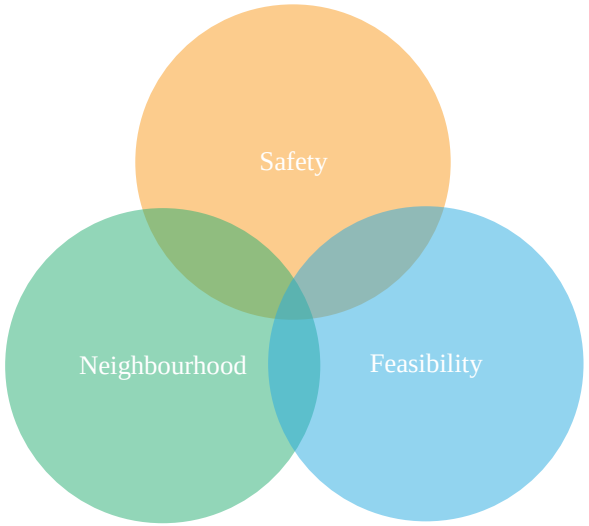
For Corridor Option 1, a significant differentiator is the ability to retain a greater supply of car parking. This requires an inherent trade-off of a one-way system with less direct access and circulation to/from Inkerman Road with one-way traffic (including changes to local access for properties along or in the streets connected to Inkerman Road). A side-effect of the prevalence of parking on both side is that it can act as a potential barrier to sight-lines between modes of travel at driveway crossings, limiting the degree of safety benefits achieved. In other areas of the design however, such as side-roads, the safety outcome is enhanced with a greater degree of pedestrian and cyclist priority achieved at the raised side-road treatments. These treatments would come at some expense and may involve other risks such as underground services being affected during construction. Option 1 is generally considered a greater opportunity to change the character of the streetscape. The visually tighter streetscape and side-road treatments offer landscape design opportunities, and may result in a slower speed environment as well as a reduction in through traffic which will enhance the local character of Inkerman Road (e.g. reduced road noise). The change to a one-way corridor has broader transport network implications and carries greater approval risk, in particular due to displacing traffic toward Balaclava Road and subsequent tram delays if not mitigated.

For Option 2, parking is only retained on one side of the road. On-street parking would be retained at key destinations on the north such as Lenny's store and the Caulfield Hebrew Congregation. While an overall parking deficit of around 120 spaces would result, the degree of demand required to be absorbed into a single side-road would be relatively modest, particularly if there is a shift in parking behaviours, such as increased uptake of on-site parking or reduction in car use.

The limited parking under Option 2 has a resultant safety benefit in that parking would not obstruct line of sight to bike riders at driveways. A limiting factor to the safety improvements achieved is the limited priority at side roads, given that there is insufficient space to achieve a 'raised' side road priority treatment outside of Section 1.

In Option 2, Retaining two-way function of Inkerman Road as a priority over car parking supply, implies a higher through-traffic function. At some intersections, reduced flaring of approaches and changes to signal phasing may require mitigation via right turn bans in some locations. However, tram performance impacts would be expected to be minor.

In contrasting the Corridor Options, it is evident that the selection of a preferred option will ultimately require some trade-off of transport objectives, including parking, public transport performance, local circulation, safety, constructability and risk.



Next Steps

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Outstanding matters for the next design stage

Following any decision to proceed with a preferred design option, the following matters should be further progressed:

- **Design Speed**: While in-principle agreement has been obtained on the reduced 40km/h speed limit on Inkerman Road via the Technical Reference Group, any speed limit change in Victoria requires ministerial approval. The viability of obtaining this agreement should be reconfirmed in future design stages.
- **Sight distance at Underpass to Dandenong Hwy**: Given the existing crash history and safety/operational issues at the underpass, further consultation with DoT should seek to explore alternative solutions including signals or partial closures in conjunction with the preferred design option if/when known.
- **Underground utilities**: There are existing sensitive utilities alignments underneath the bicycle path and zone of traffic separator. Once the preferred option and construction methodology is known, commence consultation with service authority following completion of the Corridor Plan. In the interim, Council should consider a flexible approach to the type of separation provided (e.g. options with shallow embedment depth including consideration of bolt-down kerbs).
- **Mitre 10 crossover changes**: Both options consider the possible realignment of existing crossovers to Mitre 10, from being accessed from Inkerman Rd currently to being accessed from Normanby Road in future. GECC to consult property owners as part of public consultation on the Corridor Plan.
- **Design and checking vehicles at side-roads**: A process will be required to determine the exact design vehicle and checking vehicle sizes to be adopted in refining the geometric design of side roads. A classification count of the frequency of different sizes of vehicle may help inform this design decision.
- **Normanby Road tram stop**. GECC should continue to liaise with the Department of Transport to confirm the design interface and staging of delivery for the Normanby Road tram stop upgrade. As highlighted in previous design options, this will need to consider the reclassification of Normanby Road, which is currently part of the B-double network.
- **Safety Review Close-out:** Upon commencement of the next design stage, a register of the Independent Safety Review recommendations should be developed, with a response and close-out any recommendations via GECC.

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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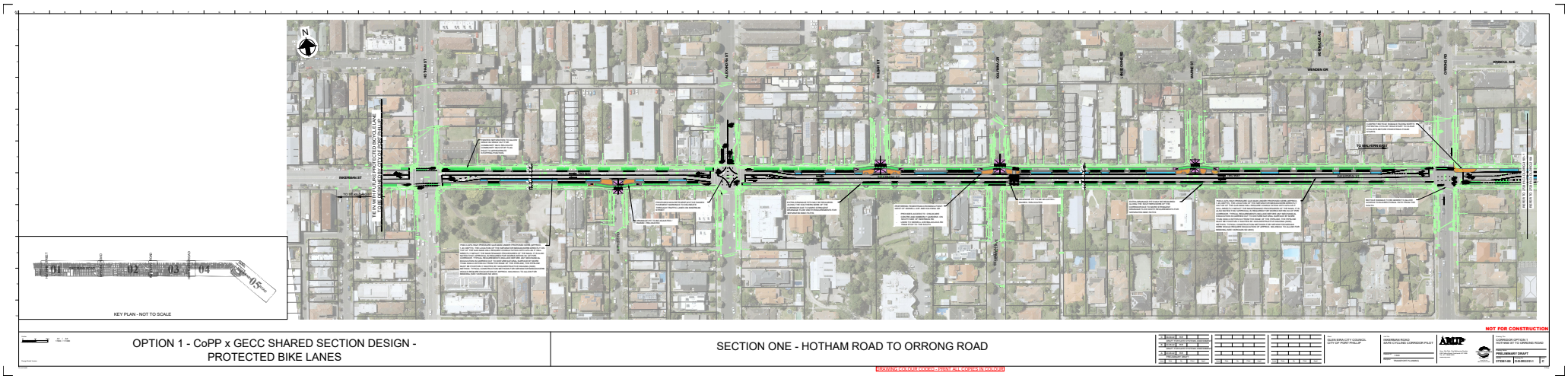
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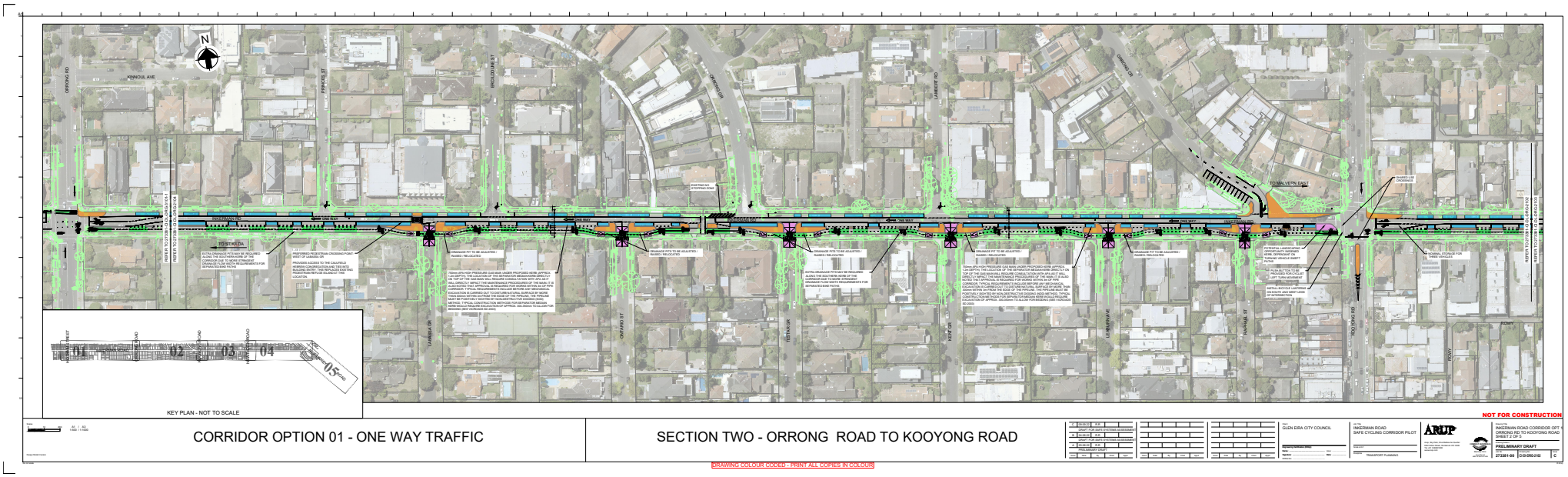
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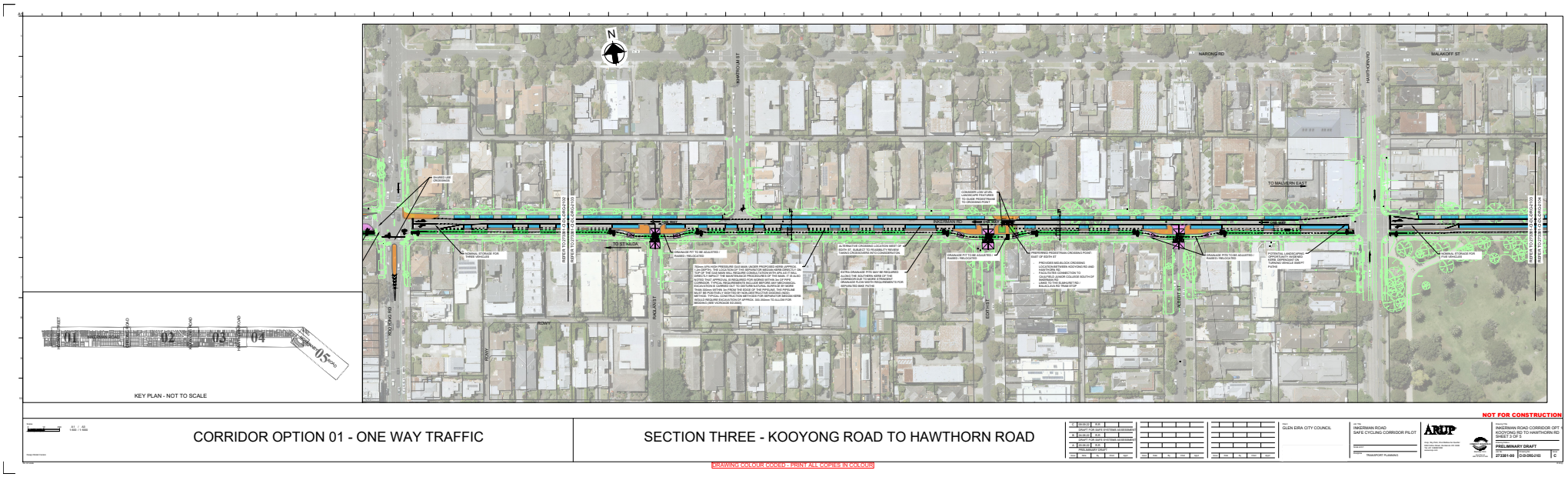
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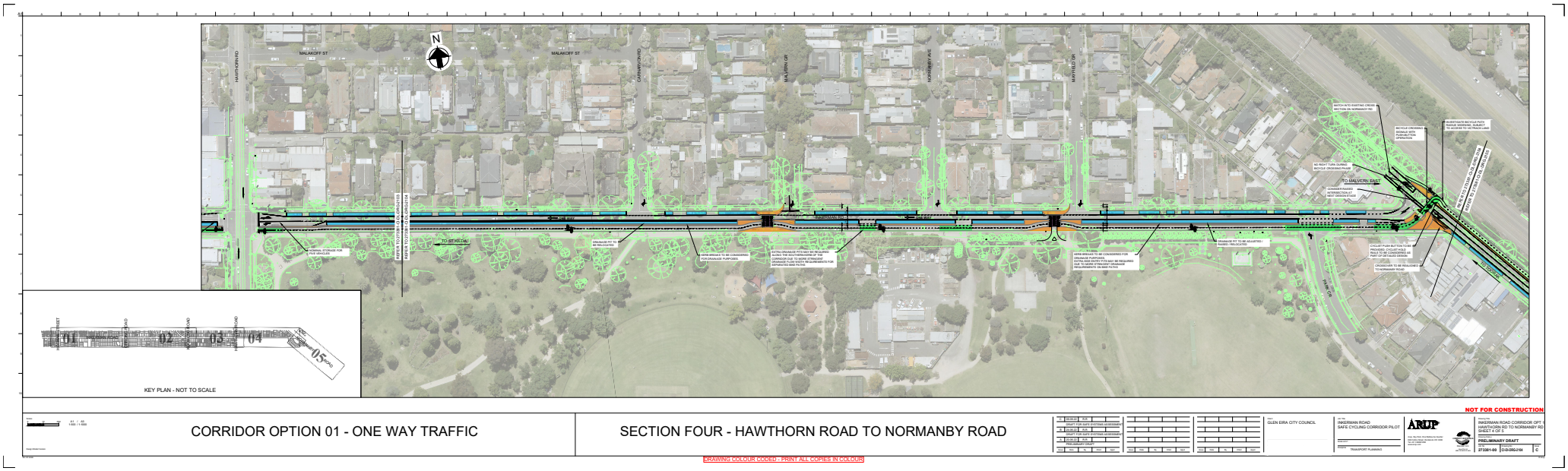
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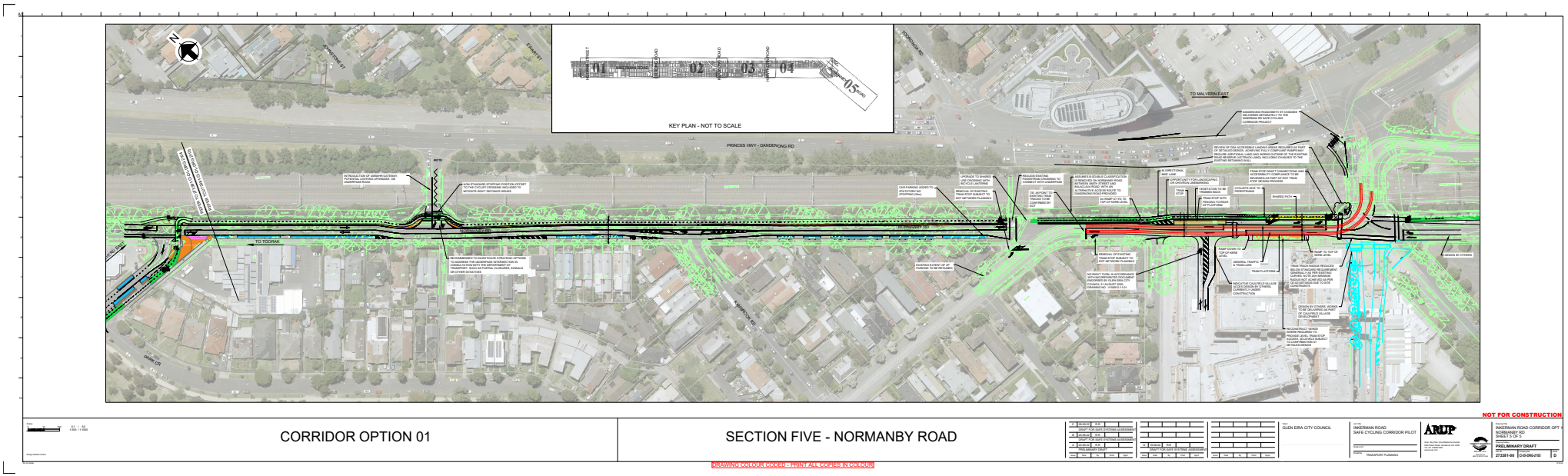
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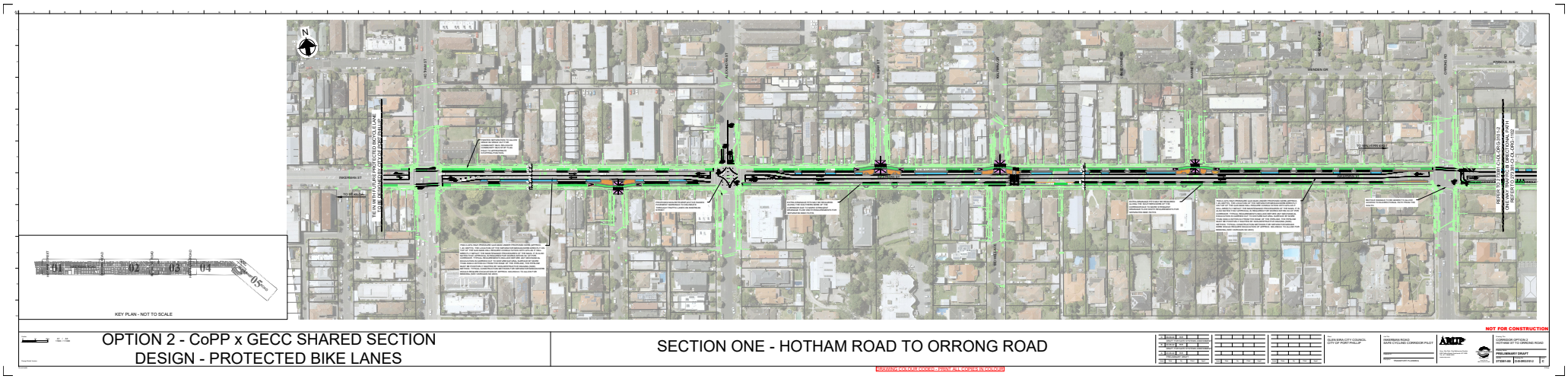
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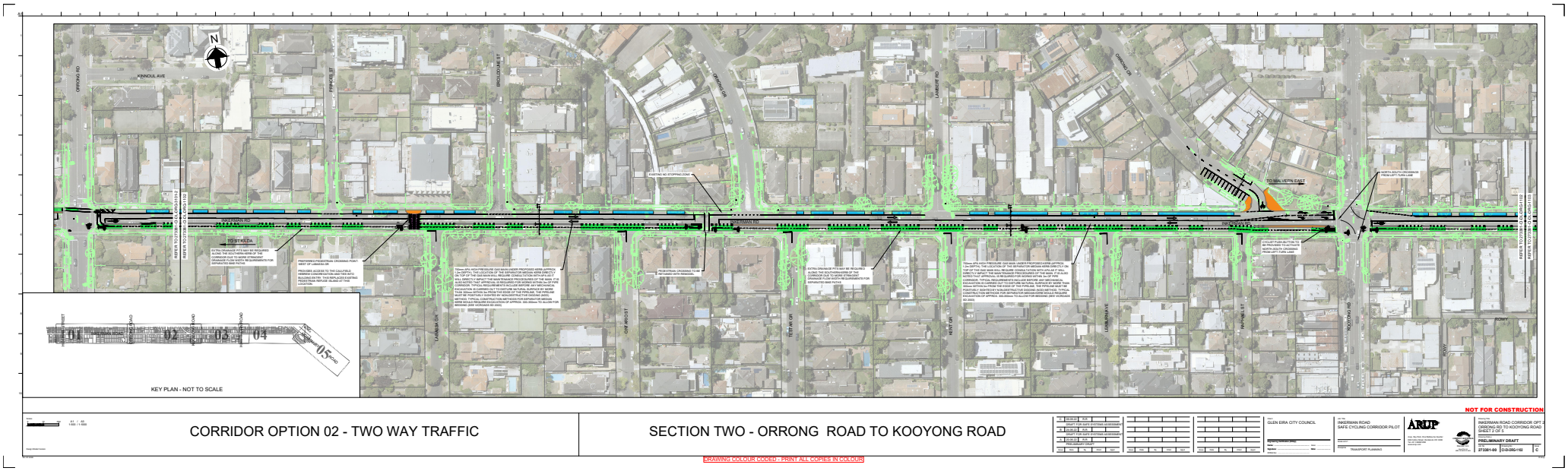
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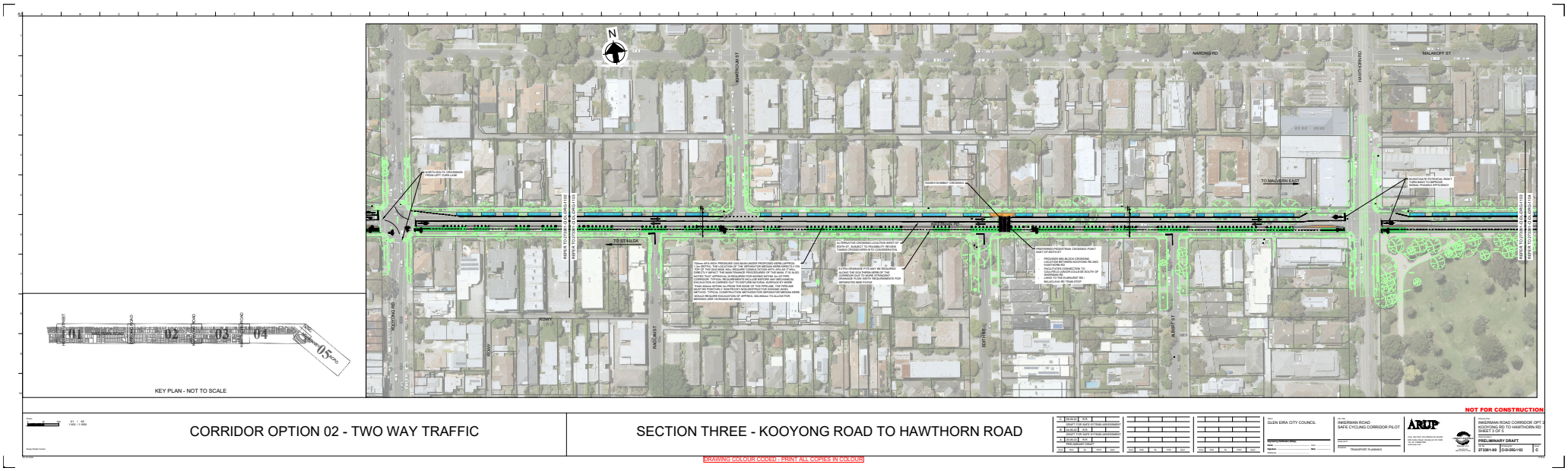
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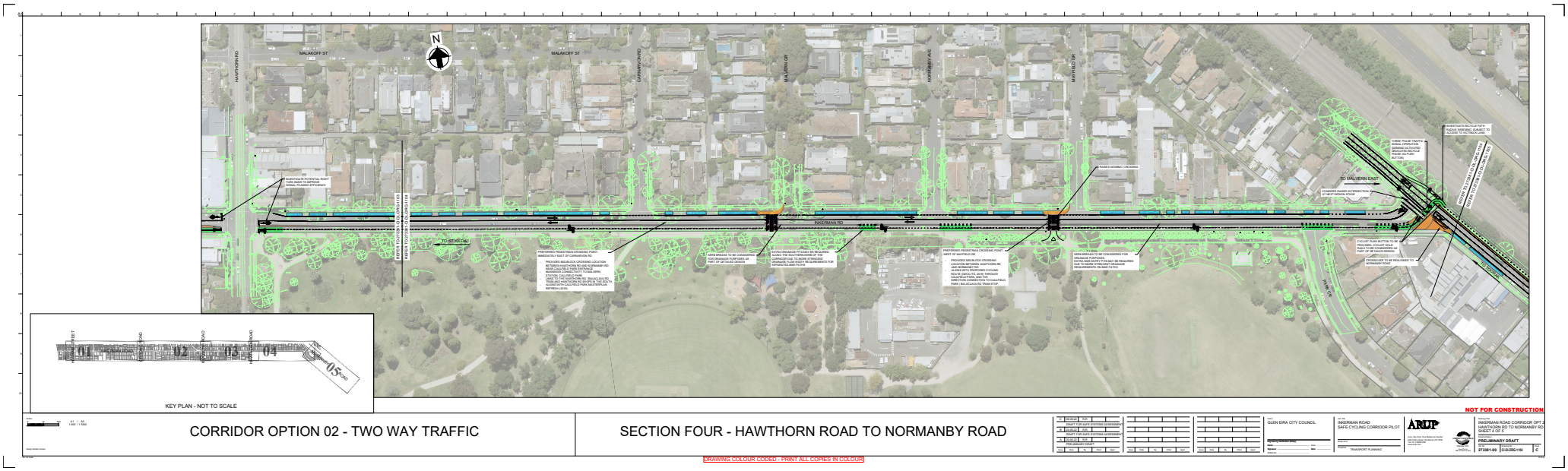
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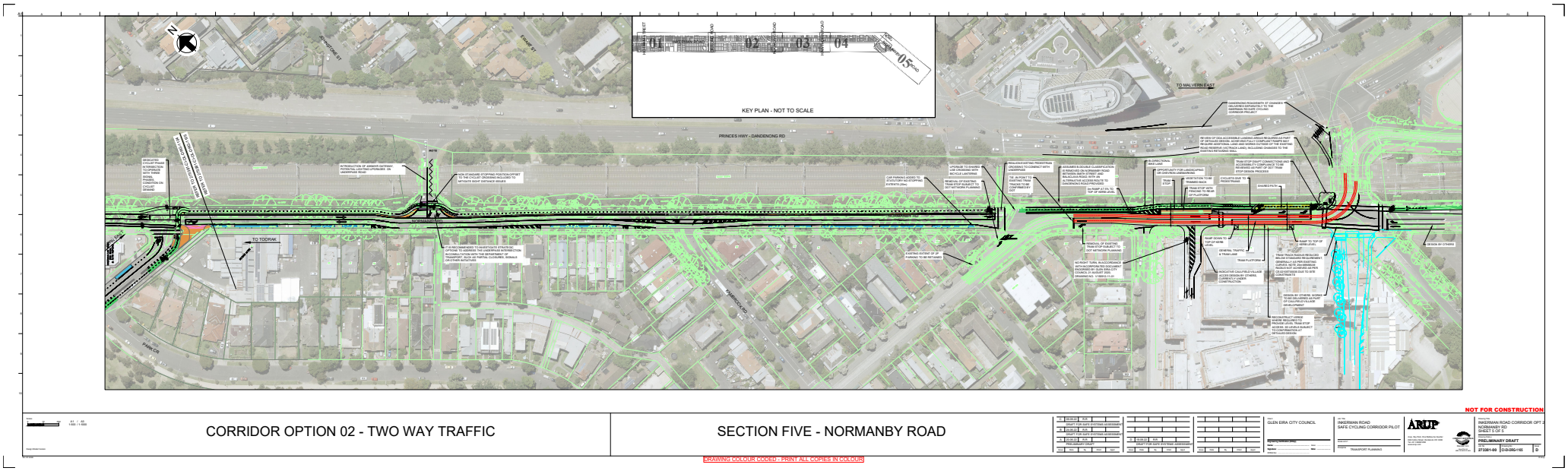
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SAFE CYCLING CORRIDOR PILOT
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TECHNICAL NOTE

To	City of Port Phillip, Glen Eira City Council	**Date**	16 August 2022
From	C. Munro	**Project No.**	0186
Subject	Cycling demand estimates for Inkerman Street		

Executive Summary

The proposed cycling corridor along Inkerman Road and Inkerman Street[1] would connect the Djerring Trail and committed St Kilda Road protected bicycle lane. The latter is expected to be completed by 2025 subject to approval of the business case. Proposals for a bike riding corridor includea buffered bicycle lane and physically protected bicycle lanes within the road reserve. Two empirical methods have been used to estimate the likely magnitude of cycling demand should the project be constructed:

1. **Comparison method:** analysis of observed counts from similar cycling projects in Victoria, Queensland and Western Australia.
2. **Uplift factors:** current demand along Inkerman Street is expanded by uplift factors derived from intercept surveys of bicycle riders at completed cycling projects across Australia.

The comparison method suggests demand could be around 900 riders on an average weekday, while the uplift method suggests demand closer to 500 riders per day towards the (busier) western end of Inkerman Street to the west of Hotham Street. These estimates are significantly larger than demand observed in 2019, which varied from around 150 riders east of Hawthorn Road to 330 riders per day in the west.

No credible approach to estimating the likely difference in demand between buffered and protected bicycle lanes could be established. In lieu of providing specific demand estimates for each of these scenarios it is suggested buffered lanes may result in demand towards the lower end of the 500 – 900 riders per day range. This can be substantiated by the stated preferences of potential riders; surveys of Melbourne residents who are interested in riding for transport, but do not currently do so, indicate that 80% of this group feel comfortable riding on protected bicycle lanes compared to only 46% on buffered bicycle lanes. It follows that protected bicycle lanes will be more attractive to a wider cross-section of the population than buffered bicycle lanes, such that users would be more representative of the wider community.

The likelihood that demand would fall towards the upper end of the range would increase with high quality connections to the Djerring Trail and St Kilda Road, as well as complementary actions such as improvements to the local street network in the form of bicycle lanes, street calming, speed limit reductions and filtered permeability.

[1] Inkerman Road changes name to Inkerman Street west of Orrong Road. For simplicity in this report the full extent of the road from Normanby Street to Nepean Highway is referred to as Inkerman *Street*.

1. Introduction

The City of Port Phillip and Glen Eira City Council are proposing an upgraded cyclist connection from the current western end of the Djerring Trail at Caulfield to the St Kilda Road protected bicycle lane (completion committed by 2025 to align with opening of ANZAC station). The route would extend along Inkerman Street over a distance of around 4.3 km. The proposed bicycle route may consist of either painted, buffered on-road bicycle lanes or physically protected bicycle lanes in the road reserve. The purpose of this analysis is to provide estimates for the likely quantum of cycling demand that will occur along Inkerman Street should the project proceed.

2. Caveats

There is no widely accepted methodology for projecting cycling demand in Victoria, Australia or internationally. Even in countries with very high cycling demand such as the Netherlands and Denmark, cycling is only crudely incorporated in strategic transport models and rarely are models used to estimate demand for developing business cases for cycling projects. Cycling demand will be heavily influenced by the attractiveness of alternative modes of travel (mainly car and public transport), land use changes, demographic shifts and cultural attitudes towards bicycle riding. None of these can be readily forecast. As such, it is necessary and pragmatic to use multiple empirical methods of infer a *range* of likely demand.

The COVID-19 pandemic has severely impacted travel from around April 2020 through to the time of preparation of this analysis. It is unclear when, and whether, travel demand will return to pre-pandemic levels. It is conceivable that, should the pandemic persist, there will be a medium- to long-term impact on public transport demand which may encourage riding substitution. Conversely, work-from-home trends may suppress commuting travel which would have a disproportionate effect on travel towards the Melbourne CBD. Given the impossibility of predicting these outcomes it is assumed herein that travel will, over the medium term[2], return to levels similar to those observed in 2019 immediately prior to the pandemic. If this assumption were to prove invalid it is not clear that the demand estimates are biased – as noted above, there are many conceivable means by which cycling demand could be *higher* or *lower* along Inkerman Street as a result of pandemic-induced changes in travel patterns.

3. Methodology

Given the lack of credible cycling demand forecasting methods, the methodology adopted in this note was to use two independent, pragmatic and transparent empirical methods:

1. **Comparison method:** identify rider counts from other locations that are of a similar context to Inkerman Street, and report estimates as a range with a central estimate, to be explicit about the uncertainty.

[2] By “medium” term we are suggesting around five years hence, or around 2025 to 2027.

2. **Uplift factors:** Apply uplift factors to existing counts on Inkerman Street using post-construction intercept surveys undertaken as part of other cycling infrastructure projects.

Neither of these methods, and indeed any other method, should be considered to provide a definitive guide as to future demand. Instead, it is recommended that such methods be used to provide only an *indication* as to the range of plausible demand. It is conceivable demand could fall outside this range, but it is suggested values far outside this range would be improbable. In this context results presented in this note express a range of values and a confidence interval.

4. Current demand

This analysis was prepared in mid-2022. For much of the previous two years travel along the corridor has been significantly impacted by the COVID-19 pandemic. Any counts in that period, for any mode, would be unrepresentative of the pre-pandemic period and *may* not be representative of future demand. As such, the base demand was taken from the immediate pre-pandemic period and consisted of two rounds of counts conducted in November 2018 and May 2019. The counts were aggregated to the immediate *west* of major intersections and are shown in Figure 4.1.

Current weekday cyclist demand on Inkerman Street varies from around 140 riders per day in the easternmost section to around 300 riders per day in the western sections. There was reasonable alignment between the two rounds of counts east of Orrong Road, but the counts from November 2018 are significantly lower than in May 2019 between Orrong Road and Chapel Street.

The November 2018 counts covered a slightly shorter time period (7 am – 7 pm) than the May 2019 counts (6 am – 7 pm). Analysis of 41 VicRoads automatic cyclist counts suggest 3.6% of cyclist traffic on weekdays in 2018 was during the hour starting at 6 am. The 2018 counts were thus expanded up by this amount to compensate for the time period differences. Further analysis of the automatic counter data indicated that the three November 2018 survey days had 12% lower demand than average for that year. Similarly, on Tuesday 28 May 2019 demand was 8% lower than the annual[3] average. Hence, in the subsequent analysis the 2018 counts (red in Figure 4.1) are expanded by a factor of 1.036 x 1.136 = 1.177 and the 2019 counts are expanded by a factor of 1.087. Averaging the seasonally adjusted counts gives an annual average daily cyclist estimate of 152 riders per day in the eastern section from Kooyong Road to Hawthorn Road and 295 riders per day in the western section from Hotham Street to Chapel Street.

[3] "Annual" refers to the calendar year in this analysis.

City of Port Phillip and Glen Eira City Council
Inkerman Street bicycle demand estimates
16 August 2022

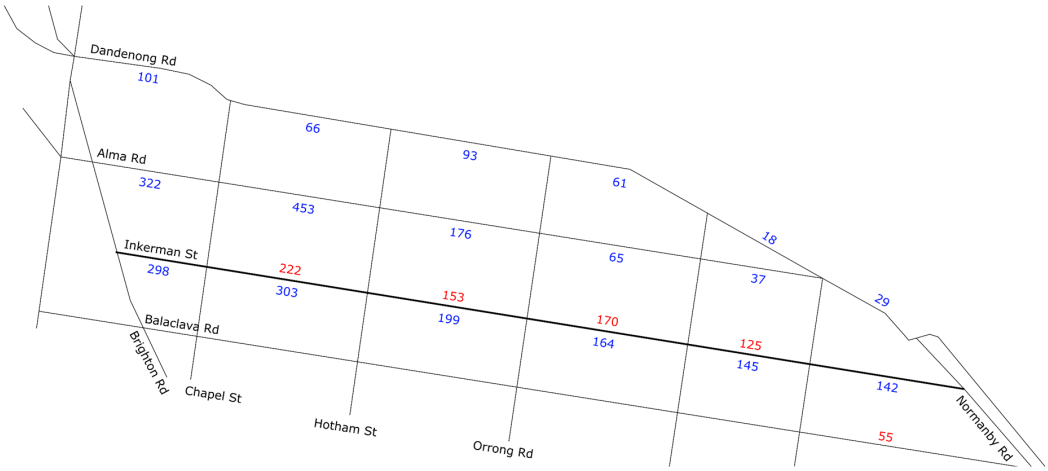

Figure 4.1: Existing cyclist counts (blue are Tue 28 May 2019 6 am – 7 pm and red are Tue 13 Nov – Thu 15 Nov 2018 7 am – 7 pm)

5. Comparison method

Cyclist counts vary markedly across seasons and across days due to sensitivity to weather. This variation is much larger at locations with a high proportion of recreational riding. As a result, the most reliable counts are taken over extended periods of, at least, several weeks and ideally permanently. For this analysis only counts data from permanent (automatic) counts were used. VicRoads maintain a network of automatic counters, mainly on off-road paths, but also on on-road protected bicycle lanes (e.g. Wellington Street, Collingwood) and on-road painted bicycle lanes (e.g. Royal Parade, Carlton and St Kilda Road). Some counters are also owned and maintained by local governments, including several on residential streets in the City of Darebin. In other jurisdictions Main Road Western Australia (MRWA), Queensland Department of Transport and Main Roads (QTMR) and Brisbane City Council (BCC) also maintain an extensive network of automatic bicycle counters. Sites were arbitrarily selected from each jurisdiction based on the following broad criteria:

- The site was located in the inner or middle metropolitan area (but not the CBD)
- The site is along a reasonably well-connected cycling corridor (usually a shared path, but occasionally an on-road bicycle lane or mixed traffic local street).

This screening provided 22 sites, for which average daily cyclist demand was calculated for 2019 (i.e. the last full year prior to the pandemic). This demand is shown in Figure 5.1; demand varies from 128 riders/day along the Christmas Street Shimmy in Northcote to around 2,500 riders/day at Canning Street and Royal Parade in Carlton. Most sites are in the range between 500 and 1,000 riders per day. The data was then trimmed of the three extreme outliers (Christmas Street, Canning Street and Royal Parade) on the basis that contextually they least represent the Inkerman Street corridor. The average daily demand among the remaining 22 sites is 896 riders per day (95% CI: 712 – 1,080). It is difficult to further narrow down among this range given the varying contexts and unknowns with regard to how well the

proposed Inkerman Street corridor will be connected to the existing and committed projects at either end and, for example, whether the corridor will feature painted buffered bicycle lanes or protected lanes. Nonetheless, this data would suggest demand is unlikely to be below 500 riders per day and would only exceed 1,000 riders per day if the corridor were of very high quality and there are associated demographic and cultural shifts towards riding.

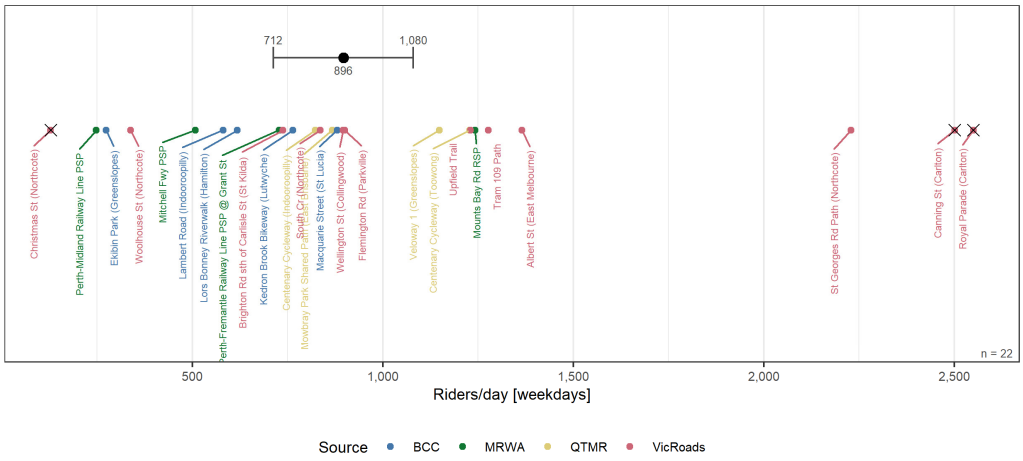

Figure 5.1: Comparison sites

6. Uplift factors

Intercept surveys after completion of cycling infrastructure projects provide insight into the change in behaviour these projects elicit. Post-construction surveys undertaken of projects in Victoria and Queensland over the past ten years bicycle riders asked bicycle riders how they would have made the trip prior to the project being completed[4], and/or what they would have done if the project were not constructed. For this analysis responses were categorised into one of four categories:

- **Induced:** all-new trips that have occurred by bicycle which the respondent indicates would not have occurred in the absence of the project.
- **Reassignment:** cycling trips that would have occurred irrespective of the project, possibly using another route.
- **Car shift:** trips that have mode shifted from private car (as driver or passenger), motorcycle or similar motorised vehicle to bicycle.
- **PT shift:** trips that have mode shifted from public transport to bicycle.

The proportion of riders who indicated they only made this riding trip because of the project is shown in Figure 6.1. There is a wide variation in this induced demand, from no induced

[4] The surveys were conducted from three months to two years after the projects were completed.

demand up to just over half of riders indicating they would not have ridden were it not for the project. In general, those projects that are predominantly recreational and are located along scenic routes (e.g. parks, shorelines or rivers) that do not offer direct routes to destinations such as workplaces, education or retail have *higher* induced demand. Projects such as the Redlynch Path and Goose Ponds Creek path fall into this category. In the context of Inkerman Street the proportion of induced demand is likely to be modest given the built-up urban context which, it is assumed, will tend to lead to a higher proportion of transport trips. Overall, the data would suggest that for major projects along corridors where there was no pre-existing connection (e.g. a new bridge, shared path through a park) the induced demand can exceed 20% but for more modest projects, and those along pre-existing corridors such as Inkerman Street, induced demand will account for less than 15% of demand.

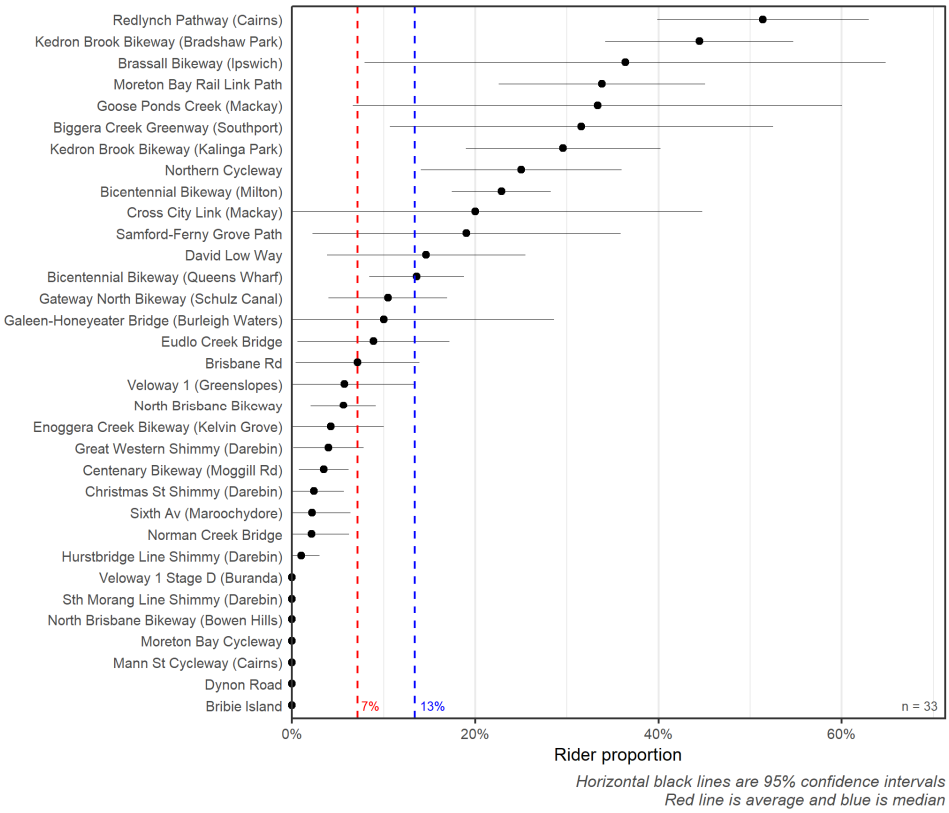

Figure 6.1: Induced demand estimates from intercept surveys

Cycling trips that would have occurred irrespective of the project account for the majority of demand for most projects (Figure 6.2). On average, around three quarters of riders using a new cycling infrastructure project would be expected to have been riding regardless. In other

words, after construction most bicycle riders using a project would either (a) have ridden on the corridor anyway, or (b) ridden somewhere else.

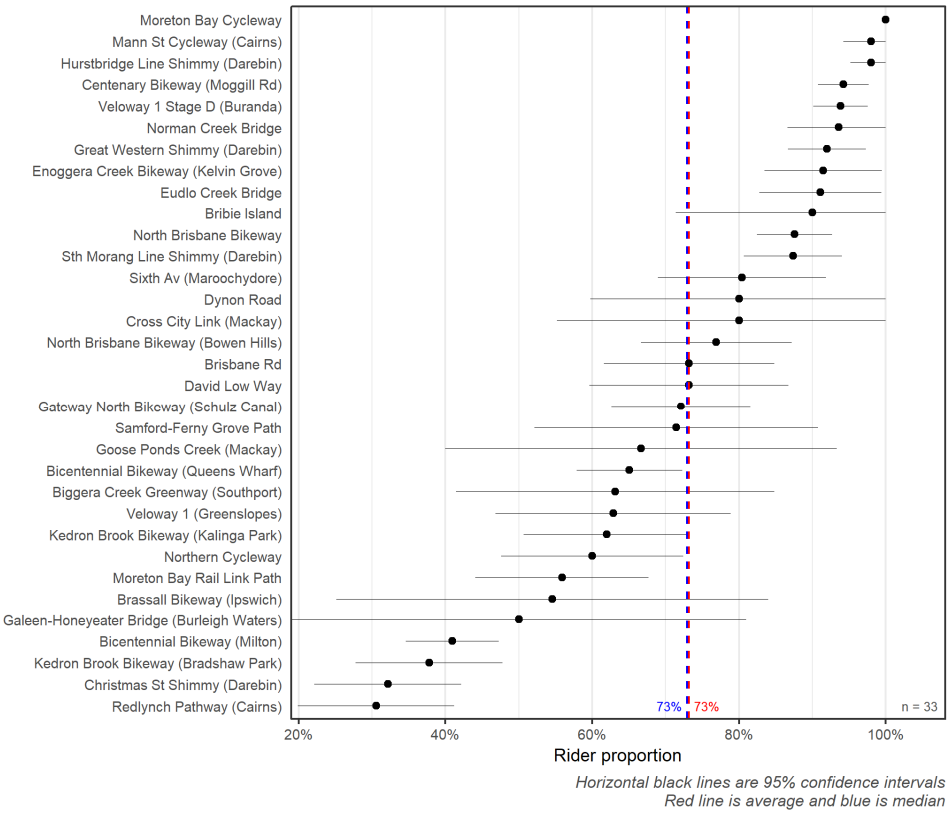

Figure 6.2: Reassignment from intercept surveys

From the 33 sites for which intercept survey data is available eight sites involved a project along an existing corridor; that is, an addition of bicycle lanes or protected bicycle lanes to an existing roadway. This is analogous to the Inkerman Street proposal. Of these eight sites, on average 67% of riders were riding on the corridor prior to the project and a further 17% had diverted from another route (Figure 6.3). It is notable that the reassignment from other routes is generally modest, and lower for those projects that involved modest improvements. Mann Street is an outlier, with high diversion from other routes. This may be explained by the quality of the project (a bi-directional shared path running alongside or within the road reserve) and the proximity to a major arterial road for which Mann Street is an attractive substitute route. The other projects consist of relatively short sections of shared path (Bribie Island), on-road painted bicycle lanes (Sixth Avenue) or shared local roads with wayfinding, sharrows and traffic calming (the four shimmy projects in Darebin).

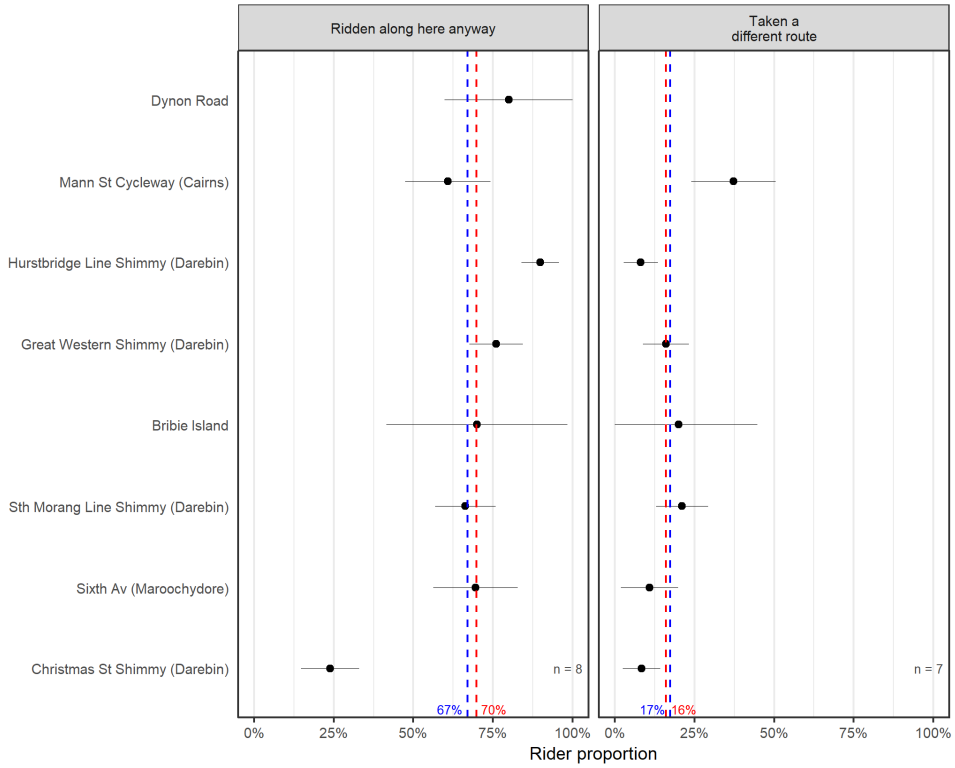

Figure 6.3: Reassignment from projects where there was a pre-existing corridor

The proportion of riders using a new cycling project that would otherwise have driven a car (or been a passenger in a car) varies from zero to 30%, with an average of around 6% (Figure 6.4). Similarly, the proportion of riders who shift from using public transport is almost always under 20%, and usually under 10% (Figure 6.5). In considering these proportions, and especially public transport shift, the relative attractiveness of these modes is central to the expected left of shift. For example, in a regional or rural setting with limited or no public transport there would be negligble shift from public transport. In an inner city location where congestion and parking reduce the attractiveness of driving the car shift may be significant. Given the Inkerman Street corridor is well serviced by public transport it is is suggested the shift from public transport could be significant.

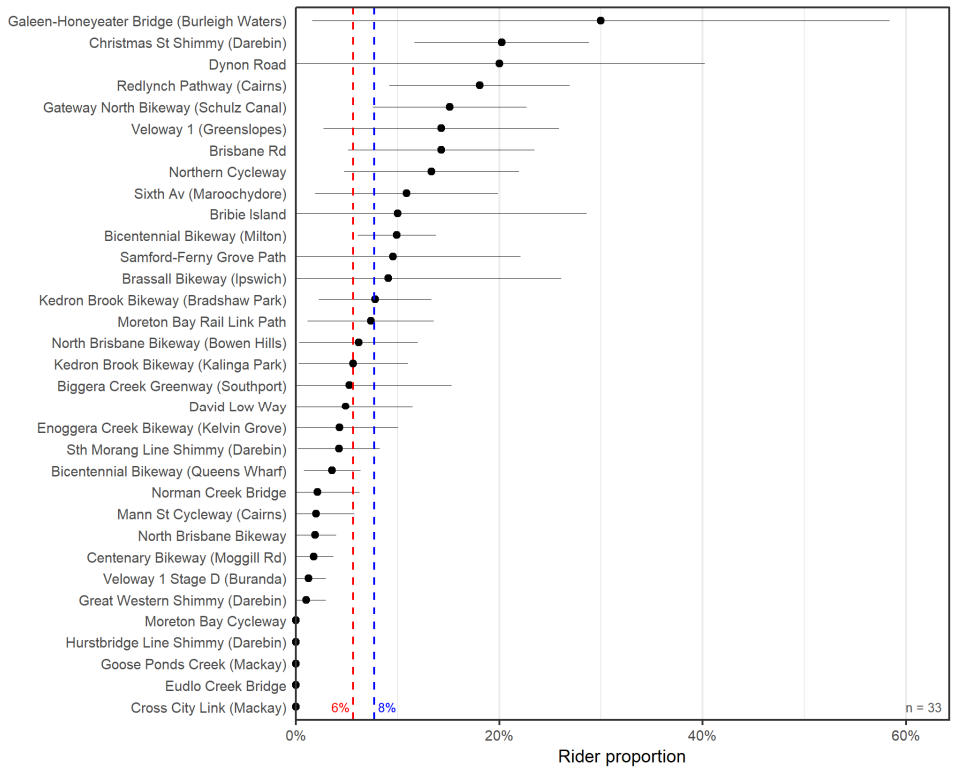

Figure 6.4: Car shift

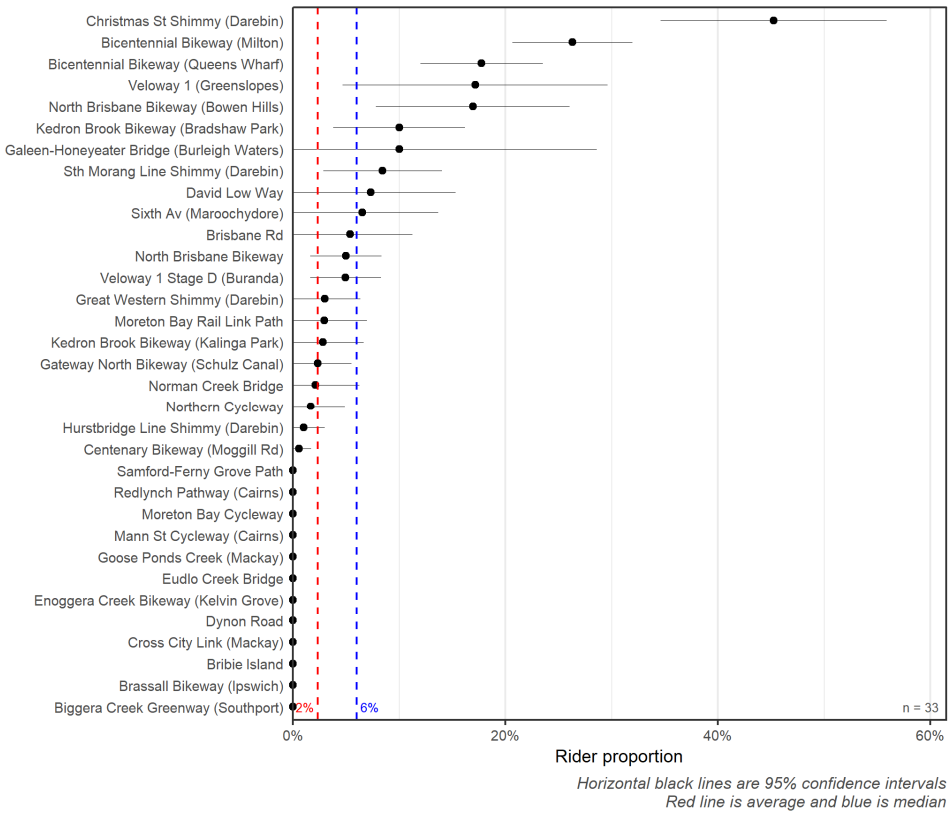

Figure 6.5: Public transport shift

Using this data, the uplift process is applied as follows:

- In the Do Nothing (DN) case the 2019 weekday (6 am – 7 pm) demand is assumed unchanged at 152 riders/day in the eastern section and 295 riders/day in western section.
- The proportion of riders using the project after completion who would have ridden along Inkerman Street irrespective of the project is assumed to be 70% with a range from 61% to 80% based on the range in Figure 6.3 trimming out the maximum and minimum observations.
- The forecast demand is then DN x 1/0.70 for the central case.
- The proportion of the demand that is re-routed from adjacent corridors (most likely Alma Street and Balaclava Street) is assumed to be 17% of forecast demand (Figure 6.3).
- The proportion of the demand that is induced is 5% (Figure 6.1), a further 5% shifted from public transport (Figure 6.5) and 3% shifted from car (Figure 6.4). Marginally higher proportions from public transport are assumed on the basis that public transport provision on the corridor is high, and the assumed elasticity from public transport to bicycle is likely to be higher than that from car to bicycle.

The result of these assumptions is shown in Figure 6.6. Under these assumptions demand is estimated to be just over 200 riders/day in the eastern section, increasing to around 420 riders/day in the western section. There are wide uncertainties with these estimates – for example, in the western end demand could vary from 369 to 485 riders per day. As a sense check, this approach estimates that 35 riders/day would divert from other routes in the eastern section and 72 riders/day in the western section. Cyclist counts provided by GECC suggest around 37 riders/day in Alma Road in the east increasing to 453 riders/day in the west. The implication, ignoring any diversion from Balaclava Road or Dandenong Road, is that most riders in the east would re-route to use Inkerman Street and under a quarter would do so in the west.

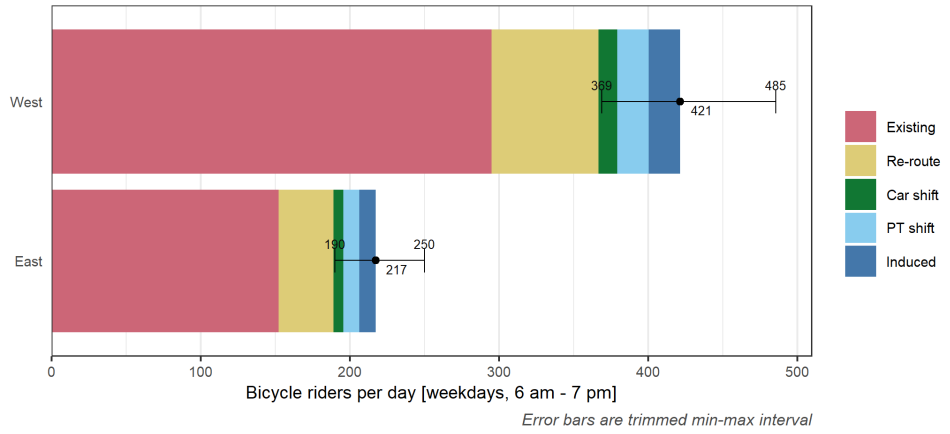

Figure 6.6: Uplift-derived demand estimates

7. Discussion

7.1 Method comparison

The comparison method estimates weekday demand of 896 riders per day (95% CI: 712 – 1,080) while the uplift method estimates demand at the busiest (west of Hotham Street) section of around 421 riders per day. These are not directly comparable, as the former method is based on a 24-hour weekday count and the latter pivots off a daytime (6 am – 7 pm) count. The VicRoads automatic cyclist counters suggest that on average 89% of bicycle traffic occurs between 6 am and 7 pm across 49 counters for which data was available in 2019. On a 24-hour basis the uplift estimates can therefore be factored by to 473 riders per day. This is still substantially less than is estimated with the comparison method. Broadly, and noting the wide uncertainty, it is suggested the most likely demand will range from around 500 riders per day to 900 riders per day towards the western end of Inkerman Street, declining to around half this range in the eastern section between Hawthorn Road and Normanby Road.

7.2 Buffered and protected lanes

There are very few double buffered bicycle lanes in Melbourne; Clarendon Street (East Melbourne) is one, and there are several single-buffered bicycle lanes (e.g. Queensberry

Street, Carlton, Mason Street Williamstown). None have cyclist counts of any reasonable duration, nor counts prior- and post-construction of the buffered bicycle lane. Therefore it is not possible to directly estimate the likely incremental demand that will arise from the current situation (no provision), to buffered bicycle lane and then to protected lanes. What is known is that infrequent bicycle riders rate physically protected bicycle lanes higher than buffered bicycle lanes; in a study of the cycling near-market for the City of Melbourne[5] 83% of respondents indicated they would feel confident riding on-road in protected bicycle lanes compared with 46% for buffered bicycle lanes. Very crudely, if this preference were to translate to additional riding activity then we may expect around 80% more new riding with a protected bicycle lane than the buffered lane.

7.3 Demographic composition

There is evidence to suggest that higher quality cycling infrastructure will attract a more diverse cohort of users. For example, stated preference data obtained for the City of Melbourne found that males assigned an average score of 3.34 out of 5 to buffered bicycle lanes compared with 3.26 by females. However, the difference is not statistically significant at the 5% level ($p = 0.410$). There is some evidence internationally to suggest that cycling infrastructure increases the female cycling participation rate; for example, research in New York[6] suggests female cycling participation was 4 – 6% higher with physically protected bicycle lanes. Similarly, there is evidence that females on average reported higher discomfort riding in mixed traffic and elevated risk perception than males[7]. Altogether, this evidence would suggest that improving the cycling provision along Inkerman Street will disproportionately benefit those who are currently underrepresented among riders along the corridor.

7.4 Complementary effects

There are numerous factors beyond the physical construction of a cycling corridor that could significantly increase riding demand. Some of these factors, such as demographic shifts towards a younger population (who, all else being equal, have a higher propensity to ride than older people) and cultural attitudes towards riding, can only be weakly influenced by council policy. However, there are many other actions which are directly within local governments remit which increase the likelihood that demand will fall towards the upper end of the range estimated in this report. These actions include:

- Ensuring high quality connections to the Djerring Trail and St Kilda Road so as to provide a safe, connected network to a wider network of destinations.

[5] CDM Research and ASDF Research (2017), *Cycling Near-Market Research*, prepared for City of Melbourne.
[6] AitBihiOuali, L. and Klingen (2022), *Inclusive roads in NYC: Gender differences in responses to cycling infrastructure*, Cities, https://doi.org/10.1016/j.cities.2022.103719.
[7] Prati, G., Fraboni, F., De Angelis, M., Pietrantoni, L, Johnson, D. and Shires, J. (2019) *gender differences in cycling patterns and attitudes towards cycling in a sample of European regular cyclists*, Journal of Transport Geography, https://doi.org/10.1016/j.jtrangeo.2019.05.006.

- Local network improvements to make access to and from the Inkerman Street corridor easier by bicycle such as bicycle lanes on connecting streets, wayfinding, speed limit reductions and traffic calming.
- Promoting bicycle riding as a convenient alternative to car and public transport for short trips.
- Increasing the relative attractiveness of riding by discouraging local car travel, such as through parking management, traffic calming and filtered permeability on local streets whereby only pedestrians and bicycle riders can traverse through physical restrictions.

While it is not possibly to quantify the uplift in demand that could be achieved from each of these actions individually, or indeed together, it is suggested that the *likelihood* of demand being towards the upper end of the range estimated in this analysis increases with these actions.

8. Conclusion

Estimating cycling demand is exceptionally difficult. Two independent empirical methods have been used in this analysis to estimate the conceivable range of demand. While it is not possible to be precise in these estimates it is suggested demand in the busiest (west of Hotham Street) section of the proposed Inkerman Street corridor is likely to be in the range of 500 to 900 riders per weekday, with demand in the section east of Hawthorn Road around half of these levels. This would represent an increase in cycling on Inkerman Street by a factor of two to three on pre-pandemic (2019) levels. The incremental change in demand that would arise from protected bicycle lanes compared to a painted, buffered bicycle lane cannot be readily estimated. However, the former is likely to attract around 80% more new riders (i.e. all-new cycling trips or trips that would otherwise have been made by car or public transport). The likelihood that demand will fall towards the upper end of the range will increase with protected bicycle lanes (compared to buffered bicycle lanes) and if complementary actions such as high-quality connections to the Djerring Trail and St Kilda Road are incorporated. Moreover, protected bicycle lanes are likely to attract a more diverse and representative cross-section of the population than the current situation (no bicycle lanes) or buffered bicycle lanes.

It is noted there are also likely to be additional e-mobility users, especially e-scooters and e-skateboards with the proposed bicycle improvements. Given the rapid evolution in technology and consumer trends in this area it is not possible to estimate possible demand by this user group.

Ironbark Sustainability

Glen Eira City Council

Cycle Path Emissions Analysis

City of GLEN EIRA

GLEN EIRA CITY COUNCIL

Prepared for
Glen Eira Council

Version	Author	Date	Description of changes
v0a	Sophie Beard	14/09/2022	First Draft
V0b	Charlotte Somers	15/09/2022	Review
v1a	Sophie Beard	15/09/2022	Issue to Council
v2a	Sophie Beard	16/09/2022	Updates following Council comments

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Ironbark has been operating since 2005 and brings together a wealth of technical and financial analysis, maintenance and implementation experience in the areas of building energy and water efficiency, public lighting and data management. We pride ourselves on supporting our clients to achieve real action regarding the sustainable management of their operations.

Our Mission
The Ironbark mission is to achieve real action on sustainability for councils and their communities.

Ironbark is a certified B Corporation. We have been independently assessed as meeting the highest standards of verified social and environmental performance, public transparency, and legal accountability to balance profit and purpose

1. Introduction

Glen Eira City Council is proposing to install a protected bi-directional bike path along Inkerman Road between Normanby Road and Hotham St. This bike lane will connect to the current western end of the Djerring Trail and is proposed to continue along Inkerman Street through the City of Port Phillip to St Kilda Road. The Glen Eira City Council component of the cycle path will be 4.5km.

The purpose of this report is to present the results of an emissions reduction analysis completed by Ironbark Sustainability on the proposed cycle path. This analysis considers the emissions saved by a modal shift from car and public transport trips to cycling, whilst accounting for the embodied emissions of a kerbside barrier between the bike path and vehicular traffic.

1.1 Context

Transport is the second largest source of emissions in Victoria and contributes 16% of the City of Glen Eira's municipal emissions (see Figure 1).[1] As part of its commitment to reduce emissions by 45 - 50% by 2030, the Victorian Government has a target to increase active transport mode share in the state to 25 per cent by the end of the decade. Efforts to increase active transport through safe cycle connections will contribute to the Glen Eira's own net zero carbon ambitions.

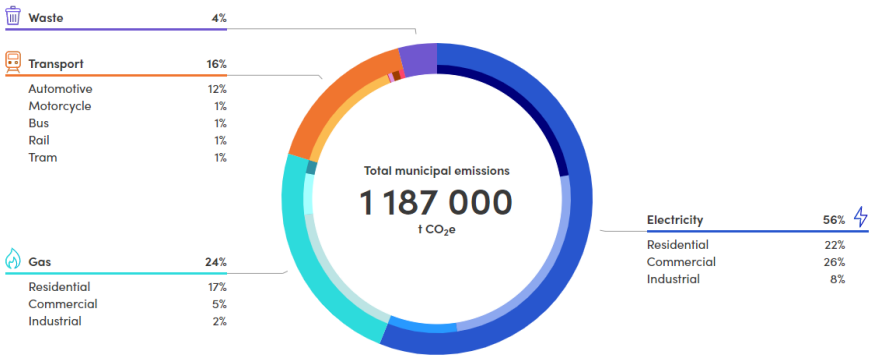

Figure 1: Glen Eira 2019/20 municipal emissions snapshot

A 2018 study in New Zealand found that the establishment of 30km of cycle paths and dedicated lanes resulted in a 1% reduction in passenger vehicle emissions by the third year of intervention.[2] This demonstrates a direct link between cycle infrastructure investment and emissions reduction, indicating the potential for larger-scale implementation of these interventions to achieve significant emissions reduction across communities.

In addition, research into the environmental, health and economic impact of active transport in Victoria has found the benefit-cost ratio of investing in walking and cycling to be 13:1.[3]

[1] https://snapshotclimate.com.au/locality/municipality/australia/victoria/glen-eira/
[2] Keall M D et al, Reductions in carbon dioxide emissions from an intervention to promote cycling and walking: A case study from New Zealand, Transportation Research Part D: Transport and Environment, Volume 65, 2018, Pages 687-696, (https://www.sciencedirect.com/science/article/pii/S136192091830419X)
[3] https://www.vichealth.vic.gov.au/-/media/PDFs/Active-Transport-Research-Summary-06.pdf?la=en&hash=0E65A8D9CBEC5D1A00EDD3B2D3C536BC5248939E

1.2 Source of Data

The following sources of data have been used in completing this analysis:

- Cycling demand estimates for Inkerman Street Technical Note, CDM Research, 16/02022
- Inkerman Road Safe Cycling Corridor Pilot Rev C drawings, Arup, 20/06/2022
- Bike Lane Design Guidelines, City of Melbourne, June 2019
- VicRoads Standards Specification Section 610 – Structural Concrete, 05/05/2009
- Infrastructure Sustainability Materials Calculator v1.2
- Emails between Ironbark Sustainability and Glen Eira City Council

2. Methodology

Ironbark has undertaken a desktop analysis to estimate the emissions saved by a modal shift from car and public transport trips to cycling as a direct result of the introduction of the proposed cycle path.

Emissions Savings

An estimate of the expected number of additional cyclists per day was obtained from the Technical Note by CDM Research (see Figure 2), which provided the following breakdown for the Glen Eira section of Inkerman Road:

- Existing weekly users: 1,067
- Expected new (additional) weekly users: 457
- Share of new weekly users shifting from car: 8%
- Share of new weekly users shifting from public transport: 5%

The calculation of expected emissions savings attributable to the proposed cycle path is based on the emissions that would have otherwise been created by the avoided car and public transport trips each week. Avoided public transport trips have been assumed to be by train.

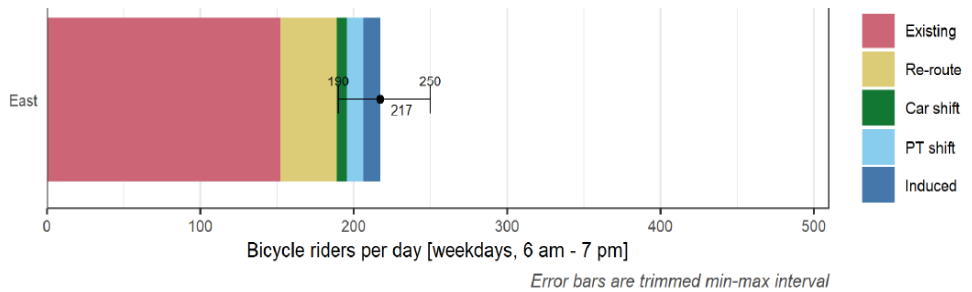

Figure 2: Uplift-derived demand estimates
Source: CDM Research Technical Note

According to the 2016 Census, the average commute by bicycle is 7.6km.[4] It has been assumed that the avoided car and train trips were of this same distance. Where actual avoided trip lengths are longer or shorter, the associated emissions savings achieved by installing the cycle path will increase or decrease accordingly.

Embodied Emissions

An estimate of the emissions produced to construct a kerbside barrier between the bike path and vehicular traffic has also been calculated. The volume of concrete required to construct the barrier has been approximated to be 176.56m^3. This is based on 2.5km of kerb along the 4.5km route (allowing for gaps for intersections, driveways and pedestrian access), and a cross sectional area of 0.07m^2 as per the standard VicRoads profile shown in Figure 3[5].

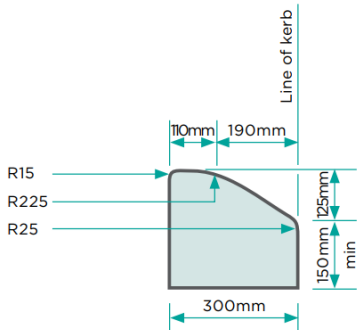

Figure 3: Semi-mountable Kerb (standard VicRoads profile)

The Infrastructure Sustainability Materials Calculator v1.2 has been used to calculate the embodied emissions of the barrier using the following inputs:

- Strength grade: 32MPa
- Supplementary Cementitious Materials: 40% of total binder content (maximum allowed by VicRoads Standards)
- Amount of concrete: 176.56m^3
- Transport: 24km by concrete agitator truck (distance from project site to nearest quarry, at Lysterfield)

Any variation of the above in the actual concrete composition, strength, quantity and transport distance will affect the actual emissions attributable to the construction of the kerbside barrier.

[4] https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/2071.0.55.001~2016~Main%20Features~Commuting%20Distance%20by%20Personal%20Characteristics~10
[5] Bike Lane Design Guidelines, pg 53, City of Melbourne, June 2019

3. Results and Discussion

The results of the emissions analysis on the proposed cycle path for Glen Eira City Council are presented in Table 1. This indicates that the installation of the path would reduce emissions by 15 t CO_2-e per year, offsetting all embodied emissions from its construction in just over three years. As road construction elements typically have a life expectancy of over 20 years, this will result in net emissions savings of over 250 tCO_2e.

Table 1: Emissions analysis results

Emissions	Quantity
Emissions saved per week	290 kg CO_2-e
Emissions saved per year	15 t CO_2-e
Embodied emissions of barrier construction	48 t CO_2-e

Based on this analysis, installation of the proposed cycle path would be environmentally beneficial over its life. It could contribute to reducing Glen Eira's transport emissions by 0.01%, an impact that can be scaled up with the further establishment of dedicated cycle paths and lanes.

Council should also consider the economic and social sustainability benefits an increase in cycling will bring to the Glen Eira community.



Gender Impact Assessment

STEP 1: Define the issue and Challenge assumptions

What is the title of the policy, program, or service?

Inkerman Road Safe Cycling Corridor - Summary

Glen Eira is currently exploring the feasibility of creating a new separated cycling facility along Inkerman Road. The purpose of this Gender Impact Assessment (GIA) is to assess two concept design options against existing conditions.

The two options are:

1. Option 1 proposes a one-way (westbound) traffic lane arrangement with on-street parallel parking provided on both sides of the carriageway.
2. Option 2 proposes two-way vehicle travel with a single on-street parking lane.

Why are you developing this project (what is the purpose)?

The population of Glen Eira is projected to increase by approximately 30,000 residents by 2036 — meaning around 20,880 more cars on our roads if current usage continues. To address this, Council adopted a multi-faceted *Integrated Transport Strategy* in 2018 to find ways of encouraging residents to use different modes of transport other than driving, for the benefit of all residents.

This includes identifying gaps in public transport and advocating to the State Government to remedy these to make it easier and safer for people to ride or walk rather than driving. One action in the *Strategy* is to conduct a pilot for a safe cycling route. The aim of the pilot is to provide a safer alternative for those who wish to ride.

In September 2018, Council initially chose Inkerman Road as the route for the pilot, being 11km from the CBD and linking the bicycle path under the Dandenong elevated rail line (Djerring trail) to the separated bicycle lane that the State Government will be constructing on St Kilda Road — northwards from Carlisle Street. The route also aligns with City of Glen Eira's identification of Inkerman Street as a proposed cycling corridor in their *Integrated Transport Strategy* — enabling a fully connected corridor.

Council has also recently committed to new carbon emission reduction targets — zero net emissions for corporate emissions by 2025 and zero net community emissions by 2030.

Supporting and transitioning commutes to transport such as cycling, will be essential to transition to zero community emissions by 2030. In order to encourage people to cycle, it is essential for investment in cycling infrastructure that is safe, convenient and direct.

Do people of different genders use or access bike lanes differently? How? Do people of different genders have different needs from the bike lanes?

YES ☒ NO ☐

Fewer women than men currently use bike lanes, shared paths and secure bike parking facilities. In addition, women report feeling less safe than men in public spaces. We do not currently have sufficient data pertaining to gender diverse people. However, we are aware of the following:

- Manual Super Tuesday 2021 Counts found that significantly more men than women (based on appearance) are riding bikes in the City of Glen Eira, with women representing only 18% of bike riders across the municipality. This is less than the average female ridership across Victoria (27%), and lower than the Australia-wide average of surveyed areas in 2021 (25%)[1].
- Throughout Victoria, only a quarter of users of secure Parkiteer bike parking cages at stations are women . The 2020/21 Parkiteer Annual report breaks down users of Parkiteer as: 67.7% men, 25.5% women, 0.58% non-binary and 6% prefer not to say. Most Parkiteer users fall in the 31-40 age range, followed closely by the 41-50 age group.[2]
- Nearly two thirds of Victorian women (61%) feel unsafe walking alone in their neighbourhoods compared to about a quarter (25%) of men.[3]
- According to Victoria Police statistics, one in 11 women has reported being sexually harassed while on public transport.[4]
- Women are more likely than men to experience sexual harassment and sexual assault:
  - 1 in 2 women has experienced sexual harassment (vs. 1 in 4 men)[5]
  - 17% of women have experienced sexual assault (vs. 4% of men)[6]

[1] Bicycle Network (2021) 'Super Tuesday Bike Count' Glen Eira
[2] Parkiteer annual report 2020-21
[3] Australian Government Department of Social Services. 2018 The Household, Income and Labour Dynamics in Australia (HILDA) Survey
[4] ibid
[5] 2016 Australia Bureau of Statistics Personal Safety Survey
[6] Sexual Violence - Victimisation | Australian Bureau of Statistics (abs.gov.au)

- The fear of sexual harassment in urban areas is so widespread that the 2016 'A Right to the Night' survey found women regularly modify their behaviour and avoid certain areas/routes to reduce their risk of harassment.
- We lack consistent, gender-disaggregated data for all modes of transport in City of Glen Eira, but the data we do have from around the world makes it clear that women are more likely than men to walk and use public transport[7].
- Meanwhile, men around the world are more likely to drive, and if a household owns a car, men tend to dominate access to it.[8]

Different reasons and patterns for travel

The gender differences don't stop at the mode of transport; it is also about why men and women are travelling. Generally, men are more likely to have a simple travel pattern: a twice daily commute in and out of the city, commuting at peak times. But women's travel patterns tend to be more complicated. Worldwide, women do 75% of unpaid care work (in Australia, women spend almost twice as many hours each day performing unpaid care work compared to men[9]) and this affects women's travel needs. A typical female travel pattern involves, for example, dropping children off at school/childcare before going to work, taking an elderly relative to the doctor and doing the grocery shopping on the way home. This is called 'trip-chaining', a travel pattern of several short inter-connected trips that has been observed in women around the world.[10] Women may therefore be travelling more at off-peak times.

Work versus recreation and unpaid work

The statistics provided by Monash University for VicHealth found that within Victoria, women's primary trip purpose when bike riding was for recreation (78%).[11] However, while travel for paid work is often grouped together into one single category, care work is often subdivided into smaller categories, some of which like 'shopping' aren't distinguished from leisure. It is therefore possible that many trips classified as 'recreational' trips may be related to care or care giving. In addition, the naming of initiatives such as 'ride to work' itself privileges mobility based around paid work. These initiatives can subtly undervalue domestic unpaid labour by counting bike trips taken for household errands like grocery shopping as 'recreation' trips instead of being counted in the regular trips reserved for commuting and paid work. Since women generally take more trips than men for daily household errands, 'recreation' trips thus reveal a gendered bias in whose bike mobility is encouraged by ride to work initiatives.[12]

Caregiving

Generally, men tend to travel on their own, but women travel encumbered – by groceries, prams, children or elderly relatives they are caring for. A recent VicHealth Wellbeing study found that 76% of Victorian mothers were primarily responsible for looking after their preschool aged children compared with just 8% of fathers[13]. As women are more likely to be pushing prams or travelling with children in cargo bikes, they are more affected by narrow footpaths and bike lanes, lack of ramps, exposure to other bike riders or motorists travelling at high speeds or inadequate street lighting.

Convenience and flexibility

Convenience is another motivator in the transport decision-making process. All users want transport that offers punctuality, predictability, shortened travel time, proximity, flexibility etc. Men tend to prefer speed, punctuality and predictability, and usually have greater access to the types of modes that deliver these qualities, whether it is private vehicles or bicycles. Women have less access to faster, predictable travel and tend to have multiple purposes in their trips, since they balance multiple roles of work, household and childcare. As a result, women favour more flexible services that bring them closer to their varied destinations[14].

In a 2018 Populus survey of 7000 people in ten US cities, women reported a more positive perception of scooters (72%) than men (67%). The survey also indicated that women might adopt e-scooters more quickly than they have bike-sharing.[15]

Safety and risk

Women are more concerned with the safety and personal security aspects of transport. They may forego trips or seek less efficient and/or more costly alternatives when there is a perceived threat.[16]

Lighting and safety

Plan International, Monash University XYX Lab and ARUP lighting researchers have pooled their expertise to analyse the relationship between urban lighting and women's perceptions of safety.

The research[17] struck on some compelling correlations between light levels and unsafe places. Analysing over 80 of the most unsafe "hotspots" identified by women in Melbourne,

[7] Handbook for Gender-Inclusive Urban Planning and Design, 2020, World Bank Group: Gender-inclusive-planing-and-design.pdf (universaldesignaustralia.net.au)
[8] Global Mobility Report 2017, Sustainable Mobility For All: 120500.pdf (worldbank.org)
[9] Face the Facts: Gender Equality 2018, Australian Human Rights Commission: Face the facts: Gender Equality 2018 | Australian Human Rights Commission
[10] Invisible Women: Exposing Data Bias in a World Designed for Men, Caroline Criado Perez, 2019 (page 30)
[11] Pearson, L. K., Dipnall, J., Gabbe, B. J., Braaf, S., White, S., Backhouse, M., & Beck, B. (2021). The potential for bike riding across entire cities: quantifying spatial variation in interest in bike riding. medRxiv. Available from**:** https://www.medrxiv.org/content/10.1101/2021.03.14.21253340v2
12 Do Jun Lee (2016) Embodied bicycle commuters in a car world, Social & Cultural Geography, 17:3, 401-422, DOI: 10.1080/14649365.2015.1077265
[13] VicHealth Coronavirus Victorian Wellbeing Impact Study**,** 2020: VicHealth Coronavirus Victorian Wellbeing Impact Study
[14] Gender and Urban Transport: Smart and Affordable. Sustainable Transport: A sourcebook for policy makers in developing cities, GTZ
[15] Not Just Tech Bros: E-Scooter Fans Are Surprisingly Diverse | WIRED (2018)
[16] Gender and Urban Transport: Smart and Affordable. Sustainable Transport: A sourcebook for policy makers in developing cities, GTZ
[17] https://theconversation.com/more-lighting-alone-does-not-create-safer-cities-look-at-what-research-with-young-women-tells-us-113359

the research found that high illuminance – or very bright and over lit spaces – does not correlate with young women's perceptions of urban safety.

This is important information as planners often light spaces to a high "P" Category (a measure used in urban place-making guidelines) of lighting. It's assumed this will reduce the risk of crime and increase the feeling of safety.

But the research shows that designing lighting that is positive for women's urban experience requires more nuance. The findings show that sites with higher light levels are more likely to be perceived as unsafe sites – the average light level across these sites was twice what was measured across safe sites.

The analysis showed that consistent and layered lighting – where there are multiple light sources and where surfaces with different reflective values are taken into consideration – makes women feel most safe. This kind of lighting reduces the "floodlit effect", the sharp drop-off of light beyond the path, and the potential for glare and contrast to blind and disorientate.

ARUP's research shows the human visual spectrum reacts better to warm light, and the data from young women showed how sensitive they are to cool white light with regard to feeling safe in cities. Spaces with warmer colour temperatures are perceived as safer places.

Looking deeper into the quality of light in Australian cities, the majority of areas perceived as unsafe had a very large range of colour rendering. The lowest colour rendering came from sodium luminaires that make everything look overly yellow. Women preferred a high-quality LED light that enabled them to distinguish shapes and colour, helping to create a sense of safety.

Gender and parking

Two design options are being considered for the Inkerman Road Safe Cycling Corridor (within the Glen Eira boundary) and these options will each result in different parking impacts. If either of these options were to proceed there will inevitably be some loss of street parking and changes to parking arrangements in the area.

We do not have gender data for the people who are currently parking in the area and therefore who is likely to be more impacted by the loss of or changes to parking. However, it is worth considering that women may be more negatively impacted by loss of parking if this means they need to walk further from their vehicles to their homes or places they are visiting (due to safety concerns, particularly at night). Considering the difference in gender and care-giving roles, women may also be more impacted by having to park further away if they are travelling with young children, prams, buggies and groceries. Pregnant women would also be negatively impacted by having to walk further. Aside from residents parking near their homes, it is worth considering who else might be parking in the area, for example, if there are parents dropping off children at childcare or school and how the parking changes may impact those groups differently.

Option 1 proposes to remove a traffic lane but retain on-street parallel parking on both sides of the carriageway. Whilst Option 2 proses to retain two-way vehicle traffic with only a single on-street parking lane. Therefore, Option 1 will retain significantly more parking than in Option 2. Given that women are considered to be more negatively impacted by loss of parking, Option 1 is more beneficial to Option 2 in terms of parking.

Do some genders benefit from the policy, program, or service more than others? How?

YES ☒ NO ☐

Men as a group currently benefit more from bike lanes due to the nature of men's travel patterns, typically being unencumbered, solo and direct commuting to and from work.

Women as a group are benefiting less from bike lanes for several reasons, including the complexity of their travel needs and patterns, involving travelling with others and incorporating unpaid errands and caregiving into their trips. Women are also less likely to use bike lanes, due to lower confidence in riding a bike on unprotected bike lanes, gendered norms and expectations regarding their appearance and increased concern with safety and security (particularly when travelling with children, alone at night and when high speeds and unprotected bike lanes are concerned).

If we do not make any changes to the design of bike lanes and travel corridor infrastructure in our city, men are likely to continue to be attracted and benefit more than women from the construction of future bike lanes, as men are currently most of the users of our bike lanes.

Women are often under-represented in bike riding campaigns and popular culture due to lower participation, and the perspective of bike riding being a male-dominated activity[18]. Despite low participation, over two thirds of women in a recent Monash University and VicHealth bike riding study[19] were interested in riding a bike and over half owned a bike. Importantly, many existing bike riding environments are often designed for the needs and confidence levels of men without disabilities[20]. Infrastructure that enables women to ride a bike includes off-road paths, and bike-infrastructure that is physically separated from motor-vehicle traffic[21]. In future urban planning and research, it is vital that a lack of participation is

[18] Daley and Rissel, 2011; Bauman et al., 2018; Knight, 2014

[19] Monash University LGA Bike Riding Typologies (vichealth.vic.gov.au)**:** https://www.vichealth.vic.gov.au/media-and-resources/publications/bike-riding-study

[20] Aldred et al., 2017; Mitra and Nash, 2017; Xie and Spinney, 2018

[21] Aldred et al., 2017; Garrard et al., 2008

not seen as a lack of interest in bike riding. Given that the findings of this study demonstrated high bike riding interest in women, understanding the specific barriers to riding a bike for women is needed to increase participation.

Further to this, a recent 2022 study found that women's participation in cycling increased significantly on roadways where the city builds protected bike lanes. Data from Citi Bike ridership numbers in New York showed that for the years going from 2013 to 2019 women's participation in cycling mainly increased for routes that are protected for at least 50 percent of the route and that the biggest uptake, of up to 20% increase in female cyclists, comes from routes for which more than 80 percent can be ridden on a protected cycling lane[22].

The provision of separated bicycling infrastructure is important for both the safety[23] and support of low-risk bicycling environments to maintain and encourage participation. Most people in this study were interested in riding a bike if infrastructure were provided that physically separated them from motor vehicle traffic. While painted bike lanes are a lower cost alternative to providing bicycling infrastructure, these do not constitute physically separated bicycling infrastructure. Research conducted in Melbourne that measured passing distances between motor vehicles and bikes identified closer, and potentially unsafe, passes when a person riding a bike was travelling in a painted bike lane compared to on-road[24]. Similarly, a previous study identified that 22% of all on-road bike riding crashes occurred while riding in a painted bike lane, highlighting their insufficiency in protecting vulnerable road-users[25]. In addition to the risk of substantial injury that painted bike lanes pose for people on bikes, they are not supportive of new bike riders, or low-stress traffic environments, with concerns about safety on the road and interactions with motorists being a major barrier to participation in bike riding[26]. As indicated by the findings of this study, removing interactions with motor vehicles through a physically separated bicycle lane could substantially increase participation in bike riding in Melbourne, while maintaining the safety of vulnerable road-users.

We need to ensure that bike lanes are wide enough for cargo bikes, comfortable for passing by faster riders, separated from vehicle traffic and have warm lighting and other aspects which will enable women to feel safer at night.

We also need to consider women's complex travel patterns, involving 'trip chaining' – multiple, short interconnected trips and the need for our bike lanes to offer women convenience and flexibility. For example, how can we ensure that women using the travel corridor can make other interconnected trips, that may be on foot or using public transport? This may involve conveniently located pram/bicycle and cargo bike parking at destinations such as childcare centres, schools, activity centres, supermarkets, medical clinics and public transport interchanges as this might assist with multiple trips and using multiple modes of transport.

What other groups might be affected by this policy, program, or service (e.g. older people, people with disabilities, CALD communities)? Intersectionality

Other groups that may be affected by this project include older residents, people with disability, CaLD communities (including the Jewish community), parents with young children and people who cannot or do not drive and have fewer transport options.

The local Jewish community has expressed some concerns about proposed bike lanes on Inkerman Street, due to the loss of parking[27]. Council will continue to engage with the Jewish community to address their concerns.

Older residents and people with disability may face barriers to using bike lanes, resulting from limited mobility, lower confidence to ride a bike and safety concerns. The barriers to women riding on our bike lanes are likely to be compounded for older women, women with disability and women from diverse cultural backgrounds. In addition to confidence and safety concerns, CaLD women may face additional barriers relating to cultural norms about clothing, learning to ride or having access to a bike and travelling alone in public spaces.

People using mobility aids may find it more complex to negotiate crossing a street with protected bike lanes. People using wider bicycles, including tricycles, cargo bikes, and handcycles, may need wider bike lanes to manoeuvre and pass.

Better representation of diverse riders will help boost inclusivity and participation rates in bike riding. More diverse imagery and targeted engagement will help women of colour, people with disability and older people feel that bike riding can be for anyone who is willing to try it as a mode of transport[28] Using inclusive language is important. PedalLove.org (USA) tries be inclusive by referring to "people who ride bikes" or "women who ride bikes" rather than "cyclist" which often evokes the image of men in lycra travelling at high speeds[29].

Will you involve internal or external stakeholders?? **YES ☒** **NO ☐**

What issues or groups will you focus on in the gender impact assessment?

[22] AitBihiOuali & Klingen. (2022) Inclusive roads in NYC: Gender differences in responses to cycling infrastructure
[23] Harris et al., 2013
[24] Beck et al., 2019
[25] Beck et al., 2016
[26] Daley and Rissel, 2011; Heesch et al., 2012; Twaddle et al., 2010; Akar and Clifton, 2009; Dill, 2009
[27] Staff, A. (2019). 'Damaging' impact of Inkerman vote'. The Australian Jewish News https://www.australianjewishnews.com/damaging-impact-of-inkerman-vote
28 McCullough, S. R., Lugo, A., & Stokkum, R. V. (2019). Making bicycling equitable: Lessons from sociocultural research
29 Treviño J. (2016). 'The Case for All-Women Cycling Clubs' Bloomberg CityLab https://www.bloomberg.com/news/articles/2016-10-17/how-to-get-women-cyclists-on-the-road

The gender impact assessment will primarily focus on women, and to the extent possible (given data limitations) gender diverse people, to help improve equitable access to bike riding and increase the number of women and gender diverse people who ride a bike for any purpose.

Issues to focus on:

- Collecting gender-disaggregated data for bike riders, pedestrians and drivers and people using parking on Inkerman Street during planning
- Improvements to safety and perceptions of safety that would lower barriers for women and other underrepresented groups to ride on this travel corridor
- Ways to mitigate any potential risks/negative impacts from reduction in parking or changes to parking arrangements
- Women's different travel patterns (trip-chaining, travelling encumbered with prams, groceries etc) and concerns about getting around alone at night
- Sufficiently wide lanes to allow use of cargo bikes for school pick up and drop off and other care giving activities
- Learnings that could be applied and adapted to other bike corridors

This may involve design elements such as:

- Kerbside protection
- Width of lanes
- Improving crossings
- Appropriate lighting (see new research on lighting[30])
- Wider network connections and bike improvements to support trip chaining

We also wish to consider these four elements of City of Casey's women and safety audit tool in our analysis:

1. Safe and secure (do women **feel safe** here? Can they see and be seen? Is there security?)
2. Connection and belonging (do women **feel welcome** here?)
3. Access and movement (can women get to and from here and **move around freely**?)
4. Look and feel (do women **feel good here** – what is the vibe like? This includes diversity of presence of others)

Groups to work with:

- Work with local groups that focus on providing a safe space for women and gender diverse people to build skills and confidence (for example: Glen Eira Bicycle user Group)

Advocacy and support for initiatives that promote bike riding for women and gender diverse people:

- The GIA may need to consider the need for accurate, gender-disaggregated data to monitor gendered patterns and trends in bike riding over time (including how to collect data on gender diverse bike riders)
- We need to consider expanding initiatives such as 'ride to work' (include unpaid work) or 'ride to school' and Festival of Everyday Riding that introduce bike riding to new and potential riders and offer opportunities to gain confidence and skills
- Support planning scheme amendments and other initiatives that improve workplace provision of showers, lockers and changing facilities to support women to ride to work

STEP 2: Open Up Thinking and Learning

What research do you have to support the focus on the groups/issues outlined above?

Surveys completed in 2017 by the City of Melbourne found that 83% of respondents living in Melbourne and adjacent municipalities (including our city) would aim to ride if a protected bike lane were provided, compared to 22% who say they would be confident to ride on conventional painted bike lanes (without buffers). The proportion of women confident to ride on streets with no bike lane provision, conventional bike lanes or buffered bike lanes is lower than the proportion of men, making this gap in confidence a greater barrier for women riding.[31]

What other research do you need to support your focus on these groups/issues?

We need to do primary research (through stakeholder consultation) with diverse groups of women and gender diverse people in our city to understand the barriers and opportunities to support more women and gender diverse people to ride along Inkerman Road. This may involve engagement with existing users of other bike lanes, potential users of Inkerman and non-users of cycling infrastructure. The research should deliberately seek to understand the motivations, constraints and enabling factors that influence women's decision-making to travel by bike. This must include the perspectives of diverse women, including younger women, older women, Culturally and Linguistically Diverse (CaLD) women, women with disability, women who have diverse sexual orientations and gender identities and women from different socio-economic backgrounds.

[30] https://theconversation.com/more-lighting-alone-does-not-create-safer-cities-look-at-what-research-with-young-women-tells-us-113359

31 Near-Market Research (2017) by CDM Research and ASDF Research for City of Melbourne Figure 19

We also need more data and research to understand if there may be different gender impacts resulting from changes to parking arrangements under the different design options for Inkerman. This research would help to mitigate any risks.

Which stakeholders will you consult and how?

- Planning for extensive community consultation on the concept designs of the corridor
- Targeted consultation involving the following groups may be appropriate (and potential groups):
  - Women (recruit from school parents, Glen Eira Bicycle User Group, residents along Inkerman, other consultative committees – see below)
  - People with disability and organisations that represent them
  - Children (schools)
  - Older people
  - Culturally and linguistically diverse groups (through the multicultural and multifaith advisory committees)
  - LGBTIQA+ people (through the new LGBTIQA+ advisory committee, Rainbow Pride Advisory group)

EVIDENCE

What did you learn from your research/stakeholders?

To be completed if project is approved to go to wider community engagement.

STEP 3: Options analysis – Use Multi-criteria Assessment

Three options

1. Option 1 proposes a one-way (westbound) traffic lane arrangement with on-street parallel parking provided on both sides of the carriageway.
2. Option 2 proposes two-way vehicle travel with a single on-street parking lane.
3. Do nothing: No Change to existing conditions

What might improve gender equality in your policy, program, or service? What are the benefits and risks associated with this option? (Option 1 and Option 2)

This section assesses the benefits and risks of both Option 1 and Option 2 against existing conditions.

- ***Option 1 Description: Design Option 1 proposes a one-way (westbound) traffic lane arrangement with on-street parallel parking provided on both sides of the carriageway.***

- ***Option 2 Description: Design Option 2 proposes two-way vehicle travel with a single on-street parking lane.***

Benefits:

Overall introducing a safe cycling facility along Inkerman Road is considered beneficial to gender equity. Women are more likely to feel unsafe cycling on a road without cycling infrastructure than men. Introducing separated cycling facility will increase opportunities for women to engage with cycling. As the data and research provided above has shown, creating a safe network of bike and walking choices, separated from roads, helps people have a better sense of safety and reduces vehicle congestion and conflict between modes.

This means providing separate paths for pedestrians and cyclist, enabling walkers, strollers and people with pets to travel at a more leisurely pace without conflict with cyclists, and vice versa. This creates and increase choices of their mode of transport and attractions for a broader range of people.

Safer Speed Limits

- Introducing safer speeds and kerbside protection, protect bike riders from both moving traffic and people exiting parked cars. They shorten road crossing distances for pedestrians and reduce vehicle speeds, making the street safer for all road users.
- Women are more likely to be pushing prams or travelling with children in cargo bikes and are more likely to be affected by other bike riders or motorists travelling at high speeds. Introducing safer speeds will limit this.
- Introducing safer speeds and protected bike lanes will allow women, all ages and abilities with the confidence to increase and lessen their concern with safety and security (particularly when travelling with children, alone at night and when high speeds and unprotected bike lanes are concerned).

Attractions for a broader range of people of all genders, ages and abilities to ride a bike.

- Better representation of diverse riders will help boost inclusivity and participation rates in bike riding. More diverse imagery and targeted engagement will help women of colour, people with disability and older people feel that bike riding can be for anyone who is willing to try it as a mode of transport[32]
- More transport options will be available for groups such as older residents, people with disability, CaLD communities (including the Jewish community), parents with young children and people who cannot or do not drive.
- Older residents and people with disability face barriers to using bike lanes. Introducing a safe and protected walking and bike corridor option will increase confidence and accessibility.
- People using wider bicycles, including tricycles, cargo bikes, and handcycles, may need wider bike lanes to manoeuvre and pass. This option will allow these users to have a safe and protected option of use.

Safe alternative to public transport and cars.

- Consistent and layered lighting throughout the corridor will allow all users to have a perception of safety and to be able to feel safe.
- Provision of a separated bicycling infrastructure can reduce the distance between car and lane and in turn reduces the risk of injury. As indicated in the findings above, removing interactions with motor vehicles through a physically separated bicycle lane could substantially increase participation in bike riding, while maintaining the safety of vulnerable road-users.

Costs/risks:

- Women may be more negatively impacted by loss of parking if the corridor is built. This would be due to the fact that they may need to walk further from their vehicles to their homes or places they are visiting (due to safety concerns, particularly at night). Given that Option 1 proposes to retain more parking than Option 2. Option 1 is considered to be more positive for gender equality.
- Considering the difference in gender and care-giving roles, women may also be more impacted by having to park further away if they are travelling with young children, prams, buggies and groceries.
- Pregnant women, people of the older age group and people with disabilities would also be negatively impacted by having to walk further to various surrounding services.
- Women as a group are benefiting less from bike lanes, including the complexity of their travel needs and patterns, involving travelling with others and incorporating unpaid errands and caregiving into their trips. Women are also less likely to use bike lanes, due to lower confidence in riding a bike on unprotected bike lanes, gendered norms and expectations regarding their appearance and increased concern with safety and security (particularly when travelling with children, alone at night and when high speeds and unprotected bike lanes are concerned).
- Fewer women than men currently use bike lanes, shared paths and secure bike parking facilities. In addition, women report feeling less safe than men in public spaces
- There is a lack of gender and intersectional data and research on the impact of a cycling and walking corridor.
- According to Victoria Police statistics, one in 11 women has reported being sexually harassed while on public transport.[33] Women are more likely than men to experience sexual harassment and sexual assault:
    - 1 in 2 women has experienced sexual harassment (vs. 1 in 4 men)[34]
    - 17% of women have experienced sexual assault (vs. 4% of men)[35]

Overall gender impact: positive for both Design Option 1 and Design Option 2

The overall gender impact of both design options is positive compared to existing conditions.

Physical activity is crucial in maintaining health and wellbeing. It benefits people of all ages, abilities, genders and cultural backgrounds. However, Option 1 is considered preferred of the 2 options given it retains more parking.

Safety is a significant barrier for many wanting to cycle/walk. This is especially the case during the winter months when many typical commuter journeys happen in hours of darkness. Safety is likely to include both road safety and personal safety.

This project could achieve higher levels of more inclusive transport by reducing road speeds and creating a protected cycling facility.

Taking steps that specifically improve the design of these corridors for all people will ensure a dense network of safe and attractive routes that provide dedicated space for bicycles and gives many more people the confidence and inclination to use a bike/walk.

Recommendation 1

It is recommended that this project proceed to community consultation. An inclusive community engagement stage be implemented that will involve engagement with existing users of other bike lanes, potential users of Inkerman and non-users of bikes lanes. Engagement should be sought to understand the motivations, constraints and enabling factors that influence people's

32 McCullough, S. R., Lugo, A., & Stokkum, R. V. (2019). Making bicycling equitable: Lessons from sociocultural research
33 ibid
34 2016 Australia Bureau of Statistics Personal Safety Survey
35 Sexual Violence - Victimisation | Australian Bureau of Statistics (abs.gov.au)

decision-making to travel by bike. This cohort must include the perspectives of diverse women, including younger women, older women, Culturally and Linguistically Diverse (CaLD) women, women with disability, women who have diverse sexual orientations and gender identities and women from different socio-economic backgrounds.

Once the report above has been completed and community engagement has occurred a more detailed recommendation will be given. However, based on the existing information Option 1 is considered the preferred option from a gender impact perspective. This is because it provides a separated cycling facility and maintains more parking than Option 2. However, both Option 1 and Option 2 are considered to have a positive gender impact outcome compared to existing conditions.

STEP 5: Monitoring and Evaluation

How will you monitor and evaluate recommendations?

A program to monitor and evaluate the outcome will be prepared if the project proceeds to detailed design and construction.



Safe Cycling Corridor

Inkerman Road

Safe System Assessment

Report for: City of Glen Eira

SAFE SYSTEM SOLUTIONS

ROAD SAFETY · AUDITING · ENGINEERING · PROJECT DEVELOPMENT

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Information Page

DATE: 12/11/2020

CLIENT: City of Glen Eira

REPORT NUMBER: S20200024

QUALITY RECORD:

Issue	*Date*	*Description*	*Prepared By*	*Reviewed By*	*Approved By*
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2	12/11/2020	Final Submission	Ash Mani	Max McCardel	

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Executive Summary

This Full Safe System Assessment (SSA) has been conducted for the planned Safe Cycling Corridor in the City of Glen Eira. The cycling corridor is primarily located along Inkerman Road (between Hotham Street and Normanby Road), in addition to the section of Normanby Road that connects Inkerman Road to Caulfield Railway Station.

A total of five concept designs were developed by ARUP Pty Ltd. Based on a variety of factors, two design options were selected and are under consideration in this SSA:

- Design Option 1
  A dedicated bi-directional cycle path with physical kerb separation is proposed along the entire route, as well as a reduced 40km/h speed limit. Inkerman Road is proposed to transform to a one-way traffic arrangement (in the westbound direction) and some on-street parking along the south side is to be removed. Finally, a series of activation places are proposed along the route (wombat crossings and shared zones are currently being considered) to provide additional pedestrian priority crossing points and act as further traffic calming.

- Design Option 2
  The same as Design Option 1, except for the following:
  - A one-way traffic arrangement along Inkerman Road (in the westbound direction), between Normanby Road and Hawthorn Road only
  - Between Hotham Street and Hawthorn Road, Inkerman Road retains a two-way traffic arrangement with on-street parking completely removed along the south side
  - The signalised intersections have modified turning/through lane arrangements in line with the two-way traffic arrangement along the majority of Inkerman Road

A more detailed description of the existing conditions and design options can be found in Section 2 of the report.

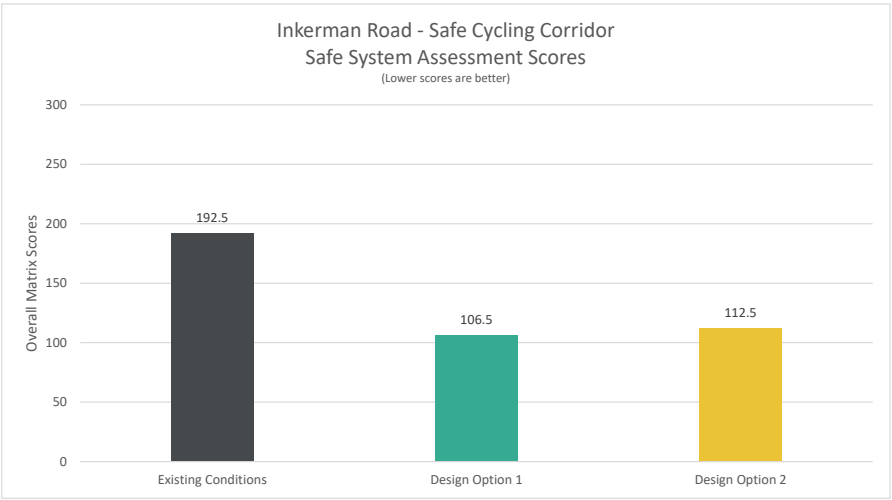
The Safe System Matrix score is the sum of scores determined for seven major crash types for each of the options, summarised in the table below.

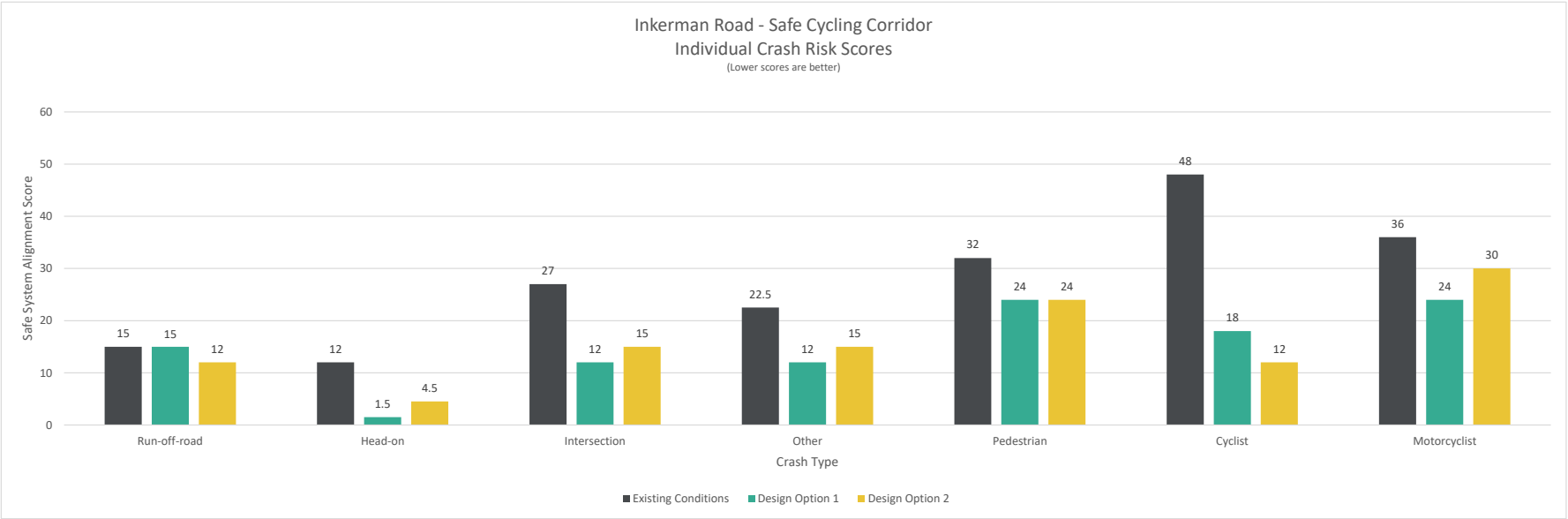
	Option	Safe System Alignment Score
	Existing Conditions	192.5 / 448
	Design Option 1 	106.5 / 448
	Design Option 2 	112.5 / 448

The lower the score, the better alignment with Safe System principles. We aim to move Towards Zero.

The breakdown of scores for each major crash type and each option has been produced on the page overleaf.


Project location
(Safe Cycling Corridor)


Inkerman Road - Safe Cycling Corridor
Safe System Assessment Scores
(Lower scores are better)
Overall Matrix Scores
300
250
200
150
100
50
0
192.5
106.5
112.5
Existing Conditions
Design Option 1
Design Option 2


Inkerman Road - Safe Cycling Corridor
Individual Crash Risk Scores
(Lower scores are better)
Safe System Alignment Score
60
50
40
30
20
10
0
15
15
12
12
1.5
4.5
27
12
15
22.5
12
15
32
24
24
48
18
12
36
24
30
Run-off-road
Head-on
Intersection
Other
Pedestrian
Cyclist
Motorcyclist
Crash Type
Existing Conditions
Design Option 1
Design Option 2

The results show that both design options are better aligned with Safe System principles, compared to the existing conditions. This is primarily attributed to the dedicated bi-directional cycle path along the entire route (which significantly improves cyclist safety) and the reduced 40km/h speed limit (which reduces the likelihood and severity of all crash types) along the entire route. In addition, the proposed activation spaces along Inkerman Road improve pedestrian safety (by providing priority or low speed crossing points) and act as traffic calming along the route.

Design Option 1 has a better (lower) score than Design Option 2 because of the one-way traffic arrangement along the length of Inkerman Road, which results in fewer conflict points along the route. As a result, Design Option 1 has the best alignment with Safe System principles, followed by Design Option 2. The existing conditions has the highest overall SSA score and is therefore the least aligned with Safe System principles.

A number of ideas for consideration are presented in this Safe System Assessment that would bring the project closer Towards Zero. They are listed below.

Other factors separately examined included:

- Safe road users
- Safer vehicles
- Advanced vehicle technology
- Maintenance and post-crash response and care

This Safe System Assessment provides a series of recommendations/options to move the Projects further Towards Zero.

Primary Treatments:	
Ideas for consideration	**Project response**
• Consider reducing the speed limit along the route to 30km/h, which is the Safe System tolerance for cyclist and pedestrian collisions	
• Consider providing an underpass for cyclists at the Inkerman Road/Normanby Road intersection, so as to completely separate cyclists from vehicular traffic	
• Consider closing off some side streets along the south side of Inkerman Road to cul-de-sac arrangements, in order to reduce the number of conflict points between vehicles, cyclists and pedestrians	
• Consider raising the signalised pedestrian/cyclist crossing points and activation spaces along the route. This encourages reduced speeds through the crossing point and increases visibility to/from vulnerable road users	

Supporting Treatments:	
Ideas for consideration	**Project response**
• Consider ways to encourage cyclists to use the bi-directional cycle path, such as good pavement quality, signage and lighting	
• Consider ensuring that all signalised intersections along the route feature Fully Controlled Right Turns (FCRTs) with no red arrow drop-offs *FCRTs are not necessary on legs with a one-way traffic arrangement*	
• Consider reducing the amount of on-street parking, so as to reduce the number of unprotected roadside hazards and visual obstructions along the route	
• Ensure that street lighting along the entire route is in accordance with AS1158	

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List of Abbreviations

AADT – Annual Average Daily Traffic

ITS – Integrated Transport Strategy

FCRT – Fully Controlled Right Turn

POS – Pedestrian Operated Signals

SSA – Safe System Assessment

SCC – Strategic Cycling Corridor

VMS – Variable Message Board

1. Background

1.1 The Safe System

The Safe System is a road safety philosophy that requires roads to be designed and managed so that crash-related death and serious injury are avoidable. The basic principles are:

1. Humans are fallible, and will inevitably make mistakes when driving, riding or walking.
2. Despite this, road trauma should not be accepted as inevitable. No one should be killed or seriously injured on our roads.
3. Consequently, to prevent serious trauma, the road system must be forgiving so that the forces of collisions do not exceed limits that the human body can tolerate.

In Victoria, the Safe System is represented by the diagram in Figure 1.



Figure 1: The Safe System

The Safe System is divided into five core interrelated components shown in Figure 2.



Figure 2: The Components of the Safe System

1.2 Safe System Assessment

A Safe System Assessment is a safety examination of a road-related program, project or initiative. The procedure for undertaking a Safe System Assessment is outlined in *AP-R509-16 Austroads Safe System Assessment Framework*. The Assessment can be undertaken on any of the following:

- An existing road, intersection or length;
- A road investment project, whether at feasibility, design or pre-opening stages;
- A community road safety program or application for funding;
- A road transport policy, strategy or operating procedure.

These assessments are carried out by a specialist, independent and qualified team that considers each of the core components of the Safe System.

1.3 Type and Depth of Assessment



Safe System Assessments can be carried out to assess existing conditions or a future project, they can also be undertaken to compare two or more options.

Safe System Assessments can be conducted by a suitably qualified individual, a team or through a workshop. The depth of investigation can also vary from an in-depth assessment to an expert-opinion based assessment.

This Safe System Assessment has the following characteristics:

Type: Existing conditions and concept designs
Method: Assessment team – investigation and site inspection
Depth: Full Safe System Assessment

1.4 Assessment Team or Group

Industry practice is to undertake Safe System Assessments as either Rapid or Full:

This **Full Safe System Assessment** was conducted by:

- **Max McCardel** (BEng (Hons)), Senior Project Engineer, Safe System Solutions Pty Ltd
- **Ash Mani** (MEng, BCom), Project Engineer, Safe System Solutions Pty Ltd

Endorsed Safe System Assessors are listed on VicRoads website at www.vicroads.vic.gov.au/business-and-industry/technical-publications/safe-system-engineering

1.5 Site Inspections and Meetings

Site inspections associated with this Safe System Assessment is provided in Table 1 below.

Table 1: Inspections and Meetings

Activity	Location	Date	Time
Initial Meeting	City of Glen Eira offices 840 Princes Highway	20/02/2020	1100
Site inspection (Day)	Inkerman Road and Normanby Road	20/02/2020	1300
Concept Design Meeting	Virtual - Zoom	05/10/2020	1100

Photos taken during the site inspection can be found in Appendix A.

2. Assessment Framework

2.1 Project Background

In 2017, the Glen Eira City Council adopted their Integrated Transport Strategy (ITS) and directed the implementation of the city's first Safe Cycling Corridor pilot project. A Safe Cycling Corridor is a road or street that aims to enable cycling as a viable transport mode choice.

In 2019, Council carried out Community Consultation and Safe Cycling Corridor Assessment using site-specific data and community views which informed the Council's decision to choose Inkerman Road as the preferred route for this project.

Located approximately 7km south-east of Melbourne CBD, Inkerman Road is a high volume two-way road that intersects several residential streets and forms signalised intersections with some other primary roads. Providing one of the main east-west connections between Caulfield North and St Kilda East, Inkerman Road is lined with numerous private residences and the occasional commercial property. The Safe Cycling Corridor also includes the section of Normanby Road that links Inkerman Road with Caulfield Railway Station. Running parallel to the train line, Normanby Road provides the main connection between Caulfield Railway Station, Caulfield Racecourse and Dandenong Road.

The five year crash history, surrounding land use map and road hierarchy map of the route can be found in Appendix B, C and D respectively.

2.2 Design Options

The application of the SSA process considers likely and foreseeable crash types, particularly in relation to trauma forces that result from such crashes, under the existing and proposed conditions.

Existing Conditions:

The section of Normanby Road being assessed (between Inkerman Road and Balaclava Road) is a two-way, two lane undivided road with a posted speed limit of 60km/h. The south side of the road is lined with residential property, side streets and a pedestrian footpath, while also featuring an on-road bike lane that is shared with on-road parking. The north side of the road is flanked by the train line and features a dedicated on-road bike lane between parallel parking bays and the live traffic lane. Finally, vehicles between Caulfield Railway Station and Balaclava Road share the road with trams, with Normanby Road forming a signalised T-intersection with the latter.

The section of Inkerman Road being assessed (between Hotham Street and Normanby Road) is a two-way, two lane undivided road with a posted speed limit of 50kmn/h. Travelling eastbound, the road forms signalised cross intersections with Hotham Street, Alexandra Street, Orrong Road, Kooyong Road and Hawthorn Road before terminating in an unsignalised T-intersection with Normanby Road. Aside from Caulfield Park (located on the south side of the road, between Hawthorn Road and Normanby Road), both sides of Inkerman Road are lined with driveways to residential properties, as well as priority controlled intersections with smaller side streets. Inkerman Road also features on-road parking facilities on both sides of the road, most of which is unmarked. While there are dedicated parking lanes between Hotham Street

and Orrong Road, the majority of Inkerman Road features wide parking lanes that are shared with on-road cyclists. Additionally, there are dedicated on-road bike lanes between Hotham Street and Orrong Road (between the dedicated parking lane and live traffic lane) and bike boxes at some of the signalised intersections. Furthermore, there are pedestrian footpaths along both sides of Inkerman Road, pedestrian crossings at all signalised intersections and a Pedestrian Operated Signal (POS) located between Testar Grove and Ontario Street.

Design Option 1:

A dedicated bi-directional protected cycle path is proposed along the entire route, running along the north side of Normanby Road (between the traffic lane and the rail line) before transitioning to the south side of Inkerman Road. The path is physically separated from the live traffic lane by raised kerb, which features intermittent breaks to allow access to the numerous driveways along the south side of Inkerman Road. The path, which crosses several side streets and signalised intersections along Inkerman Road, features raised platforms across the former and signalised cyclist crossings through the latter. There are also dedicated cyclist turning lanes at some signalised intersections, for cyclists joining/leaving the cycle path at these locations.

In addition to the bi-directional protected cycle path, a reduced speed limit of 40km/h is also proposed along the entire route, with a one-way traffic arrangement (in the westbound direction) proposed along Inkerman Road. While on-street parking is to be retained on both side of Inkerman Road, a reduced number of spaces are proposed along the south side, in an effort to improve sight distances to/from driveways and the bi-directional protected cycle path. The signalised intersections along Inkerman Road have modified turning/through lanes in line with the one-way traffic arrangement.

Finally, a series of Activation Places are proposed along Inkerman Road at the following locations:

1. Just west of Kalymna Grove
2. Just west of Labassa Grove
3. Just west of Edith Street
4. Just east of Carnarvon Road
5. Just west of Mayfield Grove

Wombat crossings or shared zones are being considered at each location, with the aim of providing pedestrian priority crossing points as well as traffic calming along the route.

Design Option 2:

The proposed changes along Normanby Road and the section of Inkerman Road between Normanby Road and Hawthorn Road are the same as Design Option 1.

The remaining section of Inkerman Road (between Hawthorn Road and Hotham Street) is also the same as Design Option 1, aside from the following:

- A two-way traffic arrangement is to be retained
- On-street parking along the south side is to be completely removed
- The signalised intersections have modified turning/through lane arrangements in line with the two-way traffic arrangement

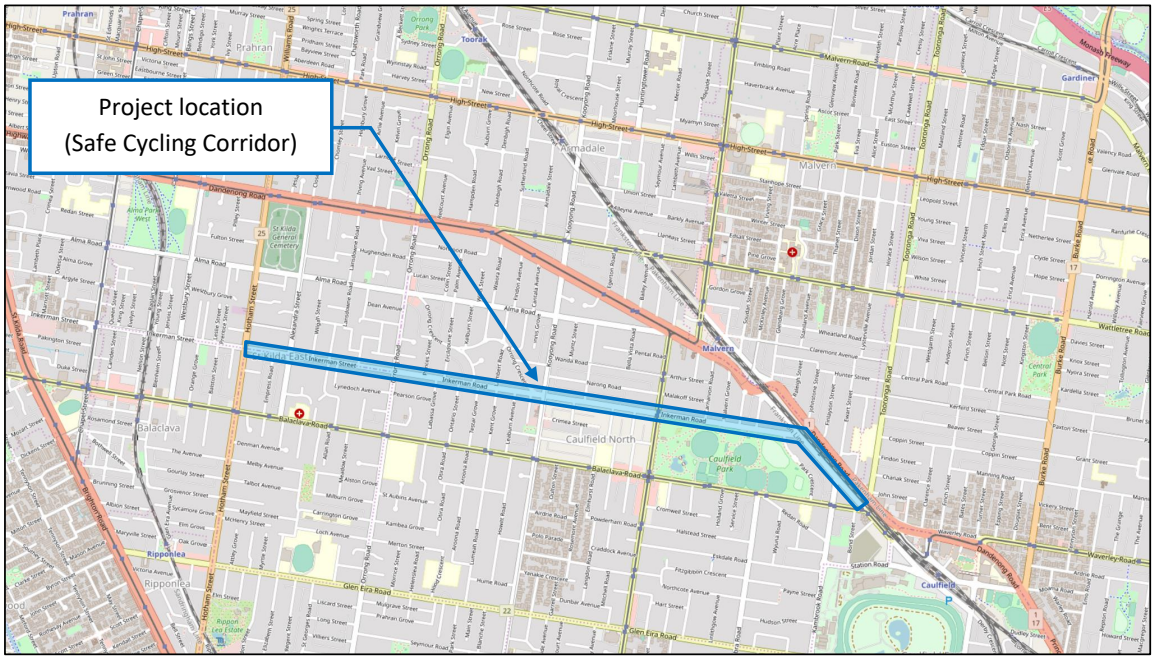

Figure 3: Map showing location of site under assessment (source: OpenStreetMap)

2.3 Context of Assessment



The proposed Safe Cycling Corridor along Inkerman Road is comprised of the elements described below:

Table 2: Austroads AP-R509-16 Prompts

Austroads AP-R509-16 Prompts	Comments
What road users are present? Consider the presence of elderly, school children and cyclists. Also note what facilities are available to vulnerable road users (e.g. signalised crossings, bicycle lanes, school zone speed limits, etc.).	• The residential nature of both Inkerman Road and Normanby Road suggest that a high number of pedestrians would be present along the route. • The entire route features pedestrian footpaths, signalised crossing points at intersections and a POS across Inkerman Road. • The existing on-road bike lanes and bike boxes suggest cyclist numbers along the route are already higher than average. • The important link provided to the broader bicycle network between Melbourne CBD and the south-east, coupled with population growth and increased congestion in Glen Eira City Council is expected to result in significant increase to the number of cyclists along Inkerman Road and Normanby Road. • There are a number of schools in the vicinity of the Inkerman Road, which increases the likelihood of school children being present along the route.
What is the function of the road? Consider location, roadside land use, area type, speed limit, intersection type, presence of parking, public transport services and vehicle flows. What traffic features exist nearby (e.g. upstream and downstream)?	• Inkerman Road provides a primary east-west connection between Caulfield North and St Kilda East. • Normanby Road provides the main link between the Caulfield Racecourse, Caulfield Railway Station and Dandenong Road. • Both roads provide direct access to numerous residences as well as several smaller residential streets. • Inkerman Road and Normanby Road feature on-road parking and bike lanes on both sides. • The eastern section of Normanby Road (between Balaclava Road and Caulfield Railway Station) features central tram tracks, meaning trams share the road with vehicles.

Austroads AP-R509-16 Prompts	Comments
What is the speed environment? What is the current speed limit? Has it changed recently? Is it similar to other roads of this type? How does it compare to Safe System speeds? What is the acceptability of lowering the speed limit at this location?	• The speed limit along Inkerman Road is 50km/h. • The speed limit along Normanby Road is 60km/h. • While the speed limits along both roads are comparable to other residential streets in the area, they are above the Safe System tolerance for collisions with cyclists and pedestrians (30km/h). • The speed compliance along the route in unknown.
What is the vehicle composition? Consider the presence of heavy vehicles (and what type), motorcyclists and other vehicles using the roadway.	• The AADT along Inkerman Road is: ▪ 7200 vpd between Normanby Road and Hawthorn Road ▪ 8600 vpd between Hawthorn Road and Kooyong Road ▪ 11000 vpd between Kooyong Road and Hotham Street • The AADT along Normanby Road is: ▪ 5400 vpd between Caulfield Railway Station and Balaclava Road ▪ 4600 vpd between Balaclava Road and Inkerman Road • Cars are the dominant vehicles along both roads. • Heavy vehicle volumes account for between 2% a 6% of traffic volume, which is below the national average. • Motorcycle volumes are unknown. • It is expected that as the population in the City of Glen Eira continues to grow, vehicle, pedestrian and cyclist traffic along the route will increase.
What is the reason for the project? Is there a specific crash type risk? Is it addressing specific issues such as poor speed limit compliance, road access, congestion, future traffic growth, freight movement, amenity concerns from the community, etc.	• Inkerman Road forms an important link between Melbourne CBD (via the planned protected bicycle lanes along St Kila Road), Caulfield Railway Station and Melbourne's southeast (via the recently completed Djerring Trail, which connects Caulfield and Dandenong). • The significant population growth currently being experienced by the City of Glen Eira is expected to increase congestion on the roads and parking spaces. This is in turn expected to push more people towards alternative forms of transport, such as cycling. • Currently, Inkerman Road only features on-road bike paths and no dedicated crossing facilities. In order to become a Safe Cycling Corridor, infrastructure needs to be improved so as to make cycling a viable mode of transport.

2.4 Austroads AP-R509-16 Matrix

In order to ensure that Safe System elements are considered, or to measure how well a given project (e.g. an intersection, road length, area, treatment type etc.) aligns with Safe System principles, a Safe System matrix is used. The purpose of the matrix is to use a risk assessment approach to assess different major crash types (those identified as the predominant contributors to fatal and serious crash outcomes) against the **exposure** to that crash risk, the **likelihood** of it occurring and the **severity** of the crash should it occur. These three attributes form the rows of the matrix.

The columns of the Safe System matrix show the crash types that represent the main crash and road user types that contribute to death and serious injury. They are included as an element of the matrix to help concentrate thinking on crash causes and solutions. They are also provided in this way to ensure that vulnerable road users are directly considered.

The seven major crash types as shown in the matrix columns are:

1. run-off-road (also referred to as 'loss of control', or 'off path on curve/straight')
2. head-on (or 'vehicles from opposing directions')
3. intersection ('vehicles from adjacent directions')
4. other (this incorporates all same direction, manoeuvring, overtaking, on path and miscellaneous crashes)
5. pedestrian
6. cyclist
7. motorcyclist

Pedestrian, cyclist and motorcyclist crashes are separated to highlight the special focus on vulnerable road users. Note that in some circumstances (depending on the purpose of the assessment) other columns may also be added or removed for specific crash types if these are of high importance (e.g. heavy vehicles).



*The aim of the Safe System matrix is to reduce the total score **towards zero**.*

As scores vary along routes and between intersections, an average score is taken for the project as a whole. Detailed matrix assessments were undertaken to determine the overall scores.

When quantifying alignment with Safe System principles, reference is made to Austroads report AP-R509-16 Safe System Assessment Framework Table 4.2 which is reproduced below as Table 3.

Table 3: Safe System Assessment Matrix – Austroads AP-509-16

Road user exposure	Crash likelihood	Crash severity
0 = there is no exposure to a certain crash type. This might mean there is no side flow or intersecting roads, no cyclists, no pedestrians, or motorcyclists).	0 = there is only minimal chance that a given crash type can occur for an individual road user given the infrastructure in place. Only extreme behaviour or substantial vehicle failure could lead to a crash. This may mean, for example, that two traffic streams do not cross at grade, or that pedestrians do not cross the road.	0 = should a crash occur, there is only minimal chance that it will result in a fatality or serious injury to the relevant road user involved. This might mean that kinetic energies transferred during the crash are low enough not to cause a fatal or serious injury (FSI), or that excessive kinetic energies are effectively redirected/dissipated before being transferred to the road user. Users may refer to Safe System-critical impact speeds for different crash types, while considering impact angles, and types of roadside hazards/barriers present.
1 = volumes of vehicles that may be involved in a particular crash type are particularly low, and therefore exposure is low. For run-of-road, head-on, intersection and 'other' crash types, AADT is < 1 000 per day. For cyclist, pedestrian and motorcycle crash types, volumes are < 10 units per day.	1 = it is highly unlikely that a given crash type will occur.	1 = should a crash occur, it is highly unlikely that it will result in a fatality or serious injury to any road user involved. Kinetic energies must be fairly low during a crash, or the majority is effectively dissipated before reaching the road user.
2 = volumes of vehicles that may be involved in a particular crash type are moderate, and therefore exposure is moderate. For run-of-road, head-on, intersection and 'other' crash types, AADT is between 1 000 and 5 000 per day. For cyclist, pedestrian and motorcycle crash types, volumes are 10–50 units per day.	2 = it is unlikely that a given crash type will occur.	2 = should a crash occur, it is unlikely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are moderate, and the majority of the time they are effectively dissipated before reaching the road user.
3 = volumes of vehicles that may be involved in a particular crash type are high, and therefore exposure is high. For run-of-road, head-on, intersection and 'other' crash types, AADT is between 5 000 and 10 000 per day. For cyclist, pedestrian and motorcycle crash types, volumes are 50–100 units per day.	3 = it is likely that a given crash type will occur.	3 = should a crash occur, it is likely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are moderate, but are not effectively dissipated and therefore may or may not result in an FSI.
4 = volumes of vehicles that may be involved in a particular crash type are very high, or the road is very long, and therefore exposure is very high. For run-of-road, head-on, intersection and 'other' crash types, AADT is > 10 000 per day. For cyclist, pedestrian and motorcycle crash types, volumes are > 100 units per day.	4 = the likelihood of individual road user errors leading to a crash is high given the infrastructure in place (e.g. high approach speed to a sharp curve, priority movement control, filtering right turn across several opposing lanes, high speed).	4 = should a crash occur, it is highly likely that it will result in a fatality or serious injury to any road user involved. Kinetic energies are high enough to cause an FSI crash, and it is unlikely that the forces will be dissipated before reaching the road user.

2.5 Safe System Matrices

Table 4: Safe System Assessment Matrix – Existing Conditions

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	The AADT along Inkerman Road is: • 7200 vpd between Normanby Road and Hawthorn Road • 8600 vpd between Hawthorn Road and Kooyong Road • 11000 vpd between Kooyong Road and Hotham Street The AADT along Normanby Road is: • 4600 vpd between Balaclava Road and Inkerman Road The weighted average AADT along the entire route is between 5000 and 10 000 vpd				For pedestrian crash types, pedestrian volumes are assumed to be greater than 100 units per day (Austroads trigger).	For cyclist crash types, cyclist volumes are assumed to be greater than 100 units per day (Austroads trigger).	For motorcycle crash types, motorcycle volumes are assumed to be between 50 and 100 units per day (Austroads trigger). This is based on the assumption that motorcycles make up approximately 1% of total traffic.
	For run-off-road crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For head-on crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For intersection crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For 'other' crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger). Other crash types may include mid-block rear end, heavy vehicle, hit object/animal, driveway exiting crashes and side swipe/lane change crashes.			
	3/4	3/4	3/4	3/4	4/4	4/4	3/4
Likelihood	Factors that **increase** the likelihood include: • None	Factors that **increase** the likelihood include: • Lack of physical separation between opposing lanes of traffic along Inkerman Road and Normanby Road (e.g. centreline barrier or raised median) • There is a crest on Inkerman Road, between Princess Street and Ercildoune Street. Motorists on approach to the crest have reduced sight distances to oncoming traffic, increasing the likelihood of head-on collisions • AADT > 4000 vpd along the entire route. Head-on crashes are more likely than run-off-road crashes to the right	Factors that **increase** the likelihood include: • Numerous side streets intersect both Inkerman Road and Normanby Road, forming unsignalised cross and T-intersections. The uncontrolled nature of these intersections increases the likelihood of 'failure to give way' type crashes • The on-street parking along the entire route means vehicles are often parked in close proximity to minor intersections. This obstructs sight lines to and from the side streets, increasing the likelihood of intersection type crashes • The majority of uncontrolled intersections along Inkerman Road and Normanby Road do not feature dedicated left turn lanes or channelised right turn lanes. This increases the likelihood of rear-end crashes along the route • Aside from the Inkerman Road / Orrong Road intersection (Inkerman Road approaches only), none of the signalised	Factors that **increase** the likelihood include: • There are numerous driveways along both sides of Inkerman Road, and the south-west side of Normanby Road. This results in a large number of conflict points between vehicles travelling along the route and vehicles exiting/entering driveways • The on-street parking along the entire route means vehicles are often parked in close proximity to driveways. This significantly obstructs sight lines to and from these driveways, increasing the likelihood of collisions between vehicles exiting driveways and vehicles on the main road • The on-street parking along the entire route increases the likelihood of vehicles colliding with motorists entering/leaving the parking lane • Inkerman Road widens to two lanes through the all of the signalised intersections (in place of the on-street parking). As such, vehicles departing the	Factors that **increase** the likelihood include: • Aside from the POS between Orrong Grove and Ontario Street, there are no pedestrian crossing points along the midblock sections of the route. This may prompt unsafe crossing movements along the route • Pedestrians on both sides of Inkerman Road and the south-west side of Normanby Road are often visually obstructed by vehicles parked along the entire route. This means vehicles turning into side streets and driveways may have a reduced visibility to pedestrians on the footpath, increasing the likelihood of pedestrian collisions • The footpaths do not feature pedestrian crossings or raised thresholds across the numerous side streets that intersect with the route	Factors that **increase** the likelihood include: • The on-road bike lanes are not physically separated or protected from the live traffic lane • None of the crossing facilities along the entire route cater to cyclists • Vehicles are parked in close proximity to driveways and side streets. As such, motorists exiting side roads and driveways often have severely obstructed sight lines to on-road cyclists and vice versa, increasing the likelihood of collisions • Roadside parking along the entire route results in continuous conflict with on-road cyclists, who are at an increased risk of being struck by vehicles exiting/entering the parking lane • As the on-street parking lanes are not separated from the bike lanes and bike shared zone, there is an increased likelihood of dooring as drivers leave their vehicles	Factors that **increase** the likelihood include: • The on-street parking along the entire route results in reduced sight distances between motorcyclists and vehicles leaving side roads and driveways • Lack of physical separation between opposing traffic lanes increases the likelihood of head-on collisions with motorcyclists

			intersections have FCRTs along Inkerman Road. This increases the likelihood of right turning vehicles being impacted by oncoming traffic • The signalised intersection between Inkerman Road and Orrong Road is located on an incline. As a result, eastbound motorists on approach have restricted sight lines to the intersection, giving them less time to perform braking or emergency manoeuvres if necessary • None of the signalised intersections along the route feature dedicated left turn lanes, which increases the likelihood of rear-end crashes along the intersection approaches • The intersections between Inkerman Road and Labassa Grove is located on a crest, which reduces sight distances to and from the intersection	intersection must merge into the right most lane, as the left lane turns into on-street parking. This may prompt erratic and unpredictable movements along the intersection departures		• The shared on-street parking lane narrows at some points along the route, forcing cyclists to temporarily enter the live traffic lane • Audio-tactile edge line is present along both sides of Inkerman Road, between Lambert Rd/Kent Grove and Orrong Road. This may destabilise cyclists and cause them to lose control • At most of the signalised intersections along the route, on-road cyclists are forced into the left-turn lane, which increases the likelihood of collisions with left turning vehicles	
	Factors that **decrease** the likelihood include: • The moderate operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) allow more time for braking and emergency manoeuvres • The entire route features either extra wide on-street parking lanes (that are shared with cyclists) or dedicated on-road bike lanes. This provides some degree of separation between the live traffic lane and parked vehicles, giving motorists that stray to the left side of the lane more opportunity to recover before impact • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment • Audio-tactile edge line is present along both sides of Inkerman Road, between Lambert Rd/Kent Grove and Orrong Road. This provides an audible warning when vehicles stray to the left side of the lane, thus reducing the likelihood of motorists running off the road	Factors that **decrease** the likelihood include: • The moderate operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) allow more time for braking and emergency manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic • There are a few isolated median islands along the route, which provide physical of separation between the opposing traffic lanes • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting	Factors that **decrease** the likelihood include: • The moderate operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) allow more time for braking and emergency manoeuvres • In addition to the Normanby Road/Balaclava Road intersection, the following intersections with Inkerman Road along the route are signalised: Hotham Street, Alexandra Street, Orrong Road, Kooyong Road and Hawthorn Road. Compared to priority controlled intersections, signalised arrangements result in a reduced crash likelihood • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances to and from the intersections • Aside from the Inkerman Road / Hawthorn Road intersection, the east and west legs at all signalised intersections along the route feature dedicated right turn lanes. This reduces	Factors that **decrease** the likelihood include: • The entire route features only a single lane in each direction, which does not permit lane switching or overtaking manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances • Less than average heavy vehicle volumes along the entire route (between 2% and 6%) reduce the likelihood of heavy vehicle collisions • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting	Factors that **decrease** the likelihood include: • Inkerman Road features footpaths on both sides of the road, while Normanby Road features a footpath along the south-west side of the road • All of the signalised intersections along the route feature signalised crossing points on all legs, which reduces the likelihood of pedestrians being struck while crossing • There is a POS crossing located between Orrong Grove and Ontario Street, which provides a midblock signalised crossing point across Inkerman Road • The significant number of vehicles parked along the route provide additional physical separation between pedestrians on the footpath and the live traffic lanes	Factors that **decrease** the likelihood include: • Aside from a few choke points, the entire route features either on-road bike lanes or a shared on-street parking lane. This provides cyclists with a dedicated space outside of the live traffic lane, which reduces the likelihood of cyclist collisions • All signalised intersections along the route feature bike boxes, allowing cyclists to store ahead of traffic • The on-road bike lanes at the Inkerman Road/Kooyong Road and Inkerman Road/Orrong Road intersections flare around the left turn lanes, which reduces the number of conflict points between vehicles and cyclists • The pavement condition along the entire route is reasonably good • Both Inkerman Road and Normanby Road appear to have adequate street lighting	Factors that **decrease** the likelihood include: • The moderate operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) allow more time for braking and emergency manoeuvres • The entire route features intermittent on-street parking or dedicated on-road bike lanes. This gives motorcyclists that stray out of their lane a chance to recover (if vehicles are not present), and errant motorcyclists more opportunity to perform braking and emergency manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic and reduces the likelihood of riders losing control • The single lane in each direction reduces the likelihood of motorcyclists being side-swiped • Reasonably consistent vertical geometry along most of the route

	• Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • AADT > 4000 vpd along the entire route. Head-on crashes are more likely than run-off-road crashes to the right • Both Inkerman Road and Normanby Road appear to have adequate street lighting		the likelihood of rear-end crashes at these intersections • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting				• Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting
	2/4	2/4	3/4	3/4	2/4	3/4	3/4
Severity	*Side impacts with fixed objects at speeds greater than 30 km/h are likely to cause death or serious injury.* *Head-on impacts with fixed objects at speeds greater than 50km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) is above the Safe System tolerance for side impact collisions with fixed objects (30km/h) • There are numerous unprotected roadside hazards along the majority of the route • Other point source infrangible hazards along both sides of the route power poles and trees	*Impacts with an oncoming vehicle at speeds greater than 70 km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • Motorists on approach to the crest on Inkerman Road (between Princess Street and Ercildoune Street) have reduced sight distances to oncoming traffic. This gives them less time to reduce their speed prior to impact with oncoming vehicles	*Side-on impacts with a vehicle at speeds greater than 50 km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • The moderate operating along Normanby Road (60km/h) is above the Safe System tolerance for side impact collisions (50km/h) • Cross and T-intersections have unfavourable crash angles • The on-street parking along the entire route means vehicles are often parked in close proximity to minor intersections. This obstructs sight lines to and from the side streets, giving motorists less opportunity to reduce their speed prior to impact	Factors that **increase** the severity include: • The on-street parking along the entire route means vehicles are often parked in close proximity to driveways. This obstructs sight lines, giving motorists less opportunity to reduce their speed prior to impact	*Pedestrians struck at speeds above 30 km/h (the Safe System tolerance) are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury.* Factors that **increase** the severity include: • The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) is above the Safe System tolerance for pedestrian collisions (30km/h) • Pedestrians on the footpath are often visually obstructed by vehicles parked along the entire route. As such motorists may have less opportunity to reduce their speed prior to impact	*Cyclists struck at speeds above 30 km/h (the Safe System tolerance) are likely to be seriously injured or killed. Also, vehicle/cyclist crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury.* Factors that **increase** the severity include: • The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) is above the Safe System tolerance for cyclist collisions (30km/h)	*Due to the vulnerability of motorcyclists, a crash between a motorcycle and a roadside hazard or parked car is likely to result in serious trauma unless speeds are very low.* Factors that **increase** the severity include: • The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) is likely to result in serious injury to riders • There are numerous unprotected roadside hazards along the route, such as parked vehicles, power poles, trees and signage • A fallen rider is likely to slide into oncoming vehicles or an unprotected roadside hazard on either side of the road
	Factors that **decrease** the severity include: • The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) gives motorists more opportunity to reduce their speed below 50km/h, which is the Safe System tolerance for head-on collisions with fixed objects • The entire route features either extra wide on-street parking lanes (that are shared with cyclists) or dedicated on-road bike lanes. This provides some degree of separation between the live traffic lane and parked vehicles, giving errant motorists	Factors that **decrease** the severity include: • The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) is below the Safe System tolerance for head-on crashes (70km/h) • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic, giving motorists more time to reduce their speed prior to impact	Factors that **decrease** the severity include: • The moderate operating along Inkerman Road (50km/h) is equal to the Safe System tolerance for side impact collisions. This speed limit is present along the majority of the route under assessment • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances to most intersections, giving motorists more opportunity to reduce their speed below the Safe System tolerance for side	Factors that **decrease** the severity include: • The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)	Factors that **decrease** the severity include: • Motorists have reasonably good sight distances to the signalised crossing points along the route, giving them more opportunity to reduce their speed prior to impact • The separation between the footpaths and traffic lanes provides some opportunity for errant motorists to reduce their speed prior to impact • Errant vehicles are likely to have their speed further reduced by parked vehicles before reaching the footpath	Factors that **decrease** the severity include: • None	Factors that **decrease** the severity include: • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic, giving motorcyclists more time to reduce their speed prior to impact

	more opportunity to reduce their speed prior to impact		impact crashes (50km/h) prior to impact				
	2.5/4	2/4	3/4	2.5/4	4/4	4/4	4/4
Product	**15/64**	**12/64**	**27/64**	**22.5/64**	**32/64**	**48/64**	**36/64**
						TOTAL	**192.5/448**

Table 5: Safe System Assessment Matrix – ***Design Option 1***

LEGEND
Black text: Common factor between the 'Existing Conditions' and this option
~~Factor~~ (strikethrough): factor that is removed or significantly diminished between the 'Existing Conditions' and this option
Red text: New or significantly altered in this option compared to the 'Existing Conditions'



	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	The AADT along Inkerman Road is: • 7200 vpd between Normanby Road and Hawthorn Road • 8600 vpd between Hawthorn Road and Kooyong Road • 11000 vpd between Kooyong Road and Hotham Street The AADT along Normanby Road is: • 4600 vpd between Balaclava Road and Inkerman Road The weighted average AADT along the entire route is between 5000 and 10 000 vpd				For pedestrian crash types, pedestrian volumes are assumed to be greater than 100 units per day (Austroads trigger).	For cyclist crash types, cyclist volumes are assumed to be greater than 100 units per day (Austroads trigger).	For motorcycle crash types, motorcycle volumes are assumed to be between 50 and 100 units per day (Austroads trigger). This is based on the assumption that motorcycles make up approximately 1% of total traffic.
	For run-off-road crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For head-on crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For intersection crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For 'other' crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger). Other crash types may include mid-block rear end, heavy vehicle, hit object/animal, driveway exiting crashes and side swipe/lane change crashes.			
	3/4	3/4	3/4	3/4	4/4	4/4	3/4
Likelihood	Factors that **increase** the likelihood include: • One-way traffic arrangement along Inkerman Road virtually eliminates the likelihood of head-on crashes along the majority of the route. However, this makes run-off-road crashes to the right more likely	Factors that **increase** the likelihood include: • Lack of physical separation between opposing lanes of traffic along ~~Inkerman Road and~~ Normanby Road (e.g. centreline barrier or raised median) • ~~There is a crest on Inkerman Road, between Princess Street and Ercildoune Street. Motorists on approach to the crest have reduced sight distances to oncoming traffic, increasing the likelihood of head-on collisions~~ • AADT > 4000 vpd along the entire route. Head-on crashes are more likely than run-off-road crashes to the right along Normanby Road	Factors that **increase** the likelihood include: • The Inkerman Road/Normanby Road intersection features an atypical layout, which may increase driver confusion and result in unpredictable movements • Numerous side streets intersect both Inkerman Road and Normanby Road, forming unsignalised cross and T-intersections. The uncontrolled nature of these intersections increases the likelihood of 'failure to give way' type crashes • The on-street parking along the entire route means vehicles are often parked in close proximity to minor intersections. This obstructs sight lines to and from the side streets, increasing the likelihood of intersection type crashes	Factors that **increase** the likelihood include: • There are numerous driveways along both sides of Inkerman Road, and the south-west side of Normanby Road. This results in a large number of conflict points between vehicles travelling along the route and vehicles exiting/entering driveways • The on-street parking ~~along the entire route means vehicles are often parked~~ shown in the concept plans is in close proximity to driveways. This significantly obstructs sight lines to and from these driveways, increasing the likelihood of collisions between vehicles exiting driveways and vehicles on the main road • The on-street parking along the entire route increases the likelihood of vehicles colliding	Factors that **increase** the likelihood include: • In spite of the proposed activation spaces along Inkerman Road, as well as the POS between Orrong Grove and Ontario Street, pedestrians may still cross at unsafe locations to access residences, parked vehicles for example • ~~Aside from the POS between Orrong Grove and Ontario Street, there are no pedestrian crossing points along the midblock sections of the route. This may prompt unsafe crossing movements along the route~~ • Pedestrians on both sides of Inkerman Road and the south-west side of Normanby Road are often visually obstructed by vehicles parked along the entire route. This means vehicles turning into side streets and	Factors that **increase** the likelihood include: • There are numerous driveways along the south side of Inkerman Road that intersect the bi-directional protected cycle path. This increases the likelihood of cyclists being impacted by vehicles exiting/entering driveways • The bi-directional protected cycle path crosses Normanby Road at the intersection with Inkerman Road, increasing the likelihood of collisions with cyclists at this location • Vehicles turning onto Normanby Road from the underpass have extremely poor sight distances to/from the bi-directional protected cycle path, due to the existing brick retaining wall. This increases the likelihood of cyclist collisions	Factors that **increase** the likelihood include: • The on-street parking along the entire route results in reduced sight distances between motorcyclists and vehicles leaving side roads and driveways • Lack of physical separation between opposing traffic lanes increases the likelihood of head-on collisions with motorcyclists along Normanby Road

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
			• The majority of uncontrolled intersections along Inkerman Road and Normanby Road do not feature dedicated left turn lanes or channelised right turn lanes. This increases the likelihood of rear-end crashes along the route • Aside from the Inkerman Road / Orrong Road intersection (Inkerman Road approaches only), none of the signalised intersections have FCRTs along Inkerman Road. ~~This increases the likelihood of right turning vehicles being impacted by oncoming traffic~~ However the one-way traffic arrangement removes the possibility of right turning vehicles being struck by oncoming traffic • Vehicles turning onto Normanby Road from the underpass have extremely poor sight distances to oncoming traffic, due to the existing brick retaining wall. This increases the likelihood of failure to give way type crashes • The signalised intersection between Inkerman Road and Orrong Road is located on an incline. ~~As a result, eastbound motorists on approach have restricted sight lines to the intersection, giving them less time to perform braking or emergency manoeuvres if necessary~~ However, motorists can no longer approach the intersection in the eastbound direction • None of the signalised intersections along the route feature dedicated ~~left~~ right turn lanes, which increases the likelihood of rear-end crashes along the intersection approaches • The intersections between Inkerman Road and Labassa Grove is located on a crest, which reduces sight distances to and from the intersection • The signalised intersections appear to have short dedicated left turn lane transitions along Inkerman Road	with motorists entering/leaving the parking lane • ~~Inkerman Road widens to two lanes through the all of the signalised intersections (in place of the on-street parking). As such, vehicles departing the intersection must merge into the right most lane, as the left lane turns into on-street parking. This may prompt erratic and unpredictable movements along the intersection departures~~	driveways may have a reduced visibility to pedestrians on the footpath, increasing the likelihood of pedestrian collisions • Vehicles turning into driveways or side streets may have their sight lines to pedestrians on the south side of Inkerman Road further reduced by cyclists along the bi-directional protected cycle path • The footpaths along Normanby Road and the north side of Inkerman Road do not feature pedestrian crossings or raised thresholds across the numerous side streets that intersect with the route • There is no separation between the footpath and bi-directional protected cycle path (along the south side of Inkerman Road) through all side street crossing points. This increases the likelihood of collisions between pedestrians and cyclists	• ~~The on-road bike lanes are not physically separated or protected from the live traffic lane~~ • ~~None of the crossing facilities along the entire route cater to cyclists~~ • The concept plans show vehicle parking ~~Vehicles are parked~~ in close proximity to driveways and side streets. As such, motorists ~~exiting~~ turning into side roads and driveways ~~often~~ may have severely obstructed sight lines to ~~on-road cyclists~~ the bi-directional protected cycle path and vice versa, increasing the likelihood of collisions • The bi-directional protected cycle path is not physically separated from the live traffic lane through the intersections along Inkerman Road • ~~Roadside parking along the entire route results in continuous conflict with on-road cyclists, who are at an increased risk of being struck by vehicles exiting/entering the parking lane~~ • ~~As the on-street parking lanes are not separated from the bike lanes and bike shared zone, there is an increased likelihood of dooring as drivers leave their vehicles~~ • ~~The shared on-street parking lane narrows at some points along the route, forcing cyclists to temporarily enter the live traffic lane~~ • Audio-tactile edge line is ~~present along both sides of Inkerman Road, between Lambert Rd/Kent Grove and Orrong Road. This may destabilise cyclists and cause them to lose control~~ not specified in the concept plans • ~~At most of the signalised intersections along the route, on-road cyclists are forced into the left-turn lane, which increases the likelihood of collisions with left turning vehicles~~ • The physical kerb separation between the bi-directional protected cycle path and traffic	

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
						lane narrows through the Normanby Road/Kambrook Road intersection • There is no separation between the footpath and bi-directional protected cycle path (along the south side of Inkerman Road) through all side street crossing points. This increases the likelihood of collisions between pedestrians and cyclists • While the proposed activation spaces (either shared zones or wombat crossings) along Inkerman Road provide pedestrian priority, they act as breaks in the bi-directional protected cycle path and may be difficult for cyclists to negotiate. This increases the likelihood of collisions between cyclists and pedestrians	
	Factors that **decrease** the likelihood include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ allow more time for braking and emergency manoeuvres • ~~The entire route features either extra wide on-street parking lanes (that are shared with cyclists) or dedicated on-road bike lanes. This provides some degree of separation between the live traffic lane and parked vehicles, giving motorists that stray to the left side of the lane more opportunity to recover before impact~~ • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment • Audio-tactile edge line is ~~present along both sides of Inkerman Road, between Lambert Rd/Kent Grove and Orrong Road. This provides an audible warning when vehicles stray to the left side of the lane, thus reducing the likelihood of motorists running off the road~~	Factors that **decrease** the likelihood include: • One-way traffic arrangement along Inkerman Road virtually eliminates the likelihood of head-on crashes along the majority of the route • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ allow more time for braking and emergency manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic along Normanby Road • ~~There are a few isolated median islands along the route, which provide physical of separation between the opposing traffic lanes~~ • Physical median islands at the Normanby Road/Kambrook Road intersection provide brief separation between the opposing traffic lanes along Normanby Road • A number of activation spaces (either shared zones or wombat	Factors that **decrease** the likelihood include: • The one-way traffic arrangement along Inkerman Road results in fewer conflict points at all intersections • The ~~moderate~~ low 40km/h posted speed limit ~~operating speeds along Inkerman Road and~~ Normanby Road ~~(50km/h and 60km/h respectively)~~ allow more time for braking and emergency manoeuvres • In addition to the Normanby Road/Balaclava Road intersection, the following intersections with Inkerman Road along the route are signalised: Hotham Street, Alexandra Street, Orrong Road, Kooyong Road and Hawthorn Road. Compared to priority controlled intersections, signalised arrangements result in a reduced crash likelihood • The Normanby Road/Kambrook Road intersection features a channelised right turn with physical median separation • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances to and from the intersections	Factors that **decrease** the likelihood include: • The one-way traffic arrangement along Inkerman Road results in fewer conflict points along the route • The low 40km/h posted speed limit along the entire route allow more time for braking and emergency manoeuvres • The entire route features only a single lane in ~~each~~ the westbound direction. ~~which does not permit~~ This prevents lane switching or overtaking manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances • Less than average heavy vehicle volumes along the entire route (between 2% and 6%) reduce the likelihood of heavy vehicle collisions • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds	Factors that **decrease** the likelihood include: • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road, creating more pedestrian priority crossing points along the route • Inkerman Road features footpaths on both sides of the road, while Normanby Road features a footpath along the south-west side of the road • Pedestrians along the south side of Inkerman Road are separated from the live traffic lane by the bi-directional protected cycle path and wide physical kerb • All of the signalised intersections along the route feature signalised crossing points on all legs, which reduces the likelihood of pedestrians being struck while crossing • The side street crossing points along the south side of Inkerman Road are raised. This decreases the likelihood of collisions between vehicles entering/exiting the side streets and crossing pedestrians • There is a POS crossing located between Orrong Grove and Ontario Street, which provides	Factors that **decrease** the likelihood include: • The provision of a dedicated bi-directional protected cycle path along the entire route discourages cyclists from riding along the road. This results in significantly fewer conflict points between vehicles and cyclists • ~~Aside from a few choke points, the entire route features either on-road bike lanes or a shared on-street parking lane~~ The entire route features a continuous two-way dedicated cycle path. This provides cyclists with a ~~dedicated~~ fully separated space outside of the live traffic lane, which significantly reduces the likelihood of cyclist collisions • The bi-directional protected cycle path along the route is physically separated from the live traffic lane by a wide raised kerb • The vehicles parked along the south side of Inkerman Road also provide physical separation between cyclists and live traffic • The side street crossing points along the south side of Inkerman Road are raised. This decreases the likelihood of collisions between vehicles	Factors that **decrease** the likelihood include: • The one-way traffic arrangement along Inkerman Road results in fewer conflict points along the route • One-way traffic arrangement along Inkerman Road virtually eliminates the likelihood of head-on crashes along the majority of the route • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ allow more time for braking and emergency manoeuvres • The entire route features intermittent on-street parking ~~or dedicated on-road bike lanes~~. This gives motorcyclists that stray out of their lane a chance to recover (if vehicles are not present), and errant motorcyclists more opportunity to perform braking and emergency manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	not specified in the concept plans • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • ~~AADT > 4000 vpd along the entire route. Head-on crashes are more likely than run-off-road crashes to the right~~ • Both Inkerman Road and Normanby Road appear to have adequate street lighting	crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting	• ~~Aside from the Inkerman Road / Hawthorn Road intersection, the east and west legs at all signalised intersections along the route feature dedicated right turn lanes.~~ All signalised intersections along Inkerman Road feature dedicated left turn lanes. This reduces the likelihood of rear-end crashes at these intersections • The side streets along the south side of Inkerman Road feature raised platforms. This encourages reduced approach speeds, reducing the likelihood of failure to give way type crashes • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting	• Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting	a midblock signalised crossing point across Inkerman Road. This is to be retained as part of the upgrade works • The significant number of vehicles parked along the route (as well as the intermittent physical kerb along the south side of Inkerman Road) provide additional physical separation between pedestrians on the footpath and the live traffic lanes	entering/exiting the side streets and crossing cyclists • The bi-directional protected cycle path features signalised crossing points across all signalised intersections along the route, as well as dedicated turning lanes at some intersections • The bi-directional protected cycle path runs along the north-east side of Normanby Road, between the traffic lane and the rail line. The lack of driveways and side streets (with the exception of the underpass) removes the possibility of cyclists being impacted by entering/exiting vehicles • ~~All signalised intersections along the route feature bike boxes, allowing cyclists to store ahead of traffic~~ • ~~The on-road bike lanes at the Inkerman Road/Kooyong Road and Inkerman Road/Orrong Road intersections flare around the left turn lanes, which reduces the number of conflict points between vehicles and cyclists~~ • The pavement condition along the entire route is reasonably good • Both Inkerman Road and Normanby Road appear to have adequate street lighting	and reduces the likelihood of riders losing control • The single lane in ~~each~~ the westbound direction significantly reduces the likelihood of motorcyclists being side-swiped along Inkerman Road • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting
	~~2~~ 2.5/4	~~2~~ 0.5/4	~~3~~ 2/4	~~3~~ 2/4	~~2~~ 1.5/4	~~3~~ 1.5/4	~~3~~ 2/4
Severity	*Side impacts with fixed objects at speeds greater than 30 km/h are likely to cause death or serious injury.* *Head-on impacts with fixed objects at speeds greater than 50km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ is above the Safe System tolerance for side impact collisions with fixed objects (30km/h)	*Impacts with an oncoming vehicle at speeds greater than 70 km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • ~~Motorists on approach to the crest on Inkerman Road (between Princess Street and Ercildoune Street) have reduced sight distances to oncoming traffic. This gives them less time to reduce their speed prior to impact with oncoming vehicles~~	*Side-on impacts with a vehicle at speeds greater than 50 km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • ~~The moderate operating along Normanby Road (60km/h) is above the Safe System tolerance for side impact collisions (50km/h)~~ • Cross and T-intersections have unfavourable crash angles • The on-street parking along the entire route means vehicles are often parked in close proximity to minor intersections. This obstructs sight lines to and from the side streets, giving	Factors that **increase** the severity include: • The on-street parking along the entire route means vehicles are often parked in close proximity to driveways. This obstructs sight lines, giving motorists less opportunity to reduce their speed prior to impact	*Pedestrians struck at speeds above 30 km/h (the Safe System tolerance) are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury.* Factors that **increase** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ is above the Safe System tolerance for pedestrian collisions (30km/h)	*Cyclists struck at speeds above 30 km/h (the Safe System tolerance) are likely to be seriously injured or killed. Also, vehicle/cyclist crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury.* Factors that **increase** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ is above the Safe System tolerance for cyclist collisions (30km/h)	*Due to the vulnerability of motorcyclists, a crash between a motorcycle and a roadside hazard or parked car is likely to result in serious trauma unless speeds are very low.* Factors that **increase** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) is likely to~~ may still result in serious injury to riders • There are numerous unprotected roadside hazards along the route, such as parked

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	• ~~There are~~ While there are fewer parking spaces along Inkerman Road and Normanby Road, numerous unprotected roadside hazards are still present along the majority of the route • Other point source infrangible hazards along both sides of the route power poles and trees		motorists less opportunity to reduce their speed prior to impact		• Pedestrians on the footpath are often visually obstructed by vehicles parked along the entire route (and cyclists along the south side of Inkerman Road). As such motorists may have less opportunity to reduce their speed prior to impact	• Cyclists riding along the bi-directional protected cycle path may be visually obstructed by parked vehicles along Inkerman Road, giving motorists less opportunity to reduce their speed prior to impact	vehicles, power poles, trees and signage • A fallen rider is likely to slide into oncoming vehicles (along Normanby Road only) or an unprotected roadside hazard on either side of the road
	Factors that **decrease** the severity include: • The 40km/h posted speed limit along the entire route is below the Safe System tolerance for head-on impacts with fixed objects (50km/h) • The reduced 40km/h speed limit along the route gives motorists more opportunity to reduce their speed to below 30km/h prior to impact, which is the Safe System tolerance for side impact collisions with fixed objects • ~~The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) gives motorists more opportunity to reduce their speed below 50km/h, which is the Safe System tolerance for head-on collisions with fixed objects~~ • ~~The entire route features either extra wide on-street parking lanes (that are shared with cyclists) or dedicated on-road bike lanes. This provides some degree of separation between the live traffic lane and parked vehicles, giving errant motorists more opportunity to reduce their speed prior to impact~~	Factors that **decrease** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ is far below the Safe System tolerance for head-on crashes (70km/h) • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic along Normanby Road, giving motorists more time to reduce their speed prior to impact	Factors that **decrease** the severity include: • The low 40km/h posted speed limit along the entire route is below the Safe System tolerance for side impact collisions (50km/h) • ~~The moderate operating along Inkerman Road (50km/h) is equal to the Safe System tolerance for side impact collisions. This speed limit is present along the majority of the route under assessment~~ • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances to most intersections, giving motorists more opportunity to further reduce their speed ~~below the Safe System tolerance for side impact crashes (50km/h) prior to impact~~	Factors that **decrease** the severity include: • ~~The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ • The low 40km/h posted speed limit along the entire route gives motorists more opportunity to further reduce their speed prior to impact	Factors that **decrease** the severity include: • Motorists have reasonably good sight distances to the signalised crossing points along the route, giving them more opportunity to reduce their speed to below the Safe System tolerance (30km/h) prior to impact • The separation between the footpaths and traffic lanes provides some opportunity for errant motorists to reduce their speed to below the Safe System tolerance (30km/h) prior to impact • Errant vehicles are likely to have their speed further reduced by parked vehicles (and the bi-directional protected cycle path/wide physical kerb along the south side of Inkerman Road) before reaching the footpath	Factors that **decrease** the severity include: • Errant vehicles are likely to have their speed reduced below 30km/h (the Safe System tolerance) by the intermittent physical kerb separation and/or parked vehicles before reaching the bi-directional protected cycle path • The provision of a dedicated bi-directional protected cycle path along the entire route discourages cyclists from riding along the road. As a result, any potential collisions with cyclists are likely to involve lower vehicle speeds	Factors that **decrease** the severity include: • The reduced 40km/h speed limit along the route gives motorists more opportunity to further reduce their speed to prior to impact • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic along Normanby Road, giving motorists more time to reduce their speed prior to impact
	~~2.5~~ 2/4	~~3~~ 1/4	~~3~~ 2/4	~~2.5~~ 2/4	4/4	~~4~~ 3/4	4/4
Product	**15/64**	**~~12~~ 1.5/64**	**~~27~~ 12/64**	**~~22.5~~ 12/64**	**~~32~~ 24/64**	**~~48~~ 18/64**	**~~36~~ 24/64**
						TOTAL	**106.5/448**

Table 6: Safe System Assessment Matrix – ***Design Option 2***

LEGEND
Black text: Common factor between the Existing Conditions and this option
~~Factor~~ (strikethrough): factor that is removed or significantly diminished between the Existing Conditions and this option
Blue text: New or significantly altered in this option compared to the Existing Conditions



	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	The AADT along Inkerman Road is: • 7200 vpd between Normanby Road and Hawthorn Road • 8600 vpd between Hawthorn Road and Kooyong Road • 11000 vpd between Kooyong Road and Hotham Street The AADT along Normanby Road is: • 4600 vpd between Balaclava Road and Inkerman Road The weighted average AADT along the entire route is between 5000 and 10 000 vpd				For pedestrian crash types, pedestrian volumes are assumed to be greater than 100 units per day (Austroads trigger).	For cyclist crash types, cyclist volumes are assumed to be greater than 100 units per day (Austroads trigger).	For motorcycle crash types, motorcycle volumes are assumed to be between 50 and 100 units per day (Austroads trigger). This is based on the assumption that motorcycles make up approximately 1% of total traffic.
	For run-off-road crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For head-on crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For intersection crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger).	For 'other' crash types, the AADT average along the entire route is between 5,000 and 10,000 vpd (Austroads trigger). Other crash types may include mid-block rear end, heavy vehicle, hit object/animal, driveway exiting crashes and side swipe/lane change crashes.			
	3/4	3/4	3/4	3/4	4/4	4/4	3/4
Likelihood	Factors that **increase** the likelihood include: • The physical kerb separation between the bi-directional protected cycle path and the traffic lane give motorists less opportunity to recover if they stray out of the traffic lane	Factors that **increase** the likelihood include: • Lack of physical separation between opposing lanes of traffic along Inkerman Road and Normanby Road (e.g. centreline barrier or raised median) • There is a crest on Inkerman Road, between Princess Street and Ercildoune Street. Motorists on approach to the crest have reduced sight distances to oncoming traffic, increasing the likelihood of head-on collisions • AADT > 4000 vpd along the entire route. Head-on crashes are more likely than run-off-road crashes to the right, where a two-way traffic arrangement is present	Factors that **increase** the likelihood include: • The Inkerman Road/Normanby Road intersection features an atypical layout, which may increase driver confusion and result in unpredictable movements • Eastbound motorists along Inkerman Road be unaware of the one-way arrangement east of Hawthorn Road, which may lead to collisions at the intersection • Numerous side streets intersect both Inkerman Road and Normanby Road, forming unsignalised cross and T-intersections. The uncontrolled nature of these intersections increases the likelihood of 'failure to give way' type crashes • The on-street parking along the entire route means vehicles are	Factors that **increase** the likelihood include: • There are numerous driveways along both sides of Inkerman Road, and the south-west side of Normanby Road. This results in a large number of conflict points between vehicles travelling along the route and vehicles exiting/entering driveways • The on-street parking ~~along the entire route means vehicles are often parked~~ shown in the concept plans is in close proximity to driveways. This significantly obstructs sight lines to and from these driveways, increasing the likelihood of collisions between vehicles exiting driveways and vehicles on the main road • The on-street parking along the entire route increases the likelihood of vehicles colliding	Factors that **increase** the likelihood include: • In spite of the proposed activation spaces along Inkerman Road, as well as the POS between Orrong Grove and Ontario Street, pedestrians may still cross at unsafe locations to access residences, parked vehicles for example • ~~Aside from the POS between Orrong Grove and Ontario Street, there are no pedestrian crossing points along the midblock sections of the route. This may prompt unsafe crossing movements along the route~~ • Pedestrians on both sides of Inkerman Road and the south-west side of Normanby Road are often visually obstructed by vehicles parked along the entire route. This means vehicles turning into side streets and	Factors that **increase** the likelihood include: • There are numerous driveways along the south side of Inkerman Road that intersect the bi-directional protected cycle path. This increases the likelihood of cyclists being impacted by vehicles exiting/entering driveways • The bi-directional protected cycle path crosses Normanby Road at the intersection with Inkerman Road, increasing the likelihood of collisions with cyclists at this location • Vehicles turning onto Normanby Road from the underpass have extremely poor sight distances to/from the bi-directional protected cycle path, due to the existing brick retaining wall. This increases the likelihood of cyclist collisions	Factors that **increase** the likelihood include: • The on-street parking along the entire route results in reduced sight distances between motorcyclists and vehicles leaving side roads and driveways • Lack of physical separation between opposing traffic lanes increases the likelihood of head-on collisions with motorcyclists, where a two-way traffic arrangement is present

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
			often parked in close proximity to minor intersections. This obstructs sight lines to and from the side streets, increasing the likelihood of intersection type crashes • The majority of uncontrolled intersections along Inkerman Road and Normanby Road do not feature dedicated left turn lanes or channelised right turn lanes. This increases the likelihood of rear-end crashes along the route • Aside from the Inkerman Road/Orrong Road intersection (Inkerman Road approaches only), none of the signalised intersections have FCRTs along Inkerman Road. This increases the likelihood of right turning vehicles being impacted by oncoming traffic • Vehicles turning onto Normanby Road from the underpass have extremely poor sight distances to oncoming traffic, due to the existing brick retaining wall. This increases the likelihood of failure to give way type crashes • The signalised intersection between Inkerman Road and Orrong Road is located on an incline. As a result, eastbound motorists on approach have restricted sight lines to the intersection, giving them less time to perform braking or emergency manoeuvres if necessary • ~~None~~ Most of the signalised intersections along the route do not feature dedicated ~~left~~ turn lanes, which increases the likelihood of rear-end crashes along the intersection approaches • The intersections between Inkerman Road and Labassa Grove is located on a crest, which reduces sight distances to and from the intersection • The signalised intersections appear to have short dedicated left turn lane transitions along Inkerman Road	with motorists entering/leaving the parking lane • ~~Inkerman Road widens to two lanes through the all of the signalised intersections (in place of the on-street parking). As such, vehicles departing the intersection must merge into the right most lane, as the left lane turns into on-street parking. This may prompt erratic and unpredictable movements along the intersection departures~~	driveways may have a reduced visibility to pedestrians on the footpath, increasing the likelihood of pedestrian collisions • Vehicles turning into driveways or side streets may have their sight lines to pedestrians on the south side of Inkerman Road further reduced by cyclists along the bi-directional protected cycle path • The footpaths along Normanby Road and the north side of Inkerman Road do not feature pedestrian crossings or raised thresholds across the numerous side streets that intersect with the route • There is no separation between the footpath and bi-directional protected cycle path (along the south side of Inkerman Road) through all side street crossing points. This increases the likelihood of collisions between pedestrians and cyclists	• ~~The on-road bike lanes are not physically separated or protected from the live traffic lane~~ • ~~None of the crossing facilities along the entire route cater to cyclists~~ • The concept plans show vehicle parking ~~Vehicles are parked~~ in close proximity to driveways and side streets. As such, motorists ~~exiting~~ turning into side roads and driveways ~~often~~ may have severely obstructed sight lines to ~~on-road cyclists~~ the bi-directional protected cycle path and vice versa, increasing the likelihood of collisions • The bi-directional protected cycle path is not physically separated from the live traffic lane through the intersections along Inkerman Road • ~~Roadside parking along the entire route results in continuous conflict with on-road cyclists, who are at an increased risk of being struck by vehicles exiting/entering the parking lane~~ • ~~As the on-street parking lanes are not separated from the bike lanes and bike shared zone, there is an increased likelihood of dooring as drivers leave their vehicles~~ • ~~The shared on-street parking lane narrows at some points along the route, forcing cyclists to temporarily enter the live traffic lane~~ • Audio-tactile edge line is ~~present along both sides of Inkerman Road, between Lambert Rd/Kent Grove and Orrong Road. This may destabilise cyclists and cause them to lose control~~ not specified in the concept plans • ~~At most of the signalised intersections along the route, on-road cyclists are forced into the left-turn lane, which increases the likelihood of collisions with left turning vehicles~~ • The physical kerb separation between the bi-directional protected cycle path and traffic	

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
						lane narrows through the Normanby Road/Kambrook Road intersection • There is no separation between the footpath and bi-directional protected cycle path (along the south side of Inkerman Road) through all side street crossing points. This increases the likelihood of collisions between pedestrians and cyclists • While the proposed activation spaces (either shared zones or wombat crossings) along Inkerman Road provide pedestrian priority, they act as breaks in the bi-directional protected cycle path and may be difficult for cyclists to negotiate. This increases the likelihood of collisions between cyclists and pedestrians	
	Factors that **decrease** the likelihood include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ allow more time for braking and emergency manoeuvres • Aside from the section of Inkerman Road between Hawthorn Road and Normanby Road, on-street parking has been removed from one side of the road along the entire route. This reduces the number of infrangible roadside hazards present • ~~The entire route features either extra wide on-street parking lanes (that are shared with cyclists) or dedicated on-road bike lanes. This provides some degree of separation between the live traffic lane and parked vehicles, giving motorists that stray to the left side of the lane more opportunity to recover before impact~~ • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment	Factors that **decrease** the likelihood include: • One-way traffic arrangement along Inkerman Road (between Hawthorn Road and Normanby Road) virtually eliminates the likelihood of head-on crashes along this section of the route • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ allow more time for braking and emergency manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic, where a two-way traffic arrangement is present • ~~There are a few isolated median islands along the route, which provide physical of separation between the opposing traffic lanes~~ • Physical median islands at the Normanby Road/Kambrook Road intersection provide brief separation between the opposing traffic lanes along Normanby Road	Factors that **decrease** the likelihood include: • The ~~moderate~~ low 40km/h posted speed limit ~~operating speeds along Inkerman Road and~~ Normanby Road ~~(50km/h and 60km/h respectively)~~ allow more time for braking and emergency manoeuvres • In addition to the Normanby Road/Balaclava Road intersection, the following intersections with Inkerman Road along the route are signalised: Hotham Street, Alexandra Street, Orrong Road, Kooyong Road and Hawthorn Road. Compared to priority controlled intersections, signalised arrangements result in a reduced crash likelihood • The Normanby Road/Kambrook Road intersection features a channelised right turn with physical median separation • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances to and from the intersections • ~~Aside from the Inkerman Road / Hawthorn Road intersection, the east and west legs at all signalised intersections along~~	Factors that **decrease** the likelihood include: • The low 40km/h posted speed limit along the entire route allow more time for braking and emergency manoeuvres • ~~The entire~~ Most of the route features only a single lane in each direction, which does not permit lane switching or overtaking manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances • Less than average heavy vehicle volumes along the entire route (between 2% and 6%) reduce the likelihood of heavy vehicle collisions • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route	Factors that **decrease** the likelihood include: • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road, creating more pedestrian priority crossing points along the route • Inkerman Road features footpaths on both sides of the road, while Normanby Road features a footpath along the south-west side of the road • Pedestrians along the south side of Inkerman Road are separated from the live traffic lane by the bi-directional protected cycle path and wide physical kerb • All of the signalised intersections along the route feature signalised crossing points on all legs, which reduces the likelihood of pedestrians being struck while crossing • The side street crossing points along the south side of Inkerman Road are raised. This decreases the likelihood of collisions between vehicles entering/exiting the side streets and crossing pedestrians • There is a POS crossing located between Orrong Grove and Ontario Street, which provides	Factors that **decrease** the likelihood include: • The provision of a dedicated bi-directional protected cycle path along the entire route discourages cyclists from riding along the road. This results in significantly fewer conflict points between vehicles and cyclists • The removal of parking along the most of Inkerman Road (south side) means that motorists will have good visibility to/from the bi-directional protected cycle path • ~~Aside from a few choke points, the entire route features either on-road bike lanes or a shared on-street parking lane~~ The entire route features a continuous two-way dedicated cycle path. This provides cyclists with a ~~dedicated~~ fully separated space outside of the live traffic lane, which significantly reduces the likelihood of cyclist collisions • The bi-directional protected cycle path along the route is physically separated from the live traffic lane by a wide raised kerb • The side street crossing points along the south side of Inkerman Road are raised. This	Factors that **decrease** the likelihood include: • The one-way traffic arrangement along a small section of Inkerman Road (between Hawthorn Road and Normanby Road) results in fewer conflict points and reduced likelihood of head-on collisions • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ allow more time for braking and emergency manoeuvres • The entire route features intermittent on-street parking ~~or dedicated on-road bike lanes~~. This gives motorcyclists that stray out of their lane a chance to recover (if vehicles are not present), and errant motorcyclists more opportunity to perform braking and emergency manoeuvres • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	• Audio-tactile edge line is ~~present along both sides of Inkerman Road, between Lambert Rd/Kent Grove and Orrong Road. This provides an audible warning when vehicles stray to the left side of the lane, thus reducing the likelihood of motorists running off the road~~ not specified in the concept plans • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • AADT > 4000 vpd along the entire route. Head-on crashes are more likely than run-off-road crashes to the right Both Inkerman Road and Normanby Road appear to have adequate street lighting	• A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route Both Inkerman Road and Normanby Road appear to have adequate street lighting	~~the route feature dedicated right turn lanes. This reduces the likelihood of rear-end crashes at these intersections~~ • The side streets along the south side of Inkerman Road feature raised platforms. This encourages reduced approach speeds, reducing the likelihood of failure to give way type crashes • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting	Both Inkerman Road and Normanby Road appear to have adequate street lighting	a midblock signalised crossing point across Inkerman Road. This is to be retained as part of the upgrade works The significant number of vehicles parked along the route (as well as the intermittent physical kerb along the south side of Inkerman Road) provide additional physical separation between pedestrians on the footpath and the live traffic lanes	decreases the likelihood of collisions between vehicles entering/exiting the side streets and crossing cyclists • The bi-directional protected cycle path features signalised crossing points across all signalised intersections along the route, as well as dedicated turning lanes at some intersections • The bi-directional protected cycle path runs along the north-east side of Normanby Road, between the traffic lane and the rail line. The lack of driveways and side streets (with the exception of the underpass) removes the possibility of cyclists being impacted by entering/exiting vehicles • ~~All signalised intersections along the route feature bike boxes, allowing cyclists to store ahead of traffic~~ • ~~The on-road bike lanes at the Inkerman Road/Kooyong Road and Inkerman Road/Orrong Road intersections flare around the left turn lanes, which reduces the number of conflict points between vehicles and cyclists~~ • The pavement condition along the entire route is reasonably good Both Inkerman Road and Normanby Road appear to have adequate street lighting	and reduces the likelihood of riders losing control • The single lane in each direction reduces the likelihood of motorcyclists being side-swiped • A number of activation spaces (either shared zones or wombat crossings) are proposed along Inkerman Road. These act as traffic calming measures, prompting reduced vehicle speeds • Reasonably consistent vertical geometry along most of the route • Acceptable pavement marking and delineation along the entire route • Both Inkerman Road and Normanby Road appear to have adequate street lighting
	2/4	~~2~~ 1.5/4	~~3~~ 2.5/4	~~3~~ 2.5/4	~~2~~ 1.5/4	~~3~~ 1/4	~~3~~ 2.5/4
Severity	*Side impacts with fixed objects at speeds greater than 30 km/h are likely to cause death or serious injury.* *Head-on impacts with fixed objects at speeds greater than 50km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ is above the Safe System tolerance for	*Impacts with an oncoming vehicle at speeds greater than 70 km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • Motorists on approach to the crest on Inkerman Road (between Princess Street and Ercildoune Street) have reduced sight distances to oncoming traffic. This gives them less time to reduce their speed prior to impact with oncoming vehicles	*Side-on impacts with a vehicle at speeds greater than 50 km/h are likely to cause death or serious injury.* Factors that **increase** the severity include: • ~~The moderate operating along Normanby Road (60km/h) is above the Safe System tolerance for side impact collisions (50km/h)~~ • Cross and T-intersections have unfavourable crash angles • The on-street parking along the entire route means vehicles are often parked in close proximity to minor intersections. This	Factors that **increase** the severity include: • The on-street parking along the entire route means vehicles are often parked in close proximity to driveways. This obstructs sight lines, giving motorists less opportunity to reduce their speed prior to impact	*Pedestrians struck at speeds above 30 km/h (the Safe System tolerance) are likely to be seriously injured or killed. Also, vehicle/pedestrian crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury.* Factors that **increase** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ is above	*Cyclists struck at speeds above 30 km/h (the Safe System tolerance) are likely to be seriously injured or killed. Also, vehicle/cyclist crashes at even lower speeds (especially involving heavy vehicles) can cause serious injury.* Factors that **increase** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ is above	*Due to the vulnerability of motorcyclists, a crash between a motorcycle and a roadside hazard or parked car is likely to result in serious trauma unless speeds are very low.* Factors that **increase** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) is likely to~~ may still result in serious injury to riders

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
	side impact collisions with fixed objects (30km/h) • ~~There are~~ In spite of the on-street parking removal, numerous unprotected roadside hazards are still present along the majority of the route • Other point source infrangible hazards along both sides of the route power poles and trees		obstructs sight lines to and from the side streets, giving motorists less opportunity to reduce their speed prior to impact		the Safe System tolerance for pedestrian collisions (30km/h) • Pedestrians on the footpath are often visually obstructed by vehicles parked along the entire route (and cyclists along the south side of Inkerman Road). As such motorists may have less opportunity to reduce their speed prior to impact	the Safe System tolerance for cyclist collisions (30km/h)	• There are numerous unprotected roadside hazards along the route, such as parked vehicles, power poles, trees and signage • A fallen rider is likely to slide into oncoming vehicles or an unprotected roadside hazard on either side of the road
	Factors that **decrease** the severity include: • The 40km/h posted speed limit along the entire route is below the Safe System tolerance for head-on impacts with fixed objects (50km/h) • The reduced 40km/h speed limit along the route gives motorists more opportunity to reduce their speed to below 30km/h prior to impact, which is the Safe System tolerance for side impact collisions with fixed objects • Aside from the section of Inkerman Road between Hawthorn Road and Normanby Road, on-street parking has been removed from one side of the road along the entire route. This reduces the number of infrangible roadside hazards present • ~~The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively) gives motorists more opportunity to reduce their speed below 50km/h, which is the Safe System tolerance for head-on collisions with fixed objects~~ ~~The entire route features either extra-wide on-street parking lanes (that are shared with cyclists) or dedicated on-road bike lanes. This provides some degree of separation between the live traffic lane and parked vehicles, giving errant motorists more opportunity to reduce their speed prior to impact~~	Factors that **decrease** the severity include: • The ~~moderate~~ low 40km/h posted speed limit along the entire route ~~operating speeds along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ is far below the Safe System tolerance for head-on crashes (70km/h) Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic (where there is a two-way traffic arrangement is present), giving motorists more time to reduce their speed prior to impact	Factors that **decrease** the severity include: • The low 40km/h posted speed limit along the entire route is below the Safe System tolerance for side impact collisions (50km/h) • ~~The moderate operating along Inkerman Road (50km/h) is equal to the Safe System tolerance for side impact collisions. This speed limit is present along the majority of the route under assessment~~ Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides good sight distances to most intersections, giving motorists more opportunity to further reduce their speed ~~below the Safe System tolerance for side impact crashes (50km/h) prior to impact~~	Factors that **decrease** the severity include: • ~~The moderate operating speed along Inkerman Road and Normanby Road (50km/h and 60km/h respectively)~~ The low 40km/h posted speed limit along the entire route gives motorists more opportunity to further reduce their speed prior to impact	Factors that **decrease** the severity include: • Motorists have reasonably good sight distances to the signalised crossing points along the route, giving them more opportunity to reduce their speed to below the Safe System tolerance (30km/h) prior to impact • The separation between the footpaths and traffic lanes provides some opportunity for errant motorists to reduce their speed to below the Safe System tolerance (30km/h) prior to impact Errant vehicles are likely to have their speed further reduced by parked vehicles (and the bi-directional protected cycle path/wide physical kerb along the south side of Inkerman Road) before reaching the footpath	Factors that **decrease** the severity include: • Errant vehicles are likely to have their speed reduced below 30km/h (the Safe System tolerance) by the intermittent physical kerb separation and/or parked vehicles before reaching the bi-directional protected cycle path The provision of a dedicated bi-directional protected cycle path along the entire route discourages cyclists from riding along the road. As a result, any potential collisions with cyclists are likely to involve lower vehicle speeds	Factors that **decrease** the severity include: • The reduced 40km/h speed limit along the route gives motorists more opportunity to further reduce their speed to prior to impact • Aside from the T-intersection between Inkerman Road and Normanby Road, the route features an entirely straight horizontal alignment. This provides excellent sight distances to oncoming traffic, giving motorists more time to reduce their speed prior to impact
	~~2.5~~ 2/4	~~2~~ 1/4	~~3~~ 2/4	~~2.5~~ 2/4	4/4	~~4~~ 3/4	4/4
Product	**~~15~~ 12/64**	**~~12~~ 4.5/64**	**~~27~~ 15/64**	**~~22.5~~ 15/64**	**~~32~~ 24/64**	**~~48~~ 12/64**	**~~36~~ 30/64**

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
						TOTAL	112.5/448

2.6 Results of assessment

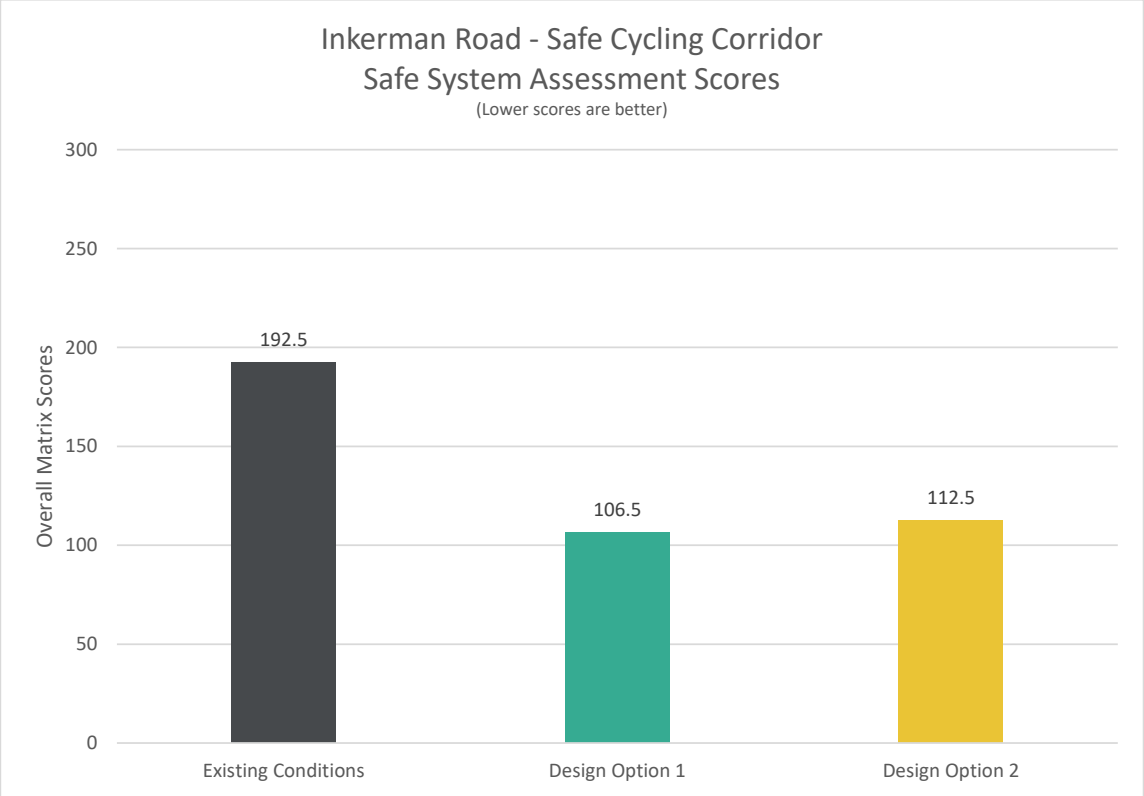

Figure 4: Overall Safe System Assessment Scores

As shown in Figure 4, both design options have a lower overall SSA score, and are therefore better aligned with Safe System Principles compared to the existing conditions.

Out of the two design options, Design Option 1 has the lowest score and hence represents the option with greatest alignment with Safe System principles. This can be primarily attributed to the reduced 40km/h speed limit and dedicated bi-directional protected cycle path along the entire route, as well as the one-way traffic arrangement along Inkerman Road resulting in fewer conflict points along the route. While Design Option 2 retains the two-way traffic arrangement along most of Inkerman Road and is therefore the least favourable of the two options, it still represents a measurable improvement in road safety compared to the existing conditions, which have the worst alignment with Safe System principles.

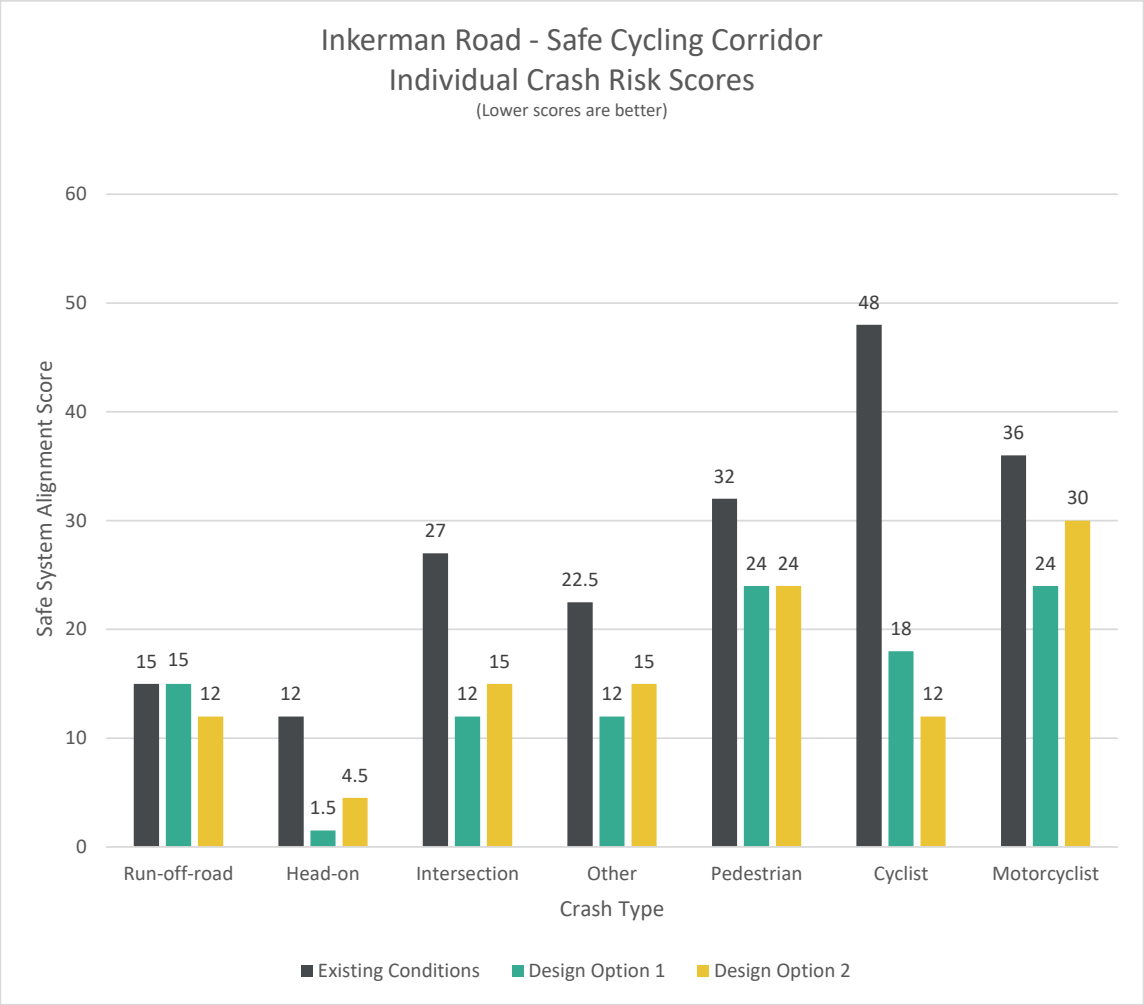

Figure 5: Individual Crash Risk Scores

Figure 5 shows the individual crash risk scores for each of the design options.

While the reduced 40km/h speed limit creates a reduction in run-off-road crash severity, the one-way traffic arrangement along Inkerman Road in Design Option 1 means vehicles that run off the road to the right cannot collide with oncoming vehicles, and therefore have a greater likelihood of colliding with roadside hazards along the north side of the road. As a result, the overall run-off road crash risk score in Design Option 1 remains the same as the existing conditions. Design Option 2, which features the removal of some on-street parking number (roadside hazards), reduced speed limit and two-way traffic arrangement along most of the route therefore has the best safety outcome for run-off-road crash risk.

All other crash types see a reduction in score (safety improvement) across both design options, compared to the existing conditions. One of the primary reasons for this is the reduced 40km/h speed limit along the entire route, which not only results in less kinetic energy in the event of a crash, but also gives motorists more time to further reduce speed prior to impact, or perform emergency manoeuvres to avoid collisions entirely. This reduces likelihood and severity of all crash types.

Cyclists see the greatest improvement in safety outcome due to the bi-directional protected cycle path running along the entire route. The physical separation between the cycle path and the live traffic lane (raised kerb and/or on-street parking), coupled with the provision cyclist crossing facilities at both signalised and unsignalised intersections improves the continuity of the cycle path and reduces the interaction between cyclists and vehicular traffic. Additionally, the physical kerb separation along with the reduced speed limit means that errant vehicle speeds are much more likely to be reduced to, or even below the Safe System tolerance for cyclist collisions (30km/h) prior to potential collisions. For these reasons, both design options generate a significant reduction in cyclist crash risk.

The removal of on-street parking (along the south side of Inkerman Road) in Design Option 2 creates less physical separation between the cycle path and the live traffic lane. However, this also results in much improved sight lines to/from the cycle path through the removal of visual obstructions (parked vehicles), which has been identified as an important safety concern. As a result, the likelihood of collisions between cyclists and vehicles turning into driveways and side streets along Inkerman Road is lower, resulting in a lower cyclist crash risk score compared to Design Option 1.

While both design options see a decrease in head-on crash risk score due to the reduced speed limit (which is far lower than the 70km/h Safe System tolerance), the Inkerman Road one-way traffic arrangement in Design Option 1 virtually eliminates the possibility of head-on collisions along most of the route. Similarly, the one-way traffic arrangement reduces the number of conflict points along the route, as right turning vehicles at signalised intersections, side streets and driveways (both into and out of) do not have to cross an oncoming lane of traffic. This means that intersection, other and motorcycle crash types all see an additional safety benefit in Design Option 1 on top of the benefit provided by the reduced 40km/h speed limit. So while both options are better than the existing conditions, Design Option 1 has the best safety outcome for head-on, intersection, other and motorcycle crash types.

Finally, pedestrians also see a reduced crash risk score under both design options. This is because of the reduced 40km/h speed limit and additional separation (provided by the bi-directional cycle path) between the footpath and traffic lane along the south side of Inkerman Road, resulting reduced crash likelihood. Furthermore, the activation spaces along Inkerman Road give pedestrians more priority (or low speed) crossing points, discouraging crossing at unsafe locations and reducing the likelihood of collisions between vehicles and pedestrians through the crossing points. Therefore, both design options have the same pedestrian crash risk score, which represents a better safety outcome compared to the existing conditions.

2.7 Safer Vehicles, People and Post-Crash Care (high level comments)

Table 7: High Level Comments

Safe System Element	Prompt	Comments/issues
Road User	Are road users likely to be alert and compliant? Are there factors that might influence this?	1. Multiple road users are present along the route, including vehicles, trams (along Normanby Road only), pedestrians and cyclists. The busy nature of the route suggests road users are more likely to be alert and compliant
Road User	What are the expected compliance and enforcement levels (alcohol/drugs, speed, road rules, and driving hours)? What is the likelihood of driver fatigue? Can enforcement of these issues be conducted safety?	• The route runs through urban environment, surrounded by residential and commercial land. Therefore drivers are not likely to have been driving for a long time, and are less likely to be fatigued • Parking lanes can be used by the police for enforcement activites
Road User	Are there special road uses (e.g. entertainment precincts, elderly, children, on-road activities, motorcyclist route), distraction by environmental factors (e.g. commerce, tourism), or risk-taking behaviours?	• Inkerman Road is an important part of the bicycle network south-east of Melbourne and is a planned part of the SCC. Therefore cyclist volumes are likely to be high • Number of schools in the surrounding area, indicating children may be present along the route, as pedestrians or cyclists
Vehicle	What level of alignment is there with the ideal of safer vehicles?	• There are no features of the road that would compromise vehicle safety features
Vehicle	Are there factors which might attract large numbers of unsafe vehicles? Is the percentage of heavy vehicles too high for the proposed/existing road design? Is this route used by recreational motorcyclists?	• There are no land uses that would attract riskier vehicle types • Heavy vehicle compositions are lower than average, and the straight alignment along the route is not likely to attract recreational motorcyclists
Vehicle	Are there enforcement resources in the area to detect non-roadworthy, overloaded or unregistered vehicles and thus remove them from the network? Can enforcement of these issues be conducted safety?	• The route is located within the purview of Victoria Police. Therefore it is assumed that some level of enforcement is conducted along the route • Parking lanes and lack of shoulder width may make it difficult for roadside enforcement activities to be carried out safely

Safe System Element	Prompt	Comments/issues
Vehicle	Has vehicle breakdown been catered for?	• On-street parking and lack of shoulder means broken-down vehicles may not be able to manoeuvre out of the traffic lane • Broken-down vehicles may also be obscured by parked vehicles along the route, creating an additional hazard
Vehicle	Have advanced vehicle features been considered?	• With reasonably good line marking, including edge lines, there is nothing to suggest that autonomous vehicle functions would struggle in this environment.
Post-crash care	Are there issues that might influence safe and efficient post-crash care in the event of a severe injury (e.g. congestion, access stopping space)?	• The road network is such that detours could be established while emergency care is being rendered • On-street parking and physical kerb make it difficult for ambulances and other emergency vehicles to manoeuvre out of the traffic lane
Post-crash care	Do emergency and medical services operate as efficiently and rapidly as possible?	• The Cabrini Malvern, Cabrini Prahran, Avenue Hospital and Caulfield Hospital are all located within 2km of the route
Post-crash care	Are other road users and emergency response teams protected during a crash event? Are drivers provided the correct information to address travelling speeds on the approach and adjacent to the incident? Is there reliable information available via radio, VMS etc.	• The road network is such that detours could be established while emergency care is being rendered • On-street parking and lack of shoulder means response teams may not have adequate space to shelter outside the live traffic lane • There is no permanent VMS or other incident warning systems.
Maintenance	Can all road features be maintained in a safe and efficient manner?	• Road maintenance would be carried out under a traffic management plan, potentially including detours • The reduced 40km/h speed limit along the entire route may result in no further speed limit reduction being necessary during road maintenance

3. Recommendations

Infrastructure recommendations are classified into categories as instructed in *AP-R509-16 Austroads Safe System Assessment Framework*.

Definitions of the alignment with Safe System principles are:

Primary Treatments: Road planning, design and management considerations that virtually eliminate the potential of fatal or serious injuries occurring in association with the foreseeable crash types.

Supporting Treatments: Road planning, design and management considerations that improve the overall level of safety associated with foreseeable crash types, but do not virtually eliminate the potential of fatal or serious injuries occurring. When applied to an existing road environment they may improve the ability for a primary treatment to be installed in the future.

Project managers are encouraged to implement as many of the recommendations as possible, with preference for Primary Treatments.

Where matrix scores still remain high, project managers are encouraged to look to the other elements of the Safe System to reduce risk.

Recommendations on moving the Project further Towards Zero are provided in the table below.

Table 8: Recommendations on moving the project further Towards Zero

Primary Treatments:	
Ideas for consideration	**Project response**
• Consider reducing the speed limit along the route to 30km/h, which is the Safe System tolerance for cyclist and pedestrian collisions	
• Consider providing an underpass for cyclists at the Inkerman Road/Normanby Road intersection, so as to completely separate cyclists from vehicular traffic	
• Consider closing off some side streets along the south side of Inkerman Road to cul-de-sac arrangements, in order to reduce the number of conflict points between vehicles, cyclists and pedestrians	
• Consider raising the signalised pedestrian/cyclist crossing points and activation spaces along the route. This encourages reduced speeds through the crossing point and increases visibility to/from vulnerable road users	

Supporting Treatments:	
Ideas for consideration	**Project response**
• Consider ways to encourage cyclists to use the bi-directional cycle path, such as good pavement quality, signage and lighting	
• Consider ensuring that all signalised intersections along the route feature Fully Controlled Right Turns (FCRTs) with no red arrow drop-offs *FCRTs are not necessary on legs with a one-way traffic arrangement*	
• Consider reducing the amount of on-street parking, so as to reduce the number of unprotected roadside hazards and visual obstructions along the route	
• Ensure that street lighting along the entire route is in accordance with AS1158	

4. Conclusions

This Safe System Assessment has been carried out on the proposed Safe Cycling Corridor upgrade works along Inkerman Road and Normanby Road. A more detailed description of the existing conditions and design options can be found in Section 2 of the report.

The results show that both design options are better aligned with Safe System principles, compared to the existing conditions. This is primarily attributed to the dedicated bi-directional cycle path along the entire route (which significantly improves cyclist safety) and the reduced 40km/h speed limit (which reduces the likelihood and severity of all crash types) along the entire route. In addition, the proposed activation spaces along Inkerman Road improve pedestrian safety (by providing priority or low speed crossing points) and act as traffic calming along the route.

Design Option 1 has a better (lower) score than Design Option 2 because of the one-way traffic arrangement along the length of Inkerman Road, which results in fewer conflict points along the route. As a result Design Option 1 has the best alignment with Safe System principles, followed by Design Option 2. The existing conditions has the highest overall SSA score and is therefore the least aligned with Safe System principles.

There are a number of features that can be added to each design to further improve the alignment with Safe System principles. These are detailed in Section 3 of the report.

5. References

Bahouth, G., Graygo, J., Digges, K., Schulman, C. & Baur, P 2014, 'The benefits and tradeoffs for varied high-severity injury risk thresholds for advanced automatic crash notification systems', Traffic Injury Prevention, vol. 15, Supplement 1, pp143-140.

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Jurewicz C, Sobhani Dr A, Woolley Dr J, Dutschke Dr J, Corben Dr B, 2015, Proposed vehicle impact speed - severe injury probability relationships for selected crash types, Australasian Road Safety Conference.

Moon and Mihailidis, Outcome Based Management of Roadside Hazards, ACRS 2013.

Appendix A: Photos



Photo 1: Normanby Road / Inkerman Road intersection – Facing east



Photo 2: Inkerman Road – Facing west



Photo 3: Inkerman Road / Hawthorn Road intersection – Facing west



Photo 4: Inkerman Road / Kooyong Road intersection – Facing west



Photo 5: Inkerman Road / Orrong Road intersection – Facing west



Photo 6: Inkerman Road / Alexandra Street intersection – Facing west



Photo 7: Inkerman Road / Hotham Street intersection – Facing north-west



Photo 8: Inkerman Road / Alexandra Street intersection – Facing east



Photo 9: Inkerman Road / Orrong Road intersection – Facing east



Photo 10: Inkerman Road / Kooyong Road intersection – Facing east



Photo 11: Inkerman Road / Hawthorn Road intersection – Facing east



Photo 12: Normanby Road / Inkerman Road intersection – Facing south-east along Normanby Road



Photo 13: On-street parking along Inkerman Road – Facing south-east



Photo 14: Bike box along Inkerman Road – Facing north-east



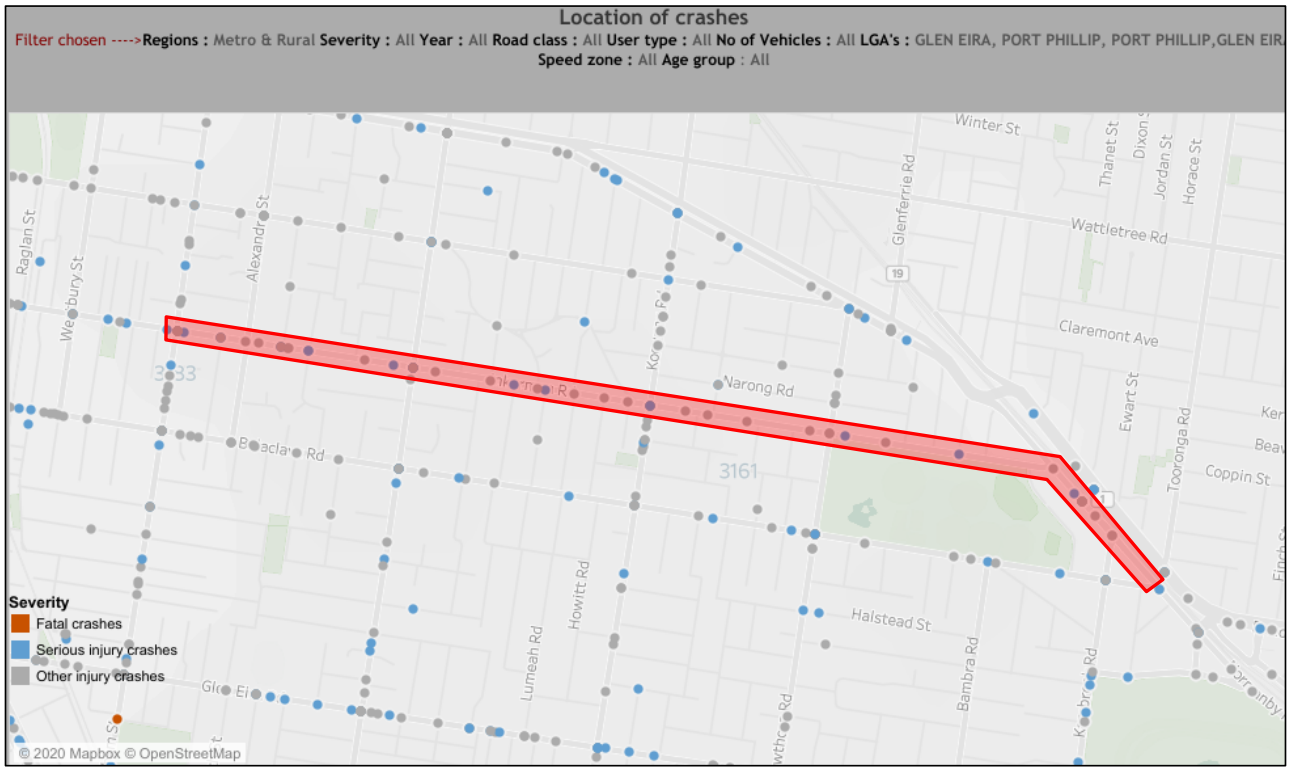
Photo 15: Audio-tactile line marking along Inkerman Road – Facing west



Photo 16: Normanby Road – Facing south-east

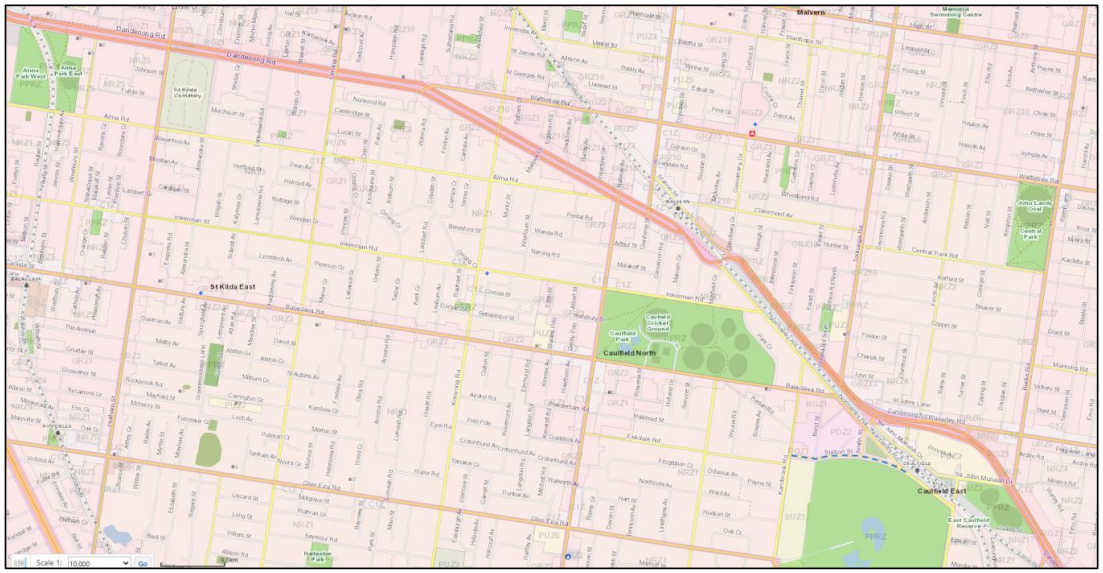
Appendix B: Crashes Past Five Years

All injury crashes (2014-18)



Source: VicRoads

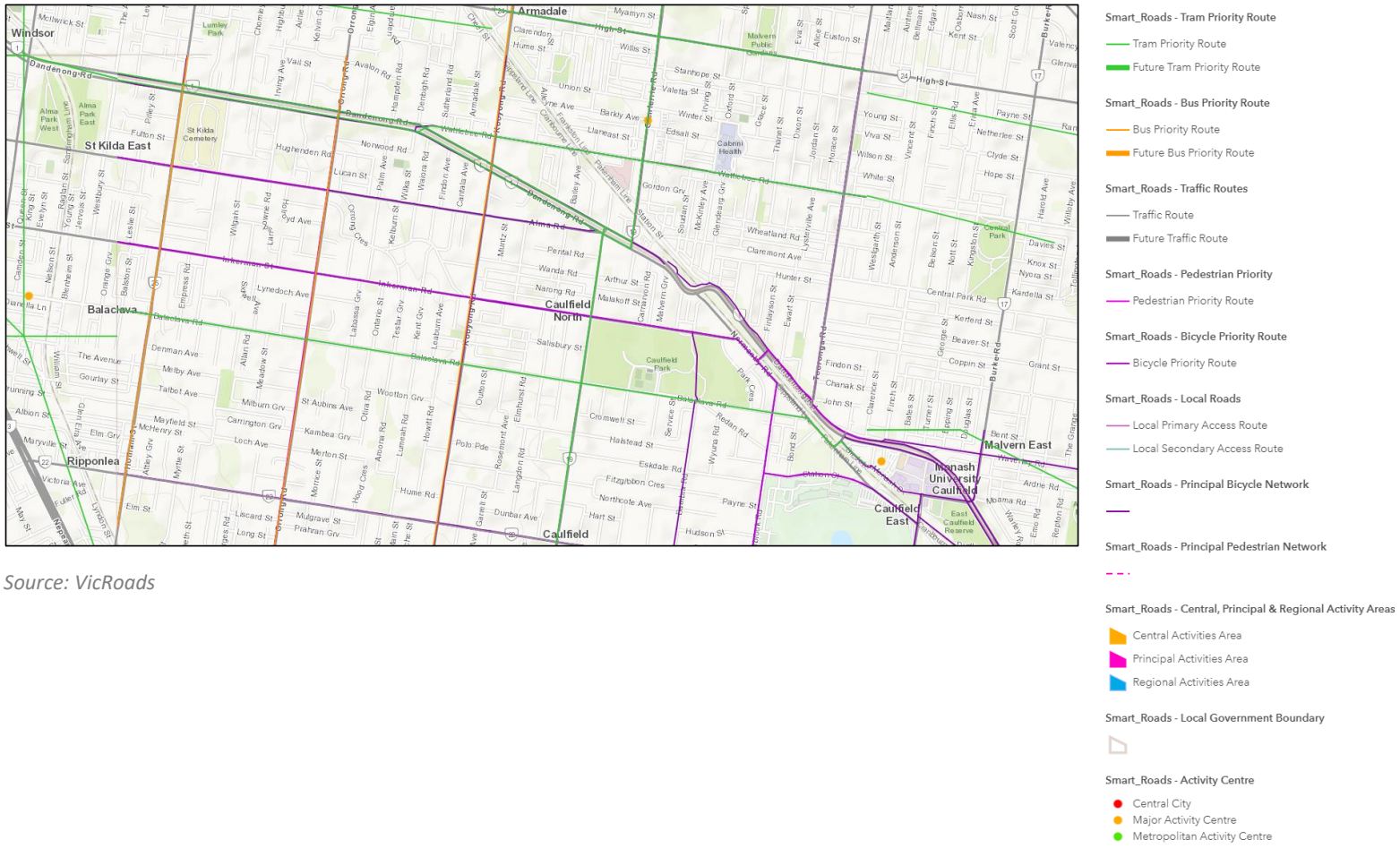
Appendix D: Surrounding Land Use



- LDRZ - Low Density Residential Zone
- MUZ - Mixed Use Zone
- TZ - Township Zone
- RGZ - Residential Growth Zone
- NRZ - Neighbourhood Residential Zone
- GRZ - General Residential Zone
- R1Z - Residential 1 Zone (superseded by GRZ)
- IN1Z - Industrial 1 Zone
- IN2Z - Industrial 2 Zone
- IN3Z - Industrial 3 Zone
- C1Z - Commercial 1 Zone
- C2Z - Commercial 2 Zone
- B1Z - Businesss 1 Zone (superseded by C1Z)
- B2Z - Business 2 Zone (superseded by C1Z)
- B3Z - Business 3 Zone (superseded by C2Z)
- B4Z - Business 4 Zone (superseded by C2Z)
- B5Z - Business 5 Zone (superseded by C1Z)
- RLZ - Rural Living Zone
- GWZ - Green Wedge Zone
- GWAZ - Green Wedge A Zone
- RCZ - Rural Conservation Zone
- FZ - Farming Zone
- RAZ - Rural Activity Zone
- PUZ1 - Public Use Zone-Service and Utility
- PUZ2 - Public Use Zone-Education
- PUZ3 - Public Use Zone-Health & Community
- PUZ4 - Public Use Zone-Transport
- PUZ5 - Public Use Zone-Cemetery/Crematorium
- PUZ6 - Public Use Zone-Local Government
- PUZ7 - Public Use Zone-Other Public Use
- PPRZ - Public Park and Recreation Zone
- PCRZ - Public Conservation and Resource Zone
- RDZ1 - Road Zone-Category 1
- RDZ2 - Road Zone-Category 2
- SUZ - Special Use Zone
- SUZ - Special Use Zone
- CDZ - Comprehensive Development Zone
- UFZ - Urban Floodway Zone
- CCZ - Capital City Zone
- DZ - Dockland Zone
- PDZ - Priority Development Zone
- UGZ - Urban Growth Zone
- ACZ - Activity Centre Zone
- PZ - Port Zone

Source: VicPlan

Appendix E: Road Hierarchy Map



Source: VicRoads

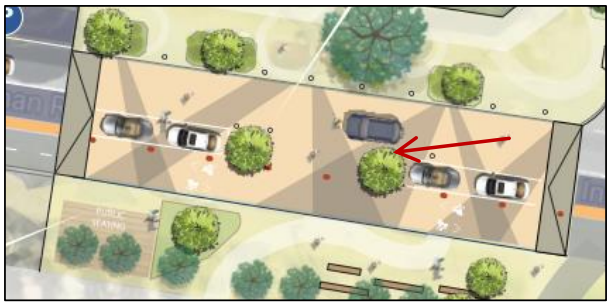
Appendix F: Activation Spaces High-Level Review

Activation Spaces High-Level Review

As discussed in the teleconference 5/10/2020, Safe System Solutions Pty Ltd has reviewed the 'Activation Space' Plan Set. As a primary recommendation, Safe System Solutions Pty Ltd suggests conducting a Road Safety Audit on the concept plans for more detailed / risk-rated findings. The following high-level design guidance / advice include:

1. **Landscaping:**

The Shared Path option shows landscaping / planting near the carriageway and crossing points. There is a potential that the landscaping will impede on sight lines, potentially creating blind spots where pedestrians may not be seen.



2. **Path pavement:**

The Shared Path option shows a new pavement surface is to be provided across the bi-directional bike path. There is a potential that this pavement surface may destabilise cyclists (if cobbled) or have poor skid resistance.





SAFE SYSTEM SOLUTIONS

3. Wombat Crossings

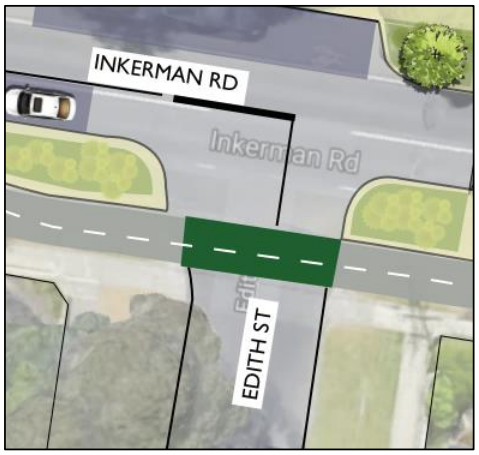
Some of the wombat crossings extend across the bi-directional bike path. This will slow cyclists down on the path and improve the visibility of and priority for pedestrians crossing. Other examples of the wombat crossing show the raised pavement is only across the carriageway. Pedestrians may not recognise (or may be confused) who gives way when crossing the bike path.





4. Thresholds

The concept plans show at-grade thresholds where the bike path crosses at side streets. Raising the threshold at these conflict points is the preferred design option.



5. Lighting

The concept plans do not show any new luminaires. Crossing points should be illuminated in line with AS 1158. An independent lighting assessment should also be carried out.



INKERMAN ROAD SAFE CYCLING CORRIDOR PLAN

INDEPENDENT SAFETY REVIEW

TRAFFIC ENGINEERING ASSESSMENT

INKERMAN ROAD SAFE CYCLING CORRIDOR PLAN INDEPENDENT SAFETY REVIEW

Client: Glen Eira City Council
Report Reference: 22155T
File Path: Y:\2022\22155T – Inkerman Road Safe Cycling Corridor Plan\08 Reports\22155TREP01F04.docx

Tuesday, September 27, 2022

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1 INTRODUCTION

SALT has been engaged by Glen Eira City Council to undertake a safety review with respect to the feasibility of proposed cycling upgrades on the Inkerman Road corridor. The corridor is intended to fill an identified missing link between the State Government's newly constructed cycling path along the Dandenong Railway Line, and the announced cycling path along St Kilda Road (2024).

The proposed link is intended to traverse the Normanby Road/Inkerman Road/Inkerman Street corridor between Smith Street (east) and Hotham Street (west) respectively.

This assessment of the proposed cycle corridor covers the following matters:

- The characteristics of the traffic environment within which the corridor will be provided;
- General road safety matters pertaining to cyclists and other road users;
- A description of the proposed corridor design and intended operational characteristics at key areas, as well as a traffic safety assessment of the proposal within the context of the surrounding traffic environment;
- An assessment of the extent that the design and operation of the corridor is consistent with the relevant guidance provided within VicRoads (DoT) guidelines, AustRoads documents and any other applicable best practice guidelines; and
- Commentary regarding applicable aspects from international studies, guidelines and best practice (as applicable) pertaining to bicycle facilities and corridors featuring similar arrangements.

As part of our assessment, we have:

- Reviewed concept plans prepared by Arup including:
  - Initial concepts (Revision B dated 24 June 2022);
  - Revised concepts following SALT's initial safety review (Revision C dated 9 September 2022);
- Reviewed the Safe Cycling Corridor Pilot – Corridor Assessments Report (September 2019);
- Reviewed the Glen Eira Cycling Action Plan (December 2019);
- Reviewed the 'Cycling demand estimates for Inkerman Street' technical note prepared by CDM Research (dated 22 July 2022);
- Reviewed and incorporated feedback received from the community reference group meeting and Council's strategic transport committee;
- Carried out a 'saddle survey' by bicycle through the proposed corridor upgrade areas during both day- and night-time conditions. The inspection overlapped with the on-road PM peak traffic conditions allowing an insight to vehicle, cyclist and pedestrian volumes and allowing observation of road user behaviors along with key points of concern as applicable to cyclists and the proposed corridor upgrade.

The intent of our assessment is to provide a relatively high-level safety review of the proposed corridor options to measure the overall improvement (or decline) in safety for the various road users when compared to existing conditions. This assessment serves to determine whether the safety benefits justify alteration to the existing corridor and subsequently, which design option should proceed to the detailed design stage. Our assessment is not a detailed Road Safety Audit, but this would be required at the next stage of design.

By way of summary of the analyses that will be described, it is concluded in-principle that the establishment of a bicycle corridor, in accordance with the supplied design options, through Inkerman Road/Inkerman Street/Normanby Road can be implemented with an overall improvement to safety when compared to existing conditions. It is noted that the designs would be subject to various mitigating treatments/modifications.

2 STUDY AREA

The study is confined to an approximate 3.75km section comprised of Inkerman Street, Inkerman Road and Normanby Road. It is noted that the proposed corridor will traverse land almost exclusively zoned for residential land use (General Residential & Neighbourhood Residential) while also abutting Caulfield Park along its northern boundary.

A total of eight (8) main road intersections have been identified over the proposed bicycle corridor route, including two (2) intersections with Transport Road Zone 2 (TRZ2) roads to which the Department of Transport (DoT) is the responsible authority.

The extent of the study area is depicted indicatively in **Figure 1**.

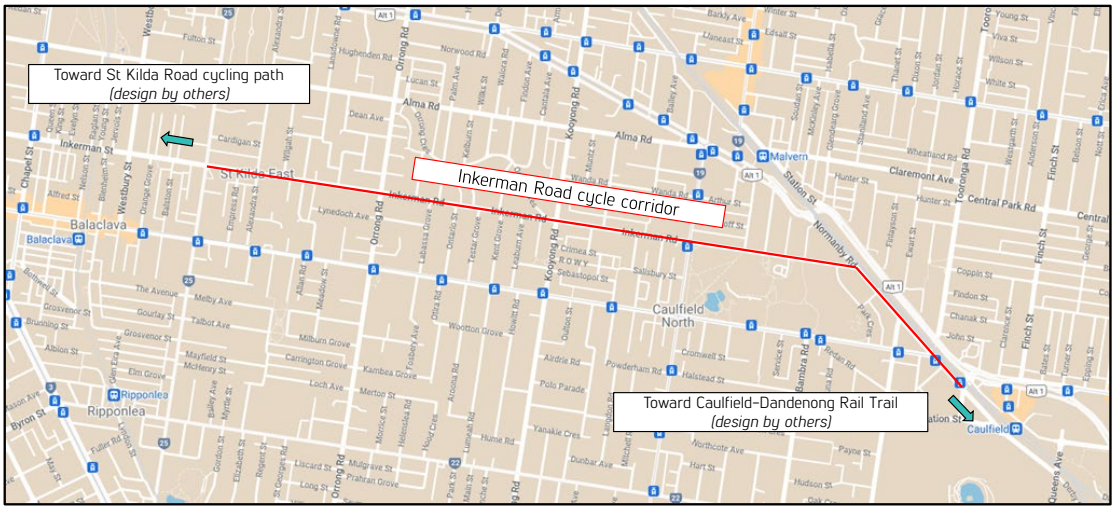


Figure 1 Inkerman Road bicycle corridor – review area

3 EXISTING CONDITIONS

3.1 LOCATION & LAND USE

A summary of the general area proximate to the proposed Inkerman Road bicycle corridor is provided hereunder for context. This offers a summary of the surrounding land use, traffic conditions across the corridor zone and how cyclists may be interacting with the surrounding environment and road users.

3.2 ZONING & POLICY

The proposed cycle corridor will be positioned through land almost exclusively zoned as General Residential (GRZ1) or Neighbourhood Residential (NRZ1 & NRZ5), noting the majority of site frontages and vehicle access to Inkerman Road, Inkerman Street and Normanby Road service residential traffic.

A sparse number of Commercial Zoned land use (C1Z) exists over the proposed corridor route, consisting of small commercial shopping strips.

Notably, Caulfield Park (and the associated cricket ground, croquet club and bowling club) (zoned as a Public Park and Recreation Zone – PPRZ) abuts the corridor near the Normanby Road intersection.

It is noted that the full extent of the proposed bicycle corridor is located within the Principal Public Transport Network (PPTN).

3.3 ROAD & TRAFFIC ENVIRONMENT

The proposed bicycle corridor will occupy Inkerman Street, Inkerman Road and Normanby Road, all of which accommodate cyclists and are identified as an existing on-road cyclist route within the Glen Eira cycle network (*Cycling Action Plan: Making it easier to cycle in Glen Eira, 2019-2024*).

Classifications of the existing roads, in accordance with the Glen Eira register of public roads, within the corridor area are as follows:

- Inkerman Street: Classified as a 'Link' road, under the care & management of Glen Eira City Council;
- Inkerman Road: Classified as a 'Link' road, under the care & management of Glen Eira City Council;
- Normanby Road (between Inkerman Road & Balaclava Road): Classified as a 'Link' road, under the care and management of Glen Eira City Council; and

Additionally, the proposed corridor will occupy a section of road to which the Department of Transport (DoT) is the responsible road authority:

- Normanby Road (between Balaclava Road & Smith Street): Classified as a Transport Road Zone 2 (TRZ2),

Commentary regarding key features of the road geometry of various road sections (within the corridor area) is provided hereunder.

3.3.1 INKERMAN STREET

Inkerman Street is oriented between Orrong Road and Hotham Street in the east and west respectively.

The road features a carriageway width of approximately 14.0 metres and provides a single traffic lane in each direction with on-street parallel parking lanes and line marked bicycle lanes provided on both sides of the road. It is noted that the bicycle lanes over Inkerman Street are line marked as an independent lane, separate to both the through lanes and parallel parking lanes.

It is noted that the bicycle lanes terminate at the intersections with Hotham Street (westbound) and Alexandra Street (bi-directional), instead requiring cyclists to merge with vehicle traffic and queue within designated bike boxes.

A total of four (4) side street intersections exist on both the north and south sides of Inkerman Street respectively, with driveway crossovers to Inkerman Street numbering 39 and 28 at the north and south sides of the carriageway respectively.

Data obtained from the *Safe Cycling Corridor Pilot – Corridor Assessment Report* indicates that this segment of Inkerman Street experiences daily vehicle volumes (average weekdays) of approximately 6,230 and 5,956 vehicles in the eastbound and westbound directions respectively.

A posted speed limit of 50km/h applies to Inkerman Street, noting the recorded 85th percentile vehicle speeds in the east and westbound directions were recorded at 55.2 and 53 km/h, generally exceeding the posted speed limit.

3.3.2 INKERMAN ROAD

Inkerman Road is oriented between Normanby Road and Orrong Road in the east and west respectively.

The road carriageway varies in width, with recorded spot measurements at various location via Nearmap aerial imagery indicating a range between 12.2 – 13.0m (approx.), with the more constrained sections occurring within the segments between Orrong Road and Hawthorn Road. The configuration of the carriageway between Orrong Road and Hawthorn Road was observed to remain consistent; offering a single trafficable through lane in each direction with on-street parallel parking lanes and bicycle lanes provided on both the north and south sides of the carriageway.

Provision has been made to enable the bicycle lanes to carry through the Kooyong Road intersection on both sides of the road, however the intersections with Hawthorn Road and Normanby Road see the bicycle lanes terminate in advance of the intersection, requiring cyclists to merge with vehicle traffic and queue within designated bike boxes.

It is noted that unlike the Inkerman Street section, there is no provision of a dedicated bicycle lane. Instead, cyclists are accommodated by means of shared parking/traffic lanes with advisory bicycle symbols.

A total of 12 and 10 side street intersections exist across the Inkerman Road segment at the north and south sides respectively., with driveway crossovers numbering 82 and 73 at the north and south sides of the carriageway respectively.

It is noted that the number of side street and crossover intersections along the south side of the Normanby Road–Hawthorn Road segment is minimal (1 & 4 respectively), largely owing to the presence of Caulfield Park.

Data obtained from the *Safe Cycling Corridor Pilot – Corridor Assessment Reports* indicate the following daily vehicle volumes (average weekdays) and 85th percentile speeds over various road segments.

It is noted that the data pre-dates a reduction to the sign posted speed limit from 60km/h to 50km/h.

Inkerman Road – between Orrong Road & Kooyong Road

- 6,006 vehicles – eastbound / 85th percentile speed of 55.2 km/h; and
- 6,229 vehicles – westbound / 85th percentile speed of 60.2 km/h.

Inkerman Road – between Kooyong Road & Hawthorn Road

- 5,433 vehicles – eastbound / 85th percentile speed of 54.1 km/h; and
- 5,334 vehicles – westbound / 85th percentile speed of 57.7 km/h.

Inkerman Road – between Hawthorn Road & Normanby Road

- 3,642 vehicles – eastbound / 85th percentile speed of 57.4 km/h; and
- 4,273 vehicles – westbound / 85th percentile speed of 59.4 km/h.

A posted speed limit of 50km/h is currently active.

3.3.3 NORMANBY ROAD

Normanby Road is oriented between Inkerman Road and Smith Street in the north and south respectively.

The road carriageway varies in width and configuration, largely applicable to the differing road authorities responsible for the road; the Council section of road varies in width between 12.2m – 11.8m in width, dependent on whether provision of parking is provided on the east side of the road. The carriageway generally provides a single trafficable through lane in each direction with widened on-street parallel parking lanes provided on the west side, accommodating both on-street vehicle parking and an abutting bicycle lane. The east side of the carriageway provides a single line-marked bicycle lane, abutting the traffic lane.

It is noted that the segment of Normanby Road between Balaclava Road and Smith Street is classified as a Transport Road Zone 2 (TRZ2). This segment of the road provides two trafficable through lanes in each direction, noting that the central traffic lanes also service light rail. On-street parallel parking is permitted on both sides of the road (in sections), subject to a 'No Stopping' restriction, active from 7:00am – 9:00am and 4:30pm – 6:30pm. Monday to Friday (excepting the indented parking on the northern side).

Wide kerbside parking / bicycle lanes are provided, transitioning to dedicated bicycle lanes at intersections.

One (1) side street intersection exists on both the east and west sides of Normanby Road, between Inkerman Road and Balaclava Road, with 15 driveway crossovers at the west side of the carriageway. No crossovers are provided at the eastern side due to the rail corridor.

Data obtained from the *Safe Cycling Corridor Pilot – Corridor Assessment Report* indicates that this segment of Normanby Road experiences daily vehicle volumes (average weekdays) of approximately 4,436 and 6,923 vehicles in the southeast-bound and northwest-bound directions respectively.

A posted speed limit of 60km/h applies to Normanby Road, noting the recorded 85th percentile vehicle speeds in the southeast and northwest-bound directions was recorded at 54.1 km/h, depicting a general adherence to the posted limit.

3.4 EXISTING CYCLIST VOLUMES

A review of the 'Cycling demand estimates for Inkerman Street' technical note, prepared by CDM Research, has been undertaken to ascertain existing cyclist volumes through the Inkerman Street corridor.

The base cyclist demand has been measured from the immediate pre-pandemic period and consisted of two rounds of counts conducted in November 2018 and May 2019. The counts were aggregated to the immediate west of major intersections, with locations and cyclist volumes as depicted in the report provided in **Figure 2**.

The report provides an analysis of the recorded counts against data obtained from 41 VicRoads automatic cyclist counts with the assessment indicating that the three November 2018 surveys had 12% lower demand than average for that year. Similarly, the May 2019 survey demand was 8% lower than the annual average. Accordingly, the 2018 counts (red in the below figure) and the 2019 counts (blue in the below figure) are adjusted by factors of 1.177 and 1.087 respectively.

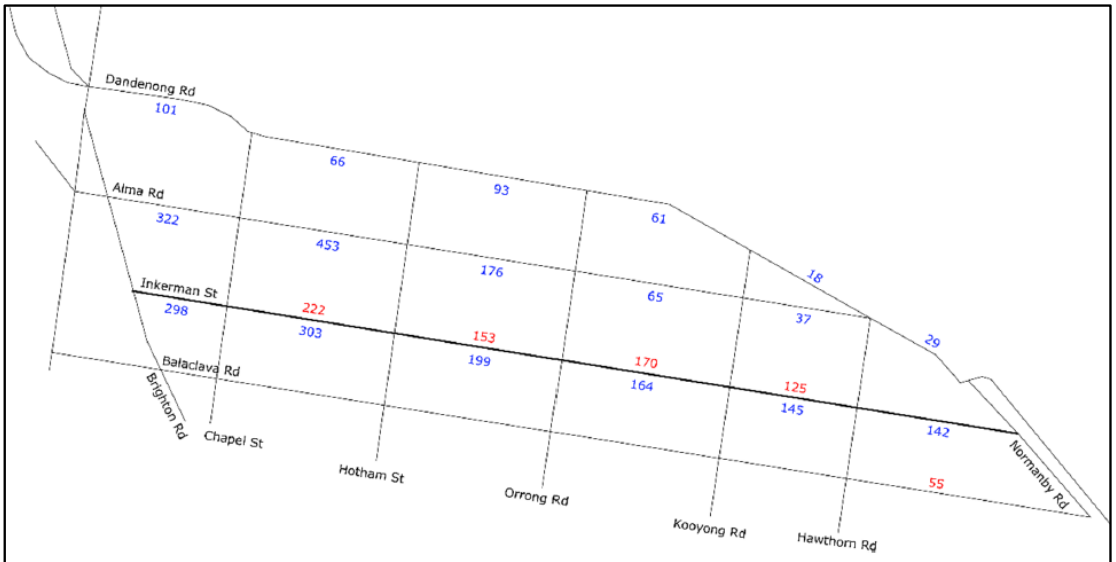


Figure 4.1: Existing cyclist counts (blue are Tue 28 May 2019 6 am – 7 pm and red are Tue 13 Nov – Thu 15 Nov 2018 7 am – 7 pm)

Figure 2 CDM Technical Note – Recorded cyclist volumes

3.5 CRASH STATISTICS

3.5.1 CRASH HISTORY - CYCLISTS

Review of the Department of Transport *CrashStats* database has been undertaken, noting the available dataset commences from July 1st 2015 and terminates on October 5, 2021 – for the purposed of this assessment, any recorded crashes which were recorded in 2015 have been omitted from the range. The assessment was undertaken over the full extent of the Inkerman Road bicycle corridor area, as depicted in **Figure 1** at the commencement of this report.

The *CrashStats* database contains only crashes where the police have attended and a level of injury has occurred, categorised by decreasing severity as 'Fatal', 'Serious' and 'Other'.

Key takeaways of the reviewed crash data are summarised as follows:

- There were 31 reported crashes, categorised as:
  - 0 'Fatal'
  - 8 'Serious';
  - 7 'Other';
- A total of 15 crashes involved cyclists (48% of the total), 8 of which were 'Serious',
- All bicycle crashes occurred in the daytime.

Table 1 overleaf provides further details regarding crashes to which a cyclist was involved.

As can be seen from this table, the dominant crash type within the selected area is '*Vehicle strikes door of parked/stationary vehicle*'. A number of additional crash types have also been identified (albeit to a lesser frequency) which would be expected along a shared vehicle/bicycle route such as side swipe incidents and collisions from driveways/behind parked vehicles.

The data listed above owes to the prevailing issue amongst crashes involving cyclists – poor observed visibility by motor vehicle drivers. It is noted that crashes recorded as '*Right Near*' and '*Left Near*' at intersections suggest a motor vehicle accessing Inkerman Road from an intersecting side street while failing to perceive a cyclist.

Notably, a high proportion of the cycle crashes resulted in serious injury.

As the existing bicycle corridor over Inkerman Road currently accommodates cyclists both formally by line marked lanes abutting the parking lanes, or informally by means of shared parking/traffic lanes with advisory bicycle symbols, the potential for 'dooring' crashes is extremely high, as detailed in the crash summary above. This poses a serious issue to cyclists along this route who may receive injury by either the dooring action itself or subsequent/potential ejection into the traffic lane and path of motor vehicles.

Table 1 Crash Type Summary (Crashes involving cyclists only)

Crash Type	Corridor Section					Total
	Hotham St – Orrong Rd	Orrong Rd – Kooyong Rd	Kooyong Rd – Hawthorn Rd	Hawthorn Rd – Normanby Rd	Inkerman Rd – Smith St	
Ped emerges from in front of parked or stationary vehicle	1[1]	-	-	-	-	1
Vehicle strikes another vehicle while emerging from driveway	1	-	-	-	-	1
Left through	1		-	-	-	1
Right through	-	1	-	1	-	2
Left near (intersections only)	-	1	-	-	-	1
Right near (intersections only)	-	-	-	1	-	1
Left turn side swipe	-	-	1	-	-	1
Vehicle strikes door of parked/stationary vehicle	-	2	1	2	-	5
Lane side swipe (vehicles in parallel lanes)	1	-	-	-	-	1
Rear end (vehicles in same lane)	-	-	-	-	1	1
Total	**4**	**4**	**2**	**4**	**1**	**15**

Note: in the context of crash type data, a 'vehicle' is an encompassing term applicable to cars, bicycles, trucks etc. All crashes listed above involve a cyclist.

*[1] Crash involves a pedestrian emerging from behind a parked/stationary **car**, before being struck by a cyclist.*

3.5.2 CRSAH HISTORY – OTHER ROAD USERS

Table 2 details additional crashes within the Inkerman Road corridor which involved other road users.

Table 2 Crash Type Summary (remaining road users)

Crash Type	Corridor Section					Total
	Hotham St – Orrong Rd	Orrong Rd – Kooyong Rd	Kooyong Rd – Hawthorn Rd	Hawthorn Rd – Normanby Rd	Inkerman Rd – Smith St	
Right through	1	–	1	–	1	**3**
Cross traffic (intersections only)	1	–	–	–	–	**1**
Ped near side. Ped hit by vehicle from the right	1	–	1	–	–	**2**
Right Near (intersections only)	–	3	–	–	–	**3**
Vehicle collides with vehicle parked on left of road	–	–	1	–	–	**1**
Head on (not overtaking)	–	–	–	1	–	**1**
Left off carriageway into object/parked vehicle	–	–	–	–	1	**1**
Left rear	–	–	–	–	1	**1**
Right rear	–	–	–	–	1	**1**
Total	**4**	3	**3**	**1**	**4**	**15**

It can be seen that the crash types throughout the Inkerman Road corridor are relatively disperse; this does not suggest a particular road safety issue for road users (excluding bicycles). Notably 'Right Near (intersections only)' was the only recorded incident type that occurred on more than one occasion – these occurred at midpoint sections between the Orrong Road & Kooyong Road intersections, detailing incidents where a vehicle on Inkerman Road collided with a vehicle departing from the intersecting side streets. This is often indicative of limited sight distance (e.g. due to parked cars) and/or risk taking manoeuvres.

3.5.3 BLACK SPOT ASSESSMENT

The National Black Spot Program quantifies an accident Black Spot as follows:

- For individual sites such as intersections, mid-block or short road sections, there should be a history of at least three casualty crashes over a five-year period.
- For lengths of road, there should be an average of 0.2 casualty crashes per kilometre per annum over the length in question over five years.

The total length of road is 3.75km and there have been 15 cycling related crashes and 15 other crashes over a period of just under 6 years, equating to 8 crashes per km overall, and 4 crashes per km for cyclists. This is significantly higher than the rate of 0.2 casualty crashes per km for a length of road (notwithstanding this includes intersections in this case, or that the time period is approximately 10 months longer than the 5 year assessment period).

It is hence evident that this section of Inkerman Road had a significant crash history.

4 CORRIDOR ASSESSMENT – INITIAL CONCEPT LAYOUTS

4.1 THE PROPOSAL

Two (2) initial bicycle corridor design options have been prepared by Arup (*dated 24/06/2022*) for implementation over the Inkerman Road corridor.

Each design option can be summarised by segments as follows:

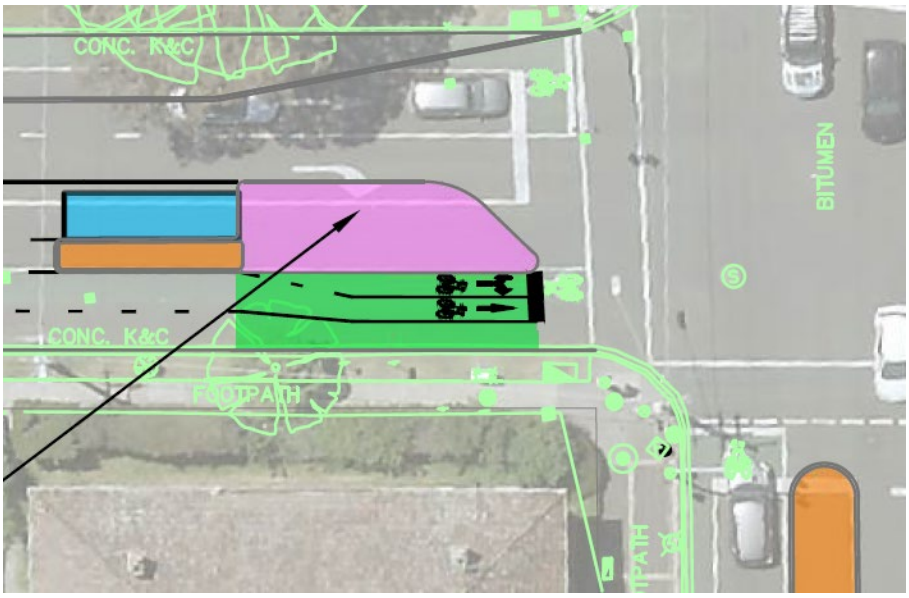
- Section 1: Hotham Road – Orrong Road;
- Section 2: Orrong Road – Kooyong Road;
- Section 3: Kooyong Road – Hawthorn Road;
- Section 4: Hawthorn Road – Normanby Road; and
- Section 5: Inkerman Road – Smith Street.

It is noted that the designs for both Option 1 and Option 2 over the two end segments (Sections 1 & 5) have, for the most part, been replicated over both concept options. The key point of variation of these components pertains to the intersection arrangements proposed at Orrong Road (Section 1) or Inkerman Road/Normanby Road (Section 2).

A general summary of each section within the relevant corridor option is provided in **Error! Reference source not found.** and Table 4 hereunder.

Table 3 Design Option 1 – Corridor Summary

Section	Description
Section 1	Section 1 covers the extent of Inkerman Street between Hotham Road and Orrong Road. The proposed reconfiguration to the carriageway will retain the existing two-way operation with a single traffic lane in each direction. Protected bicycle lanes are proposed on each side of the road with a constructed separation strip, with on-street parallel parking lanes provided on one side of the road only. While the corridor arrangement is consistent between Hotham Road and Orrong Road, it is noted the proposed design varies slightly either side of Alexandra Street; with on-street parallel parking provided on the south side of the carriageway, west of Alexandra Street, and on the north side of the carriageway, east of Alexandra Street. The intersection with Alexandra Street will see the east and westbound bicycle lanes continue through the intersection, with line marked bicycle hook turn boxes provided at the northwest and southeast corners of the intersection, accommodating access to the Inkerman Street corridor from Alexandra Street. Raised pedestrian/cyclist crossings are proposed at a number of intersecting side streets including: ▪ Empress Road (south side); ▪ Wilgah Street (north side); ▪ Kalymna Grove (north side); and ▪ Marne Street (north side); A raised pedestrian crossing over Inkerman Street is also proposed, east of the intersection with Kalymna Grove.

Section 2	Section 2 covers the extent of Inkerman Road between Orrong Road and Kooyong Road. The proposed reconfiguration of the carriageway will convert Inkerman Road into a one-way street in the westbound direction for motor vehicles. On-street parallel parking lanes/bays are proposed on both sides of the carriageway, with a two-way protected bicycle lane and constructed separation strip provided along the southern side of the road. A constructed outstand is proposed on the northeast corner of the Orrong Road/Inkerman Road intersection, with line marked bicycle hook turn boxes proposed at the northeast, southeast and southwest corners of the intersection. Raised pedestrian/cyclist crossings are proposed at a number of intersecting side streets, including: ▪ Labassa Grove (south side); ▪ Ontario Street (south side); ▪ Testar Grove (south side); ▪ Kent Grove (south side); ▪ Leaburn Avenue (south side); and ▪ Raphael Street (south side); A raised pedestrian crossing over Inkerman Road is also proposed, west of the intersection with Labassa Grove. In addition, an existing pedestrian crossing to the west of Orrong Grove will be upgraded as part of the design. Notably, the concept plan details that the eastbound bicycle lane splits into a dedicated through and dedicated left/right turn lane at the intersection with Kooyong Road. This is a non-typical design arrangement and may require alterations to the proposed intersection to ensure cyclists can be safely accommodated. The split bicycle lane is depicted below: 
Section 3	Section 3 covers the extent of Inkerman Road between Kooyong Road and Hawthorn Road. The proposed reconfiguration of the carriageway is continued from Section 2 with Inkerman Road converted to a one-way street in the westbound direction for motor vehicles, on-street parallel parking lanes/bays proposed on both sides of the carriageway and a two-way protected bicycle lane and constructed separation strip provided along the southern side of the road.

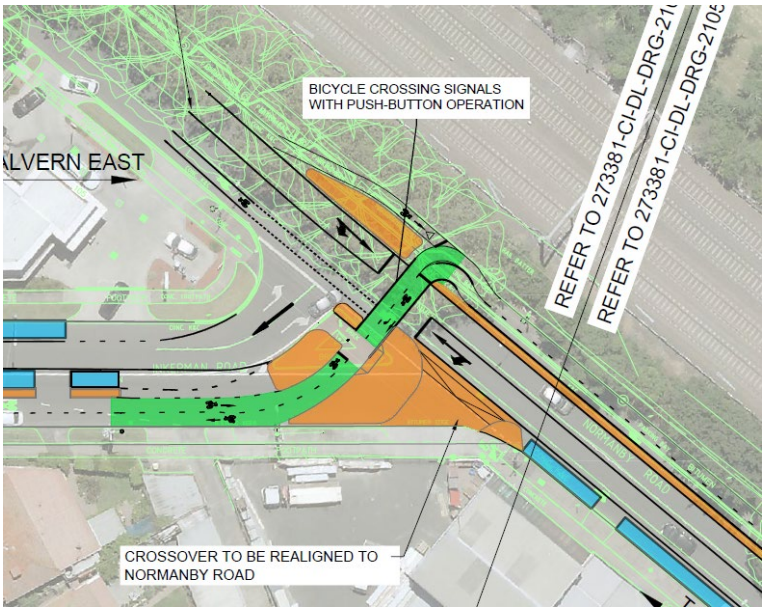
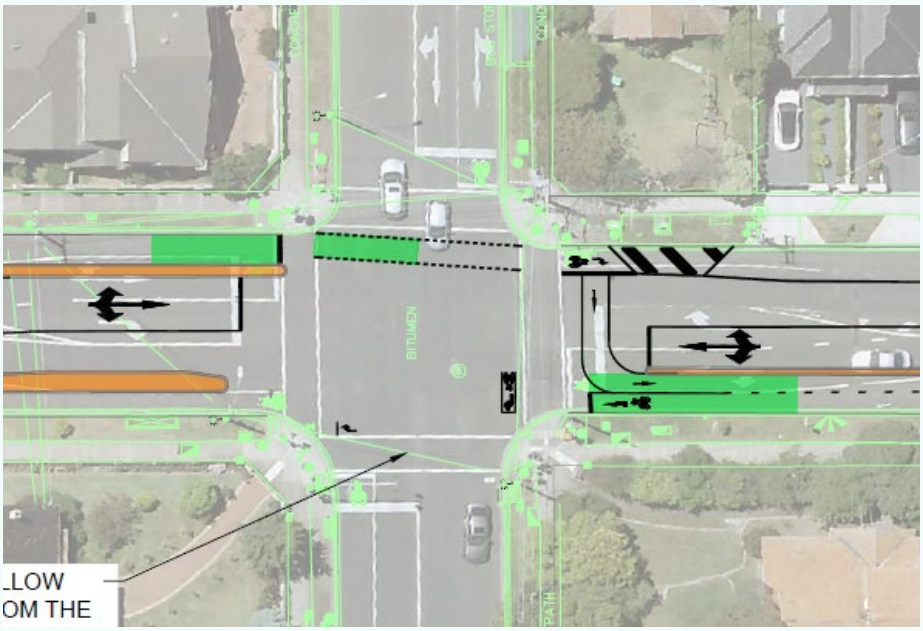
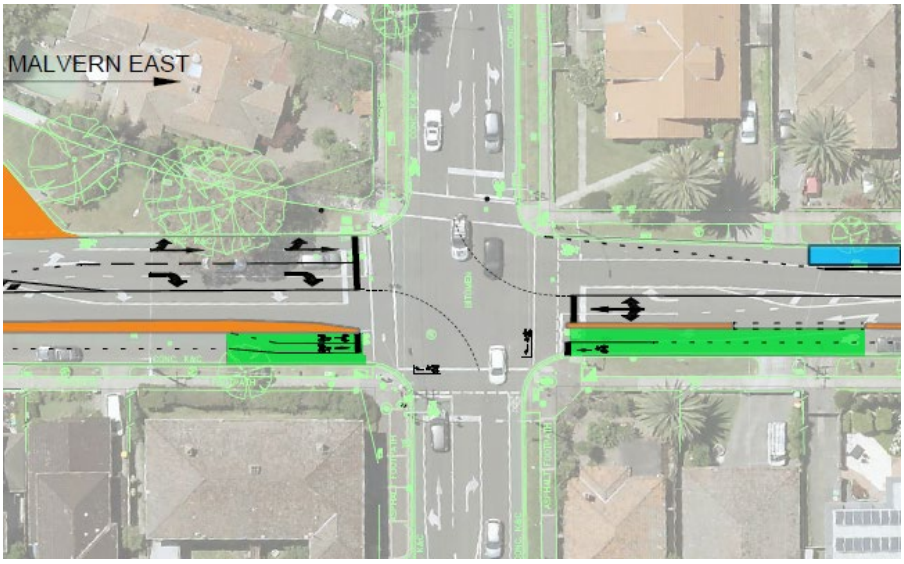
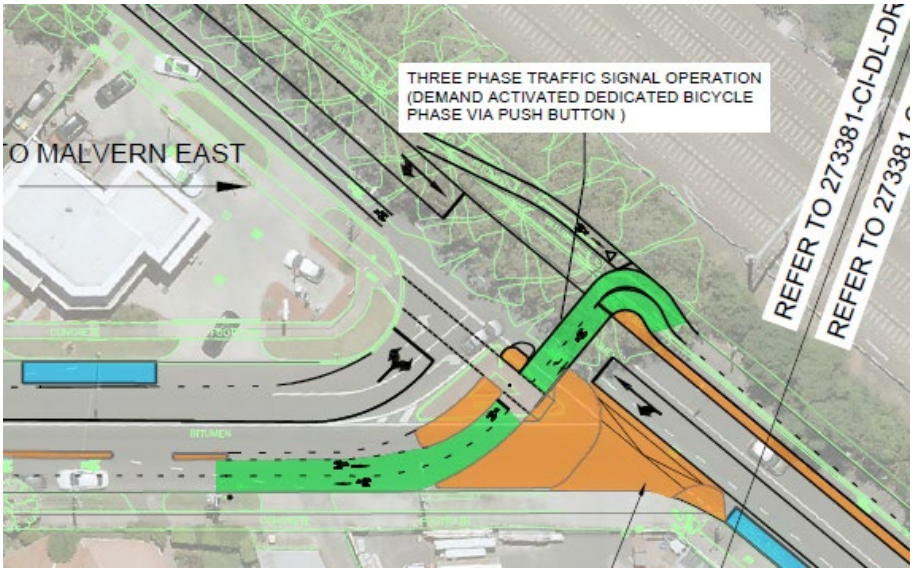
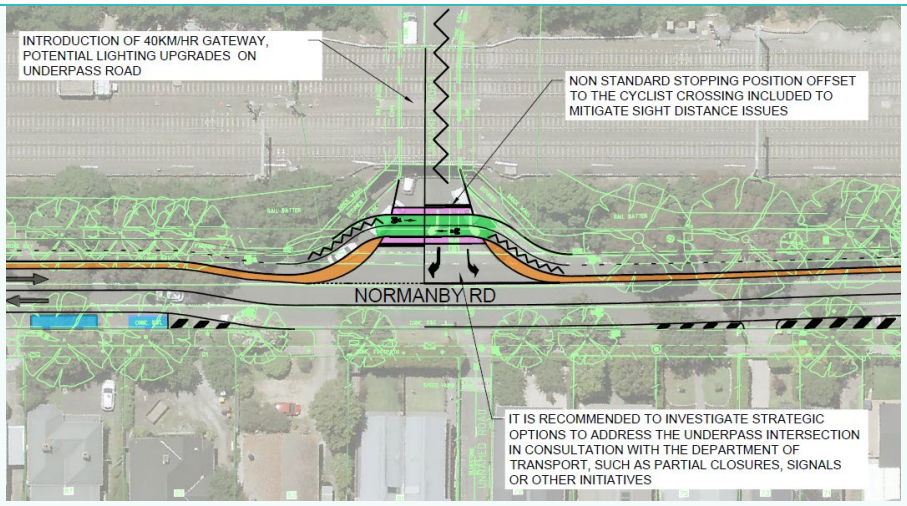
	A constructed kerb outstand is proposed on the northeast corner of the Kooyong Road/Inkerman Road intersection, with a constructed dividing median proposed on the southern leg (Kooyong Road) to the intersection. As the two-way protected bicycle lane arrangement continues from Section 2, direct bicycle lane access is provided through the Kooyong Road intersection. Raised pedestrian/cyclist crossings are proposed at a number of intersecting side streets including: ▪ Raglan Street (south side); ▪ Edith Street (south side); and ▪ Albert Street (south side); A raised pedestrian crossing over Inkerman Road is also proposed, east of the intersection with Edith Street.
Section 4	Section 4 covers the extent of Inkerman Road between Hawthorn Road and Normanby Road. The proposed reconfiguration of the carriageway is continued from Section 3 with Inkerman Road converted to a one-way street in the westbound direction for motor vehicles, on-street parallel parking lanes/bays proposed on both sides of the carriageway and a two-way protected bicycle lane and constructed separation strip provided along the southern side of the road. As the two-way protected bicycle lane arrangement continues from Section 3, direct bicycle lane access is provided through the Hawthorn Road intersection. It is noted that this section abuts the northern boundary of Caulfield Park. As such, the number of vehicle crossovers and intersecting side streets at the south side of the carriageway is minimal. Two (2) raised pedestrian crossings are proposed over Inkerman Road, west of the intersections with Malvern Grove and Mayfield Grove. The proposed crossing points will see the construction of kerb outstands on both the north and south sides of the Inkerman Road carriageway. Within this section, the eastern end of Inkerman Road forms a T-junction with Normanby Road. The two-way protected bicycle lane arrangement continues through this intersection, with bicycle crossing signals subject to push-button operation proposed to accommodate access in the south-east direction. 
Section 5	Refer section 5 commentary in **Table 4**.

Table 4 Design Option 2 – Corridor Summary

Section	Description
Section 1	Section 1 covers the extent of Inkerman Street between Hotham Road and Orrong Road. There is no major variation to the proposed configuration of the carriageway in comparison to the Option 1 proposal; the existing two-way operation with a single traffic lane in each direction will be retained. Protected bicycle lanes are proposed on each side of the road with a constructed separation strip, with on-street parallel parking lanes provided on the south side of Inkerman Street (west of Alexandra Street) and north side of Inkerman Street (east of Alexandra Street). Raised pedestrian/cyclist crossings are also proposed at the same intersecting side streets: ▪ Empress Road (south side); ▪ Wilgah Street (north side); ▪ Kalymna Grove (north side); and ▪ Marne Street (north side); There does not appear to be any variation in the design of these intersection arrangements. The notable departure from the Option 1 design is the intersection arrangement with Orrong Road. Where the Option 1 design provided dedicated left- and right-turn lanes at the Inkerman Street leg, Option 2 now proposes a shared through/left/right-turn lane, resulting from the continued two-way operation of the corridor for vehicle traffic. Additionally, no constructed kerb outstand is proposed on the northeast corner of the intersection. Instead, the line marked bicycle lane on the north side of the carriageway continues through the intersection into a dedicated bike store/queuing area, before transitioning into the two-way protected bicycle lane on Inkerman Road. 
Section 2	Section 2 covers the extent of Inkerman Road between Orrong Road and Kooyong Road. The proposed reconfiguration of the carriageway will retain the two-way vehicle traffic arrangement with a single vehicle lane in each direction. On-street parallel parking lanes/bays are proposed on the north side of the carriageway only, with a two-way protected bicycle lane and constructed separation strip provided along the southern side of the road.

	A raised pedestrian crossing over Inkerman Road is proposed, west of Labassa Grove. In addition, an existing pedestrian crossing to the west of Orrong Grove shall be retained, subject to design alteration to ensure it appropriately interacts with the corridor proposal. The intersection with Kooyong Road provides a dedicated right-turn lane, with a shared through/left-turn lane, as per existing conditions. It is noted that, as per design option 1, the eastbound bicycle lane splits into a dedicated through and dedicated left/right turn lane at the intersection with Kooyong Road. As mentioned prior, this is a non-typical design arrangement and may require alterations to the proposed intersection to ensure cyclists can be safely accommodated. In addition, two (2) line marked bicycle hook-turn boxes are provided within the intersection in option 2, accommodating southbound and westbound cyclists seeking to travel west and north respectively. 
Section 3	Section 3 covers the extent of Inkerman Road between Kooyong Road and Hawthorn Road. The proposed reconfiguration of the carriageway is continued from Section 2 with Inkerman Road retained as a two-way street for motor vehicles, on-street parallel parking lanes/bays proposed on north side of the carriageway only and a two-way protected bicycle lane and constructed separation strip provided along the southern side of the road. Similarly, no raised pedestrian/cyclist crossings are proposed over the intersecting side streets. A raised pedestrian crossing over Inkerman Road is proposed east of the intersection with Edith Street. Alterations to the traffic lanes would occur at the intersections with Hawthorn Road and Kooyong Road, with the inbound lanes to each intersection now proposed to operate as shared through/left- and right- turn lanes.
Section 4	Section 4 covers the extent of Inkerman Road between Hawthorn Road and Normanby Road. The proposed reconfiguration of the carriageway is continued from Section 3 with Inkerman Road retained as a two-way street for motor vehicles, on-street parallel parking lanes/bays proposed on north side of the carriageway only and a two-way protected bicycle lane and constructed separation strip provided along the southern side of the road. As the two-way protected bicycle lane arrangement continues from Section 3, direct bicycle lane access is provided through the Hawthorn Road intersection.

	As noted in the Section 4 – design option 1 comments, this section abuts the northern boundary of Caulfield Park. As such, the number of vehicle crossovers and intersecting side streets at the south side of the carriageway is minimal. Two (2) raised pedestrian crossings are proposed over Inkerman Road, west of the intersections with Malvern Grove and Mayfield Grove. The proposed crossing points will see the construction of kerb outstands on the north sides of the Inkerman Road carriageway. Within this section, the eastern end of Inkerman Road forms a T-junction with Normanby Road. The two-way protected bicycle lane arrangement continues through this intersection, with bicycle crossing signals subject to push-button operation proposed to accommodate access in the northwest direction. The intersection arrangement at this location is similar to that proposed in design option 1, with the only notable difference being a reduction in the central median width to accommodate the additional traffic lane. 
Section 5	Section 5 covers the extent of Normanby Road between Inkerman Road and Smith Street. It is noted that the segment of Normanby Road between Balaclava Road and Smith Street is classified as a Transport Road Zone 2 (TRZ2), to which the Department of Transport (DoT) is the responsible road authority, with this section generally featuring a wider carriageway width in comparison to the Council section. Accordingly, commentary is provided in the two (2) sections below. Normanby Road (between Inkerman Road & Balaclava Road) The proposed reconfiguration of the carriageway will retain the existing two-way arrangement for motor-vehicles. On-street parallel parking lanes/bays are proposed over the southwest side of the carriageway only, with a two-way protected bicycle lane and constructed separation strip provided along the northeast side of the road. A raised cyclist crossing is proposed at the intersection with the underpass road (located opposite the property at 81 Normanby Road):



Normanby Road (between Balaclava Road & Smith Street)

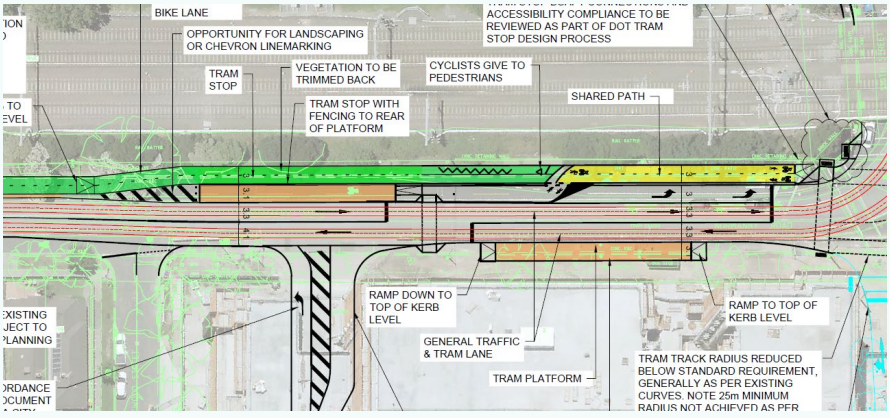
This section of Normanby Road is under the care and management of DoT given the presence of light rail within the road reserve, servicing the Route 3/3a trams.

The proposed reconfiguration of the carriageway will retain the existing two-way arrangement for motor-vehicles, however this will be reduced to a single through lane in each direction, shared with light rail.

The two-way protected bicycle lane and constructed separation strip will continue along the northeast side of the carriageway and will be constructed within the Normanby Road/Balaclava Road intersection with provision for the existing signalised pedestrian crossing at the Normanby Road northwest leg.

The supplied concept plan indicates two (2) new raised tram stops are to be constructed on the northeast and southwest sides of the carriageway between Balaclava Road and Smith Street. Separation between the northeast tram stop and two-way bicycle lane is proposed via installation of fencing to the rear of the tram platform.

Notably, pedestrian access to this tram stop and the proposed bicycle lanes intersect. At the point of intersection, it is proposed to provide a shared path which terminates at the intersection with Smith Street. It is unclear how the northern footpath within the Smith Street underpass connects to the shared path/tram stop at this location, with initial review of the plans suggesting pedestrians are required to step onto the roadway.



4.2 DESIGN ASSESSMENT CONSIDERATIONS

A number of applicable standards and reference documents are available to ensure bicycle facilities are both designed to the appropriate standard and offer due consideration to best practice principles, allowing operation in a safe and effective manner.

Key reference documents that have been reviewed in relation to the Inkerman Road corridor proposal and supplied concept plans include:

- AustRoads Guide to Road Design Part 6A: Paths for Walking and Cycling;
- AustRoads Guide to Road Design Part 3: Geometric Design;
- Cycling Aspects of AustRoads Guides (*2017*);
- Australian Standard AS1742.9-2018: Bicycle Facilities;
- VicRoads Traffic Engineering Manual: Design Guidance for strategically important cycling corridors;
- VicRoads Traffic Engineering Manual: Guidance on Treating Bicycle Car Dooring Collisions

Additional reference elements and commentary provided from case study data, as sourced from the National Association of City Transportation Officials (NACTO) and the NACTO Urban Bikeway Design Guide has also been considered in a broader sense to further understand best practice applications & considerations.

4.3 SAFE SYSTEMS APPROACH

The Safe System approach to road safety focuses on creating a forgiving road system that acknowledges that people make mistakes and have limited ability to withstand crash forces without being killed or seriously injured.

AustRoads details that all parts of the road and transport system - roads and roadsides, speeds, vehicles, and road use, all need to be improved and strengthened - so that if one part fails, other parts will still protect people involved in a crash.

There are four (4) key principles that form the basis of the Safe System Philosophy:

- People make mistakes that can lead to road crashes.
- The human body has a limited physical ability to tolerate crash forces before harm occurs.
- A shared responsibility exists amongst those who plan, design, build, manage and use roads and vehicles and provide post-crash care to prevent crashes resulting in serious injury or death.
- All parts of the system must be strengthened to multiply their effects; and if one part fails, road users are still protected.

These Safe System principles must be given due consideration in all activities within the road safety management of a road network, and are considered within our assessment.

4.4 SAFETY REVIEW

A safety assessment and review of the proposed corridor options against relevant standards, and considering general traffic engineering principles, is provided hereunder. The review has been undertaken for each section, as detailed in the preceding sections, and provides commentary regarding general design considerations as well as location-specific issues which were identified.

It is noted that the intersections within the proposed cycle corridor have been separated and examined independently for each design option. This includes:

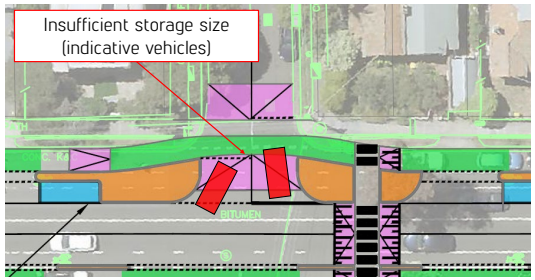
- Hotham Street / Inkerman Street;
- Inkerman Street / Alexandra Street;
- Inkerman Street / Inkerman Road / Orrong Road;
- Inkerman Road / Kooyong Road;
- Inkerman Road / Hawthorn Road;
- Inkerman Road / Normanby Road;
- Normanby Road / Balaclava Road; and
- Normanby Road / Smith Street.

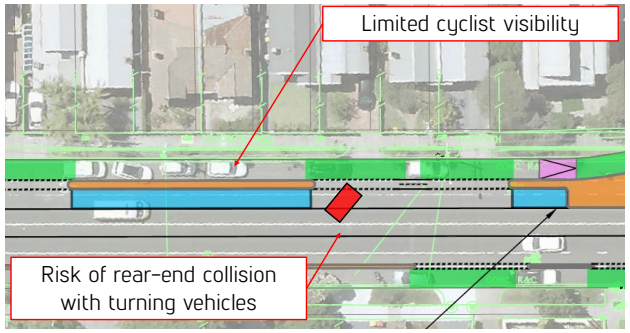
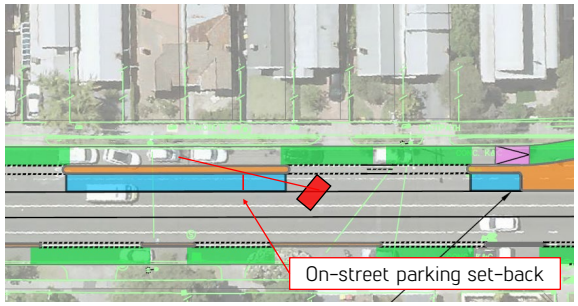
Recommended treatments are provided in the corresponding column to each item.

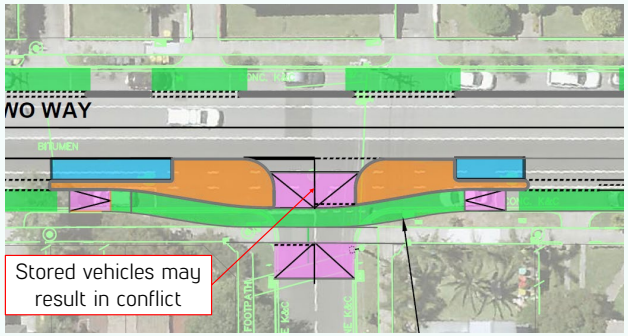
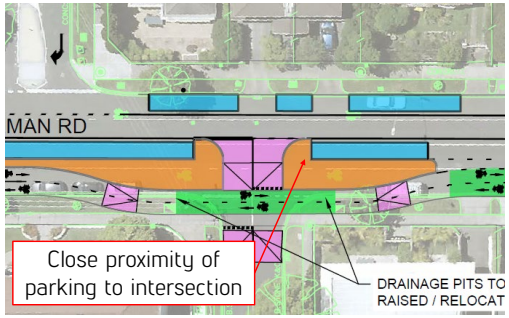
4.4.1 OPTION 1 – SECTIONS

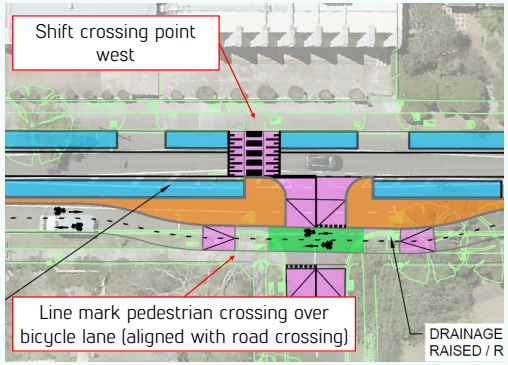
Table 5 Section Safety Review – Option 1

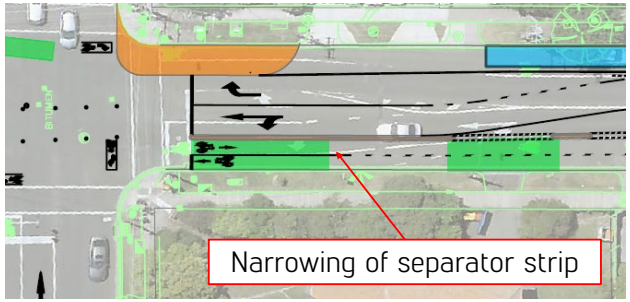
Section 1: Hotham Street – Orrong Road			
Item	Issue / location	Comment	Recommendation
1.	Raised pedestrian/cyclist crossings (*Empress Rd, Wilgah St, Kalymna Gr, Marne St*)	The proposal indicates the provision of raised pedestrian/bicycle crossings at several intersecting side streets, along with the construction of kerb outstands into the Inkerman Street road reserve. These crossings are provided at several side street intersections to the north side of Inkerman Street, between Alexandra Street and Orrong Road. No dimensions are provided for these sections, though it is noted an approximate 4–5m setback occurs between the Inkerman Street eastbound traffic lane and edge of the intersecting bicycle lanes at these locations. This area may be perceived as a vehicle storage area for drivers (and is presumably intended as so) seeking access to Inkerman Street though is insufficient in size to fully accommodate a vehicle. Accordingly, drivers will likely overhang and block the bicycle lane behind the vehicle which may lead to conflict or require a cyclist to swerve into the adjacent pedestrian path, risking collision with a pedestrian. This also applies to vehicles seeking access to the side streets from Inkerman Street who will overhang and restrict movement along the corresponding traffic lane. Given the setback of the bicycle lane from the moving traffic lane, any driver who commences this movement and is required to give way to a cyclist will be required to stop the vehicle during the turning manoeuvre – this may lead to an increase in 'rear end' vehicle crashes by unsuspecting motorists trailing the vehicle.	Ensure a vehicle storage area of at least 6.0m can be accommodated between the traffic lane and bicycle lane to prevent overhang into the adjacent lanes. If this cannot be achieved, consideration could be given to realigning the bicycle lane close to the edge of the carriageway, such that it is not possible for cars to store. Given the additional set back from the traffic lane, a sight distance assessment should then be undertaken and on-street parallel parking in the east and west directions of the intersection should be removed as appropriate. Sufficient sight distance will reduce the likelihood of drivers encroaching on the bicycle lane to achieve visibility of oncoming traffic.

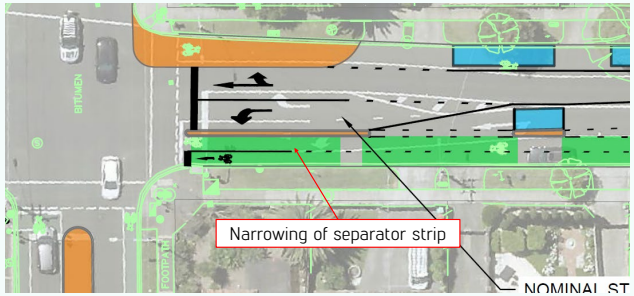
			
2.	Bicycle lane separators (*Extent of corridor – no parking sides*)	The proposal indicates the provision of protected bicycle lanes on both the north and south sides of the Inkerman Street carriageway. The bicycle infrastructure has been designed as follows: ▪ 2.2m wide bicycle lane w/ 0.5m separation strip (north side of Inkerman Street, west of Alexandra Road); ▪ 2.1m wide bicycle lane w/ 1.0m wide separation strip (south side of Inkerman Street, west of Alexandra Road); ▪ 2.2m wide bicycle lane w/ 1.0m separation strip (north side of Inkerman Road, east of Alexandra Road); and ▪ 2.0m wide bicycle lane w/0.5m separation strip (south side of Inkerman Road, east of Alexandra Road). The absolute minimum width for bicycle lanes is 1.5m, with the desirable 2.0m enabling cyclists to pass one another. Physical separation from motor traffic should be provided by a raised traffic island or a safety strip that is desirably 1.0m, with a 0.6m provision being the minimum (refer AGRD Part 3 and VicRoads guidelines). West of Alexandra Street, the northern bicycle lane is provided with a 0.5m separation strip. East of Alexandra Street, the southern bicycle lane is also provided with a 0.5m separation strip. These are below the minimum dimensions specified, as per AGRD Part 3. Additionally, the traffic lanes provided over this section measure the minimum width of 3.0m. Consideration should be given to providing additional separation between the moving traffic lane and edge of the bicycle lane.	**West of Alexandra Street:** Consideration should be given to reducing the overall width of the eastbound bicycle lane to ensure a sufficient separation strip can be provided. A bicycle lane width of 2.0m is sufficient to enable cyclists to pass one another, and will enable the provision of a 0.7m wide constructed separation strip. **East of Alexandra Street:** As per the above, consideration should be given to reducing the overall width of the westbound bicycle lane to ensure a sufficient separation strip can be provided. The bicycle lane currently measures 2.0m and can be reduced to 1.8m in width. This allows suitable separation from the adjacent westbound traffic lane. Consideration should be given to providing a 1.0m separation strip if possible, given the relatively high volume of vehicles recorded over this section (>6,000 vehicles, each direction).

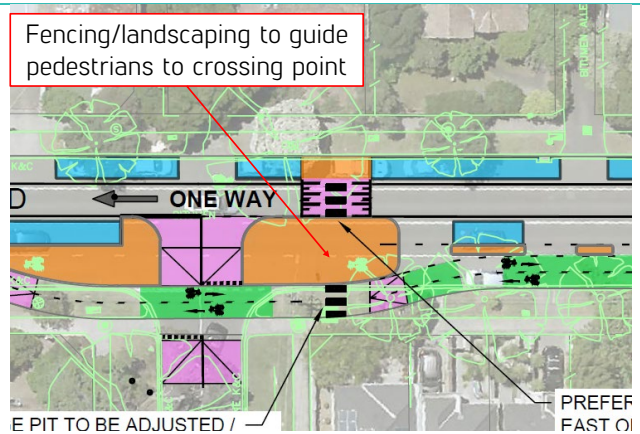
3.	Sightlines (*residential driveways*)	A large number of residential crossovers exist within the corridor section (overall). The provision of on-street parallel parking abutting the bicycle lanes may restrict visibility of cyclists for residents accessing their properties. Given the potential impediment to view lines for on-coming cyclists, it is likely that a resident accessing their property (particularly via left-turn movement) would not be able to perceive a cyclist until the turning movement has commenced. This may result in drivers colliding with a cyclist or stopping the vehicle during the turning manoeuvre and overhanging the traffic lane, increasing the likelihood of a 'rear end' collision by trailing vehicles. 	Ensure on-street parking is adequately set back to enable sufficient perception of oncoming cyclists. 
Section 2: Orrong Road – Kooyong Road			
Item	Issue / Location	Comment	Recommendation
4.	Raised pedestrian/cyclist crossings (*Labassa Gr, Ontario St, Testar Gr, Kent Gr, Leaburn Ave, Raphael St*)	The proposal indicates the provision of raised pedestrian/bicycle crossings at several intersecting side streets, along with the construction of kerb outstands into the Inkerman Street road reserve. No dimensions are provided for these sections, though it is noted an approximate 5-6m setback occurs between the Inkerman Street east- or west-bound traffic lane and edge of the intersecting bicycle lanes at these locations.	Undertake ingress/egress vehicle swept path assessment for a B99 design vehicle. If swept path assessment indicates vehicle overhang within the bicycle lane/traffic lane, increase the size of the storage area.

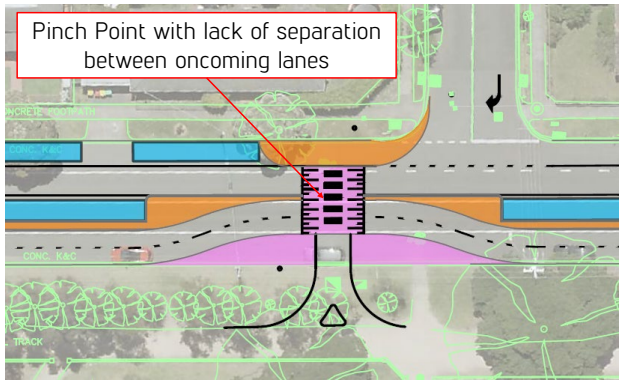
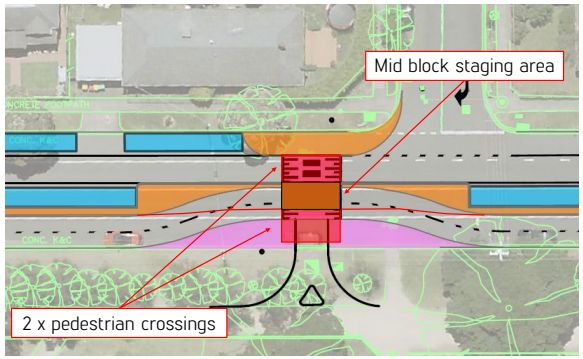
		Vehicle swept path assessment should be undertaken for these intersections to ensure vehicles propped within the storage area (between the bicycle lanes and traffic lane) do not overhang either the bicycle lane or traffic lane – the latter of which may lead to an increase in 'rear end' vehicle crashes by unsuspecting motorists trailing the vehicle.  	
5.	Raised pedestrian/cyclist crossings (*Labassa Gr, Ontario St, Testar Gr, Kent Gr, Leaburn Ave, Raphael St*)	The side street intersections within this section featuring raised pedestrian/cyclist crossings are also provided with kerb outstand areas. Provision for indented on-street parallel parking has been provided in very close proximity to the intersections and will restrict sightlines for exiting drivers.  	Ensure vehicle parking at these locations is set back a minimum of 10.0m from the intersecting side street to enable improved visibility for oncoming traffic or drivers within parked vehicles.

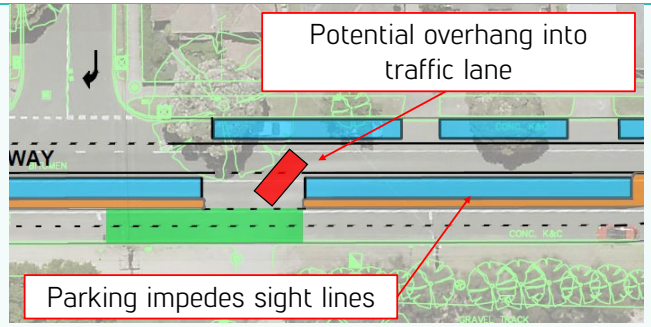
6.	Pedestrian Crossing (*Inkerman Rd / Labassa Gr*)	A raised pedestrian zebra crossing is proposed over Inkerman Road, located at the intersection with Labassa Grove. The proposed location of the crossing is in very close proximity to the Labassa Grove intersection, with the base of the eastern ramp almost directly aligned with the Labassa Grove western kerb line. On-street parallel parking is permitted on the south side of the road, directly abutting the pedestrian path of travel, this may result in vehicle overhang, impeding the pedestrian travel path when crossing. Additionally, as Inkerman Road will be operating as a one-way street, it is likely access to this parking space will require reverse access or a correctional reverse manoeuvre which may result in a collision with an unsuspecting pedestrian. The on-street parallel parking proposed on the north side of the carriageway features no physical deterrent to prevent vehicles from parking on the ramped sections of the crossing and may restrict visibility of pedestrians for westbound vehicle traffic, heightening the chance of a pedestrian 'emerging' from behind a parked vehicle and being struck. Furthermore, pedestrians will be required to cross the two-way bicycle path without protection which may lead to a conflict, particularly from pedestrians who do not expect a cyclist travelling westbound.  	The proposed raised zebra crossing should be shifted further west to enable suitable separation from the Labassa Grove intersection. The kerb outstands servicing the south side of the crossing point should extend further west, ensuring the full adjacent envelope of the raised crossing is free from parked vehicles. A kerb outstand should be constructed on the northern side of the crossing point and sufficient clearance provided between the crossing location and on-street parking, east of the crossing, to ensure visibility of pedestrians. A pedestrian zebra crossing should be provided over the two-way bicycle lane to ensure safety for pedestrians.

7.	Separation strip width (*Inkerman Road west leg – on approach to Hotham Street intersection*)	The separation strip at the commencement of the two-way bicycle lane (east of Hotham Street) narrows below the 1.0m width provided throughout the rest of the section. No dimensions are provided, though presumably a 0.5m separation strip is provided. This would provide insufficient clearance between cyclists and vehicles in the adjacent lane.  	Realign the traffic lanes on approach to the Hotham Street Intersection to accommodate a separation strip of 0.6m (minimum) or 1.0m (desirable). The extent of the proposed hardstand area at the northeast corner of the intersection can be reduced to accommodate the required width.
8.	Driveway crossovers (*south side*)	Risk exists to cyclists on the two-way bicycle lane given the high number of intersecting driveway crossovers, largely applicable to westbound cyclists as departing vehicles may not expect a cyclist to arrive from this direction. Additionally, the provision of on-street parallel parking along the south side of the carriageway may draw a driver's attention from the bicycle lanes due to the sightline impact to the moving traffic lane.	The provision of bicycle line markings and surface treatments at the crossovers serves to advise the presence of bicycle lanes. Vehicle parking on the south side of the carriageway should be restricted or removed to reduce the impact of 'visual clutter' and sightline restrictions. Nonetheless, the prevailing issue is the unexpected arrival of a bicycle in the eastbound direction. As a primarily residential area, it is anticipated long-term residents will quickly adapt to the proposed design, and the risk associated with this item will reduce over time.

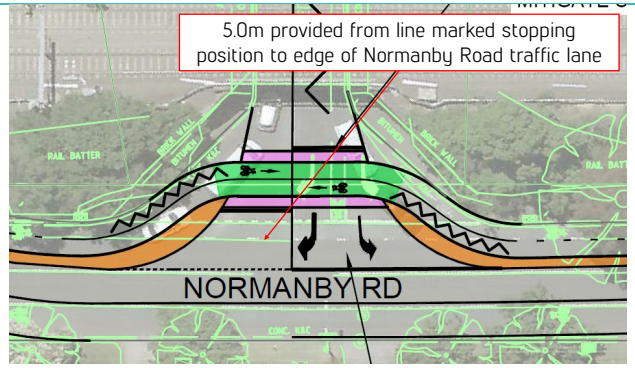
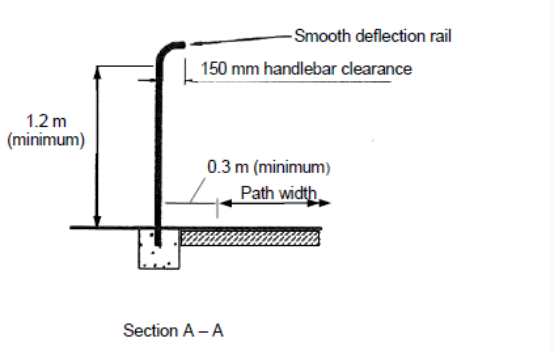
Section 3: Kooyong Road – Hawthorn Road			
Item	Issue / Location	Comment	Recommendation
9.	Raised pedestrian/cyclist crossings (*Raglan St, Edith St, Albert St*)	Refer commentary provided in Section 1 – Item 1.	
10.	Separation strip width (*Inkerman Road west leg – on approach to Kooyong Road intersection*)	The separation strip at the commencement of the two-way bicycle lane (east of Hotham Street) narrows below the 1.0m width provided throughout the rest of the section. No dimensions are provided, though presumably a 0.5m separation strip is provided. This would provide insufficient clearance between cyclists and vehicles in the adjacent lane. 	Realign the traffic lanes on approach to the Kooyong Road intersection to accommodate a separation strip of 0.6m (minimum) or 1.0m (desirable). Additionally, given the width of the bicycle lanes (1.9m & 1.8m indicatively from the closest set of dimensions) these could be narrowed to 1.6m in width each to accommodate the required separation width.
11.	Pedestrian Crossing (*Inkerman Rd / Edith St*)	While no path is shown between the two crossing points on Inkerman Road, it is noted these will be connected with a path. Given the area is at-grade some pedestrians may seek to take the shortest route when crossing the bicycle lane and avoid the designated crossing point. This may lead to a conflict with a cyclist.	It is recommended that some physical obstruction, such as landscaped edges be provided within the area between crossing points to guide pedestrians to the designated crossing area over the two-way bicycle lane, reducing the conflict potential with a cyclist.

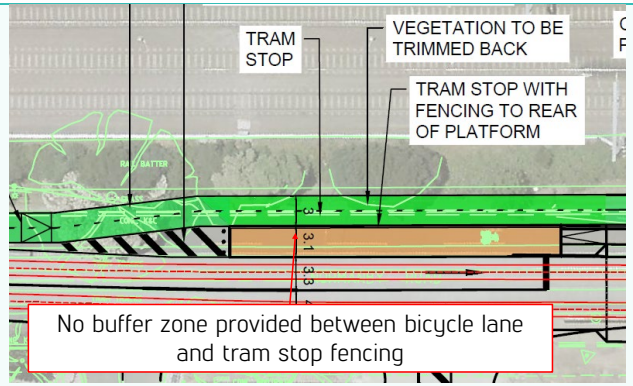
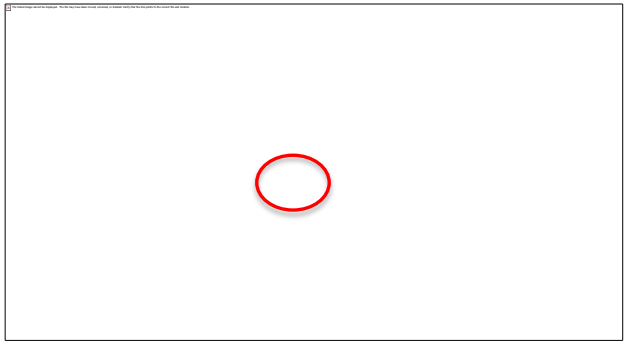
			
12.	Driveway crossovers *(south side)*	Refer commentary provided in **Section 2 – Item 1**.	
Section 4: Hawthorn Road – Normanby Road			
Item	Issue / Location	Comment	Recommendation
13.	Pedestrian Crossings (*Malvern Gr, Mayfield Gr*)	Two raised zebra crossings are proposed within this section, providing access to Caulfield Park. The crossing points will feature constructed kerb outstands on both the north and south sides of Inkerman Road. Due to the proposed outstand on the south side of Inkerman Road, the two-way bicycle lane will be shifted laterally toward the traffic lane. The concept suggests the separating median will narrow at this point and appears to be below the 0.6m minimum. Additionally, at the level of the pedestrian crossing, there will be no physical separation between the eastbound bicycle lane and westbound traffic lane.	A staging area should be provided within the zebra crossing of sufficient size that a pedestrian can comfortably prop between the eastbound bicycle lane and westbound traffic lane. This provision would require widening of the dividing median on either side of the pedestrian crossing and will assist in providing suitable separation between cyclists and vehicles when traversing the crossing. The extent of kerb outstand provided at the Caulfield Park frontage can be reduced as required to accommodate this change.

		This proximity may result in a collision incident where a vehicle or bicycle partially swerves toward the oncoming traffic lane. Additionally, the lack of separation may cause eastbound cyclists to ride closer to the westbound bicycle lane to obtain separation from passing cars, increasing the likelihood of colliding head-on with an oncoming cyclist.  	
14.	Restricted sight distance to cyclists (Caulfield Park frontage)	Two vehicle crossovers to Inkerman Road from Caulfield Park exist within the approximate section opposite Normanby Avenue, servicing the City of Glen Eira Park Depot. Inkerman Road will operate as a one-way (westbound) road under this option. On-street parallel parking is proposed on both sides of the carriageway, however the proposed provision along the southern separation strip between the bicycle lanes may impede visibility of a cyclist. This impediment to sightlines is particularly hazardous to the westbound bicycle lane, to which a driver would be required to look 'behind' the vehicle to perceive a westbound cyclist. In addition to the potential conflict with cyclists due to restricted visibility, a risk of 'rear-end' collision exists with trailing drivers who do not expect the turning vehicle to stop mid-manoeuvre.	Ensure on-street parking on the south side of Inkerman Road, within the vicinity of the vehicle crossovers, is appropriately set-back to permit sight lines of the bicycle lanes for turning drivers. This has the added benefit of operating as an informal turning lane/area (east of the crossovers), reducing the likelihood of overhang into the traffic lane.

			
Section 5: Inkerman Road – Smith Street			
Item	Issue / Location	Comment	Recommendation
It is noted that the same alterations are proposed to the Normanby Road carriageway between Inkerman Road and Smith Street over both Design Option 1 and Design Option 2. Accordingly, the comments provided hereunder is applicable to both designs.			
15.	Overhead obstructions	The two-way bicycle path over Normanby Road is proposed along the northeast side of the carriageway in close proximity to a number of existing trees. Several existing trees between Inkerman Road and the underpass connection not Dandenong Road/Princes Highway were observed to overhang and 'lean' into the carriageway, posing a collision risk to passing cyclists. Additionally, a minimum clearance of 0.5m should be provided between the edge of the bicycle lane and any trees to prevent the handlebars of passing cyclists 'catching', per AustRoads guidelines.	Any trees which encroach into the cycle path and do not provide a minimum 2.2m height clearance above the bicycle lanes should be trimmed/removed. Ensure 0.5m clearance is provided between the edge of the bicycle lane and adjacent trees, or otherwise remove trees.

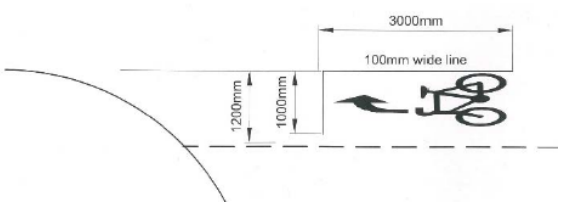
			
16.	Raised bicycle crossing (*Normanby Road & Dandenong Road/Princes Highway underpass*)	A raised bicycle crossing is proposed on the southwest side of the Normanby Road & Dandenong Road/Princes Highway underpass. A review of the proposed concept suggests a 5.0m–5.5m storage area is provided between the ramped section of the bicycle crossing and eastbound traffic lane on Normanby Road. This is insufficient to store a vehicle. It is noted that the distance between the edge of the Normanby Road traffic lane and closest bicycle lane over the crossing measures 6.5m. While this may be able to accommodate a vehicle heading to Normanby Road from the underpass, the area is considered insufficient for vehicles turning right into the underpass from Normanby Road. Notably, a line marked stopping position is provided at the commencement of the raised platform, and will likely result in a vehicle overhang the traffic lane on Normanby Road to the rear. This increases the risk of a vehicle colliding with another vehicle stored in this area, or may result in vehicles travelling on Normanby Road swerving into the oncoming traffic lane.	The crossing point should be located such that the storage area between Normanby Road and the line marked stopping area measures a minimum of 6.0m. With further design anticipated at detailed design stages, it is recommended this intersection be subject to further review.

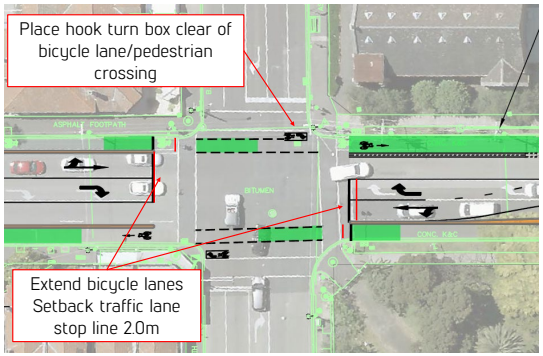
			
17.	Tram stop fencing	Two tram platforms are proposed over Normanby Road Between Balaclava Road and Smith Street. The plans indicate the two-way bicycle lane will be positioned to the rear of the tram stop and provided a width of 3.0m (1.5m bicycle lanes in each direction). Fencing has been indicated on the plans, separating the tram stop from the bicycle lanes. No details regarding the type of fencing proposed has been indicated on the plans. Nonetheless, a buffer zone will need to be provided to mitigate the risk of a cyclist striking the fence and losing control.	Ensure adequate clearance to proposed fence – refer AustRoads GTTM Part 6A: 

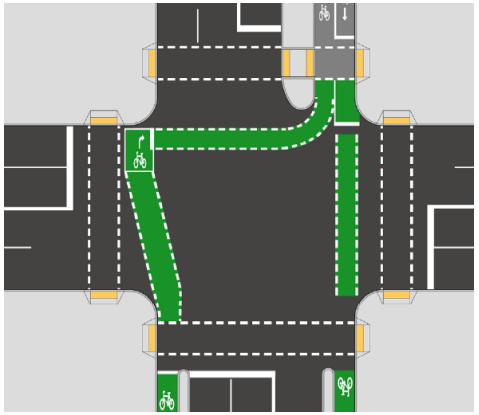
			
18.	Shared path section	A shared path is proposed between the tram stop on the northeast side of Normanby Road and the Smith Street intersection. A 3.0m path width has been indicated (1.5m lanes in each direction). The separation strip between the shared path and the left-turn lane appears to be approximately 400mm wide. This may result in cars overhanging the shared path when entering the left-turn lane, resulting in risk of collision with pedestrians/cyclists. 	Undertake swept path analysis and seek to increases clearances between the left-turn lane and shared path. This may involve narrowing the width of the left-turn lane below 3.0m and/or narrowing the traffic lanes on Normanby Road.

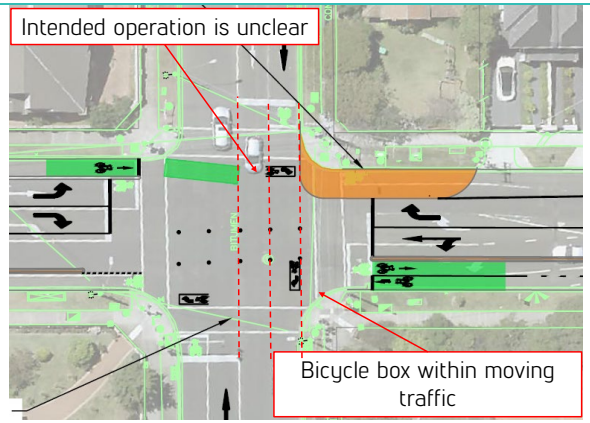
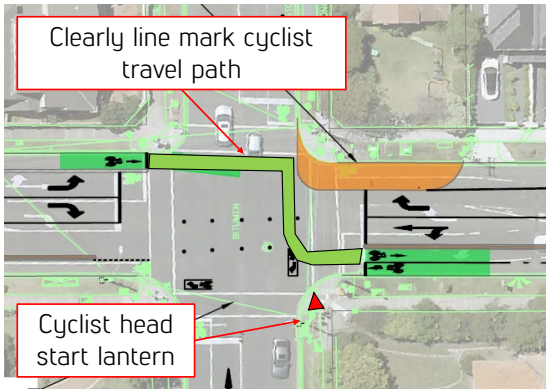
4.4.2 OPTION 1 – INTERSECTIONS

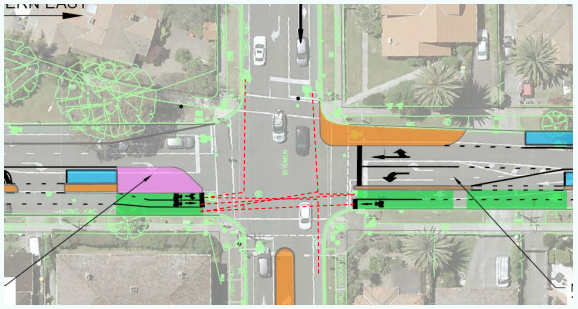
Table 6 Intersection Safety Review – Option 1

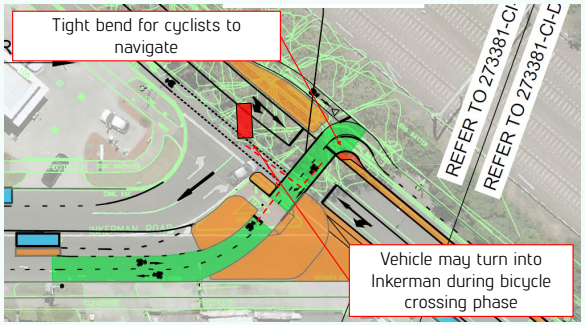
Design Option 1			
Item	Location	Comment	Recommendation
19.	Hotham Street / Inkerman Street	The intersection of Hotham Street and Inkerman Street provides protected bicycle lanes on each side of the carriageway. This arrangement is provided on both the east and west intersection legs, noting the initial section of bicycle lane on the north side of the carriageway (east leg) is proposed to feature a line marked separation strip to accommodate community bus access. Bicycle lane line markings are proposed through the intersection, linking the corresponding lane segments from the east and west legs within the intersection. Green surfacing treatment has been indicated within the first half of each bicycle lane within the intersection – it is unclear as to whether the full length of lane will be provided with the surface treatment. Access to the north and southbound directions on Hotham Street is proposed via the provision of line marked bicycle hook turn boxes. The supplied concept indicates the bicycle hook turn box servicing access in the southbound direction overlaps with the eastbound bicycle lane. No dimensions are provided, though it is noted that the Bicycle hook turn box will need to be provided at a length of 3.0m and width of 1.0m as follows: **Figure 5.6: Bicycle hook turn box detail**  	Ensure the guiding bicycle lane within the intersection (both east- and west-bound) is provided with a surface treatment over the full length of the line marked lane to ensure suitable visibility for both cyclists and motorists. Ensure the bicycle hook turn box accommodating cyclists intending to travel southbound along Hotham Street does not overlap with the bicycle lane within the intersection. If sufficient separation between the bicycle lane and/or pedestrian crossing on the north leg of the intersection cannot be achieved, the pedestrian crossing point may need to be shifted further north as required. Extend the length of the east-and-west-bound bicycle lanes such that the designated stop point is located 0.2m from the line marked pedestrian crossing paths, and adjust the stop lines for the adjacent vehicle traffic lanes to achieve a separation of 2.0m. This enables cyclists to be easily seen by a stationary driver at the stop line, particularly where the vehicle is a van or truck in which case the cyclist would otherwise be hidden from view below the left-hand side window.

		Additionally, it is noted that the stop lines for both the east- and west-bound bicycle lanes align with the vehicle traffic lane stop lines. This may place a cyclist out of view for an inattentive driver or truck/van drivers who may not perceive a cyclist below the left-hand side window.	 A green cyclist 'head start' lantern is recommended for the north-south signal phase/s, to allow cyclists in the hook turn boxes to safely commence their movement.
20.	Inkerman Street / Alexandra Street	The intersection of Inkerman Street and Alexandra Street provides protected bicycle lanes on each side of the carriageway. This arrangement is provided on both the east and west intersection legs, with constructed separation strips provided along each bicycle lane leading into the intersection. Two (2) hook turn bicycle boxes are proposed within the intersection to facilitate access to the Inkerman Road bicycle corridor from Alexandra Street. Non-retroreflective raised pavement markings are proposed in the north- and south-bound directions within the intersection, aligned to the Alexandra Street traffic lanes. The east and westbound bicycle lanes are provided with a head start storage area – this is a preferable treatment for the primary corridor, offering benefits as discussed in Point 1 above.	The overall arrangement of the proposed intersection is considered appropriate in this section. No dimensions are provided at the east- and west-bound head start storage areas, though a minimum separation of 2.0m should be provided.

21.	Inkerman Road / Orrong Road	The intersection of Inkerman Street / Inkerman Road / Orrong Road will operate as the proposed transition point between the one-way bicycle lanes provided on each side of the Inkerman Street carriageway (west leg), and the two-way bicycle lane proposed over the south side of Inkerman Road (east leg). The supplied concept indicates that a kerb outstand shall be constructed on the northeast corner of the intersection, extending south into the Inkerman Road carriageway – no extension into Orrong Road reserve is proposed. The transition into the two-way bicycle lane may be difficult for cyclists to perceive/understand, particularly those who are new/inexperienced to cycling. As the corridor forms a key component of the Glen Eira Cycle Network, provision should be made to ensure all road users are aware of the intended arrangements. Furthermore, three hook turn bicycle boxes are proposed within the intersection. It is noted that the bicycle box at the southeast corner of the intersection, accommodating southbound cyclists intending to head west, overlaps with the southbound traffic lane on Orrong Road – this significantly increases the risk of a vehicle-bicycle collision and potential sideswipe incidents between cars as it forces premature merging of the southbound traffic lanes.	As part of the Glen Eira Cycle Network, the bicycle path should be easily perceivable by cyclists of all experience levels. To ensure the transition into the two-way bicycle lane is clear to cyclists (and vehicles), the full path within the intersection from the north side of Inkerman Street to the south side of Inkerman Road should be clearly line marked. An example arrangement is provided below, detailing the clear path of travel for cyclists transitioning to the opposite side of the carriageway:  A green cyclist 'head start' lantern is recommended on the southeast corner of the intersection, facing north. This would allow cyclists stored within the bicycle hook turn box at the northern leg to suitably clear under priority and would enable southbound cyclists from Orrong Road to move into the intersection. The bicycle hook turn box facilitating access to the westbound bicycle lane will need to be located further east as it is currently within the southbound traffic lane – this may

			require the existing pedestrian crossing on the east leg to be shifted to accommodate this. 
22.	Inkerman Road / Kooyong Road	The intersection of Inkerman Road / Kooyong Road provides a two-way bicycle lane on both the east and west approach legs, with constructed separation strips/landscaping buffers provided in advance of the intersection, separating the bicycle lanes with adjacent traffic lanes. Notably, the two-way bicycle lane on the western approach leg splits into two lanes; a primary through lane and short left- and right-turn lane. It is noted that the dedicated left/right turn bicycle lane is positioned on the north side of the eastbound though lane, requiring any right-turning cyclists to cross the path of east- and west-bound bicycles. No cyclist specific signal lanterns have been identified within the concept and it is unclear as to how cyclist movements will be accommodated. There does not appear to be any provision to enable cyclists to easily access Kooyong Road in the north- and south-bound directions without conflicting with other cyclists. The below figure indicates the cyclist connection paths at the various intersection legs – as can be seen no accommodation has	The proposed layout of the intersection leaves cyclists exposed to a considerable degree of danger, both from conflicts with vehicles and other cyclists within the network. The proposed layout does not suitably integrate the north- and south-bound legs of Kooyong Road into the two-way bicycle lane, nor does it detail the intended path of travel or operation of the intersection from the perspective of a cyclist. A detailed concept plan of the proposed intersection should be prepared that clearly defines the intended path of travel for each bicycle movement within the intersection. It is noted that incorporation of a dedicated bicycle signal phase may be required within the intersection and/or 'push to activate' cyclist signals for certain movements. Alterations to the proposed geometry of the intersection may also be required, which may include additional set-backs of the traffic lane, relocation of pedestrian crossings and provision of additional physical barriers to protect cyclists.

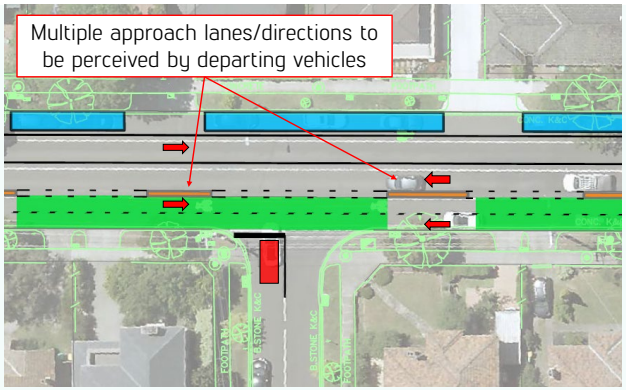
		been provided to ensure the movement of cyclists who are not travelling east- or west-bound through the intersection. A significant number of conflict points exists, including with other cyclists.  It is understood that Kooyong Road also forms part of the Glen Eira Cycle Network. Accordingly, as an intersection between two key bicycle corridors, it is important to ensure the proposed arrangement and operation of the intersection is clear to cyclists of all abilities and offers a high-standard of safety.	
23.	Inkerman Road / Hawthorn Road	Both the east and west legs of the Inkerman Road / Hawthorn Road intersection feature a protected two-way bicycle lane on the south side of the carriageway. The proposed separation strips appear to provide suitable separation from the adjacent traffic lanes. There is no provision catering to north- and south-bound access to/from Hawthorn Road on the supplied concept plan. The bicycle lanes on the east leg of the intersection are provided in-line with the adjacent traffic lanes.	The overall arrangement of the proposed intersection is considered appropriate in this section. It is recommended that the bicycle lanes on the east leg of the intersection are extended and positioned 0.2m from the pedestrian crossing line. The adjacent traffic lanes should be recessed a further 2.0m behind the bicycle lane stop point to provide visibility to a cyclist waiting at the intersection. Bicycle hook turn boxes can be provided on the plan to clearly define turning areas for cyclists seeking access to/from Hawthorn Road. It is recommended some provision be made for cyclists seeking access to the south when travelling eastbound. It is difficult to simply provide a hook turn bicycle box to accommodate this movement as any position in advance of the east-leg traffic lanes could only be done so under a dedicated bicycle phase.

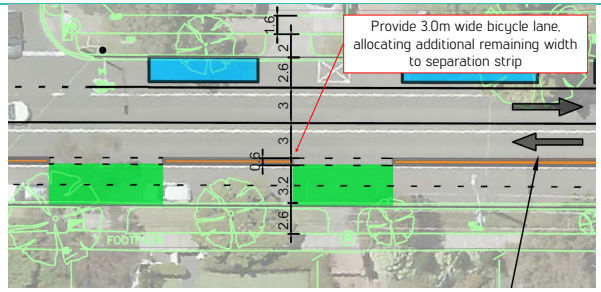
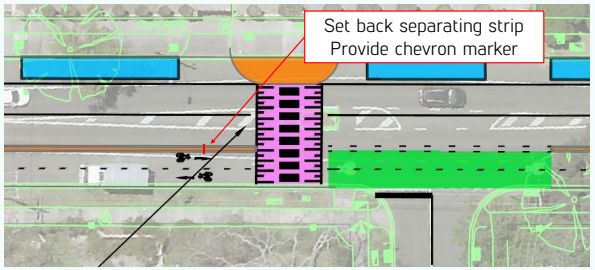
24.	Inkerman Road / Normanby Road	The intersection of Inkerman Road with Normanby Street forms a T-junction intersection. Inkerman Road features the two-way bicycle lane on the south side of the carriageway, with a two-way bicycle lane provided on the northeast side of the Normanby Road carriageway. A signalised bicycle crossing point is proposed, linking these two segments and activated via push-button operation. The path also permits access to a line marked bicycle lane in the northwest bound direction. The general operation and provision for cyclists at this intersection is considered an appropriate arrangement. However, concern is raised with the potential for vehicle conflict with cyclists left/right turning from the two-way path to access the northwest bound bicycle lane on Normanby Road. While the signals would restrict through movements over Normanby Road, vehicles would still be permitted to turn right into Inkerman Road from the southeast bound traffic lane on Normanby Road. The commencement of a turning movement for a vehicle into Inkerman Road and bicycle into Normanby Road are in very close proximity to one another, and may result in a collision. Additionally, the internal radius at the northwest bound bicycle lane (Normanby Road) appears relatively tight, and there is no curvature to enable cyclists to comfortably turn left from the Inkerman Road bike lane into the Normanby Road (NW bound) bicycle lane. 	The stop line on the NW side of the POS should be relocated to the north side of the Inkerman Road intersection to prevent vehicles from unexpectedly turning into the path of northwest bound cyclist traffic. This has the added benefit of providing protected crossing periods for pedestrians travelling to/from this direction across Inkerman Road. The internal radius of the bicycle lane on the northeast side of Normanby Road should be increased and/or the lane widened to more comfortably accommodate cyclists around the bend. Both cyclist stopping points in advance of the intersection should be provided with hold rails.

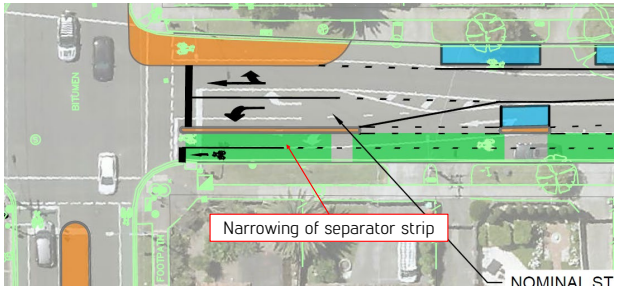
4.4.3 OPTION 2 – SECTIONS

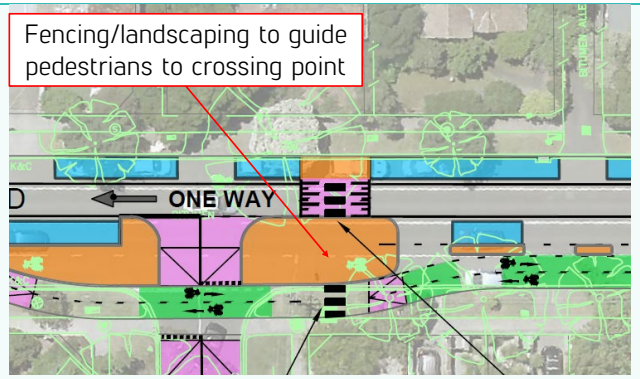
Table 7 Section Safety Review – Option 2

	Section 1: Hotham Road to Orrong Road		
Item	Issue / location	Comment	Recommendation
25.	It is noted that the design of the Hotham Street / Orrong Road corridor is shared between Design Option 1 & Design Option 2, including the Inkerman Street / Hotham Street intersection and Inkerman Street / Alexandra Street Intersection. Accordingly, refer Section 1 of the Option 1 Section Safety Review in **Table 5** for applicable review comments. Variation within this corridor only occurs at the intersection with Orrong Road, refer the Option 2 – Intersection Safety Review in Error! Reference source not found. for comments.		
	Section 2: Orrong Road to Kooyong Road		
Item	Issue / location	Comment	Recommendation
26.	Intersecting side street (*south side*)	The two-way bicycle lane is provided over the south side of the carriageway throughout this section, intersecting with numerous local streets on this side of the carriageway. Unlike Option 1, which accommodates a vehicle storage area between the bicycle lanes and moving traffic lane, vehicles accessing Inkerman Road from the side streets are required to perceive both cars and cyclists in both directions before commencing the movement. It is noted that cyclists are often overlooked by drivers even when travelling in single bicycle lanes and abutting the flow of traffic. The additional separation from the traffic lane may increase the likelihood of a cyclist being overlooked,	There appears no way to resolve this other than adopting separate eastbound and westbound bicycle lanes on each side of Inkerman Road.

		 Furthermore, while vehicles would be required to halt at the line marked stop line and only move into Inkerman Road when traffic conditions area clear, the lack of physical controls would likely mean vehicles would encroach and prop within the bicycle lanes when attempting to access Inkerman Road. While this may not necessarily be a major issue in the initial stages of operation, any substantial increase in cyclist numbers along this corridor (which would be expected given the provision of these facilities) would gradually increase the risk in the longer term.	
27.	Separation Strips	Separation strips between the bicycle lanes and westbound traffic lane appear to be provided at variable widths between 1.0m and 0.5m. In this case, the increase in separation strip width for a reduction in the bicycle lane width is considered more beneficial from a safety perspective. It is noted that the vehicle traffic lanes proposed measure 3.0m each. This is relatively narrow and is the minimum lane width which can be supported. Accordingly, it is considered likely that vehicles will travel along the outer edges of the traffic lane for separation from oncoming vehicles, as this would increase the	Given the proximity of the eastbound bicycle lane to the westbound traffic lane, the width of the separating strip should be maximised where possible. The road environment is quite narrow throughout this section, with numerous breaks in the separating strip to accommodate driveway access. Accordingly, where the separation strip is below 1.0m, it is recommended bicycle lanes be reduced to 1.5m in each direction, with any remaining surplus space allocated to the constructed/line marked separation strips.

		proximity of vehicle travel to the eastbound bicycle lane, cyclists may be more inclined to ride toward the centre of the two-way bicycle lane for a greater sense of perceived safety, increasing the likelihood of a 'head on' crash with another cyclist.	
28.	Raised pedestrian crossing (*Labassa Grove*)	The raised pedestrian crossing west of Labassa Grove features a constructed separation strip, commencing immediately west of the crossing point. The proximity to the raised crossing may reduce the ability of the separation strip to be adequately perceived by drivers. Additionally, the narrow 3.0m traffic lanes passing a constructed kerb outstand at the north side of the road creates a 'pinch point' which may result westbound vehicles driving to the edge of the traffic lane. Accordingly, possibility exists for drivers to collide/mount the separating strip in this area, with potentially for vehicles to overhanging the adjacent bicycle path of travel.	It is recommended that clearance be provided between the raised pedestrian crossing and constructed separation strip. An advisory chevron sign should be erected at the nose of separation strip 
29.	Driveway crossovers (*south side*)	Risk exists to cyclists on the two-way bicycle lane given the high number of intersecting driveway crossovers, largely applicable to westbound cyclists as departing vehicles may not expect a cyclist to arrive from this direction.	The provision of bicycle line markings and surface treatments at the crossovers serves to advise the presence of bicycle lanes. Nonetheless, the prevailing issue is the unexpected arrival of a bicycle in the eastbound direction. As a primarily residential area, it is anticipated long-term residents will quickly adapt to the proposed design, and the risk associated with this item will reduce over time.

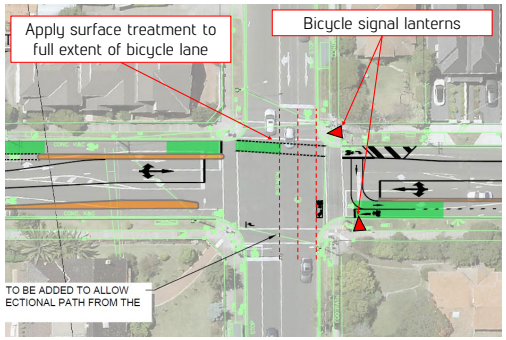
Section 3: Kooyong Road to Hawthorn Road			
Item	Issue / location	Comment	Recommendation
30.	Raised pedestrian/cyclist crossings (*Raglan St, Edith St, Albert St*)	Refer commentary provided in Section 1 – Item 1.	
31.	Separation strip width (*Inkerman Road west leg – on approach to Kooyong Road intersection*)	The separation strip at the commencement of the two-way bicycle lane (east of Hotham Street) narrows below the 1.0m width provided throughout the rest of the section. No dimensions are provided, though presumably a 0.5m separation strip is provided. This would provide insufficient clearance between cyclists and vehicles in the adjacent lane. 	Realign the traffic lanes on approach to the Kooyong Road intersection to accommodate a separation strip of 0.6m (minimum) or 1.0m (desirable). Additionally, given the width of the bicycle lanes (1.9m & 1.8m indicatively from the closest set of dimensions) these could be narrowed to 1.6m in width each to accommodate the required separation width.
32.	Pedestrian Crossing (*Inkerman Rd / Edith St*)	While no path is shown between the two crossing points on Inkerman Road, it is noted these will be connected with a path. Given the area is at-grade some pedestrians may seek to take the shortest route when crossing the bicycle lane and avoid the designated crossing point. This may lead to a conflict with a cyclist.	It is recommended that some physical obstruction, such as landscaped edges be provided within the area between crossing points to guide pedestrians to the designated crossing area over the two-way bicycle lane, reducing the conflict potential with a cyclist.

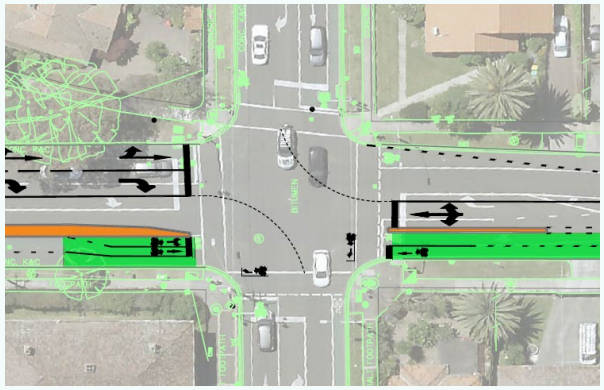
			
33.	Driveway crossovers (*south side*)	Refer commentary provided in **Section 2 – Item 29**.	
Section 4: Hawthorn Road to Normanby Road			
Item	Issue / location	Comment	Recommendation
34.	No significant issues pertaining to safety have been identified throughout this section. It is noted that this section of the corridor can be considered an ideal location for the provision of a two-way bicycle lane given the minimal presence of intersecting side streets/crossovers and absence of on-street parking against the constructed separation strip. The uniform access to Caulfield Park along this section also justifies this arrangement.		
Section 5: Normanby Road to Smith Street			
Item	Issue / location	Comment	Recommendation
It is noted that the same alterations are proposed to the Normanby Road carriageway between Inkerman Road and Smith Street over both Design Option 1 and Design Option 2. Accordingly, the comments provided hereunder is applicable to both designs.			

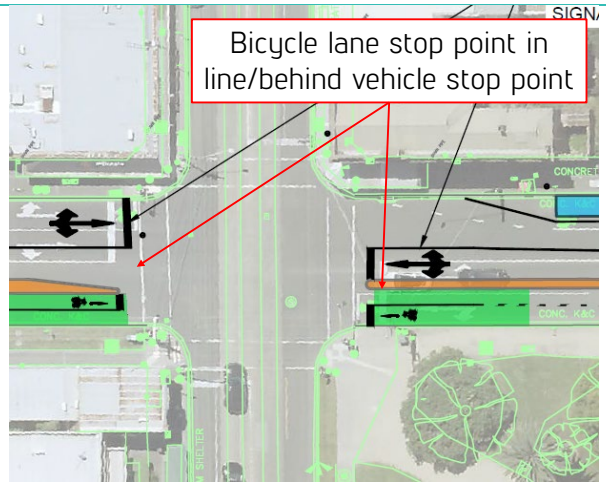
4.4.4 OPTION 2 – INTERSECTIONS

Table 8 Intersection Safety Review – Option 2

	Section 1		
Item.	Location	Comment	Recommendation
35.	Hotham Street / Inkerman Street	The proposed intersection arrangement is identical to that proposed within Design Option 2. Accordingly, refer Intersection 1 comment within Intersection Safety Review – Option 1.	As per Intersection 1 recommendation in Intersection Safety Review – Option 1.
36.	Inkerman Street / Alexandra Street	The proposed intersection arrangement is identical to that proposed within Design Option 2. Accordingly, refer Intersection 2 comment within Intersection Safety Review – Option 1.	As per Intersection 2 recommendation in Intersection Safety Review – Option 1.
37.	Inkerman Road / Orrong Road	The intersection of Inkerman Street / Inkerman Road / Orrong Road will operate as the proposed transition point between the one-way bicycle lanes provided on each side of the Inkerman Street carriageway (west leg), and the two-way bicycle lane proposed over the south side of Inkerman Road (east leg). It is noted that the supplied concept within Design Option 2 features alterations to the traffic lanes at the east and west legs. The east and west legs offer a single shared through/left- and right-turn lane, whereas Design Option 1 provided a shared through/left and dedicated right turn at the east leg, with dedicated left- and right- turn lanes provided at the west leg. The supplied concept indicates that a line marked section shall be provided on the northeast corner of the intersection, beyond the pedestrian crossing. A clear line marked transition to the two-way bicycle lane is provided, though this should be provided with a full surface treatment given the corridor forms a key component of the Glen Eira Cycle Network to ensure all road users are aware of the intended operation.	As part of the Glen Eira Cycle Network, the bicycle path should be easily perceivable by cyclists of all experience levels. To ensure the transition into the two-way bicycle lane is clear to cyclists (and vehicles), the full path within the intersection from the north side of Inkerman Street to the south side of Inkerman Road should be clearly line marked. Additionally, a set of bicycle signal lanterns should be provided on the southeast corner of the intersection facing north and northeast corner facing east to allow cyclists to access the two-way bicycle lane. A green cyclist 'head start' lantern is recommended on the southeast and northeast corners of the intersection, facing north. This would allow cyclists stored within the bicycle hook turn box at the northern leg to suitably clear under priority, and would enable southbound and

		Furthermore, two hook turn bicycle boxes are proposed within the intersection, located at the southeast and southwest corners of the intersection respectively. The bicycle box located at the southeast corner of the intersection partially encroaches on the southbound traffic lane, increasing the risk of collision with a vehicle.	eastbound cyclists from Orrong Road and Inkerman Road respectively to move into the intersection. The bicycle hook turn box facilitating access to the westbound bicycle lane will need to be located further east as it is currently within the southbound traffic lane. 
38.	Inkerman Road / Kooyong Road	The intersection of Inkerman Road / Kooyong Road provides a two-way bicycle lane on both the east and west approach legs, with constructed separation strips/landscaping buffers provided in advance of the intersection, separating the bicycle lanes with adjacent traffic lanes. Notably, the two-way bicycle lane on the western approach leg splits into two lanes; a primary through lane and short left- and right-turn lane. It is noted that the dedicated left/right turn bicycle lane is positioned on the north side of the eastbound though lane, requiring any right-turning cyclists to cross the path of east- and west-bound bicycles. No cyclist specific signal lanterns have been identified within the concept and it is unclear as to how cyclist movements will be accommodated. There does not appear to be any provision to enable cyclists to easily access Kooyong Road in the north- and south-bound directions without conflicting with other cyclists.	The proposed layout of the intersection leaves cyclists exposed to a considerable degree of danger, both from conflicts with vehicles and other cyclists within the network. The proposed layout does not suitably integrate the north- and south-bound legs of Kooyong Road into the two-way bicycle lane, nor does it detail the intended path of travel or operation of the intersection from the perspective of a cyclist. Notably, the same issues are present as with Design Option 1, however the additional inbound traffic lanes from the west leg must now also be considered. Given the complexity of this arrangement it is likely a dedicated bicycle phase will be required to appropriately manage cyclists through this intersection. A detailed concept plan of the proposed intersection should be prepared that clearly defines the intended

		It is noted the proposed intersection arrangement is subject to the same issues as identified for Design Option 1, however it now also includes inbound traffic lanes on the west leg of the intersection.  It is understood that Kooyong Road also forms part of the Glen Eira Cycle Network. Accordingly, as an intersection between two key bicycle corridors, it is important to ensure the proposed arrangement and operation of the intersection is clear to cyclists of all abilities and offers a high-standard of safety.	path of travel for each bicycle movement within the intersection. It is noted that incorporation of a dedicated bicycle signal phase may be required within the intersection and/or 'push to activate' cyclist signals for certain movements. Alterations to the proposed geometry of the intersection may also be required, which may include additional set-backs of the traffic lane, relocation of pedestrian crossings and provision of additional physical barriers to protect cyclists.
39.	Inkerman Road / Hawthorn Road	Both the east and west legs of the Inkerman Road / Hawthorn Road intersection feature a protected two-way bicycle lane on the south side of the carriageway. The proposed separation strips appear to provide suitable separation from the adjacent traffic lanes. Notably, the Option 2 design features a single shared through/right- and left-turn lane on the east and west legs of the intersection. Additionally, the concept plan details that right turn bans may be implemented to improve the signal phasing efficiency. The stop lines for the proposed bicycle lanes are provided in line with the adjacent traffic lanes, which may result is drivers failing to perceive a waiting cyclist, particularly on the west leg.	The overall arrangement of the proposed intersection is considered appropriate in this section. It is recommended that the bicycle lanes on the east and west legs of the intersection are extended and positioned 0.2m from the pedestrian crossing line. The adjacent traffic lanes should be recessed a further 2.0m behind the bicycle lane stop point to provide visibility to a cyclist waiting at the intersection. Bicycle hook turn boxes should be provided on the plan to clearly define turning areas for cyclists seeking access to/from Hawthorn Road. It is recommended some provision be made for cyclists seeking access to the south when travelling eastbound. It is difficult to simply

			provide a hook turn bicycle box to accommodate this movement as any position in advance of the east-leg traffic lanes could only be done so under a dedicated bicycle phase.
40.	Inkerman Road / Normanby Road	The intersection of Inkerman Road with Normanby Street forms a T-junction intersection. Inkerman Road features the two-way bicycle lane on the south side of the carriageway, with a two-way bicycle lane provided on the northeast side of the Normanby Road carriageway. A signalised bicycle crossing point is proposed, linking these two segments and activated via push-button operation. The path also permits access to a line marked bicycle lane in the northwest bound direction. The general operation and provision for cyclists at this intersection is considered an appropriate arrangement. The proposed intersection would likely be subject to two-phase traffic signals, permitting southeast/northwest bound traffic flow on Normanby Road & left/right turn access to Normanby Road from Inkerman Road. As a dedicated bicycle phase will operate via push button, the proposed intersection arrangement is considered acceptable.	A signalised bicycle crossing point is proposed, linking these two segments and activated via push-button operation. The path also permits access to a line marked bicycle lane in the northwest bound direction. It is recommended a line marked bicycle lane be provided through the intersection in the northwest bound direction, linking with the two-way bicycle lane at the Normanby Road crossing point. The internal radius of the bicycle lane on the northeast side of Normanby Road should be increased and/or the lane widened to more comfortably accommodate cyclists around the bend. Additionally, it is recommended hold rails be provided at the designated stop points to Normanby Road.

5 COMPARATIVE ASSESSMENT

The preceding body of this report aims to detail the current road and traffic environment of the Inkerman Road corridor (as detailed in **Section 3.3**) and provide an in-depth review of the supplied corridor options. This including the issues identified within the detailed concept corridor layout(s) and the potential for remediation works or treatments to rectify key points of concern.

While the preceding safety review of the corridor options has been undertaken as a more 'micro' scale review, analysing the key details of each corridor proposal, a general high-level assessment of each design option in comparison to the existing conditions of the Inkerman Road corridor is provided hereunder.

It is noted that while certain drawbacks to each corridor option have been identified, as per the safety review detailed in **Section 4.4**, it is generally considered that both design options will result in an overall increase to the level of safety for road users throughout the corridor when compared with existing conditions, with a substantial increase in safety expected with respect to cyclists.

The subsequent discussion aims to incorporate the findings of the safety assessment as detailed in **Section 4.4** and the existing road/traffic environment, as discussed in **Section 3.3**, to provide a more generalised/high-level assessment of the safety benefits and drawbacks for each road user. This information is summarised in a response format, with key considerations identified within the existing conditions 'benchmark' compared to each design option, with due consideration to the preceding safety assessment and potential for remediation works.

The primary safety drivers are discussed in **Table 8** overleaf.

Alterations provided within each design option which add benefit when compared to existing conditions are provided in green. Where an aspect of the proposed design alteration in the supplied concept is considered to have a detrimental effect to safety in comparison to existing conditions, the corresponding point will be highlighted red.

Any items offering minor/moderate improvement are highlighted in orange.

Table 9 Comparison to Existing Conditions

Road User	Existing Conditions	Design Option 1	Design Option 2
Pedestrians	**Speeds** ▪ The Inkerman Road corridor is within land zoned almost exclusively for residential use. The area features a high number of dwellings with a significant proportion of residential frontages to the Inkerman Road corridor. ▪ A number of schools have been identified within the vicinity of the Inkerman Road corridor. This would be commensurate with a higher proportion of children within the area, particularly during the AM peak traffic period, and approaching the PM peak traffic period. ▪ The speed environment of the Inkerman Road corridor is 50km/h, and 60km/h over the Normanby Road section. A review of the *Safe Cycling Corridor Pilot – Corridor Assessment Report* indicates the 85th percentile vehicle speeds recorded throughout this section generally exceed the sign posted limit.	▪ The speed environment of the proposed corridor is reduced to 40km/h. This reduces the likelihood and severity of a conflict with a pedestrian.	▪ The speed environment of the proposed corridor is reduced to 40km/h. This reduces the likelihood and severity of a conflict with a pedestrian.
	Crossings ▪ Signalised pedestrian crossing opportunities are presented at the intersections with Hotham Street, Alexandra Street, Orrong Road, Hawthorn Road, Balaclava Road and Smith Street. An additional push operated signal crossing is provided between Orrong Grove and Ontario	▪ The existing traffic island pedestrian crossing provided west of Labassa Grove is proposed to be replaced with a raised pedestrian crossing. ▪ Additional raised pedestrian zebra crossings are proposed at mid-block sections throughout the corridor, including east of Sidwell Avenue, east	▪ The existing traffic island pedestrian crossing provided west of Labassa Grove is proposed to be replaced with a raised pedestrian crossing. ▪ Additional raised pedestrian zebra crossings are proposed at mid-block sections throughout the corridor, including east of Sidwell Avenue, east

Road User	Existing Conditions	Design Option 1	Design Option 2
	Street, with a traffic island pedestrian crossing provided west of Labassa Grove. ▪ With exception to the Pedestrian Operated Signal crossing between Orrong Road and Ontario Street (and to a lesser degree, the traffic island pedestrian crossing west of Labassa Grove) there are no pedestrian crossing points provided within the midblock sections of the corridor.	of Edith Street, West of Malvern Grove and West of Mayfield Grove. ▪ A pedestrian crossing opportunity is provided over Inkerman Road at the intersection with Inkerman Road.	of Edith Street, West of Malvern Grove and West of Mayfield Grove. ▪ A pedestrian crossing opportunity is provided over Inkerman Road at the intersection with Inkerman Road.
	Sight lines ▪ The provision of on-street parallel parking within the corridor on both sides of the road impedes sight lines to pedestrians crossing side street intersections and property crossovers. ▪ No pedestrian crossing treatments are provided at intersecting side streets.	▪ It is proposed to maximise the provision of on-street parking by means of permitting on-street parallel parking on both sides of the carriageway. The provision offers a slight improvement to existing conditions in that the parking over the south side of the carriageway is offset from the footpath due to the presence of the two-way bicycle lane. Nonetheless, the provision of parking impedes visibility of pedestrians as per the existing conditions. ▪ Raised pedestrian crossings are proposed at intersecting side streets over the north and south side of the carriageway between Hotham Street and Orrong Road. This offers a higher degree of priority to pedestrians crossing the road and reduces oncoming vehicle speeds. ▪ East of Orrong Road, raised pedestrian crossings are proposed at intersecting side streets over the south side of the	▪ No on-street parking is proposed on the south side of the carriageway, abutting the proposed two-way bicycle lane. This offers unrestricted sightlines on approach to the intersecting side streets and numerous vehicle crossovers. ▪ Raised pedestrian crossings are proposed at intersecting side streets over the north and south side of the carriageway between Hotham Street and Orrong Road. This offers a higher degree of priority to pedestrians crossing the road and reduces oncoming vehicle speeds. In comparison to Design Option 1, no raised crossing treatments are proposed to the intersecting side streets on the south side of the carriageway, east of Orrong Road. Line marked bicycle lane treatments are proposed across the intersections, which may reduce oncoming vehicle

Road User	Existing Conditions	Design Option 1	Design Option 2
		carriage way. This offers a higher degree of priority to pedestrians crossing the road and reduces oncoming vehicle speeds.	speeds and subsequently improve safety for pedestrians.
	Sight lines ▪ The road corridor features a single traffic lane in each direction, orientated with a relatively straight alignment and relatively similar vertical geometry. This allows pedestrians to perceive oncoming vehicles well in advance.	▪ The proposed alteration of the Inkerman Road carriageway for one-way vehicle operation (westbound) reduces the number of conflict points for pedestrians crossing the carriageway and the total distance a pedestrian is required to cross over the carriageway. Additionally, pedestrians are now only required to perceive vehicles arriving from the east. The orientation and visibility of oncoming traffic remains unchanged.	▪ Inkerman Road shall retain two-way operation as per existing conditions with a single traffic lane in each direction. The restriction of on-street parking to only a single side of the carriageway offers improved sightlines, in turn offering slight benefit when crossing the two traffic lanes. The road orientation remains unchanged, though visibility is improved.
	Footpath & bicycle lane separation ▪ The existing footpath is sufficiently separated from the dedicated bicycle lanes over the extent of the corridor.	▪ The provision of raised crossing points at intersecting side streets laterally shifts the two-way bicycle lanes until abutting the footpath. This proximity and the potential for overhang into the bicycle lane by vehicles seeking access to Inkerman Road/Inkerman Street will allow vehicles to swerve onto the footpath and may result in a collision with a pedestrian.	▪ The proposed bicycle lanes are generally separated from the existing footpaths. Nonetheless, the bicycle lane abuts the footpath at raised crossing points at the intersecting side streets between Hotham Street and Orrong Road. The minimal provision of raised crossings in comparison to Design Option 1 and restriction to one-way bicycle lanes at the raised crossing points lessens the risk associated with a cyclist swerving onto the footpath. It is determined the benefits of the proposed raised crossings within this option offsets this risk.

Road User	Existing Conditions	Design Option 1	Design Option 2
	Trams ▪ Under existing conditions the Normanby Road section (between Balaclava Road and Smith Street) features four traffic lanes with tram stops. This required pedestrians to cross the outer traffic lanes to access a tram from the central road reserve.	▪ The same carriageway arrangement is proposed under both Design Option 1 and Design Option 2, proposing a reduction to a single traffic lane with constructed tram platforms for access. Accordingly, pedestrians will be permitted to access trams without stepping onto an active traffic lane, eliminating the potential for conflict with a vehicle or cyclist.	
Vehicles (*overall – incorporating cars, trucks and motorcycles*)	**Speeds** ▪ The speed environment of the Inkerman Road corridor is 50km/h, and 60km/h over the Normanby Road section. A review of the *Safe Cycling Corridor Pilot – Corridor Assessment Report* indicates the 85th percentile vehicle speeds recorded throughout this section (with exception to Normanby Road) generally exceed the sign posted limit.	▪ The speed environment of the proposed corridor is reduced to 40km/h. This reduces the likelihood and severity of incidents such as head-on collisions and permits increased time for braking and emergency manoeuvres.	▪ The speed environment of the proposed corridor is reduced to 40km/h. This reduces the likelihood and severity of incidents such as head-on collisions and permits increased time for braking and emergency manoeuvres.
	Parking ▪ The Inkerman Road corridor permits two-way vehicle travel by means of a single traffic lane in each direction. The widened parking lanes (which operate as dual parking/cyclist lanes) permit suitable separation from parked vehicles. ▪ On-street parallel parking is permitted over both sides of Inkerman Road carriageway, impeding sightlines to intersecting side streets and vehicle crossovers. ▪ The existing on-street bicycle lanes offer additional separation between the	▪ The Inkerman Road corridor is proposed to operate as a one-way road (westbound) by means of single 3.0m traffic lane. On-street parallel parking lanes/bays are proposed on both sides of the carriageway, generally measuring 2.6-2.7m in width. The reduced buffer between the parking lane and traffic lane (as provided by the bicycle lane under existing conditions) increases the risk of a car door opening into a vehicles path of travel. Additionally, the cars parked on the north side of the carriageway will have the passenger side of the vehicle abutting the traffic lane, as opposed to	▪ The Inkerman Road corridor permits two-way vehicle travel by means of a single traffic lane in each direction. On-street parallel parking lanes/bays are proposed on the north side of the carriageway only (as per existing conditions) with no on-street parking proposed on the south side of the carriageway. As per Design Option 1, the lack of a line marked bicycle lane reduces the informal 'buffer zone' for vehicles reversing from the intersecting crossovers o the north side, though this is offset by the sightline benefits applied to all intersecting crossovers on the south

Road User	Existing Conditions	Design Option 1	Design Option 2
	parking lanes and traffic lane. This assists vehicles reversing from residential properties by acting as a 'buffer zone', permitting the vehicle to reverse further into the roadway and increasing sightlines before protruding into the moving carriageway.	the drivers side – vehicle passengers are more susceptible to opening the car doors into the path of an oncoming vehicle. ▪ The provision of on-street parallel parking on both sides of the carriageway impedes sightlines to the intersecting side streets and vehicle crossovers. Under the one-way arrangement, no buffer to the on-street parking is presented due to the absence of the line marked bicycle lanes (as per existing conditions) with the absence of the eastbound traffic lane further reducing sightlines to the north side of the carriageway in comparison. ▪ The buffer between the on-street parking lanes and moving traffic lane is reduced in the absence of the line marked bicycle lanes. This restricts the extent to which a vehicle can reverse from a property to the traffic lane with the intent of maximising sightlines. Nonetheless, as vehicle traffic will be restricted to one-way (westbound) with vehicles arriving on the driver side of the vehicle, the overall risk is considered marginally offset. ▪ The one-way traffic arrangement over this section will require a significant redistribution of traffic to the surrounding road network. This will increase congestion at nearby intersections, noting the increase in vehicle traffic may compound safety	side of the carriageway from the absence of parking. ▪ The absence of on-street parking on the south side of the carriageway eliminates the potential for a car door to be inadvertently opened into the path of an oncoming vehicle. ▪ The absence of on-street parking on the south side of the carriageway significantly improves sightlines for vehicles departing from the intersecting side streets and vehicle crossovers where forward egress is undertaken. ▪ The absence of on-street parking on the south side of the carriageway may slightly reduce delays incurred in the westbound direction due to vehicles undertaking parking manoeuvres, particularly reverse parallel parking movements.

Road User	Existing Conditions	Design Option 1	Design Option 2
		issues which already exist within these areas. ▪ On-street parallel parking on both sides of the road will now be accessed from a single traffic lane. Any delays incurred as a result from parking movements (particularly reverse parallel parking movements) will essentially be doubled.	
	Lane configuration ▪ The intersection arrangements feature two traffic lanes on the east-west legs, generally consisting of a dedicated right-turn lane and shared through/left turn lane. It is noted the intersection of Inkerman Road/Alexandra Street features two lanes at the intersection absent of vehicle movement, with the Inkerman Road/Hawthorn Road intersection line marked at shared left-turn/through and right-turn/through lanes. The lane arrangements at the intersections generally permit east- and west-bound vehicle traffic to continue through the corridor unimpeded by right-turning vehicles.	▪ Design Option 1 generally restricts the corridor to a one-way arrangement (westbound), with dedicated turn lanes and a shared through/turn-lane at the intersection. As a one-way arrangement, the potential for vehicles to be impeded by turning vehicles is reduced when compared to existing conditions and reduces the likelihood of vehicles undertaking an 'overtaking' manoeuvre within the intersection.	▪ Design Option 2 maintains the two-way vehicle traffic arrangement through the Inkerman Road corridor. While some intersections/legs feature dual traffic lanes at the approaches, the lane arrangement is largely restricted to a single shared left- and right-turn/though lane. Vehicles which undertake turning movements may be required to give way to oncoming traffic or crossing pedestrians, requiring drivers to temporarily stop within the intersection and blocking trailing vehicles. If a turning vehicle partially blocks the traffic lane, east -or west-bound drivers may undertake an 'overtaking' manoeuvre within the intersection which may result in conflict with an oncoming vehicle or cyclist – this is largely dependent on intended signal phasing.
	Sight lines	▪ The restriction to a one-way (westbound) arrangement through the Inkerman Road corridor at this section	▪ Corridor Option 2 permits left- and right- turn movements into Normanby Road from a single shared

Road User	Existing Conditions	Design Option 1	Design Option 2
	▪ The intersection of Inkerman Road/Normanby Road features dedicated left- and right- turn lanes from Inkerman Road. A vehicle occupying the right-turn lane may impede sightlines for left turning vehicles.	means vehicles are no longer permitted to turn into Normanby Road. Accordingly, the number of vehicle movements and potential conflict points is reduced and the issue of sightlines removed.	traffic lane, removing the existing sightline issue for vehicles seeking access to Normanby Road. Additionally, the potential for these movements to be undertaken during a signal phase increases safety (though it is noted it is unclear as to whether a dedicated signal phase can be provided, or if it will run concurrently with the bicycle phase, where right-turning vehicles would be required to give way.
Cyclists	**Lane Separation** ▪ Under existing conditions provision for bicycles is made via line marked bicycle lanes provided between the on-street parking lanes/bays and moving traffic lane or within a widened parking lane. Significant risk existing to cyclists being 'doored' or involved in a 'side swipe' incident from a moving vehicle.	Both Design Option 1 and Design Option 2 feature protected bicycle lanes on either side of the road between Hotham Street and Orrong Road, before converting to a two-way bicycle lane for the remaining corridor section. The provision of protected bicycle lanes (Hotham Street-Orrong Road) significantly increases safety for cyclists though this section, though it is noted visibility of cyclists on the south side of the carriageway, between Hotham Street and Alexandra Street, is impeded by the provision of on-street parking. This section is relatively minor in length, and it is noted the remaining section between Alexandra Street and Orrong Road does not proposed on-street parking over the south side of the carriageway. Accordingly, visibility is significantly increased overall and the separation from the moving traffic lane further increases safety.	
		▪ The two-way bicycle lane component of Design Option 1 features bicycle lanes protected by a constructed separator strip along the south side of the carriageway. The bicycle lanes are offset from the moving traffic lane, though are positioned behind a significant provision of on-street parallel parking lanes/bays across the full extent of the Inkerman Road corridor. The potential for 'dooring' incidents is reduced, though not removed and it is noted that the	▪ The two-way bicycle lane component of Design Option 2 similarly features bicycle lanes protected by a constructed separator strip along the south side of the carriageway. While the lanes are closer to the moving traffic lane, no provision for on-street parallel parking is proposed along the south side of the carriageway for the full extent of the corridor. This removes the potential for 'dooring' incidents completely and offers significantly improved sightlines of

Road User	Existing Conditions	Design Option 1	Design Option 2
		passenger side of a parked vehicle would be the one opening into the bicycle lane – passengers are typically less likely to perceive a cyclist. The potential for a conflict with a cyclist at an intersecting crossover is increased, due to drivers who would not expect a cyclist to arrive from the west direction. Furthermore, the provision of on-street parking on the south side of the carriageway impedes sightlines to the moving traffic lane and demands a greater level of driver awareness to correctly perceive incidents. Nonetheless, safety to cyclists is generally improved with this option.	cyclists from both the moving traffic lanes and intersecting side streets/crossovers. It is noted the potential for a conflict with a cyclist at an intersecting crossover is increased, due to drivers who would not expect a cyclist to arrive from the west, though it is expected long term residents would quickly adapt to the alterations. Furthermore, the absence of on-street parking along the south side of the carriageway offers a significant sightline improvement to cyclists, increasing visibility of both the bicycle lane and moving traffic lane. This arrangement can be considered a significant improvement to existing conditions.
	Dooring / Pedestrian Visibility (Caulfield Park) ▪ The section of Inkerman Road between Hawthorn Road and Normanby Road features shared on-street parking/bicycle lanes on both sides of the carriageway. Fronting Caulfield Park, this is a desirable destination, particularly for those with children. The significant length of unobstructed parking lanes increases the potential for a dooring incident to occur, along with the potential conflict with pedestrians emerging from behind parked cars.	▪ Design Option 1 proposes to separate cyclists via the protected two-way bicycle lane along the south side of the carriageway, with dedicated raised zebra crossings for pedestrians. Visibility to pedestrians is improved significantly, though significant sections of on-street parking are proposed, with the passenger side of parked vehicles opening into the bicycle lanes. Nonetheless, complete separation from the moving traffic lane and buffer provided by the on-street parking will improve safety for cyclists.	▪ Design Option 2 proposed to separate cyclists via the protected two-way bicycle lane along the south side of the carriageway, with raised zebra crossings for pedestrians. No on-street parking is proposed along the south side of the carriageway, significantly improving visibility within this section for all road users (pedestrians, cyclists and vehicles) and completely removes the potential for 'dooring' incidents to occur. This arrangement can be considered a significant improvement to existing conditions, and is a more preferable

Road User	Existing Conditions	Design Option 1	Design Option 2
			arrangement to that proposed in Design Option 1.
	Intersections ▪ Poor provision exists for cyclists at the various intersections along the Inkerman Road cycle corridor. No physical separation from the moving traffic lane is provided, with the bicycle lanes observed to narrow at points at the intersections of Hotham/Inkerman, Orrong/Inkerman and Kooyong Inkerman to accommodate the additional traffic lanes at the intersections. With respect to other intersections, the bicycle lanes terminate approximately 20m prior to the intersection before recommencing on the departure side (approximately 20m). No dedicated bicycle signal phasing or 'head-start' opportunities exist along this section.	▪ Both Design Option 1 and Design Option 2 feature significantly improved provision for cyclists at intersections. Protected, physically separated, bicycle lanes are provided to the intersection, with the traffic lanes generally set-back from the designated stop point within the bicycle lanes. Under both design options cyclists will be able to approach the intersections without risk of a vehicle occupying the bicycle lane. Furthermore, cyclist lanterns & signal phases are proposed including 'head start' signals to allow cyclists to clear an intersection before motor vehicles. Dedicated bicycle hook turn boxes have been indicated within a number of intersections, improving movements for cyclists seeking to turn right. It is noted that the proposed intersection arrangements at the Inkerman Road/Orrong Road (merge point with the two-way bicycle lane) follow the relevant design principles for an intersection accommodating this movement, with the Design Option 2 arrangement considered the more preferable option. The intersection with Inkerman Road/Kooyong Road should be further developed to more appropriately accommodate cyclists and detail how certain movements will be undertaken (eg. right-turns when travelling east bound), noting Kooyong Road is also identified as a key component of the Glen Eira Cycle Network. Nonetheless, the proposed intersection arrangements within the supplied concept options are almost identical, and will offer a significant improvement to cyclists navigating these intersections.	
	Dooring (Normanby Road) ▪ The Normanby Road section offers line marked bicycle lanes abutting on-street parking, increasing the likelihood of a 'dooring' incident occurring. The absence of any form of physical protection may result in 'side swipe' incidents occurring. Furthermore, cyclists may find difficulty navigating the Inkerman Road/Normanby Road intersection.	▪ The arrangement of the intersection design between Design Option 1 and Design Option 2 is generally similar, noting Design Option 2 proposes a further setback for traffic signals on the north leg of Normanby Road, restricting the ability for a vehicle to access Inkerman Road during a red phase. Cyclists will be able to access a dedicated, physically separated, two-way bicycle path on the northeast side of the Normanby Road carriageway via a push button activated signal phase, significantly improving safety for cyclists through the intersection. No on-street parking is proposed to abut the bicycle lanes, eliminating the potential for 'dooring' incidents occurring. At the intersection with Balaclava Road, the bicycle lanes will transition to off-road bicycle lanes. The arrangements proposed over Normanby Road are considered a significant improvement to the existing conditions over this section. The proposed signal locations	

Road User	Existing Conditions	Design Option 1	Design Option 2
		on the northwest leg of Normanby Road within Design Option 2 make this the more preferable option.	
	Side Street Intersections ▪ Bicycles will cross intersecting local streets though no provision is made to highlight these movements aside from dashed line markings. The provision of on-street parking restricts sightlines to an incoming cyclists and increases the likelihood of an incident occurring.	▪ Design Option 1 proposes raised intersection crossings with clear line marked bicycle lanes over the intersecting local streets. This provides a clear visual stimulus to drivers, with the relocation of on-street parking to the moving traffic lane side of the bicycle lanes eliminating sightline impediments to the bicycle lane for vehicles departing from the intersecting local streets. While beneficial overall, a number of the raised crossing points do not appear to provide a sufficient storage area between the bicycle lanes and moving traffic lane, which will likely result in a vehicle overhanging the bicycle lane – this applies between Hotham Street and Orrong Road only.	▪ Design Option 2 features raised pedestrian/cyclist crossing points between Hotham Street and Orrong Road (as per Design Option 1) which is subject to the same vehicle storage issue. The remaining intersections feature fully line marked lanes with a surface treatment indicating the presence of bicycle lanes. Unlike Design Option 1, the bicycle lanes feature no 'kinks' or bends on approach to the side streets due to the absence of raised crossing facilities. This offers increased sightline provision of the bicycle lanes. The full view of the moving traffic lanes (due to absence of on street parking – south side only) provides a full unimpeded view of all approaching road users which may reduce the likelihood of a driver failing to perceive or overlooking an incoming cyclist.

6 REVIEW OF AMENDED CONCEPT LAYOUTS

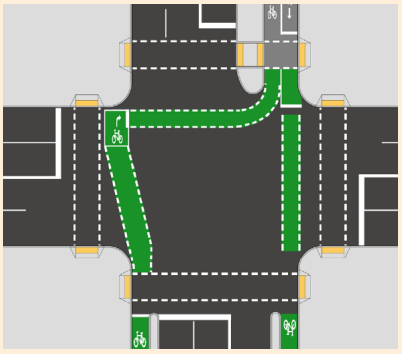
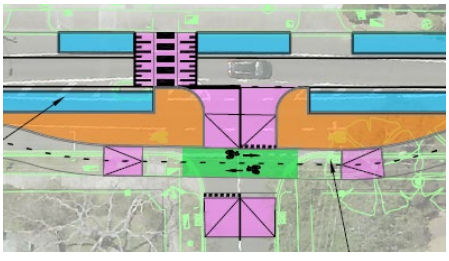
In response to the findings of the safety review for the initial concept layouts, outlined in Sections 4 and 5 above, the concept layout plans have been amended by Arup *(Revision C dated 9/09/2022)*.

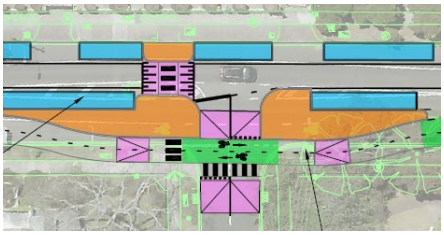
Some though not all changes have been implemented. This may be for reasons of practicality, cost and/or design constraints. In such cases, we do not intend to repeat any of the commentary outlined in the preceding sections.

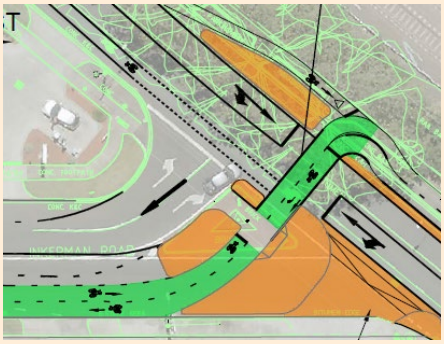
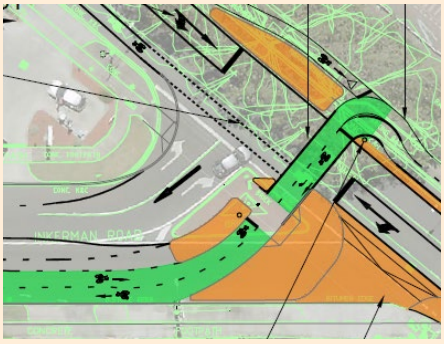
Commentary on the changes that *have* been implemented are provided as follows:

6.1 OPTION 1

Table 10 Option 1 Design Changes

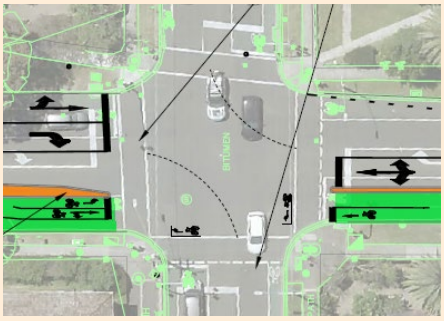
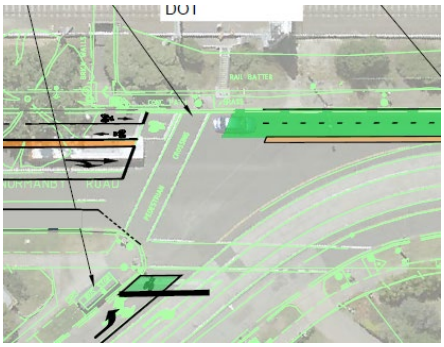
Location	Change	Commentary
Inkerman Street / Orrong Road	Line marking altered to assist eastbound bicycle switch over from north side to south side. **ORIGINAL**  **PROPOSED** 	This change is deemed generally suitable, though could potentially be improved with repositioning the eastern crosswalk further east to improve separation between the bicycle boxes and the southbound traffic lane, and to enable a continuous green travel path as per the below diagram. There is scope to address this as part of the detailed design; however, the design as proposed is not deemed fatal to the overall strategy. 
Inkerman Road / Labassa Grove (and other similarly treated intersections).	The intersection raised area and stop line has been altered to avoid conflict with the proposed wombat crossing. The wombat crossing has been shortened. A zebra crossing has been added on the side road and across the shared path. **ORIGINAL** 	These changes are deemed satisfactory.

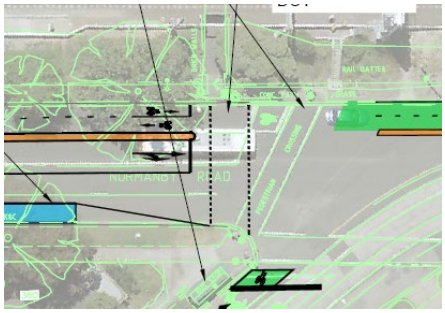
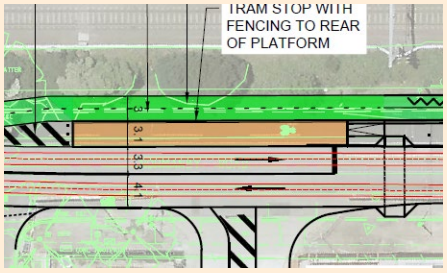
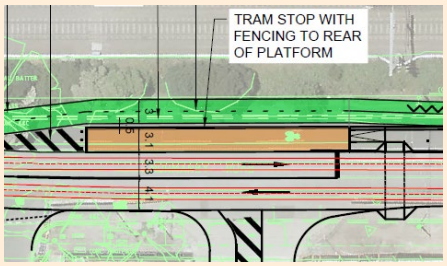
	PROPOSED 	
Inkerman Road / Kooyong Road	Hook turn boxes have been added for the S→W and W→N movements. Left turn bicycle movements from E→N have been omitted. Shared use crossings have been proposed on the south and west legs. Bicycle lanterns are proposed on the south and west legs of the intersection. ORIGINAL  PROPOSED 	Whilst going some way to addressing the safety concerns for cyclists at this intersection, it remains a confusing arrangement for cyclists. For example, knowing how to travel from E→N and S→E using the shared crossings is not plainly obvious. A more detailed understanding of the proposed arrangement, including associated signal phasing, is required. Dedicated bicycle phases may have a large impact on traffic flow.
Inkerman Road / Edith Street	The kerb outstand has been extended to improve pedestrian sight lines. ORIGINAL 	This outcome is deemed satisfactory

	PROPOSED 	
Inkerman Road / Normanby Road	The stop line on Normanby Road has been moved back, and no right turn will be provided during the bicycle crossing phase. A cyclist push button and hold rails have been noted on the plans. The plans note that bicycle path radius widening will be investigated. ORIGINAL  PROPOSED 	These changes are deemed satisfactory.

6.2 OPTION 2

Table 11 Option 2 Design Changes

Location	Change	Commentary
Inkerman Road / Kooyong Road	EBD bicycle line marking altered to a dedicated through/right lane and left only lane. Cyclist push button provided to activate north-south crossing from left-turn lane. **ORIGINAL**  **PROPOSED** 	The cyclist push button and line marking changes adequately assists the E→N movement. However, positioning the pedestal near enough the stop line, whilst maintaining clearance from the traffic lane, may be difficult. Nonetheless, the intersection remains largely concerning for cyclist safety, as per Option 01. Greater detail of cyclist movements and signal phasing is required, which can potentially be addressed in the detailed design phase.
Normanby Road / Balaclava Road	The west approach pedestrian crossing has been realigned to align with the pedestrian underpass. **ORIGINAL** 	This change is deemed satisfactory.

	PROPOSED 	
Normanby Road Tram Stop (Options 01 and 02)	An additional 500mm of clearance has been provided between the edge of the shared path and the tram stop. ORIGINAL  PROPOSED 	This change is deemed satisfactory.

7 CONCLUSIONS

The preceding assessment provided within this report pertains to the proposed design options for the cycling corridor across the Inkerman Street / Inkerman Road / Normanby Road section between Smith Street and Hotham Street in the east and west respectively.

Two concept options have been prepared and subject to the safety assessment detailed above.

A review of the supplied concept options (Corridor Option 1 & Corridor Option 2) indicates five (5) distinct sections along the east/westbound carriageway, separated between key north- and south-bound intersecting roads. It is noted that the general design arrangements for Section 1 (Hotham Street to Orrong Road) and Section 2 (Inkerman Road to Smith Street) are the same. Accordingly, the primary point of deviation between the proposed corridor options pertains to Sections 2 through 4, covering the extent of Inkerman Road between Normanby Road and Orrong Road.

Both corridor options propose a separated, two-way bicycle lane along the south side of the Inkerman Road carriageway, and northeast side of the Normanby Road carriageway. Whereas Design Option 2 permits two-way vehicle travel with a single on-street parking lane, Design Option 1 proposes a one-way (westbound) traffic lane arrangement with on-street parallel parking provided on both sides of the carriageway.

Based on the preceding safety assessment, and with due consideration to the benefits and drawbacks of each arrangements (including existing conditions), the proposed arrangements of the Inkerman Road corridor can be ranked as follows:

Table 12 Inkerman Road Corridor – User Safety Ranking Comparison

User	Existing Conditions	Design Option 1	Design Option 2
Cyclists	3	2	1
Pedestrians	3	1	2
Vehicles	2	3	1
OVERALL ASSESSMENT	3	2	1

Based on the preceding assessment, notably the items discussed in **Table 9**, it is determined that either design option will offer a substantial improvement when compared to existing conditions, with exception to vehicles in Design Option 2.

Should the proposed corridor options proceed to detailed design, it is recommended from purely a safety perspective that **Design Option 2** be pursued due to the overall benefit for all road users. While the benefit to pedestrians does not rank as high as Option 1, this is due to the lower provision of raised pedestrian crossing opportunities at intersecting side streets only and is by no means an inferior option with respect to pedestrians. Though the provision of these crossing points is fewer, the drawbacks associated with the raised crossings to other road users is considered to outweigh the benefits to pedestrians. Furthermore, under Option 2 a significant improvement to sightlines can be achieved, allowing full unobscured visibility of the carriageways south side which will allow cyclists to be perceived at all times, as well as improving the ability for vehicles to access/depart the driveways safely.

Significant benefit to cyclists is also offered under this option, with sightline visibility being the primary factor, followed by the full removal of 'dooring' potential. Risk exists due to the high number of intersecting crossovers, largely applicable to westbound cyclists, however as a primarily residential area it is anticipated long-term residents will quickly adapt to the proposed design. The risk (associated with two-way bicycle lanes) is considered further reduced as the total number of intersection points is reduced, given all crossovers on the north side of the carriageway are effectively removed for interaction with the bicycle lanes.

The risks associated with vehicles are considered improved within Option 2, though the Option 1 arrangements are considered less desirable than existing conditions. As Option 1 restricts the carriageway to a single one-way traffic lane (westbound), vehicle delays may be reduced at intersections, though vehicle movements associated with crossovers/side streets and on-street parallel parking spaces over both sides of the carriageway now have the potential to impact an entire corridor section.

Furthermore, the restricted nature of the carriageway to a single traffic lane which abuts on-street parking on each side of the road creates a restricted road environment which negatively impacts sightlines and may increase the likelihood of parked vehicles opening their doors into an oncoming traffic lane, a pedestrian emerging from behind a parked car, or a collision with a vehicle departing a property. Option 1 will also require the redistribution of vehicle traffic to the surrounding road network, with increased volumes potentially compounding existing safety issues which may already exist within the surrounding road network (such as unprotected right-turn manoeuvres at intersections).

The ability for Option 2 to maintain bi-directional vehicle traffic is considered, from a safety lens, the most desirable arrangement, though as intersections along the corridor will feature shared left- and right-turn/through lanes, additional consideration to signal phasing and potential right-turn bans should be investigated.

Further to the above, as detailed throughout the body of this report, additional consideration will need to be undertaken with respect to the operation of the Inkerman Road/Kooyong Road intersection for cyclists.

Considering the overall benefit to safety associated with **Design Option 2**, this is determined the most desirable corridor arrangement.

Notwithstanding, it is noted that the local side street intersections proposed within Corridor Option 1 are a more preferable treatment as it generally allows a vehicle to store between the vehicle traffic lanes and bicycle lanes when accessing Inkerman Road – reducing the likelihood of a vehicle parking over the bicycle lanes.

The proposed intersection arrangement at the Inkerman Road / Orrong Road (the transition point into the two-way bicycle lane) generally feature the same operation in both options, with the Corridor Option 2 design being the preferable arrangement. Nonetheless, subject to the intersection recommendations specified within this report it is envisaged safe operation can be achieved for cyclists with both options.

Significant concern is raised with respect to the Inkerman Road / Kooyong Road intersection, noting both Inkerman Road and Kooyong Road are key cycle routes within the Glen Eira Cycle Network. Greater consideration is required for this intersection, including the potential for a dedicated cyclist only signal phase to fully accommodate cyclists at this intersection. This can be investigated further as the project moves into functional and detailed design.

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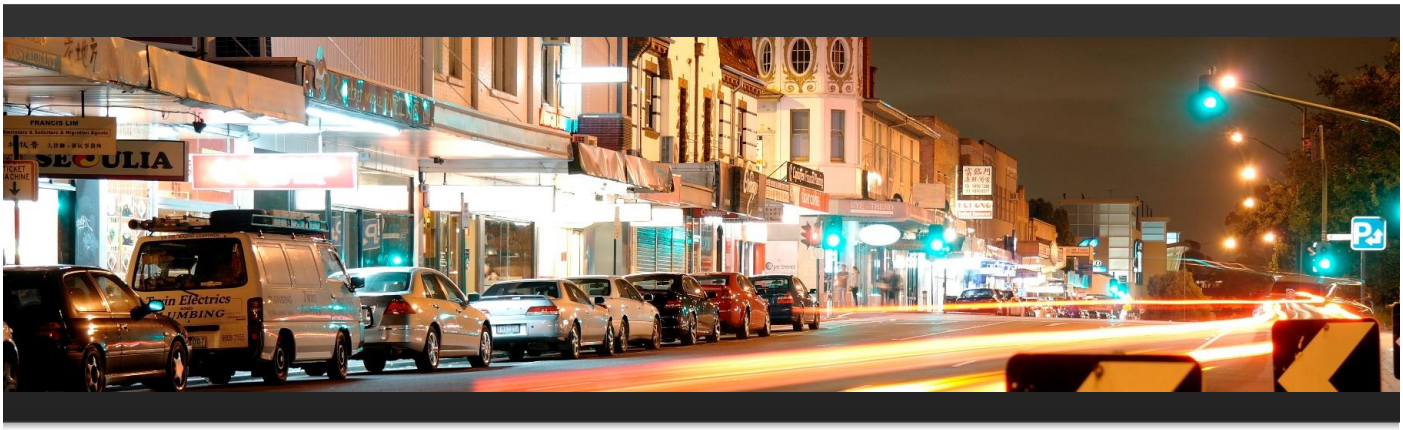
Inkerman Road – Safe Cycle Corridor Project

Traffic Network Impact Assessment



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EXECUTIVE SUMMARY

Project Background

Glen Eira City Council are seeking to explore the feasibility of altering Inkerman Road to be one-way for vehicle movements (direction currently undetermined) between Normanby Road and Orrong Road as part of the Safe Cycle Corridor Project. The one-way arrangement is proposed to facilitate the construction of a two-way off-road cycle path along Inkerman Road to support and encourage commuter and recreational cycling.

The three options contemplated for vehicle changes to Inkerman Road are as follows:

- **Option 1**: Inkerman Road to be one-way westbound from Orrong Road to Normanby Road.
- **Option 2**: Inkerman Road to be one-way eastbound from Orrong Road to Normanby Road.
- **Option 3**: Inkerman Road to be one-way eastbound from Hawthorn Road to Normanby Road (along the frontage of Caulfield Park).

Data Collection

In order to ascertain recent and accurate data**, one**mile**grid** commissioned Trans Traffic Surveys to conduct traffic movement counts for 17 intersections that surround the subject site, extending from Chapel Street to Normanby Road on the Alma Road, Inkerman Road and Balaclava Road corridors.

Origin / Destination (OD) surveys were also undertaken to determine popular vehicle travel routes within a road network, with survey gates set up at 45 locations along Inkerman Road, capturing all side roads between Hotham Road and Hawthorn Road.

Both the turning movement counts and the OD surveys were undertaken and recorded in late November 2021; with surveys conducted on a Tuesday, Thursday, Friday and Saturday.

The turning movement survey results for each intersection were compiled together to determine the overall network peak hours instead of individual intersection peak hours. As such, it was determined that the peak hours of the overall network occurred during the following times:

- Weekday AM Commuter Peak: Tuesday, 8am – 9am
- Weekday PM Commuter Peak: Thursday, 5pm – 6pm
- Weekday PM School Pick-Up: Friday, 3:15pm – 4:15pm
- Weekend Peak: Saturday, 12pm – 1pm

Existing & Adjusted Traffic Conditions

All intersections across all four peak hours, with the exception of the Inkerman Road / Orrong Road intersection, were operating well within their respective capacities under existing conditions (as per the November 2021 survey volumes). The Inkerman Road / Orrong Road intersection was seen to be approaching capacity during two of the peak hours, but the results are considered acceptable for critical movements at an intersection during high peak periods.

It is acknowledged that due to the COVID-19 pandemic, traffic volume data collected after early 2020 may not represent typical traffic conditions. To ensure appropriate baseline data was utilised, the surveyed traffic volumes were factored up in each of the four peak hours based on the 30th design hour (30th busiest peak hour of the year) in addition 10 years' of traffic growth, at a growth rate of 1.2% per annum, was also applied to the traffic volumes. The design hour for the peak periods has been identified by utilising SCATs data at all signalised intersections in the network model in 2019 (last pre-COVID year).

The road network was then reanalysed based on the adjusted volumes to determine the performance of the intersections across the four peak hours.

The results revealed that taking into consideration the design hour adjustment factor and 10 years' of traffic growth in the area, all intersections will experience increased traffic movements in the peak hours which will in turn will impact performance (degree of saturation, queues, delays, level of service, etc.). Several of the intersections across the network approached or exceeded capacity in some of the peak hours, primarily in the three weekday peak hours and not during the Saturday peak hour.

The Inkerman Road / Orrong Road intersection, that is currently operating close to capacity in the existing conditions analysis, will exceed capacity during all three of the weekday peak hours under the design hour plus growth conditions.

Safe Cycle Corridor Traffic Conditions

Each of the three options for Inkerman Road involves changing the direction of traffic along Inkerman Road from two-way to one-way for a particular length. This alteration to the road network will result in some vehicles movements at intersections no longer being permitted, and as such, vehicles currently making these movements will be redistributed throughout the network to undertake their journey. An individual redistribution model was designed for the road network for each of three options, with the results of the OD surveys used in each of the four peak hours to determine the destination of vehicles whose route is proposed to be removed. Those vehicle movement have then been redistributed through the road network to reach their destination via the most convenient alternative travel route.

The design hour plus growth traffic conditions formed a baseline to compare against the Safe Cycle Corridor options conditions. As previously stated, the design hour plus growth traffic conditions resulted in several of the intersections across the network approaching or exceeding capacity in some of the peak hours. It is therefore worth noting that some of the intersections will be operating above capacity before taking into consideration the traffic redistribution as a result of the Safe Cycle Corridor options.

For Options 1& 2, the one-way arrangement of Inkerman Road between Orrong Road and Normanby Road has reduced traffic movements at the intersections along Inkerman Road for this stretch and has therefore improved the performance of those intersections. However, those traffic movements have been redistributed to the intersections along Alma Road and Balaclava Road and therefore have resulted in increased turning movements at a number of peripheral intersections to Inkerman Road. Some minor changes to the Inkerman Road / Kooyong Road intersection are required to improve operating conditions during the School Pick-Up Peak.

Option 3 conditions resulted in the least impact on the road network due to the reduced length of the one-way section of Inkerman Road. Particularly noteworthy is that under Option 3 conditions there is to be minimal discernible difference to the operation of the Alma Road Corridor, with the eastern end of Balaclava Road experiencing the majority of redistricted traffic volumes and therefore experiencing the greatest impact.

Both Option 1 and Option 2 result in significant increases to the average travel time along Balaclava Road between Normanby Road and Chapel Street which will impact the tram routes 16 and 3/3a. Option 1 will increase the travel time in the eastbound direction by almost 3 minutes during the School Pick-Up Peak whereas Option 2 will increase the travel time in the eastbound direction by almost 4 minutes in the AM Commuter Peak.

Option 3 will have the least impact on tram travel times along Balaclava Road, with a maximum delay to through movements coming in the School Pick-Up Peak when the eastbound through route is to increase by 54 seconds.

Recommendations

When looking at the intersection performances under Option 1 & 2 conditions, there are many similarities with the number and specific intersections that exceed capacity during the four peak hours investigated. The design hour plus growth conditions that were used as a baseline for the analysis was a major contributor to the high level of traffic, but the road network changes and traffic redistribution under Option 1 & 2 conditions did increase the total number of intersections that exceeded capacity during at least one of the peak hours. The impact that both Option 1 & 2 will have on travel times along Balaclava Road, and thus the travel times of tram routes along Balaclava Road, make these options undesirable and are not expected to be supported by Yarra Trams or DoT. Regardless, when comparing the two options it is considered that Option 1 is the preferred of the two as it has a lesser impact on the operation of Balaclava Road and therefore a lesser impact on tram routes 16 & 3/3a.

Option 3 presents the least disruption to a road network that is expected to experience growth into the future and has the least impact on the operation of the tram routes along Balaclava Road when compared against the other options. Option 3 is considered viable as it does not result in additional intersections within the network exceeding capacity when compared with the design hour plus growth conditions and contains the impact to one end of the Inkerman Road Corridor.

Based on the above investigation analysis and results, it is recommended that Option 3 – being Inkerman Road one-way eastbound between Hawthorn Road and Normanby Road (along Caulfield Park) – is adopted as the preferred option to consider further for the Inkerman Road Safe Cycle Corridor.

It should be noted that whilst altering Option 3 to have Inkerman Road be one-way westbound could be explored, it is expected to displace a greater number of existing vehicle movements during the School Pick-Up Peak and therefore will likely have a greater impact to the surrounding road network during this period. As such, Option 3 with Inkerman Road being one-way eastbound is recommended.

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1 INTRODUCTION

onemile**grid** has been requested by Glen Eira City Council to undertake a Network Impact Assessment of the proposed changes to the configuration of Inkerman Road as a part of the Safe Cycle Corridor Project.

As part of this assessment the subject site has been inspected with due consideration of the proposal and traffic data has been sourced and relevant background reports have been reviewed.

2 PROJECT BACKGROUND

Glen Eira City Council are seeking to explore the feasibility of altering Inkerman Road to be one-way for vehicle movements (direction currently undetermined) between Normanby Road and Orrong Road as part of the Safe Cycle Corridor Project. The one-way arrangement is proposed to facilitate the construction of a two-way off-road cycle path along Inkerman Road to support and encourage commuter and recreational cycling.

This report will explore the traffic impacts of the surrounding road network of three options, each altering the vehicle movements along Inkerman Road. The three options are as follows:

- **Option 1**: Inkerman Road to be one-way westbound from Orrong Road to Normanby Road.
- **Option 2**: Inkerman Road to be one-way eastbound from Orrong Road to Normanby Road.
- **Option 3**: Inkerman Road to be one-way eastbound from Hawthorn Road to Normanby Road (along the frontage of Caulfield Park).

A view of all three options is shown in Figure 1 below.

Figure 1 Inkerman One-Way Options



3 EXISTING TRAFFIC CONDITIONS

3.1 General

onemile**grid** has undertaken an independent traffic analysis of the impacts of the proposed alterations to Inkerman Road between Orrong Road and Normanby Road on the surrounding road network. The existing conditions analysis for the intersections utilises turning movement surveys undertaken by Trans Traffic Surveys on behalf of **one**mile**grid** in November 2021, which serves as the baseline of the traffic analysis, and is as follows.

3.2 Intersection Volumes

In order to ascertain recent and accurate data**, one**mile**grid** commissioned Trans Traffic Surveys to conduct traffic movement counts for the following 17 intersections that surround the subject site:

- Alma Road intersection with:
  - Chapel Street, Hotham Street, Orrong Road, Kooyong Road & Hawthorn Road (5).
- Inkerman Road intersection with:
  - Chapel Street, Hotham Street, Orrong Road, Kooyong Road, Hawthorn Road & Normanby Road (6).
- Carlisle Street/Balaclava Road intersection with:
  - Chapel Street, Hotham Street, Orrong Road, Kooyong Road, Hawthorn Road & Normanby Road (6).

The counts were undertaken and recorded in 15-minute blocks on the following days and times: -

Table 1 Turning Movement Survey Days & Times

Day	*Date*	*Time 1*	*Time 2*
Tuesday	23/11/2021	6am – 10am	3pm – 7pm
Thursday	25/11/2021	6am – 10am	3pm – 7pm
Friday	26/11/2021	6am – 10am	3pm – 7pm
Saturday	27/11/2021	8am – 4pm	N/a

A view of the location of these intersections is shown in Figure 2 below.

Figure 2 Intersection Turning Movement Counts



The survey results for each intersection were compiled together to determine the overall network peak hours instead of individual intersection peak hours. As such, it was determined that the peak hours of the overall network occurred during the following times:

- Weekday AM Commuter Peak: Tuesday, 8am – 9am
- Weekday PM Commuter Peak: Thursday, 5pm – 6pm
- Weekday PM School Pick-Up: Friday, 3:15pm – 4:15pm
- Weekend Peak: Saturday, 12pm – 1pm

The results of the surveys during the peak hours are attached in Appendix A.

3.3 Intersection Operation

3.3.1 General

To assess the operation of the intersections during the peak hours, the traffic volumes have been input into SIDRA Intersection, a traffic modelling software package.

The SIDRA Intersection software package has been developed to provide information on the capacity of an intersection with regard to a number of parameters. Those parameters considered relevant are, Degree of Saturation (DoS), 95th Percentile Queue, and Average Delay as described below.

Table 2 SIDRA Intersection Parameters

Parameter	*Description*
Degree of Saturation (DoS)	The DoS represents the ratio of the traffic volume making a particular movement compared to the maximum capacity for that particular movement. The value of the DoS has a corresponding rating depending on the ratio as shown below. *Degree of Saturation* / *Rating* Up to 0.60 – Excellent 0.61 – 0.70 – Very Good 0.71 – 0.800 – Good 0.81 – 0.90 – Fair 0.91 – 1.00 – Poor Above 1.00 – Very Poor It is noted that whilst the range of 0.91 – 1.00 is rated as 'poor', it is acceptable for critical movements at an intersection to be operating within this range during high peak periods, reflecting actual conditions in a significant number of suburban signalised intersections.
Average Delay (seconds)	Average delay is the time delay that can be expected for all vehicles undertaking a particular movement in seconds.
95th Percentile (95%ile) Queue	95%ile queue represents the maximum queue length in metres that can be expected in 95% of observed queue lengths in the peak hour

For the signalised intersections, the signal phasing input into SIDRA Intersection for each individual intersection was sourced from VicRoads' OP SHEETS, which provide the existing signal phasing for each signalised intersection across Victoria. Therefore, the existing conditions analysis will utilise the existing signal phasing at each of the intersections.

When analysing intersections in SIDRA, intersections can be analysed as a standalone single intersection or as part of a Network Model of intersections that are coordinated together to better understand the spread of congestion between upstream and downstream intersections. The intersections surveyed for the investigation were separated into three corridors when analysed, with each corridor being its own Network Model within the SIDRA Intersection software.

The three corridors are as follows:

- Alma Road Corridor – four intersections along Alma Road (excluding Dandenong Road intersection);
- Inkerman Road Corridor – six intersections along Inkerman Road; and
- Balaclava Road Corridor – six intersections along Balaclava Road.

A network phase time of 80 seconds was adopted for all signalised intersections.

3.3.2 Degree of Saturation – All Intersections

A summary of results is provided in Table 3 – Table 5 below, with the full SIDRA outputs for each intersection is attached in Appendix B. It is noted that in the summary shown in Table 3 below, only the DoS for each leg of each intersection is presented, rather than all data outputs such as level of service (LoS), queues and delays. This allows for a clear comparison of the performance of each intersection's leg across all four peak hours.

Refer to full detailed results attached in Appendix B for the LoS, 95th percentile queues and average delays experienced by motorists for each movement at all intersections.

Table 3 Alma Road Corridor SIDRA Analysis – Existing Conditions

Intersection	*Approach*	*Degree of Saturation (DoS)*			
		AM Commuter	*PM Commuter*	*School Pick-Up*	*Saturday*
Alma Road Corridor					
Alma Rd / Chapel St	South	0.28	0.29	0.24	0.27
	East	0.34	0.34	0.34	0.29
	North	0.32	0.32	0.37	0.28
	West	0.22	0.33	0.37	0.23
Alma Rd / Hotham St	South	0.80	0.48	0.48	0.42
	East	0.78	0.72	0.52	0.46
	North	0.40	0.68	0.60	0.45
	West	0.58	0.63	0.60	0.34
Alma Rd / Orrong Rd	South	0.43	0.29	0.49	0.32
	East	0.43	0.47	0.48	0.41
	North	0.35	0.45	0.52	0.41
	West	0.32	0.41	0.48	0.28
Alma Rd / Kooyong Rd	South	0.63	0.51	0.49	0.50
	East	0.61	0.65	0.60	0.55
	North	0.57	0.67	0.62	0.55
	West	0.54	0.58	0.58	0.32

Table 4 Inkerman Road Corridor SIDRA Analysis – Existing Conditions

Intersection	*Approach*	*Degree of Saturation (DoS)*			
		AM Commuter	*PM Commuter*	*School Pick-Up*	*Saturday*
Inkerman Road Corridor					
Inkerman Rd / Chapel St	South	0.31	0.34	0.29	0.27
	East	0.35	0.38	0.40	0.32
	North	0.34	0.44	0.41	0.33
	West	0.27	0.44	0.41	0.34
Inkerman Rd / Hotham St	South	0.52	0.40	0.47	0.39
	East	0.40	0.30	0.27	0.23
	North	0.39	0.62	0.49	0.48
	West	0.51	0.62	0.50	0.48
Inkerman Rd / Orrong Rd	South	0.87	0.62	**0.92**	0.47
	East	**0.95**	0.79	0.78	0.46
	North	0.51	0.81	0.78	0.56
	West	0.78	0.88	**0.97**	0.55
Inkerman Rd / Kooyong Rd	South	0.76	0.66	0.80	0.59
	East	0.75	0.68	0.45	0.51
	North	0.77	0.80	0.84	0.59
	West	0.76	0.80	0.82	0.60
Inkerman Rd / Hawthorn Rd	South	0.40	0.39	0.53	0.32
	East	0.27	0.22	0.19	0.25
	North	0.32	0.36	0.53	0.29
	West	0.41	0.40	0.53	0.32
Inkerman Rd / Normanby Rd	South	0.38	0.28	0.27	0.39
	North	0.11	0.16	0.18	0.22
	West	0.68	0.51	0.78	0.76

Orange = approaching capacity

Table 5 Balaclava Road Corridor SIDRA Analysis – Existing Conditions

Intersection	*Approach*	*Degree of Saturation (DoS)*			
		AM Commuter	*PM Commuter*	*School Pick-Up*	*Saturday*
Balaclava Road Corridor					
Carlisle St / Chapel St	South	0.24	0.31	0.29	0.26
	East	0.27	0.39	0.43	0.38
	North	0.26	0.55	0.45	0.39
	West	0.23	0.56	0.42	0.34
Balaclava Rd / Hotham St	South	0.63	0.48	0.69	0.44
	East	0.63	0.67	0.71	0.49
	North	0.43	0.70	0.70	0.48
	West	0.44	0.49	0.45	0.32
Balaclava Rd / Orrong Rd	South	0.56	0.36	0.61	0.24
	East	0.55	0.32	0.40	0.27
	North	0.39	0.41	0.41	0.27
	West	0.41	0.41	0.59	0.26
Balaclava Rd / Kooyong Rd	South	0.57	0.39	0.59	0.28
	East	0.57	0.42	0.33	0.28
	North	0.49	0.46	0.63	0.31
	West	0.56	0.47	0.62	0.30
Balaclava Rd / Hawthorn Rd	South	0.52	0.41	0.46	0.31
	East	0.34	0.32	0.28	0.30
	North	0.49	0.48	0.58	0.33
	West	0.51	0.47	0.59	0.33
Balaclava Rd / Normanby Rd	South	0.19	0.13	0.12	0.18
	North	0.21	0.19	0.23	0.22
	West	0.21	0.20	0.24	0.23

3.3.3 Key Intersection Results

As shown above, all intersections across all peak hours with the exception of the Inkerman Road / Orrong Road intersection were operating within their respective capacities under existing conditions.

3.3.3.1 Inkerman Road / Orrong Road

The Inkerman Road / Orrong Road intersection is currently operating essentially at capacity, with a DoS at 0.95 and 0.97 in the morning commuter and school pick-up peak hours respectively. As outlined in Table 2, whilst the DoS range of 0.91 – 1.00 is rated as 'poor', it is acceptable for critical movements at an intersection to be operating within this range during high peak periods.

Furthermore, video footage was observed of the Inkerman Road / Orrong Road intersection during the two critical peak periods to determine if the flow of traffic is acceptable during these peak hours. It was observed a handful of vehicles from the north approach did not make it through the intersection during the green cycle due to downstream queues during the school pick-up peak only. This occurred for a short period of high congestion, lasting only 10-15 minutes, and then returned to normal traffic flow with all vehicles that arrived at the intersection clearing through in a single cycle. This concentrated 'peak within the peak' is typical for school pick-up times on local roads where a school, or multiple schools, are in close proximity.

3.4 Origin / Destination Survey

Origin / Destination (OD) Surveys are a form of vehicle movement survey that help determine vehicle travel routes within a road network. Small cameras are set up at specific locations, commonly referred to as 'gates', and capture an image of a vehicles licence plate number and records the vehicle as it passes through that gate. This is done at all the gates the vehicle travels through allowing the determination of which gate the vehicle entered the network in and which gates it went through before departing the network, thus identifying popular travel routes within the road network.

For this OD survey, a total of 45 gates were established along Inkerman Road, capturing all side roads between Hotham Road and Hawthorn Road.

A view of the gate locations, as well as the gate number, is provided in Figure 3.

In addition, the survey results that were deemed critical movements along the road network were analysed, with particular interest given to eastbound and westbound routes along Inkerman Road as these are the routes that would be most affected by the proposed one-way arrangement.

A table of the critical east-west movement along Inkerman Road during the peak hours is provided in Table 6.

Figure 3 OD Survey Gate Location and Numbers

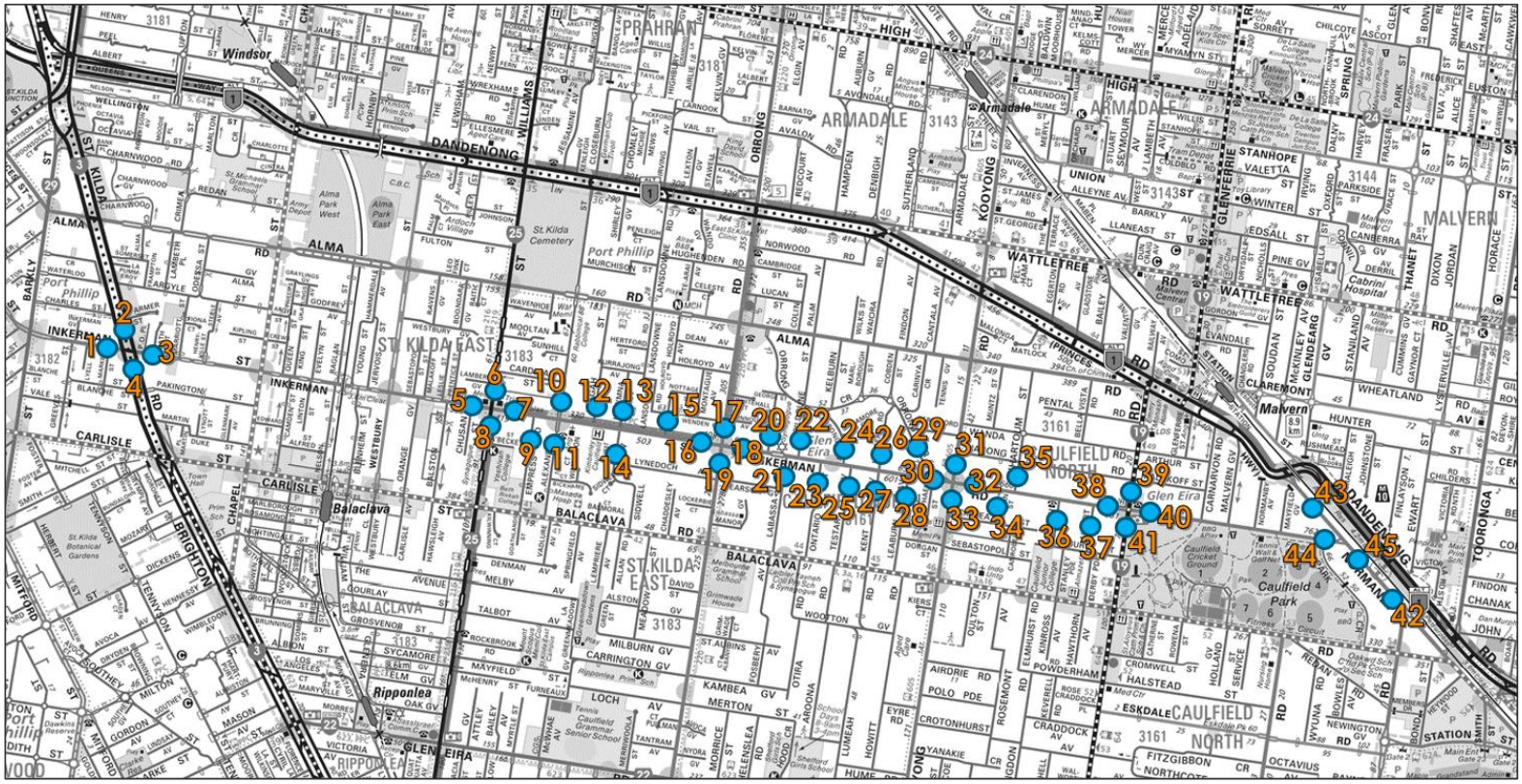
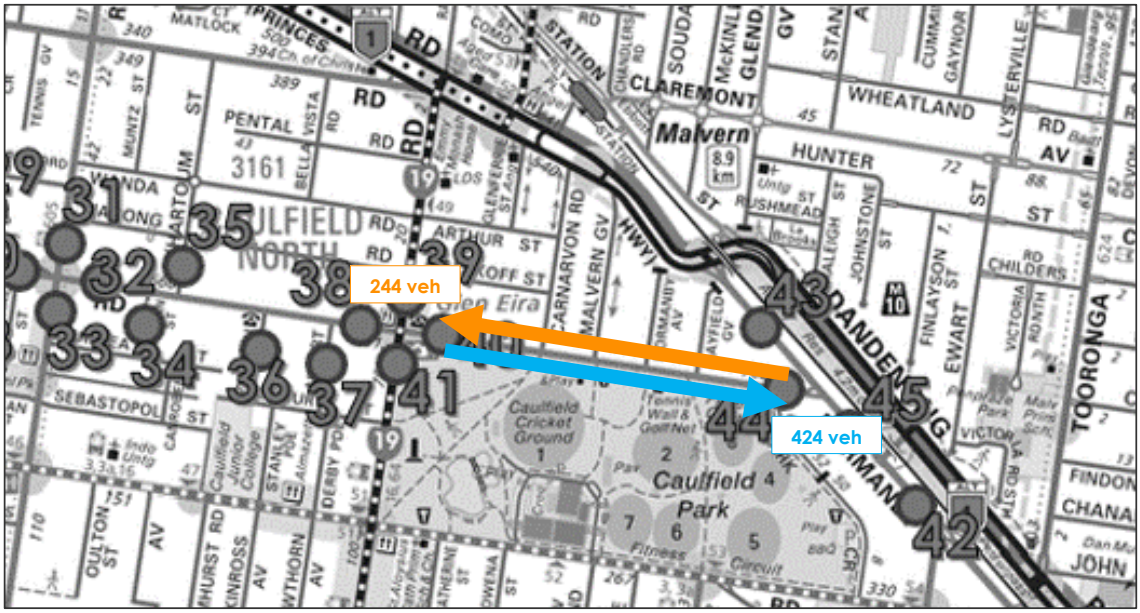


Table 6 OD Survey Results – East/West Movements

Origin (Gate No.)	Destination (Gate No.)	AM Commuter Peak Hour (veh)	PM Commuter Peak Hour (veh)	School Pick-Up Peak Hour (veh)	Saturday Peak Hour (veh)
Westbound					
44	**40**	306	302	244	265
	32	233	149	182	182
	18	123	168	109	118
	7	89	118	72	85
Eastbound					
7	**16**	354	453	470	369
	30	202	250	269	259
	38	129	165	170	174
	44	84	87	102	107

Further to the above, the east-west movements along Inkerman Road between Hawthorn Road and Normanby Road were of particular interest as they are impacted by all three Safe Cycle Corridor options under investigation. It was seen that the east and west movements between OD gates 40 and 44 were fairly comparable in both directions, with vehicle travel not favoured in either direction during the peak hours with expectation of the School Pick-Up Peak. During this peak period nearly double the number of vehicles were seen to be travelling eastbound compared to westbound, as illustrated in Figure 4 below.

Figure 4 Traffic Between OD Gate 40 and 44 – School Pick-Up Peak



A spreadsheet allowing the lookup of the number of vehicles that travelled from a particular gate to another in all four peak hours has been provided to Council for future reference, allowing any routes of interest to be reviewed in the future.

4 DESIGN HOUR + GROWTH TRAFFIC CONDITIONS

4.1 Design Hour

It is acknowledged that due to the COVID-19 pandemic, traffic volume data collected after early 2020 may not represent typical traffic conditions. It should be noted that there were no lockdowns or restrictions on local travel on the survey dates, and that DoT recommends collecting data for intersections in the months of either May or November (as was the case for this investigation) to best reflect regular traffic patterns. Regardless, to determine the appropriateness of the intersection volumes collected, it is important to explore a number of standard considerations that may impact the data collection whereby a subsequent adjustment may be required (road construction, road crashes, weather events, volumes not returning to pre-pandemic levels, etc.).

onemile**grid** has adopted the methodology outlined in the Department of Transport's *Transport Modelling Guidelines, Volume 5: Intersection Modelling (June 2021)* to determine what is known as the 'design hour'.

The design hour is a model peak hour that determines an adjustment factor that can be applied to surveyed intersection volumes to provide more robust operation conditions, rather than relying solely on several survey days during the same week. The design hour helps adjusts traffic volumes from a 'regular peak hour' to the '30th busiest peak hour of the year'.

The design hour for the weekday peak periods has been identified by utilising SCATs data to derive the total vehicle volumes during the peak hours of all signalised intersections in the network model on every day of 2019 (last pre-COVID year). The peak hour volumes on each day of the year were then ranked from 1 (busiest hour) to 365 (least busy hour), with the 30th busiest hour for each intersection selected and added together to determine the network design hour (as per DoT guidelines). Each of the three weekday network design hours (AM Commuter Peak, PM Commuter Peak & School Pick-Up Peak) were then compared against the SCATs volumes of the network during that same peak hour on the peak survey date in November 2021 to determine the difference between the survey date and the design hour.

For the Saturday peak hour, a slightly different approach was adopted. Rather than utilising the specific peak hour on every day in 2019, the daily volumes for each of the intersections on only the 52 Saturdays in 2019 were utilised to determine the 85th percentile Saturday volume of the network to compare against the SCATs data on the survey day. This is considered a more appropriate approach to determine the Saturday peak hour adjustment factor as the daily traffic profile on the weekend is typically considerably different to that of a weekday.

The analysis outlined above determined the design hour adjustment factor for each of the four peak hours, which are outlined in Table 7 below.

Table 7 Design Hour – Peak Hour Traffic Volume Adjustment Factor

Peak Hour	*Design Hour Adjustment Factor*
Weekday Morning Commuter Peak	8.3%
Weekday Evening Commuter Peak	12.8%
Weekday School Pick-Up Peak	2.6%
Saturday Peak	6.7%

4.2 Future Growth

The consideration of future traffic growth on any road network is paramount to exploring operational matters and delivering on design and performance criteria. The typical time period adopted when analysing future growth impacts on the performance of an intersection or a road network is 10 years post construction.

The draft Glen Eira Housing Strategy (January 2022 edition) outlines the anticipated future dwelling and population growth in Glen Eira from 2021 to 2036. The report estimates a population growth of 29,330 people between 2021 and 2036, equivalent to a linear growth rate of 1.2% per annum over the 15-year period. Assuming future traffic generation by residents of Glen Eira remains fairly consistent with current conditions, the volumes of vehicles on the road network could be expected to growth in line with the municipality's population.

This is considered conservative and does not take into account any change in travel mode, such as increased use of public or active transport or reduced trips due to working from arrangements, for existing or new residents in the area from the current conditions.

4.3 Design Hour + Growth Impact

4.3.1 Degree of Saturation – All Intersections

In order to determine the future traffic conditions of the road network separate of the road network changes proposed as part of the Safe Cycle Corridor, the surveyed volumes have been factored up to give consideration to the design hour of each of the four peak hours identified. The factored-up volumes were then further adjusted for 10 years of population growth, utilising the rate of 1.2% linear growth per annum.

To assess the operation of the intersections under the design hour and growth conditions, the factored-up traffic volumes have been input into SIDRA Intersection, a traffic modelling software package.

The DoS for each intersection is outlined in Table 8 – Table 10 below. The results show that a total of four (4) intersections will exceed capacity during at least one of the peak hours under the design hour plus growth conditions.

Refer to full detailed results attached in Appendix C for the LoS, 95th percentile queues and average delays experienced by motorists for each movement at all intersections.

Table 8 Alma Road Corridor SIDRA Analysis – Design Hour + Growth Traffic Conditions

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Existing	Design Hr + Growth	Existing	Design Hr + Growth	Existing	Design Hr + Growth	Existing	Design Hr + Growth
Alma Road Corridor									
Alma Rd / Chapel St	South	0.28	0.39	0.29	0.38	0.24	0.27	0.27	0.31
	East	0.34	0.49	0.34	0.47	0.34	0.41	0.29	0.37
	North	0.32	0.51	0.32	0.49	0.37	0.47	0.28	0.38
	West	0.22	0.26	0.33	0.46	0.37	0.45	0.23	0.30
Alma Rd / Hotham St	South	0.80	**1.02**	0.48	0.60	0.48	0.55	0.42	0.51
	East	0.78	**1.04**	0.42	0.88	0.52	0.59	0.46	0.55
	North	0.40	0.48	0.68	0.89	0.60	0.73	0.45	0.55
	West	0.58	0.77	0.63	0.77	0.60	0.70	0.34	0.40
Alma Rd / Orrong Rd	South	0.43	0.87	0.29	0.41	0.49	0.81	0.32	0.38
	East	0.43	**0.96**	0.47	0.88	0.48	0.85	0.41	0.63
	North	0.35	0.68	0.45	0.85	0.52	0.80	0.41	0.61
	West	0.32	0.62	0.41	0.77	0.48	0.82	0.28	0.38
Alma Rd / Kooyong Rd	South	0.63	0.77	0.51	0.70	0.49	0.61	0.50	0.60
	East	0.61	0.74	0.65	0.73	0.60	0.62	0.55	0.66
	North	0.57	0.71	0.67	**0.95**	0.62	0.78	0.55	0.68
	West	0.54	0.70	0.58	**0.94**	0.58	0.79	0.32	0.46

Orange = approaching capacity
Red = exceeds capacity

Table 9 Inkerman Road Corridor SIDRA Analysis – Design Hour + Growth Traffic Conditions

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Existing	Design Hr + Growth	Existing	Design Hr + Growth	Existing	Design Hr + Growth	Existing	Design Hr + Growth
Inkerman Road Corridor									
Inkerman Rd / Chapel St	South	0.31	0.36	0.34	0.56	0.29	0.34	0.27	0.31
	East	0.35	0.45	0.38	0.71	0.40	0.49	0.32	0.44
	North	0.34	0.45	0.44	0.71	0.41	0.54	0.33	0.45
	West	0.27	0.38	0.44	0.61	0.41	0.53	0.34	0.45
Inkerman Rd / Hotham St	South	0.52	0.68	0.40	0.79	0.47	0.60	0.39	0.47
	East	0.40	0.43	0.30	0.35	0.27	0.32	0.23	0.29
	North	0.39	0.52	0.62	0.87	0.49	0.53	0.48	0.59
	West	0.51	0.67	0.62	0.83	0.50	0.62	0.48	0.62
Inkerman Rd / Orrong Rd	South	0.87	**1.14**	0.62	**0.97**	**0.92**	**1.10**	0.47	0.60
	East	**0.95**	**1.15**	0.79	**1.00**	0.78	0.86	0.46	0.65
	North	0.51	**0.90**	0.81	**1.15**	0.78	**0.92**	0.56	0.75
	West	0.78	**0.95**	0.88	**1.12**	**0.97**	**1.07**	0.55	0.75
Inkerman Rd / Kooyong Rd	South	0.76	**0.92**	0.66	0.81	0.80	0.88	0.59	0.74
	East	0.75	**0.91**	0.68	0.89	0.45	0.54	0.51	0.60
	North	0.77	**0.91**	0.80	**0.99**	0.84	**0.94**	0.59	0.73
	West	0.76	0.89	0.80	**1.00**	0.82	**0.94**	0.60	0.72
Inkerman Rd / Hawthorn Rd	South	0.40	0.60	0.39	0.54	0.53	0.68	0.32	0.40
	East	0.27	0.35	0.22	0.28	0.19	0.23	0.25	0.29
	North	0.32	0.48	0.36	0.59	0.53	0.68	0.29	0.39
	West	0.41	0.62	0.40	0.58	0.53	0.67	0.32	0.41
Inkerman Rd / Normanby Rd	South	0.38	0.46	0.28	0.30	0.27	0.31	0.39	0.46
	North	0.11	0.14	0.16	0.20	0.18	0.20	0.22	0.27
	West	0.68	**1.04**	0.51	0.65	0.78	**0.99**	0.76	**1.24**

Orange = approaching capacity
Red = exceeds capacity

Table 10 Balaclava Road Corridor SIDRA Analysis – Design Hour + Growth Traffic Conditions

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Existing	Design Hr + Growth	Existing	Design Hr + Growth	Existing	Design Hr + Growth	Existing	Design Hr + Growth
Balaclava Road Corridor									
Carlisle St / Chapel St	South	0.24	0.29	0.31	0.61	0.29	0.42	0.26	0.35
	East	0.27	0.36	0.39	0.72	0.43	0.67	0.38	0.63
	North	0.26	0.34	0.55	**0.91**	0.45	0.65	0.39	0.58
	West	0.23	0.31	0.56	0.89	0.42	0.61	0.34	0.55
Balaclava Rd / Hotham St	South	0.63	**0.92**	0.48	0.69	0.69	0.84	0.44	0.60
	East	0.63	0.89	0.67	**0.94**	0.71	0.83	0.49	0.60
	North	0.43	0.54	0.70	**0.95**	0.70	0.85	0.48	0.60
	West	0.44	0.57	0.49	0.77	0.45	0.59	0.32	0.41
Balaclava Rd / Orrong Rd	South	0.56	0.84	0.36	0.71	0.61	0.84	0.24	0.29
	East	0.55	0.83	0.32	0.53	0.40	0.53	0.27	0.34
	North	0.39	0.50	0.41	0.59	0.41	0.49	0.27	0.33
	West	0.41	0.67	0.41	0.69	0.59	0.85	0.26	0.32
Balaclava Rd / Kooyong Rd	South	0.57	0.89	0.39	0.65	0.59	0.81	0.28	0.38
	East	0.57	0.84	0.42	0.66	0.33	0.46	0.28	0.38
	North	0.49	0.80	0.46	0.73	0.63	0.85	0.31	0.43
	West	0.56	0.81	0.47	0.68	0.62	0.83	0.30	0.41
Balaclava Rd / Hawthorn Rd	South	0.52	0.67	0.41	0.63	0.46	0.55	0.31	0.48
	East	0.34	0.46	0.32	0.49	0.28	0.33	0.30	0.30
	North	0.49	0.60	0.48	0.80	0.58	0.76	0.33	0.50
	West	0.51	0.72	0.47	0.82	0.59	0.75	0.33	0.50
Balaclava Rd / Normanby Rd	South	0.19	0.23	0.13	0.17	0.12	0.14	0.18	0.22
	North	0.21	0.25	0.19	0.25	0.23	0.27	0.22	0.27
	West	0.21	0.26	0.20	0.25	0.24	0.27	0.23	0.27

Orange = approaching capacity

4.3.2 Key Intersection Results

It is clear from the results presented above, taking into consideration the design hour adjustment factor and 10 years' worth of traffic growth in the area, all intersections will experience increased traffic movements in the peak hours which in turn will impact performance (degree of saturation, queues, delays, level of service, etc.). A summary of the impact that the design hour and growth factors will have on average delays on particular legs and/or intersections as a whole at the key intersections identified in the above results is provided in the following sections.

4.3.2.1 Alma Road / Hotham Road

The Alma Road / Hotham Road intersection reached capacity during the AM Commuter Peak, with the south and east approaches experiencing noticeable increases to the average delay of 41 and 39 seconds respectively.

4.3.2.2 Alma Road / Orrong Road

The eastern leg of the Alma Road / Orrong Road intersection experiences a 22 second increase under the design hour plus growth conditions in the AM Commuter Peak Hour.

4.3.2.3 Alma Road / Kooyong Road

The northern and western legs of the Alma Road / Kooyong Road intersection begun to approach capacity during the PM Commuter Peak, experiencing increases to the average delay of 30 and 3 seconds respectively.

4.3.2.4 Inkerman Road / Orrong Road

The Inkerman Road / Orrong Road intersection, that is already operating close to capacity in the existing conditions analysis, will exceed capacity during all three of the weekday peak hours under the design hour plus growth conditions. The AM Commuter Peak, PM Commuter Peak and School Pick-Up Peak will experience an increase to average delay across the entire intersection of 58, 64 and 34 seconds respectively, with some legs/movement being higher than these times.

4.3.2.5 Inkerman Road / Kooyong Road

The Inkerman Road / Kooyong Road intersection will approach capacity in all three of the weekday peak hours under the design hour plus growth conditions. The AM Commuter Peak, PM Commuter Peak and School Pick-Up Peak will have increased average delay across the entire intersection of 15, 21 and 10 seconds respectively.

4.3.2.6 Inkerman Road / Normanby Road

The western leg of Inkerman Road / Normanby Road intersection (Inkerman Road leg) will be the only leg of the intersection that will exceed capacity under design hour plus growth conditions. The critical peak hour is on the Saturday, when the right turn movement from Inkerman Road onto Normanby Road will operate well above capacity and result in increased average delays of 233 seconds (over 3 and a half minutes).

Whilst the results indicate upgrades to the intersection should be investigated, including signalisation, the road network changes explored for the Safe Cycle Corridor options also alleviate the issues at the intersection as detailed in subsequent sections of this report.

4.3.2.7 Carlisle Street / Chapel Street

The northern leg of the Carlisle Street / Chapel Street intersection will experience a 14 second increase under the design hour plus growth conditions in the PM Commuter Peak Hour.

4.3.2.8 Balaclava Road / Hotham Road

The southern leg of the Balaclava Road / Hotham Road intersection will experience an 18 second increase under the design hour plus growth conditions in the AM Commuter Peak Hour.

In the PM Commuter Peak Hour, the eastern and northern leg of the intersection will experience an increase delay of 9 and 20 second accordingly.

5 SAFE CYCLE CORRIDOR – TRAFFIC REDISTRIBUTION

5.1 General

Each of the three options explored in this report for Inkerman Road involves changing the direction of traffic along Inkerman Road from two-way to one-way for a particular length. This alteration to the road network will result in some vehicles movements at intersections no longer being permitted, and as such, vehicles currently making these movements will be redistributed throughout the network to undertake their journey.

The following sections describe the traffic redistribution adopted for each option in order to assess the impacts on the surrounding intersections and the road network as a whole.

5.2 Option 1: One-Way Westbound

By making Inkerman Road one-way westbound only, all vehicles currently travelling eastbound along Inkerman Road between Orrong Road and Normanby Road will be redistributed elsewhere within the road network to undertake their journey.

As previously outlined, the OD survey results help determine the travel routes of vehicles throughout the network. The results of the OD surveys have therefore been used as a guide to assist in accurately redistributing existing eastbound movement along Inkerman Road to a suitable alternative route based on where the OD surveys identified these vehicles would depart the network.

For example, the OD surveys revealed that a total of 152 vehicles in the AM Commuter Peak Hour travelled from the intersection of Inkerman Road / Orrong Road all the way east to Normanby Road – using Inkerman Road to undertake this journey. These movements were primarily made up of vehicles coming from the west along Inkerman Road (103 vehicles), but also included some vehicles travelling north up Orrong Road (30 vehicles) and some vehicles travelling south down Orrong Road (19 vehicles). These vehicle movements were redistributed to Balaclava Road to complete their eastbound journey to Normanby Road as it is the closest east-west through route connecting to Normanby Road, all doing so from the intersection of Balaclava Road / Orrong Road.

Similar redistribution of travel routes has been undertaken for all vehicles that travelled eastbound along Inkerman Road between Orrong Road and Normanby Road, including vehicles turning onto Inkerman Road from Hawthorn Road and Kooyong Road. The most convenient and logical alternative route, using the destination of vehicles movements determined by the OD surveys, has been adopted to understand the likely new vehicle movements through the road network as a result of the proposed changes to Inkerman Road.

A view of the alternative routes that the redistributed traffic is expected to take based on Option 1, as well as the redistribution example detailed above, is illustrated in Figure 5 and Figure 6 below.

Figure 5 Option 1 Traffic Redistribution – Overall

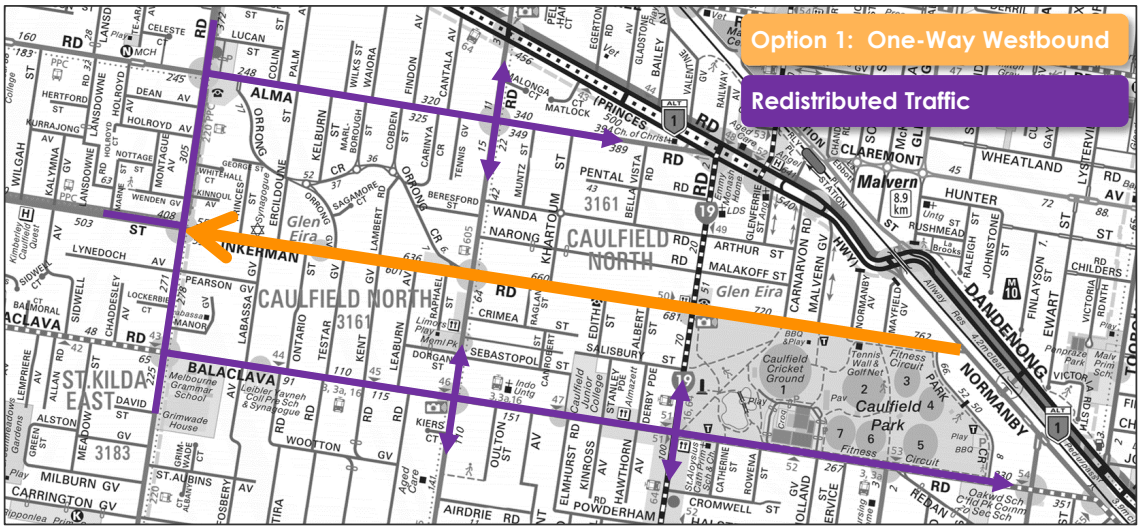
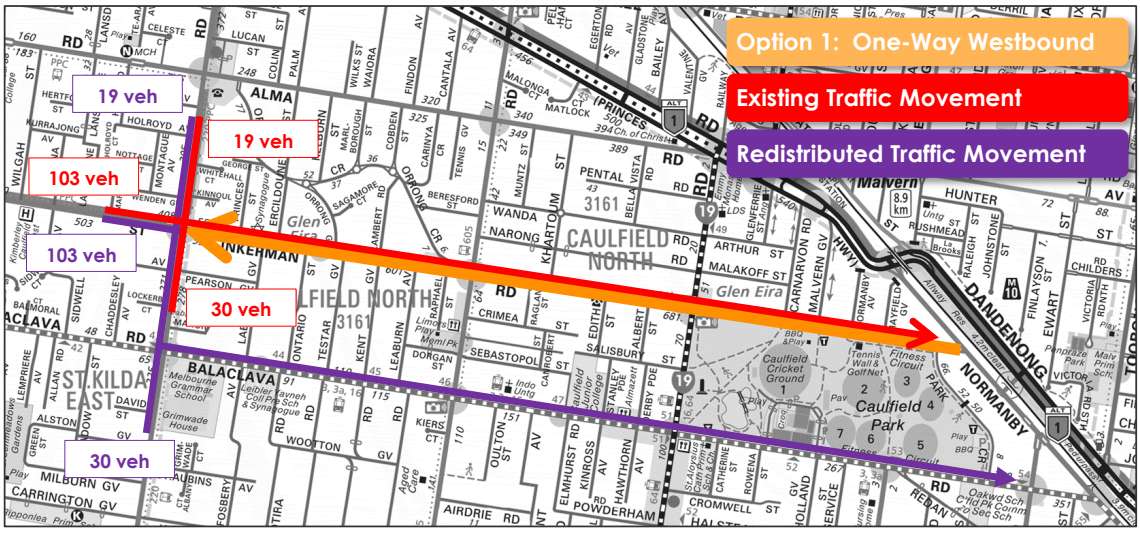


Figure 6 Option 1 Traffic Redistribution – Example



It should be noted that this analysis is considered conservative as it does not remove any existing vehicles from the road network as a result of the one-way arrangement of Inkerman Road. It is considered likely that some motorists that currently travel eastbound along Inkerman Road will elect to avoid the road network altogether and utilise Dandenong Road or Glen Eira Road for their eastbound joinery, thus reducing the impact the one-way arrangement would have on the operation of the intersections in the area. The analysis presented in subsequent sections is therefore considered the worst-case scenario for the proposed arrangement.

Furthermore, no additional westbound through volumes were added to Inkerman Road at any of the intersections between Orrong Road and Normanby Road. With Inkerman Road being one-way only, it is considered possible that additional vehicles travelling west may elect to use Inkerman Road as opposed to Alma Road or Balaclava Road. With no opposing traffic, motorists may find it

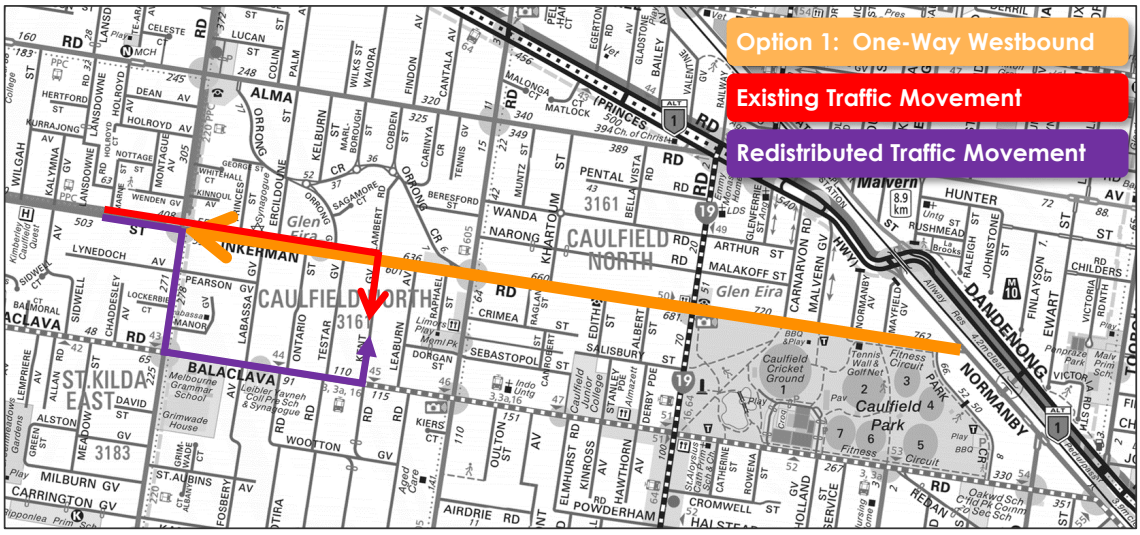
more comfortable to turn right into local streets along this stretch of Inkerman Road which could reduce delays for westbound movements, in particular for residents whose residence is located in the local streets on the north side of Inkerman Road.

Regarding local traffic movements, being vehicles that travelled east along Inkerman Road to access local side streets (Orrong Grove, Khartoum Street, etc.), it was assumed in the distribution model that these vehicles entered the local road network from either Alma Road or Balaclava Road depending on which side of Inkerman Road their property was located.

To give a greater understanding, an example of how the local traffic movements have been redistributed throughout the road network is provided below.

In the Weekday AM Commuter Peak, a total of 10 vehicles were observed to travel eastbound through the Inkerman Road / Orrong Road intersection and the turn right into Kent Street (determine by the OD surveys). Under Option 1 conditions, those 10 vehicles will no longer be able to travel east along Inkerman Road once they reach Orrong Road, and have been redistricted to turn right at Orrong Road to head south, then turn left at Balaclava Road to head east to enter Kent Street from the south as shown in Figure 7 below.

Figure 7 Option 1 – Local Traffic Redistribution Example (Kent Road Access)



As shown in the example above, the redistribution of traffic has resulted in an additional 10 right turns from Inkerman Road onto Orrong Road and an additional 10 left turns from Orrong Road onto Balaclava Road. This is considered a conservative approach as motorists may elect to alter their travel route further upstream and approach the area along Balaclava Road, reducing the number of additional turning movements at the Orrong Road intersections with Inkerman Road and Balaclava Road and thus reducing the impact the one-way arrangement has on the intersections.

However, it is acknowledged that some vehicles currently making turns from Inkerman Road into side streets like Kent Street may be doing so in order to 'rat-run' through the local streets and avoid signalised intersections rather than to access residential properties, as the example above suggests. Continuing with the example above, there may currently be 5 vehicles that end their journey in Kent Street (e.g. arriving home) whilst the other 5 vehicles continue south on Kent Street and turn left onto Balaclava Road to continue their journey by either turning right to head south or continue eastbound at the Balaclava Road / Kooyong Road intersection. Whilst the model redistributes the traffic movements to Balaclava Road to access Kent Street, it does not remove any volumes from the Balaclava Road / Kooyong Road intersection. Therefore, any vehicles that are currently using the local street to rat-run through and turn at an intersection further down the network are still accounted for at those intersections under Option 1 conditions.

5.3 Option 2: One-Way Eastbound

By making Inkerman Road one-way eastbound only, all vehicles currently travelling westbound along Inkerman Road between Orrong Road and Normanby Road will be redistributed elsewhere within the road network to undertake their journey.

As previously outlined, the OD survey results have been used as a guide to assist in accurately redistributing existing westbound movement along Inkerman Road to a suitable alternative route based on where the OD surveys identified these vehicles would depart the network.

For example, the OD surveys revealed that a total of 123 vehicles in the AM Commuter Peak Hour travelled from the intersection of Inkerman Road / Normanby Road all the way west to Orrong Road – using Inkerman Road to undertake this journey. These vehicles then primarily departed the intersection of Inkerman Road / Normanby Road by continuing west along Inkerman Road (99 vehicles), however several vehicles also turned left to proceed south along Orrong Road (13 vehicles) whilst others turned right to travel north along Orrong Road (11 vehicles).

These vehicle movements were redistributed to Balaclava Road to complete their westbound journey to Orrong Road as it is the closest east-west through route connected from Normanby Road. The southbound vehicles proceeded south at the Balaclava Road / Orrong Road intersection whilst the westbound and northbound vehicles travelled north up Orrong Road to turn either left or continue straight at the intersection of Inkerman Road / Orrong. Whilst it is acknowledged that some westbound vehicles may elect to simply continue straight along Balaclava Road rather than relocating back to Inkerman Road, it is considered more likely that the majority of vehicles will wish to travel along Inkerman Road as it does not contain a tram route and was in line with their previous destination.

Similar redistribution of travel routes has been undertaken for all vehicles that travelled westbound along Inkerman Road between Orrong Road and Normanby Road, including vehicles turning onto Inkerman Road from Hawthorn Road and Kooyong Road. The most convenient and logical alternative route, using the destination of vehicles movements determined by the OD surveys, has been adopted to understand the likely new vehicle movements through the road network as a result of the proposed changes to Inkerman Road.

A view of the alternative routes that the redistributed traffic is expected to take based on Option 2, as well as the redistribution example detailed above, is illustrated in Figure 8 and Figure 9 below.

Figure 8 Option 2 Traffic Redistribution – Overall

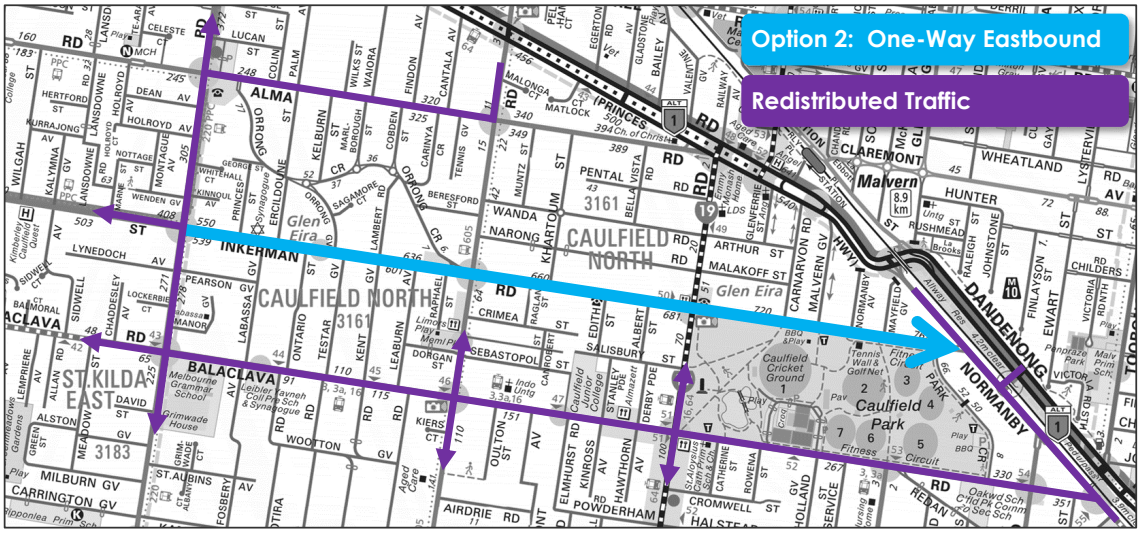
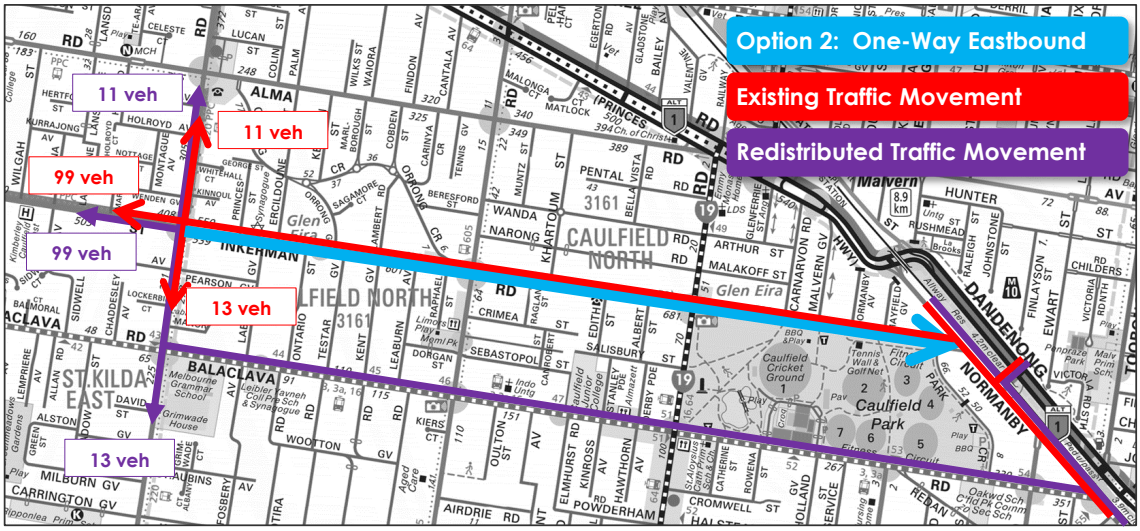


Figure 9 Option 2 Traffic Redistribution – Example



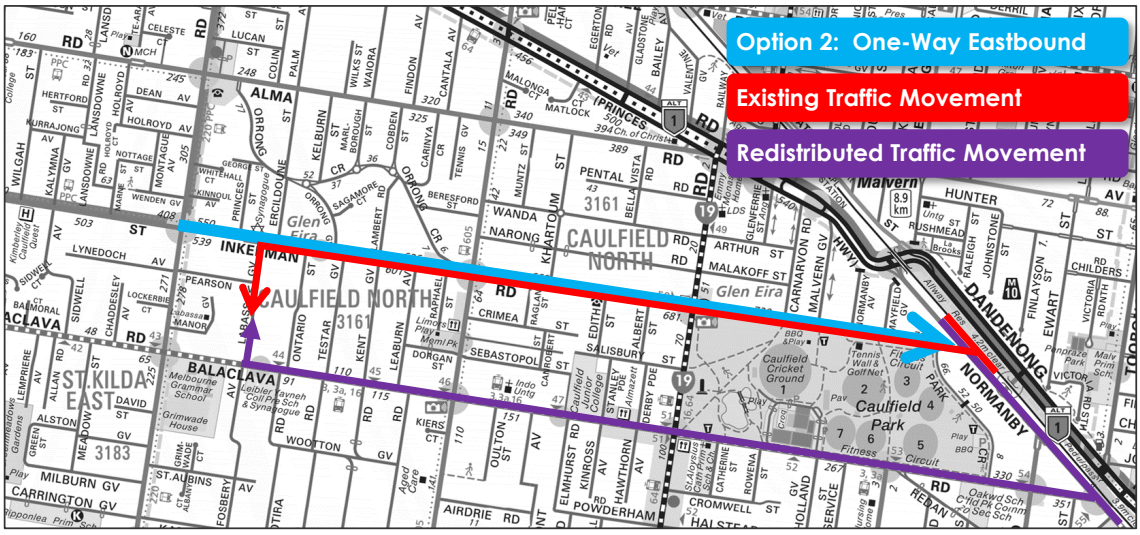
Similar to Option 1, no existing vehicle movements were removed from the road network as a result of the one-way arrangement of Inkerman Road, nor were additional eastbound through vehicle movements relocated from Alma Road and Balaclava Road to travel along the new one-way section of Inkerman Road.

Regarding local traffic movements, being vehicles that travelled west along Inkerman Road to access local side streets (Orrong Grove, Khartoum Street, etc.), it was assumed in the distribution model that these vehicles entered the local road network from either Alma Road or Balaclava Road depending on which side of Inkerman Road their property was located.

To give a greater understanding, an example of how the local traffic movements have been redistributed throughout the road network is provided below.

In the Weekday AM Commuter Peak, a total of 10 vehicles were observed to travel westbound through the Inkerman Road / Normanby Road intersection and the turn left into Labassa Grove (determined by the OD surveys). Under Option 2 conditions, those 10 vehicles will no longer be able to travel west along Inkerman Road from Normanby Road, and have been redistricted to travel west along Balaclava Road and turn right into Labassa Grove from the south as shown in Figure 7 below.

Figure 10 Option 2 – Local Traffic Redistribution Example (Labassa Grove Access)



As shown in the example above, the redistribution of traffic has resulted in an additional 10 turning movements at the Balaclava Road / Normanby Road intersection as well as additional westbound through movements at the Balaclava Road intersections with Hawthorn Road and Kooyong Road. It was not assumed that vehicles would utilise Kambrook Road to cut through and avoid the Balaclava Road / Normanby Road intersection as there will likely need to be restrictions to vehicle movements made between Normanby Road and Kambrook Road, as detailed in Section 10.

Similar to Option 1, it is acknowledged that some vehicles that currently make turns from Inkerman Road into side streets like Labassa Grove may be doing so in order to 'rat-run' through the local streets and avoid signalised intersections rather than to access residential properties, as the example above suggests. Continuing with the example above, there may currently be 5 vehicles that end their journey in Labassa Grove (e.g. arriving home) whilst the other 5 vehicles continue south on Labassa Grove and turn right onto Balaclava Road to continue their journey by either turning left to head south or continue westbound at the Balaclava Road / Orrong Road intersection. Whilst the model redistributes the traffic movements to Balaclava Road to access Labassa Grove, it does not remove any volumes from the Balaclava Road / Orrong Road intersection. Therefore, any vehicles that are currently using the local street to rat-run through and turn at an intersection further down the network are still accounted for at that intersection under Option 1 conditions.

5.4 Option 3: One-Way Eastbound along Caulfield Park

By making Inkerman Road one-way eastbound only along the frontage of Caulfield Park, all vehicles currently travelling westbound along Inkerman Road between Hawthorn Road and Normanby Road will be redistributed elsewhere within the road network to undertake their journey.

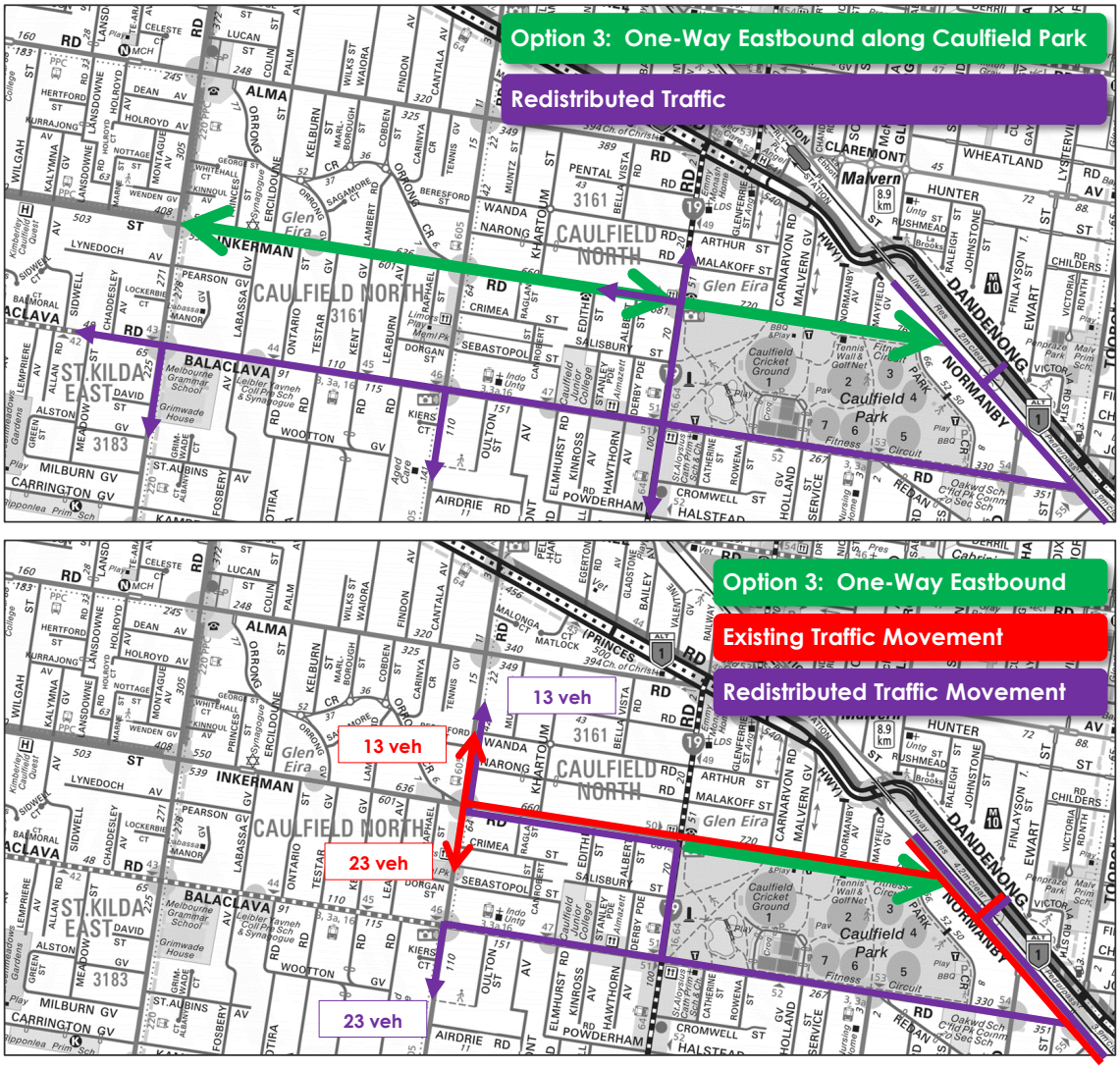
As previously outlined, the OD survey results have been used as a guide to assist in accurately redistributing existing westbound movement along Inkerman Road to a suitable alternative route based on where the OD surveys identified these vehicles would depart the network.

Due to ease of access from Normanby Road, all westbound vehicles at the Normanby Road end were redistributed to Balaclava Road to travel along the south side of Caulfield Park. All westbound and northbound movement were sent back to Inkerman Road via Hawthorn Road, whilst all southbound movement remained on Balaclava Road to proceed south at the appropriate intersections.

For example, the OD surveys revealed that a total of 13 vehicles in the AM Commuter Peak Hour travelled from the intersection of Inkerman Road / Normanby Road all the way west to Orrong Road using Inkerman Road to then head north. Similarly, 23 vehicles in the AM Commuter Peak Hour travelled from the intersection of Inkerman Road / Normanby Road all the way west to Orrong Road using Inkerman Road to then head south. The vehicles travelling north will be redistributed back to Inkerman Road via Hawthorn Road whereas the southbound vehicles will continue along Balaclava Road to turn left at Orrong Road.

A view of the alternative routes that the redistributed traffic is expected to take based on Option 3, as well as the redistribution example detailed above, is illustrated in Figure 11 below.

Figure 11 Option 3 Traffic Redistribution



Similar to the other options, no existing vehicle movements were removed from the road network vehicles from the road network as a result of the one-way arrangement of Inkerman Road, nor were additional eastbound through vehicle movements relocated from Alma Road and Balaclava Road to travel along the new one-way section of Inkerman Road.

The local traffic, being vehicles that currently travel west along Inkerman Road to access local side streets on the north side between Normanby Road and Hawthorn Road, will be required to access the local streets via an alternative route. Inbound vehicles can either circulate to the intersection of Inkerman Road / Hawthorn Road to access the local street by travelling east along Inkerman Road or enter the local network from westbound lanes of Dandenong Road into Glenferrie Street and head south along Carnarvon Road to get to Inkerman Road. Outbound vehicles from Normanby Avenue and Mayfield Grove will be required to travel east along Inkerman Road to Normanby Road before circulating the road network to their preferred direction of travel.

6 OPTION 1 TRAFFIC CONDITIONS

6.1 Intersection Layouts

As previously outlined, Option 1 involves making Inkerman Road one-way westbound only for vehicles between Orrong Road and Normanby Road, as shown in Figure 12 below.

Figure 12 Option 1

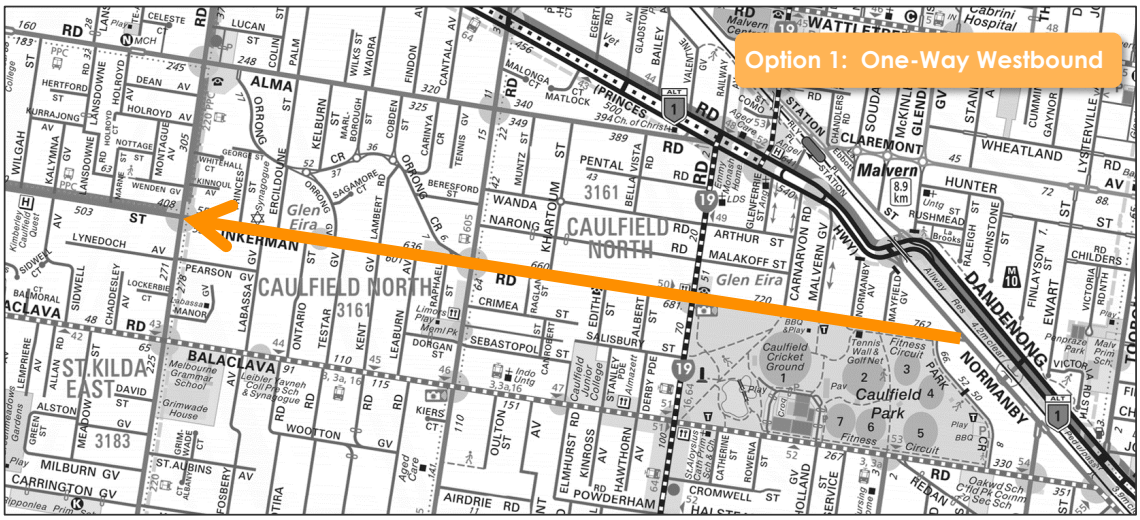

Option 1: One-Way Westbound
INKERMAN
CAULFIELD NORTH
3161
Glen Eira
CAULFIELD NORTH
BALACLAVA
ST KILDA EAST
3183
CAULFIELD
NORTH
3161
Glen Eira
Caulfield Park
CLAREMONT
Malvern
WHEATLAND
HUNTER
DANDENONG
NORMANBY
ALMA
ORRONG
KELBURN
CORBEN
CARINYA
PENTAL
WANDA
NARONG
KHARTOUM
ARTHUR
MALAKOFF
CARNARVON
MALVERN
LYNEDOCH
PEARSON
SIDWELL
LOCKERBIE
CHADDESLEY
LABASSA
ONTARIO
TESTAR
KENT
LEABURN
DORGAN
SEBASTOPOL
CRIMEA
RAGLAN
SALISBURY
ALBERT
EDITH
CARGILL
DERBY
STANLEY
WOOTTON
KIERS
OULTON
ELMHURST
KINROSS
HAWTHORN
POWDERHAM
CROMWELL
HOLLAND
ROWENA
CATHERINE
AIRDRIE
MILBURN GV
CARRINGTON GV
ST.AUBINS
FOSBERY
TIRA
MEADOW
ALSTON
DAVID
GREEN
ALLAN
LEMPRIERE
BALMORAL
SIDWELL
LYNEDOCH
KURRAJONG
KALYMNA
WILGAH
HERTFORD
LANSDOWNE
HOLROYD
DEAN
LUCAN
COLLINS
PALM
WILKS ST
WAIORA
FINDON
CANTALA
MALONGA
MATLOCK
PRINCES
EGERT
GLADSTONE
BAILEY
VALENTIA
RAILWAY
STATION
CHANDLERS
SOUDAN
GLENDEARG
GAYNOR
CUMMINS
LYSTERVILLE
RUSHMEAD
RALEIGH
JOHNSTONE
FINLAYSON
EWART
VICTORIA
ROWYTH
CHILDERS
MAYFIELD
Caulfield Cricket Ground
Tennis Wall & Golf Net
Fitness Circuit
Caulfield Junior College
Caulfield Recreation Centre
Caulfield Park
Fitness Circuit
Oakwd Sch Child Pk Comm Sec Sch
Panpraze Park
Malv Primi Sch
Caulfield Hospital
Malvern Central
Gabrini Hospital
Kimberley Gardens
Grimwade House
Melbourne Grammar School
Leibler Yavneh College Sch & Synagogue
Aged Care
Indo Unng
Limes Pl
Memi Pk
Caulfield Junior College
St Aloysius Catholic Primary Sch
Caulfield Grammar Sch
Caulfield Grammar Sch
Caulfield Grammar

Figure 13 Inkerman Road / Orrong Road – Option 1

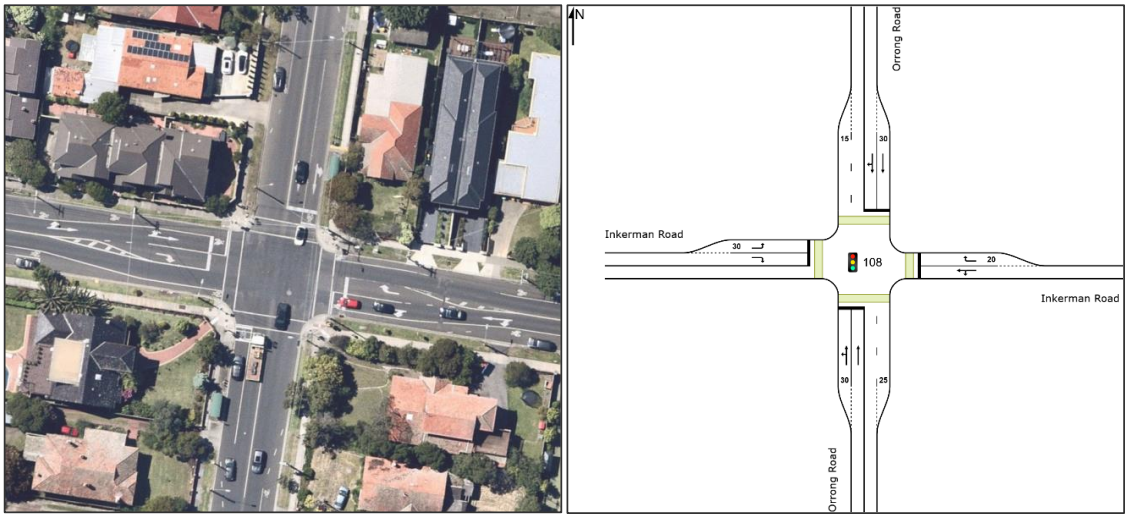


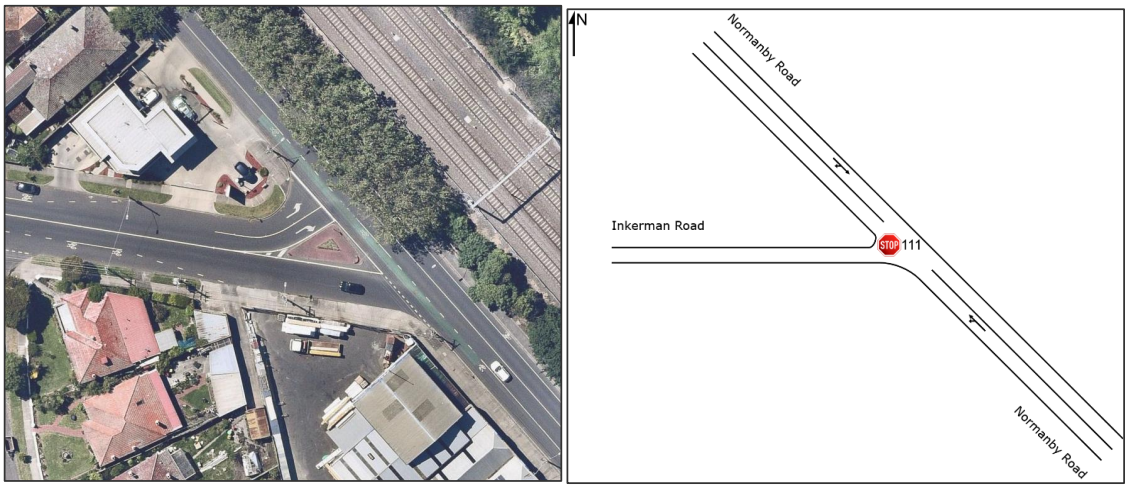
Figure 14 Inkerman Road / Kooyong Road – Option 1



Figure 15 Inkerman Road / Hawthorn Road – Option 1



Figure 16 Inkerman Road / Normanby Road – Option 1



6.2 Intersection Impact

6.2.1 Degree of Saturation – All Intersections

Based on the Option 1 traffic redistribution and the changed intersection configurations outlined above, the traffic volumes have been input into SIDRA Intersection to determine the performance of the intersections under Option 1 conditions.

The DoS for each intersection, compared against the design hour plus growth conditions, is outlined in Table 11 – Table 13 below. The results show that a total of six (6) intersections will exceed capacity during at least one of the peak hours under the Option 1 conditions.

Refer to full detailed results attached in Appendix D for the LoS, 95th percentile queues and average delays experienced by motorists for each movement at all intersections.

Table 11 Alma Road Corridor SIDRA Analysis – Option 1

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 1	Design Hr + Growth	Option 1	Design Hr + Growth	Option 1	Design Hr + Growth	Option 1
Alma Road Corridor									
Alma Rd / Chapel St	South	0.39	0.34	0.38	0.38	0.27	0.27	0.31	0.31
	East	0.49	0.43	0.47	0.46	0.41	0.41	0.37	0.37
	North	0.51	0.45	0.49	0.49	0.47	0.47	0.38	0.38
	West	0.26	0.29	0.46	0.46	0.45	0.45	0.30	0.30
Alma Rd / Hotham St	South	**1.02**	**1.02**	0.60	0.60	0.55	0.55	0.51	0.51
	East	**1.04**	**1.03**	0.88	0.87	0.59	0.51	0.55	0.55
	North	0.48	0.48	0.89	0.89	0.73	0.73	0.55	0.55
	West	0.77	0.78	0.77	0.77	0.70	0.70	0.40	0.40
Alma Rd / Orrong Rd	South	0.87	**1.02**	0.41	0.81	0.81	**1.03**	0.38	0.76
	East	**0.96**	**1.03**	0.88	**1.03**	0.85	0.69	0.63	0.84
	North	0.68	0.67	0.85	0.86	0.80	0.83	0.61	0.73
	West	0.62	0.72	0.77	0.89	0.82	0.64	0.38	0.45
Alma Rd / Kooyong Rd	South	0.77	0.81	0.70	0.75	0.61	0.68	0.60	0.60
	East	0.74	0.69	0.73	0.66	0.62	0.57	0.66	0.66
	North	0.71	0.74	**0.95**	**1.00**	0.78	0.85	0.68	0.68
	West	0.70	0.82	**0.94**	**0.98**	0.79	0.83	0.46	0.56

Orange = approaching capacity
Red = exceeds capacity

Table 12 Inkerman Road Corridor SIDRA Analysis – Option 1

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 1	Design Hr + Growth	Option 1	Design Hr + Growth	Option 1	Design Hr + Growth	Option 1
Inkerman Road Corridor									
Inkerman Rd / Chapel St	South	0.36	0.36	0.56	0.67	0.34	0.35	0.31	0.31
	East	0.45	0.44	0.71	0.75	0.49	0.46	0.44	0.44
	North	0.45	0.45	0.71	0.75	0.54	0.55	0.45	0.45
	West	0.38	0.38	0.61	0.74	0.53	0.53	0.45	0.45
Inkerman Rd / Hotham St	South	0.68	0.68	0.79	0.75	0.60	0.60	0.47	0.47
	East	0.43	0.42	0.35	0.29	0.32	0.29	0.29	0.29
	North	0.52	0.52	0.87	0.84	0.53	0.53	0.59	0.59
	West	0.67	0.66	0.83	0.84	0.62	0.62	0.62	0.62
Inkerman Rd / Orrong Rd	South	**1.14**	**1.13**	**0.97**	0.78	**1.10**	**0.96**	0.60	0.59
	East	**1.15**	**1.20**	**1.00**	**1.29**	0.86	**1.15**	0.65	**0.90**
	North	**0.90**	**1.20**	**1.15**	**1.31**	**0.92**	**1.21**	0.75	0.89
	West	**0.95**	**1.19**	**1.12**	**1.32**	**1.07**	**1.16**	0.75	**0.91**
Inkerman Rd / Kooyong Rd	South	**0.92**	0.83	0.81	0.70	0.88	0.59	0.74	0.59
	East	**0.91**	**0.92**	0.89	**0.95**	0.54	0.75	0.60	0.68
	North	**0.91**	**0.91**	**0.99**	**0.97**	**0.94**	0.73	0.73	0.68
	West	0.89		**1.00**		**0.94**		0.72	
Inkerman Rd / Hawthorn Rd	South	0.60	0.38	0.54	0.33	0.68	0.27	0.40	0.30
	East	0.35	0.38	0.28	0.36	0.23	0.32	0.29	0.32
	North	0.48	0.36	0.59	0.35	0.68	0.32	0.39	0.31
	West	0.62		0.58		0.67		0.41	
Inkerman Rd / Normanby Rd	South	0.46	0.46	0.30	0.36	0.31	0.31	0.46	0.46
	North	0.14	0.14	0.20	0.20	0.20	0.20	0.27	0.27
	West	**1.04**		0.65		**0.99**		**1.24**	

Orange = approaching capacity
Red = exceeds capacity
Black = leg removed as part of Safe Cycle Corridor option

Table 13 Balaclava Road Corridor SIDRA Analysis – Option 1

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 1	Design Hr + Growth	Option 1	Design Hr + Growth	Option 1	Design Hr + Growth	Option 1
Balaclava Road Corridor									
Carlisle St / Chapel St	South	0.29	0.29	0.61	0.61	0.42	0.42	0.35	0.35
	East	0.36	0.35	0.72	0.72	0.67	0.66	0.63	0.63
	North	0.34	0.34	**0.91**	**0.91**	0.65	0.65	0.58	0.58
	West	0.31	0.31	0.89	0.89	0.61	0.61	0.55	0.55
Balaclava Rd / Hotham St	South	**0.92**	0.89	0.69	0.67	0.84	0.84	0.60	0.60
	East	0.89	0.84	**0.94**	**0.94**	0.83	0.85	0.60	0.60
	North	0.54	0.51	**0.95**	**0.95**	0.85	0.85	0.60	0.60
	West	0.57	0.60	0.77	0.76	0.59	0.58	0.41	0.41
Balaclava Rd / Orrong Rd	South	0.84	**1.02**	0.71	**0.91**	0.84	**1.10**	0.29	0.31
	East	0.83	**1.07**	0.53	0.68	0.53	0.66	0.34	0.46
	North	0.50	0.68	0.59	1.01	0.49	0.65	0.33	0.46
	West	0.67	0.80	0.69	**0.92**	0.85	**1.07**	0.32	0.43
Balaclava Rd / Kooyong Rd	South	0.89	**1.12**	0.65	**1.03**	0.81	**1.44**	0.38	0.81
	East	0.84	0.78	0.66	0.81	0.46	**1.05**	0.38	0.27
	North	0.80	**1.09**	0.73	**1.03**	0.85	**1.14**	0.43	0.80
	West	0.81	**1.17**	0.68	**1.05**	0.83	**1.17**	0.41	0.82
Balaclava Rd / Hawthorn Rd	South	0.67	**0.92**	0.63	0.85	0.55	0.79	0.48	0.78
	East	0.46	0.50	0.49	0.55	0.33	0.31	0.30	0.56
	North	0.60	0.71	0.80	**0.95**	0.76	**0.90**	0.50	0.69
	West	0.72	**0.91**	0.82	**0.94**	0.75	**0.95**	0.50	0.63
Balaclava Rd / Normanby Rd	South	0.23	0.29	0.17	0.23	0.14	0.19	0.22	0.29
	North	0.25	0.34	0.25	0.37	0.27	0.38	0.27	0.38
	West	0.26	0.35	0.25	0.37	0.27	0.38	0.27	0.37

Orange = approaching capacity
Red = exceeds capacity

6.2.2 Key Intersection Results

As would be expected, the one-way arrangement of Inkerman Road between Orrong Road and Normanby Road has reduced traffic movements at the intersections along Inkerman Road for this stretch and has therefore improved the performance of those intersections. However, those traffic movements have been redistributed to the intersections along Alma Road and Balaclava Road and therefore have results in increased turning movements at a number of peripheral intersections to Inkerman Road.

A summary of the impact that the Option 1 conditions will have on average delays on particular legs and/or intersections as a whole at the key intersections identified in the above results is provided in the following sections.

It is worth noting that once an intersection exceeds capacity in the SIDRA Intersection software (DoS over 1.00), delays on critical movements/legs of an intersection increase exponentially.

6.2.2.1 Alma Road / Orrong Road

The southern leg of the Alma Road / Orrong Road intersection reached capacity during two of the three weekday peak hours, experiencing increases to the average delay of 25 and 39 seconds in the AM Commuter Peak and the School Pick-Up Peak respectively.

In addition, the eastern leg of the intersection will experience a 23 second increase under the Option 1 conditions in the PM Commuter Peak Hour.

6.2.2.2 Inkerman Road / Orrong Road

The Inkerman Road / Orrong Road intersection will operate less favourably in all four of the peak hours under Option 1 conditions. The AM Commuter Peak, PM Commuter Peak, School Pick-Up Peak and Saturday Peak will have increased average delay across the entire intersection of 78, 120, 65 and 12 seconds respectively.

It should also be noted that the southern leg of the intersection will improve as a result of right turns no longer being permitted on the southern leg of the intersection into Inkerman Road, thus reducing delays for through movements.

6.2.2.3 Balaclava Road / Orrong Road

The Balaclava Road / Orrong Road intersection will either approach or exceed capacity in all three of the weekday peak hours under Option 1 conditions. The AM Commuter Peak, PM Commuter Peak and School Pick-Up Peak will have increased average delay across the entire intersection of 30, 1 and 47 seconds respectively.

In addition, the eastern leg of the intersection will experience a 20 second increase under the Option 1 conditions in the AM Commuter Peak Hour.

6.2.2.4 Balaclava Road / Kooyong Road

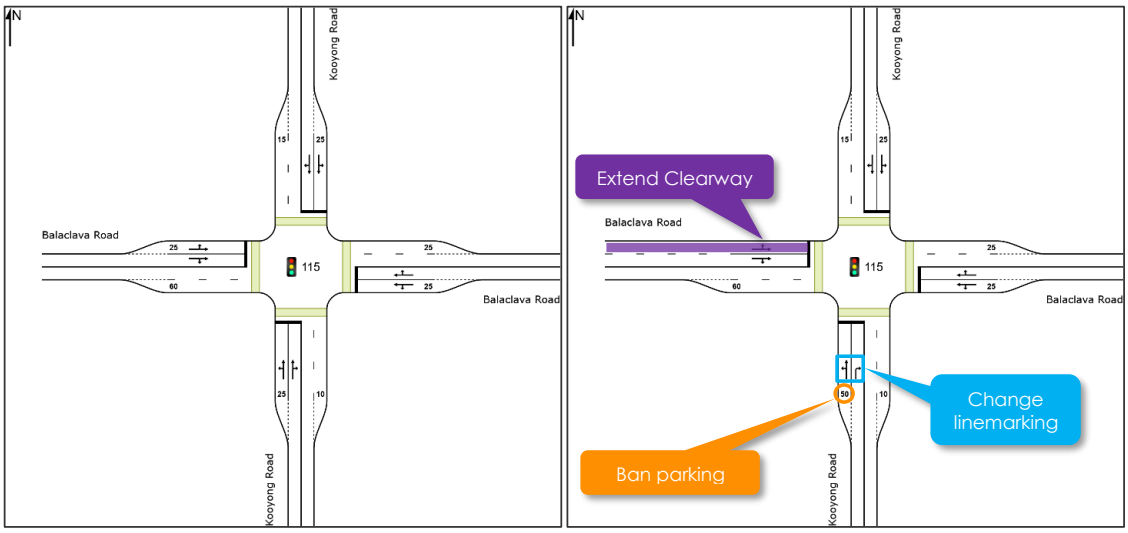
The Balaclava Road / Kooyong Road intersection will exceed capacity in all three of the weekday peak hours under Option 1 conditions, with the School Pick-Up Peak having a DoS of 1.44 in the south approach. The AM Commuter Peak, PM Commuter Peak and School Pick-Up Peak will have increased average delay across the entire intersection of 112, 50 and 130 seconds respectively.

Based on the above, the following changes are proposed to improve the operation of the Balaclava Road / Kooyong Road intersection in the School Pick-Up Peak Hour:

- Modify the inside lane on the south leg from a through & right turn lane to a to right turn lane only;
- Extend the parking ban on the kerbside lane of the southern leg to extend short lane to 50m:
  - Currently, No Stopping 4pm – 6pm.
  - Proposed, No Stopping 3pm – 6pm.
- Extend the clearway on the kerbside lane of the western leg between Kooyong Road and Orrong Road:
  - Currently, No Stopping 4pm – 6pm.
  - Proposed, No Stopping 3pm – 6pm.

A view of how these changes affect the intersection layout is shown in Figure 17 below.

Figure 17 Balaclava Road / Kooyong Road – Proposed Changes for Option 1



The result of the analysis, taking into consideration the above changes to the Balaclava Road / Kooyong Road intersection, is provided in Table 14 below. As shown, whilst the intersection will still operate above capacity, the impact has been reduced by the proposed changes. It should be noted that the changes have a very minor impact on the operation of the intersection during the other three peak hours.

For comparison; the AM Commuter Peak, PM Commuter Peak and School Pick-Up Peak will have increased average delay across the entire intersection of 109, 23 and 22 seconds respectively when compared against the design hour plus growth conditions – which represents an improvement of 108 seconds in the School Pick-Up Peak when compared with the existing layout of the Balaclava Road / Kooyong Road intersection (Table 13).

The full detailed results are attached in Appendix D, which provide the LoS, 95th percentile queues and average delays experienced by motorists for each movement at all intersections taking into consideration the proposed modifications to the Balaclava Road / Kooyong Road intersection.

Table 14 Balaclava Road Corridor SIDRA Analysis – Option 1 (with modifications)

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 1 (with mods)	Design Hr + Growth	Option 1 (with mods)	Design Hr + Growth	Option 1 (with mods)	Design Hr + Growth	Option 1 (with mods)
Balaclava Road Corridor									
Carlisle St / Chapel St	South	0.29	0.29	0.61	0.61	0.42	0.42	0.35	0.35
	East	0.36	0.35	0.72	0.72	0.67	0.67	0.63	0.63
	North	0.34	0.34	**0.91**	**0.91**	0.65	0.65	0.58	0.58
	West	0.31	0.31	0.89	0.89	0.61	0.61	0.55	0.55
Balaclava Rd / Hotham St	South	**0.92**	0.89	0.69	0.67	0.84	0.82	0.60	0.60
	East	0.89	0.84	**0.94**	**0.94**	0.83	0.88	0.60	0.60
	North	0.54	0.51	**0.95**	**0.95**	0.85	0.82	0.60	0.60
	West	0.57	0.60	0.77	0.76	0.59	0.61	0.41	0.41
Balaclava Rd / Orrong Rd	South	0.84	**1.02**	0.71	**0.91**	0.84	**1.10**	0.29	0.31
	East	0.83	**1.06**	0.53	0.68	0.53	0.69	0.34	0.46
	North	0.50	0.68	0.59	**1.01**	0.49	0.65	0.33	0.46
	West	0.67	0.80	0.69	**0.92**	0.85	**1.07**	0.32	0.43
Balaclava Rd / Kooyong Rd	South	0.89	**1.13**	0.65	**1.03**	0.81	0.87	0.38	0.87
	East	0.84	0.78	0.66	0.81	0.46	0.61	0.38	0.30
	North	0.80	**1.12**	0.73	**1.05**	0.85	**0.97**	0.43	0.81
	West	0.81	**1.13**	0.68	0.99	0.83	**1.00**	0.41	0.88
Balaclava Rd / Hawthorn Rd	South	0.67	0.45	0.63	0.85	0.55	**0.90**	0.48	0.78
	East	0.46	0.16	0.49	0.55	0.33	0.55	0.30	0.56
	North	0.60	0.30	0.80	**0.95**	0.76	**1.00**	0.50	0.69
	West	0.72	0.48	0.82	**0.94**	0.75	**1.13**	0.50	0.63
Balaclava Rd / Normanby Rd	South	0.23	0.29	0.17	0.23	0.14	0.20	0.22	0.29
	North	0.25	0.34	0.25	0.37	0.27	0.39	0.27	0.38
	West	0.26	0.36	0.25	0.37	0.27	0.39	0.27	0.37

Orange = approaching capacity
Red = exceeds capacity

7 OPTION 2 TRAFFIC CONDITIONS

7.1 Intersection Layouts

As previously outlined, Option 2 involves making Inkerman Road one-way eastbound only for vehicles between Orrong Road and Normanby Road, as shown in Figure 18 below.

Figure 18 Option 2

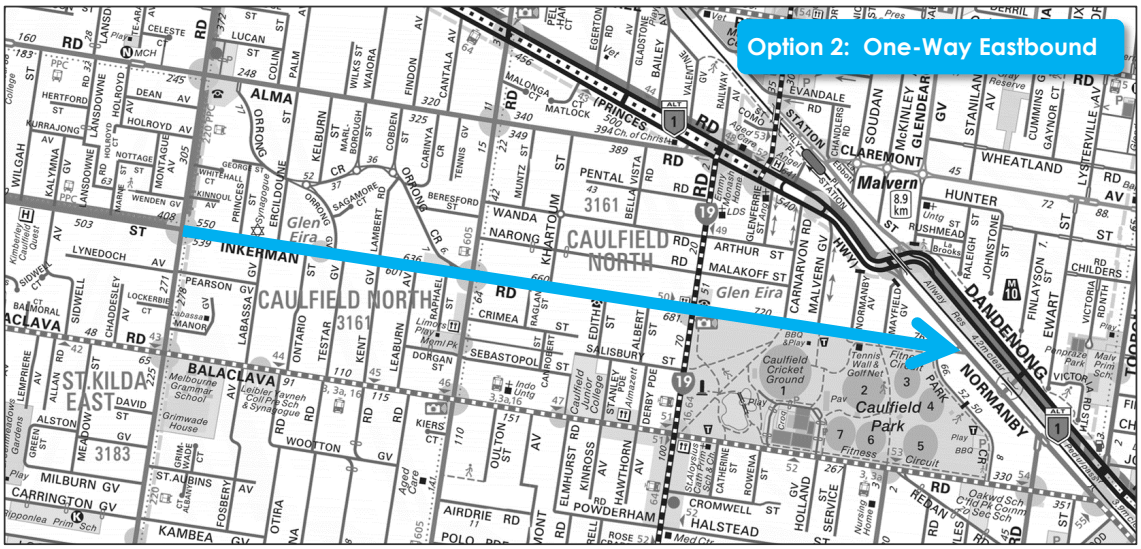

Option 2: One-Way Eastbound
INKERMAN
CAULFIELD NORTH
3161
CAULFIELD NORTH
3161
Glen Eira
Glen Eira
ST KILDA EAST
3183
BALACLAVA
ALMA
CAULFIELD
NORTH
3161
CLAREMONT
WHEATLAND
Malvern
HUNTER
RUSHMEAD
Caulfield Park
Caulfield Cricket Ground
DANDENONG
NORMANBY
HALSTEAD
POWDERHAM
ARTHUR ST
MALAKOFF ST
WANDA
NARONG
PENTAL
CRIMEA
SEBASTOPOL
DORGAN ST
WOOTTON
MILBURN GV
CARRINGTON GV
KAMBEA
AIRDRIE RD
POLO
CROMWELL ST
ROWENA ST
ELMHURST RD
KINROSS AV
HAWTHORN AV
OULTON ST
KIERS CT
LEABURN
RAPHAEL ST
LAMBERT RD
ORRONG
CR
ORRONG
ST
KELBURN
ST
MARLBOROUGH
ST
COBDEN
ST
CARINYA
CR
TENNIS
GV
BERESFORD
ST
SAGAMORE
CT
KHARTOUM
ST
BELLA VISTA
RD
MUNTZ
ST
CARNARVON RD
MALVERN GV
NORMANBY
AV
MAYFIELD
GV
STATION
RD
EVANDALE
RD
SOUDAN
RD
McKINLEY
GV
GLENDEAR
GV
STANILAND
AV
CUMMINS
GAYNOR CT
LYSTERVILLE AV
RD
HWY
M1
M10
8.9
km
RALEIGH
ST
JOHNSTONE
ST
FINLAYSON
ST
EWART
ST
VICTORIA
RD
NTH
CHILDERS
ST
AV
ST
RD
REDAN
ST
SERVICE
ST
HOLLAND
GV
ROSE
ST
LYNEDOCH
AV
SIDWELL
ST
CHADDESLEY
AV
LOCKERBIE
AV
PEARSON GV
LABASSA GV
ONTARIO
ST
TESTAR
ST
KENT
ST
LEMPRIERE
AV
ALLAN
RD
ALSTON
ST
MEADOW
GV
DAVID
ST
GREEN
ST
WADE
CT
GRIME
ST
ST.ALBANS
AV
FOSBERY
AV
OTIRA
NA
ALBERT
ST
EDITH
ST
RAGLAN
ST
CAMBRIDGE
ST
SALISBURY
ST
DERBY PDE
CATHERINE
ST
ALBERT
ST
ALMAZEET
ST
STANLEY
ST
PRINCES
ST
MATLOCK
CT
MALONGA
CT
EGERTON
RD
GLADSTONE
AV
BAILEY
AV
VALENTIA
RD
RAILWAY
AV
FINDON
AV
CANTALA
AV
WILKS ST
WAIORA
AV
LUCAN
ST
COLIN
ST
PALM
ST
CELESTE
CT
LANSDOWNE
RD
HERTFORD
ST
HOLROYD
AV
DEAN
AV
KURRAJONG
AV
NOTTAGE
ST
MONTAGUE
AV
WENDEN GV
WILGAH
AV
KALYMNA
AV
WHITEHALL
ST
KINNOUL
AV
PRINCES
ST
ERCILDOUNE
ST
BALMORAL
AV
CLAYLAVA
AV
Melbourne Grammar School
Grimwade House
Melbourne Hebrew Sch
Caulfield Junior College
Caulfield Cricket Ground
Caulfield Park
Fitness Circuit
Tennis Wall & Golf Mer
BBQ & Play
Play
Pav
Oakwd Sch
Child Pk Comm
Child Pk Sec Sch
Pandraze Park
Malv Prim Sch
Aged Care
Nursing Home
Med Ctr
Indo Unty
Untg
Brooks
Almazeet
Ch of Christ
Synagogue
Kadimah Coll Pk & Synagogue
Kelvin Grove
Glenferrie Hill
Glenferrie
Gardens
Memi Pk
Limes Park
Sch
Ch
Ch

Figure 19 Inkerman Road / Orrong Road – Option 2

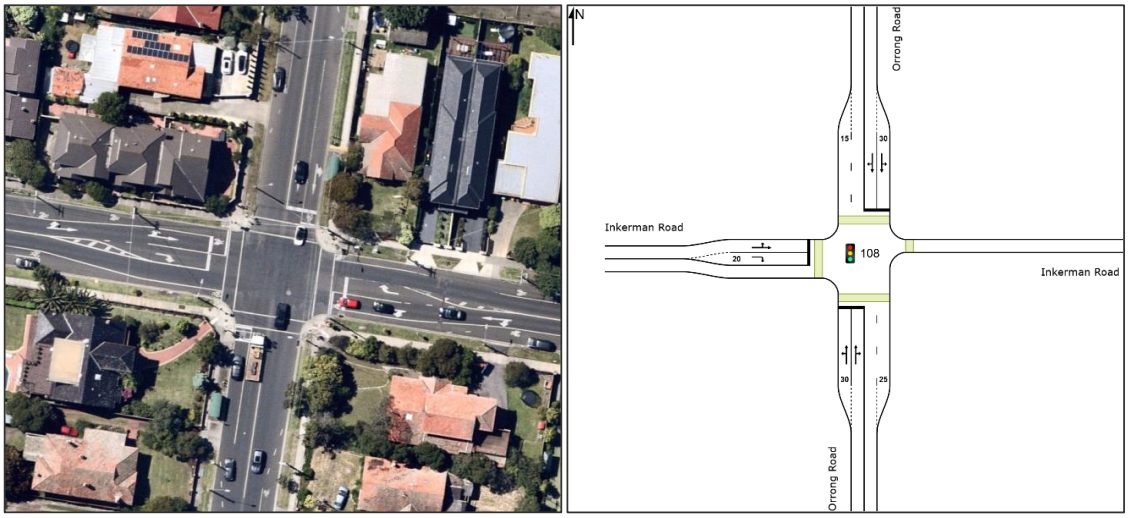


Figure 20 Inkerman Road / Kooyong Road – Option 2

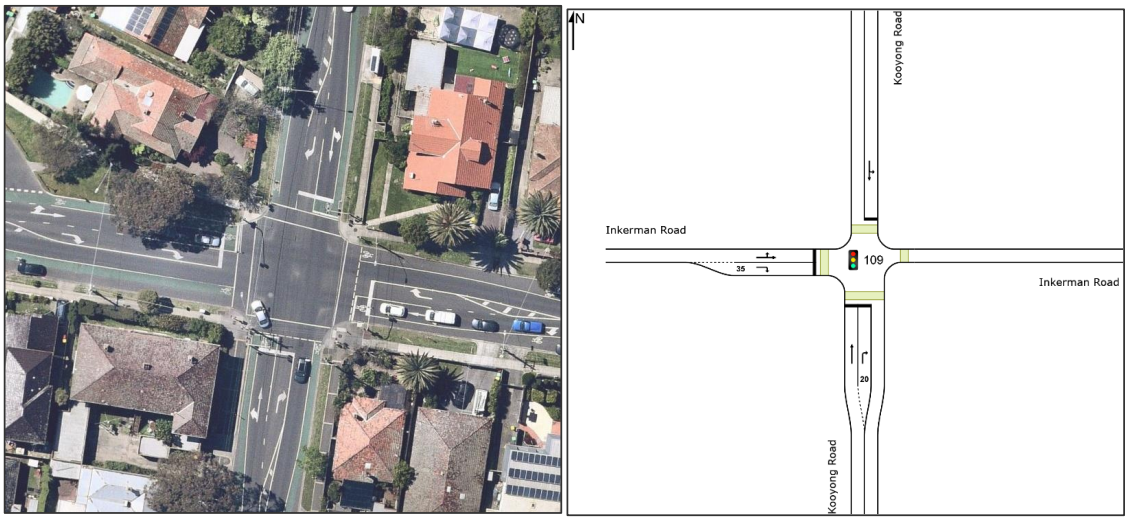


Figure 21 Inkerman Road / Hawthorn Road – Option 2

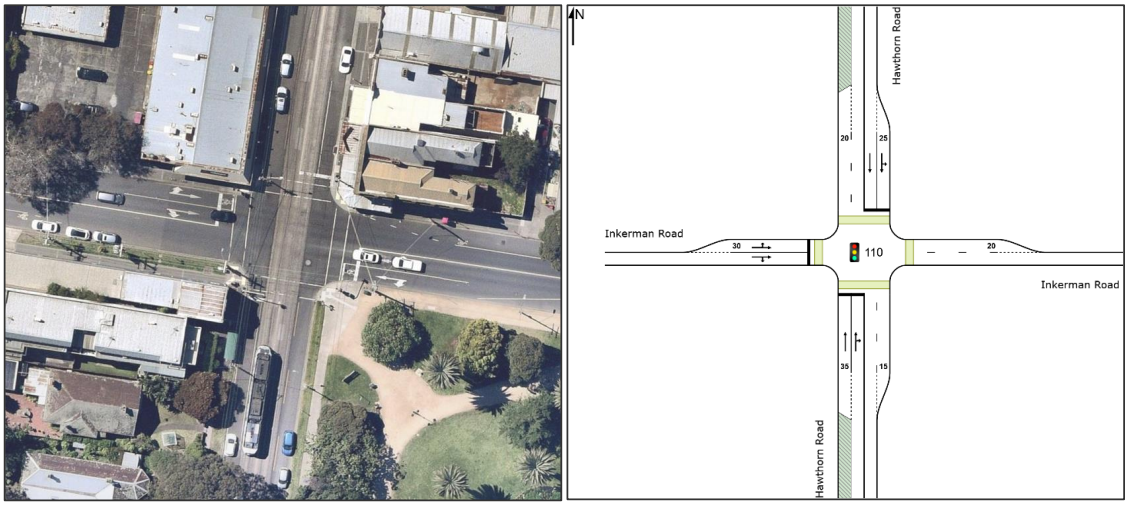
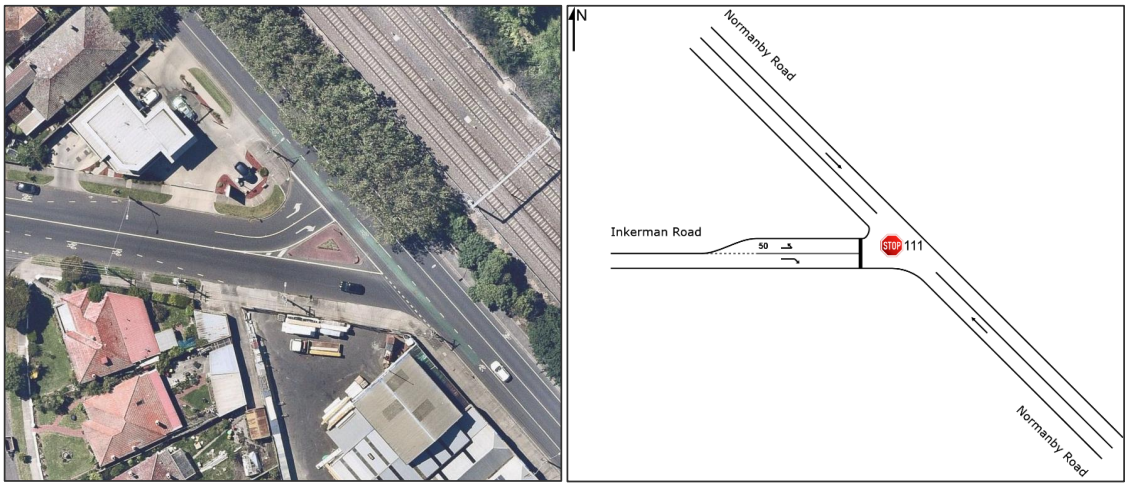


Figure 22 Inkerman Road / Normanby Road – Option 2



7.2 Intersection Impact

7.2.1 Degree of Saturation – All Intersections

Based on the Option 2 traffic redistribution and the changed intersection configurations outlined above, the traffic volumes have been input into SIDRA Intersection to determine the performance of the intersections under Option 2 conditions.

The DoS for each intersection, compared against the design hour plus growth conditions, is outlined in Table 15 – Table 17 below. The results show that a total of seven (7) intersections will exceed capacity during at least one of the peak hours under the Option 2 conditions.

Refer to full detailed results attached in Appendix E for the LoS, 95th percentile queues and average delays experienced by motorists for each movement at all intersections.

Table 15 Alma Road Corridor SIDRA Analysis – Option 2

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 2	Design Hr + Growth	Option 2	Design Hr + Growth	Option 2	Design Hr + Growth	Option 2
Alma Road Corridor									
Alma Rd / Chapel St	South	0.39	0.34	0.38	0.38	0.27	0.27	0.31	0.31
	East	0.49	0.43	0.47	0.46	0.41	0.41	0.37	0.37
	North	0.51	0.45	0.49	0.49	0.47	0.47	0.38	0.38
	West	0.26	0.29	0.46	0.46	0.45	0.45	0.30	0.30
Alma Rd / Hotham St	South	**1.02**	**0.99**	0.60	0.60	0.55	0.55	0.51	0.51
	East	**1.04**	**1.04**	0.88	0.87	0.59	0.59	0.55	0.55
	North	0.48	0.47	0.89	0.89	0.73	0.73	0.55	0.55
	West	0.77	0.78	0.77	0.77	0.70	0.70	0.40	0.40
Alma Rd / Orrong Rd	South	0.87	**0.96**	0.41	0.45	0.81	0.87	0.38	0.45
	East	**0.96**	**0.93**	0.88	**0.90**	0.85	**0.91**	0.63	0.72
	North	0.68	0.73	0.85	**0.92**	0.80	0.82	0.61	0.74
	West	0.62	0.44	0.77	0.85	0.82	0.78	0.38	0.35
Alma Rd / Kooyong Rd	South	0.77	0.80	0.70	0.72	0.61	0.65	0.60	0.63
	East	0.74	0.80	0.73	0.79	0.62	0.63	0.66	0.72
	North	0.71	0.78	**0.95**	**1.07**	0.78	0.85	0.68	0.72
	West	0.70	0.67	**0.94**	**1.02**	0.79	0.78	0.46	0.51

Orange = approaching capacity
Red = exceeds capacity

Table 16 Inkerman Road Corridor SIDRA Analysis – Option 2

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 2	Design Hr + Growth	Option 2	Design Hr + Growth	Option 2	Design Hr + Growth	Option 2
Inkerman Road Corridor									
Inkerman Rd / Chapel St	South	0.36	0.37	0.56	0.68	0.34	0.35	0.31	0.31
	East	0.45	0.47	0.71	0.79	0.49	0.49	0.44	0.44
	North	0.45	0.47	0.71	0.77	0.54	0.55	0.45	0.45
	West	0.38	0.37	0.61	0.71	0.53	0.53	0.45	0.45
Inkerman Rd / Hotham St	South	0.68	0.68	0.79	0.79	0.60	0.60	0.47	0.47
	East	0.43	0.49	0.35	0.34	0.32	0.32	0.29	0.29
	North	0.52	0.52	0.87	0.87	0.53	0.53	0.59	0.59
	West	0.67	0.68	0.83	0.81	0.62	0.63	0.62	0.62
Inkerman Rd / Orrong Rd	South	**1.14**	**1.06**	**0.97**	**1.08**	**1.10**	**1.09**	0.60	0.67
	East	**1.15**		**1.00**		0.86		0.65	
	North	**0.90**	0.88	**1.15**	**1.14**	**0.92**	0.89	0.75	0.74
	West	**0.95**	**1.07**	**1.12**	**1.16**	**1.07**	**1.07**	0.75	0.77
Inkerman Rd / Kooyong Rd	South	**0.92**	0.83	0.81	0.70	0.88	0.73	0.74	0.67
	East	**0.91**		0.89		0.54		0.60	
	North	**0.91**	0.81	**0.99**	0.88	**0.94**	0.84	0.73	0.68
	West	0.89	0.83	**1.00**	0.88	**0.94**	0.85	0.72	0.66
Inkerman Rd / Hawthorn Rd	South	0.60	0.44	0.54	0.40	0.68	0.50	0.40	0.33
	East	0.35		0.28		0.23		0.29	
	North	0.48	0.34	0.59	0.34	0.68	0.49	0.39	0.28
	West	0.62	0.44	0.58	0.40	0.67	0.52	0.41	0.33
Inkerman Rd / Normanby Rd	South	0.46	0.24	0.30	0.13	0.31	0.14	0.46	0.27
	North	0.14	0.12	0.20	0.20	0.20	0.19	0.27	0.24
	West	**1.04**	0.74	0.65	0.57	**0.99**	0.81	**1.24**	0.89

Orange = approaching capacity
Red = exceeds capacity
Black = leg removed as part of Safe Cycle Corridor option

Table 17 Balaclava Road Corridor SIDRA Analysis – Option 2

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 2	Design Hr + Growth	Option 2	Design Hr + Growth	Option 2	Design Hr + Growth	Option 2
Balaclava Road Corridor									
Carlisle St / Chapel St	South	0.29	0.29	0.61	0.61	0.42	0.42	0.35	0.35
	East	0.36	0.34	0.72	0.69	0.67	0.66	0.63	0.57
	North	0.34	0.34	**0.91**	**0.91**	0.65	0.65	0.58	0.58
	West	0.31	0.31	0.89	0.89	0.61	0.61	0.55	0.55
Balaclava Rd / Hotham St	South	**0.92**	0.89	0.69	0.66	0.84	0.84	0.60	0.56
	East	0.89	0.84	**0.94**	**0.90**	0.83	0.85	0.60	0.59
	North	0.54	0.59	**0.95**	**1.00**	0.85	0.85	0.60	0.56
	West	0.57	0.60	0.77	0.76	0.59	0.59	0.41	0.46
Balaclava Rd / Orrong Rd	South	0.84	**1.11**	0.71	**1.08**	0.84	**1.12**	0.29	0.67
	East	0.83	**0.94**	0.53	**1.03**	0.53	**0.91**	0.34	0.51
	North	0.50	**0.93**	0.59	**1.19**	0.49	**0.97**	0.33	0.59
	West	0.67	**1.12**	0.69	**1.15**	0.85	**1.15**	0.32	0.65
Balaclava Rd / Kooyong Rd	South	0.89	**1.13**	0.65	**0.96**	0.81	**0.93**	0.38	0.62
	East	0.84	**1.10**	0.66	**1.01**	0.46	**0.91**	0.38	0.69
	North	0.80	**1.01**	0.73	**1.07**	0.85	**0.95**	0.43	0.67
	West	0.81	**1.10**	0.68	0.86	0.83	0.76	0.41	0.33
Balaclava Rd / Hawthorn Rd	South	0.67	0.87	0.63	**1.10**	0.55	0.89	0.48	0.79
	East	0.46	0.70	0.49	**1.12**	0.33	0.69	0.30	0.67
	North	0.60	0.77	0.80	**1.18**	0.76	**1.04**	0.50	0.75
	West	0.72	0.88	0.82	0.86	0.75	**0.98**	0.50	0.77
Balaclava Rd / Normanby Rd	South	0.23	0.15	0.17	0.15	0.14	0.11	0.22	0.17
	North	0.25	0.53	0.25	0.58	0.27	0.43	0.27	0.50
	West	0.26	0.53	0.25	0.55	0.27	0.42	0.27	0.47

Orange = approaching capacity
Red = exceeds capacity

7.2.2 Key Intersection Results

Similar to Option 1, the one-way arrangement of Inkerman Road between Orrong Road and Normanby Road has reduced traffic movements at the intersections along Inkerman Road for this stretch and has therefore improved the performance of those intersections. However, those traffic movements have been redistributed to the intersections along Alma Road and Balaclava Road and therefore have results in increased turning movements at a number of peripheral intersections to Inkerman Road.

A summary of the impact that the Option 2 conditions will have on average delays on particular legs and/or intersections as a whole at the key intersections identified in the above results is provided in the following sections.

7.2.2.1 Balaclava Road / Orrong Road

The Balaclava Road / Orrong Road intersection will exceed capacity in all three of the weekday peak hours under Option 2 conditions. The AM Commuter Peak, PM Commuter Peak and School Pick-Up Peak will have increased average delay across the entire intersection of 36, 77 and 47 seconds respectively.

7.2.2.2 Balaclava Road / Kooyong Road

The Balaclava Road / Kooyong Road intersection will either approach or exceed capacity in all three of the weekday peak hours under Option 2 conditions. The AM Commuter Peak, PM Commuter Peak and School Pick-Up Peak will have increased average delay across the entire intersection of 105, 59 and 15 seconds respectively.

7.2.2.3 Balaclava Road / Hawthorn Road

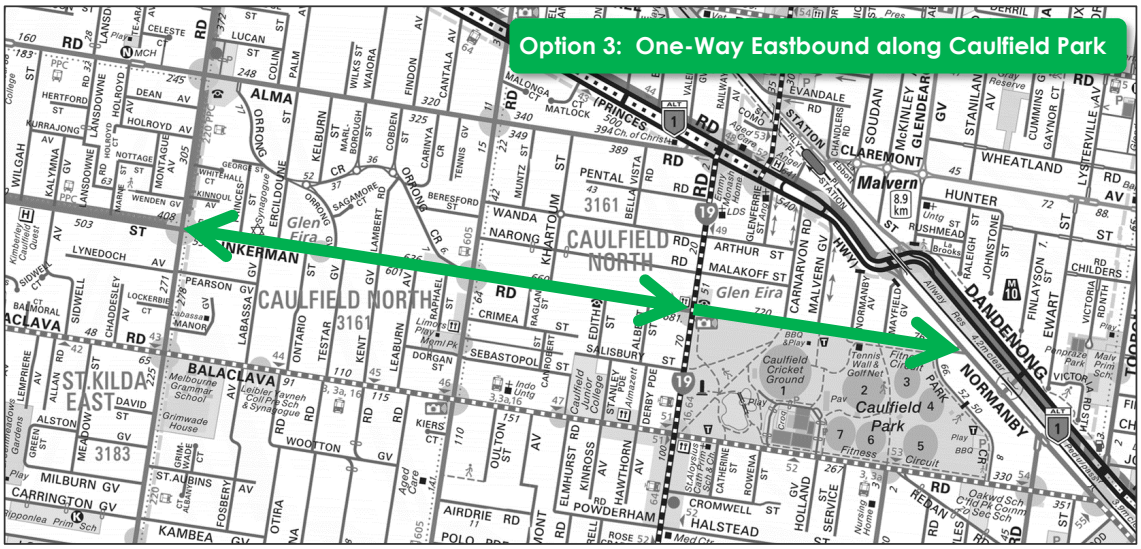
The Balaclava Road / Hawthorn Road intersection will experience an 82 second increase under the Option 2 conditions in the PM Commuter Peak Hour.

8 OPTION 3 TRAFFIC CONDITIONS

8.1 Intersection Layouts

As previously outlined, Option 3 involves making Inkerman Road one-way eastbound only for vehicles between Hawthorn Road and Normanby Road (along Caulfield Park) and maintaining two-way traffic movement along the rest of Inkerman Road, as shown in Figure 23 below.

Figure 23 Option 3



As a result of the one-way arrangement of Inkerman Road, several layout changes are required at the Inkerman Road intersections with Hawthorn Road and Normanby Road. The details of which are outlined below and shown in Figure 24 – Figure 25, with the existing intersection layout shown on the left and the proposed future layout shown on the right:

- Inkerman Road / Hawthorn Road:
  - Remove westbound lanes on both east and west leg;
  - Remove linemarking permitting westbound turns into Inkerman Road; and
  - Adjust phasing to suit new intersection (if required).
- Inkerman Road / Normanby Road:
  - Remove westbound lane on west leg.

Figure 24 Inkerman Road / Hawthorn Road – Option 3

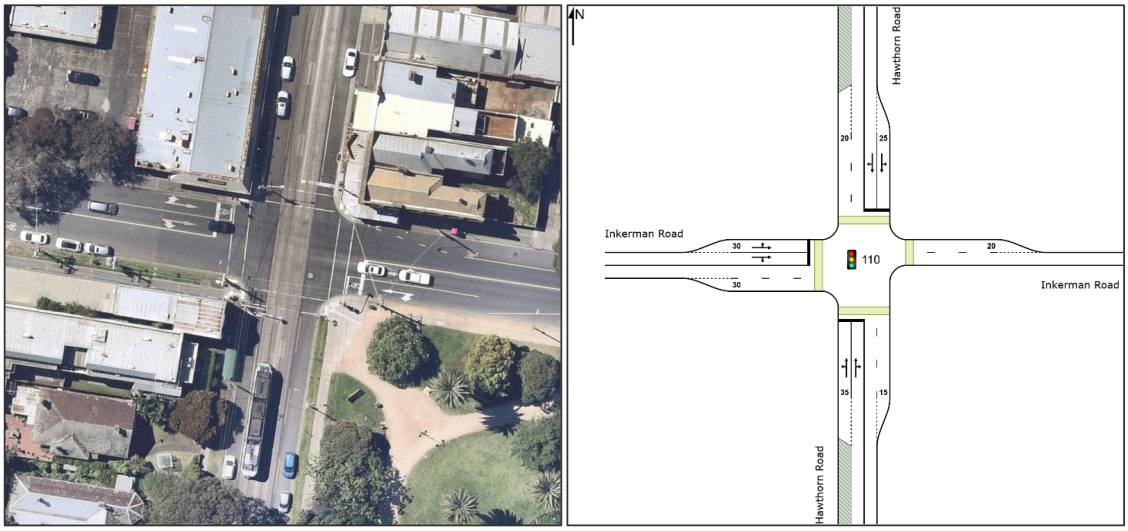
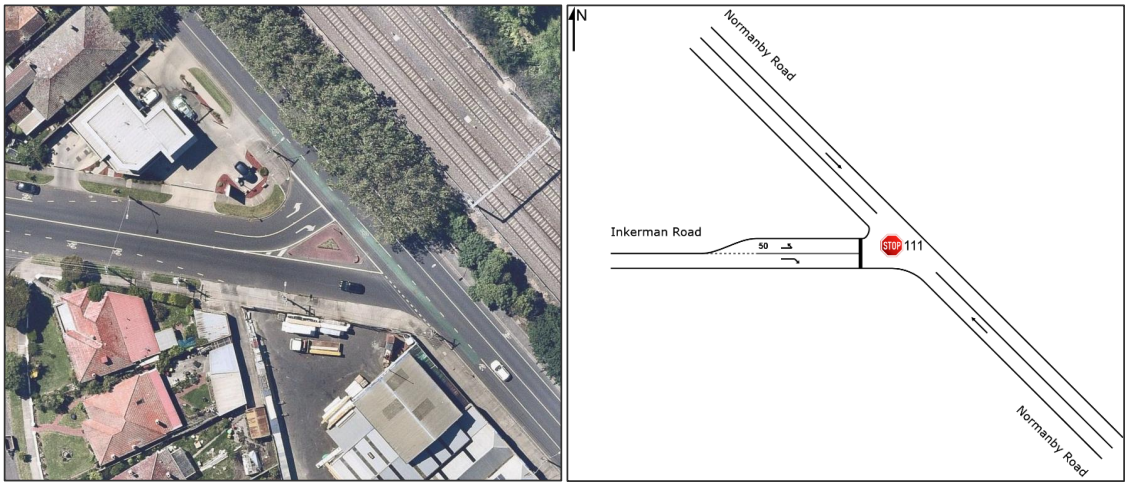


Figure 25 Inkerman Road / Normanby Road – Option 3



8.2 Intersection Impact

8.2.1 Degree of Saturation – All Intersections

Based on the Option 3 traffic redistribution and the changed intersection configurations outlined above, the traffic volumes have been input into SIDRA Intersection to determine the performance of the intersections under Option 3 conditions.

The DoS for each intersection, compared against the design hour plus growth conditions, is outlined in Table 18 – Table 20 below. The results show that a total of three (3) intersections will exceed capacity during at least one of the peak hours under the Option 3 conditions.

Refer to full detailed results attached in Appendix F for the LoS, 95th percentile queues and average delays experienced by motorists for each movement at all intersections.

Table 18 Alma Road Corridor SIDRA Analysis – Option 3

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 3	Design Hr + Growth	Option 3	Design Hr + Growth	Option 3	Design Hr + Growth	Option 3
Alma Road Corridor									
Alma Rd / Chapel St	South	0.39	0.34	0.38	0.38	0.27	0.27	0.31	0.31
	East	0.49	0.43	0.47	0.47	0.41	0.41	0.37	0.37
	North	0.51	0.45	0.49	0.49	0.47	0.47	0.38	0.38
	West	0.26	0.29	0.46	0.46	0.45	0.45	0.30	0.30
Alma Rd / Hotham St	South	**1.02**	**1.02**	0.60	0.60	0.55	0.55	0.51	0.51
	East	**1.04**	**1.04**	0.88	0.88	0.59	0.59	0.55	0.55
	North	0.48	0.48	0.89	0.89	0.73	0.73	0.55	0.55
	West	0.77	0.78	0.77	0.77	0.70	0.70	0.40	0.40
Alma Rd / Orrong Rd	South	0.87	0.87	0.41	0.41	0.81	0.81	0.38	0.38
	East	**0.96**	**0.96**	0.88	0.88	0.85	0.85	0.63	0.63
	North	0.68	0.68	0.85	0.85	0.80	0.80	0.61	0.61
	West	0.62	0.57	0.77	0.77	0.82	0.82	0.38	0.38
Alma Rd / Kooyong Rd	South	0.77	0.77	0.70	0.70	0.61	0.61	0.60	0.60
	East	0.74	0.74	0.73	0.73	0.62	0.62	0.66	0.66
	North	0.71	0.71	**0.95**	**0.95**	0.78	0.78	0.68	0.68
	West	0.70	0.70	**0.94**	**0.94**	0.79	0.79	0.46	0.46

Orange = approaching capacity
Red = exceeds capacity

Table 19 Inkerman Road Corridor SIDRA Analysis – Option 3

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 3	Design Hr + Growth	Option 3	Design Hr + Growth	Option 3	Design Hr + Growth	Option 3
Inkerman Road Corridor									
Inkerman Rd / Chapel St	South	0.36	0.36	0.56	0.69	0.34	0.34	0.31	0.31
	East	0.45	0.45	0.71	0.75	0.49	0.49	0.44	0.44
	North	0.45	0.45	0.71	0.77	0.54	0.54	0.45	0.45
	West	0.38	0.38	0.61	0.68	0.53	0.53	0.45	0.45
Inkerman Rd / Hotham St	South	0.68	0.68	0.79	0.75	0.60	0.60	0.47	0.47
	East	0.43	0.41	0.35	0.34	0.32	0.31	0.29	0.28
	North	0.52	0.52	0.87	0.84	0.53	0.53	0.59	0.59
	West	0.67	0.66	0.83	0.84	0.62	0.62	0.62	0.62
Inkerman Rd / Orrong Rd	South	**1.14**	**1.08**	**0.97**	**0.97**	**1.10**	**1.10**	0.60	0.60
	East	**1.15**	**1.16**	**1.00**	**0.92**	0.86	0.82	0.65	0.76
	North	**0.90**	0.80	**1.15**	**1.15**	**0.92**	**0.92**	0.75	0.75
	West	**0.95**	**1.02**	**1.12**	**1.12**	**1.07**	**1.07**	0.75	0.75
Inkerman Rd / Kooyong Rd	South	**0.92**	**0.92**	0.81	0.81	0.88	0.88	0.74	0.74
	East	**0.91**	0.80	0.89	0.77	0.54	0.43	0.60	0.50
	North	**0.91**	**0.91**	**0.99**	**0.99**	**0.94**	**0.94**	0.73	0.73
	West	0.89	**0.93**	**1.00**	**0.97**	**0.94**	**0.93**	0.72	0.72
Inkerman Rd / Hawthorn Rd	South	0.60	0.81	0.54	0.71	0.68	0.75	0.40	0.47
	East	0.35		0.28		0.23		0.29	
	North	0.48	0.37	0.59	0.38	0.68	0.44	0.39	0.31
	West	0.62	0.75	0.58	0.70	0.67	0.75	0.41	0.47
Inkerman Rd / Normanby Rd	South	0.46	0.24	0.30	0.13	0.31	0.14	0.46	0.27
	North	0.14	0.12	0.20	0.20	0.20	0.19	0.27	0.24
	West	**1.04**	0.76	0.65	0.58	**0.99**	0.81	**1.24**	0.89

Orange = approaching capacity
Red = exceeds capacity
Black = leg removed as part of Safe Cycle Corridor option

Table 20 Balaclava Road Corridor SIDRA Analysis – Option 3

Intersection	Approach	Degree of Saturation (DoS)							
		AM Commuter		PM Commuter		School Pick-Up		Saturday	
		Design Hr + Growth	Option 3	Design Hr + Growth	Option 3	Design Hr + Growth	Option 3	Design Hr + Growth	Option 3
Balaclava Road Corridor									
Carlisle St / Chapel St	South	0.29	0.29	0.61	0.61	0.42	0.42	0.35	0.35
	East	0.36	0.36	0.72	0.72	0.67	0.67	0.63	0.63
	North	0.34	0.34	**0.91**	**0.91**	0.65	0.65	0.58	0.58
	West	0.31	0.31	0.89	0.89	0.61	0.61	0.55	0.55
Balaclava Rd / Hotham St	South	**0.92**	**0.92**	0.69	0.69	0.84	0.87	0.60	0.60
	East	0.89	**0.92**	**0.94**	**0.95**	0.83	0.82	0.60	0.62
	North	0.54	0.58	**0.95**	**0.95**	0.85	0.87	0.60	0.58
	West	0.57	0.58	0.77	0.75	0.59	0.58	0.41	0.42
Balaclava Rd / Orrong Rd	South	0.84	0.88	0.71	0.72	0.84	0.85	0.29	0.30
	East	0.83	0.89	0.53	0.63	0.53	0.55	0.34	0.34
	North	0.50	0.51	0.59	0.58	0.49	0.49	0.33	0.34
	West	0.67	0.68	0.69	0.71	0.85	0.83	0.32	0.30
Balaclava Rd / Kooyong Rd	South	0.89	**1.05**	0.65	0.77	0.81	**0.92**	0.38	0.41
	East	0.84	**1.01**	0.66	0.80	0.46	0.52	0.38	0.44
	North	0.80	**0.92**	0.73	0.83	0.85	**0.92**	0.43	0.43
	West	0.81	0.84	0.68	0.68	0.83	0.89	0.41	0.40
Balaclava Rd / Hawthorn Rd	South	0.67	**0.91**	0.63	0.78	0.55	**0.92**	0.48	0.76
	East	0.46	0.77	0.49	**1.13**	0.33	0.74	0.30	0.72
	North	0.60	0.76	0.80	**0.90**	0.76	**1.03**	0.50	0.66
	West	0.72	**0.90**	0.82	**0.96**	0.75	**1.04**	0.50	0.80
Balaclava Rd / Normanby Rd	South	0.23	0.15	0.17	0.15	0.14	0.11	0.22	0.17
	North	0.25	0.54	0.25	0.58	0.27	0.43	0.27	0.50
	West	0.26	0.53	0.25	0.59	0.27	0.42	0.27	0.47

Orange = approaching capacity
Red = exceeds capacity

8.2.2 Key Intersection Results

Option 3 conditions results in the least impact on the road network due to the reduced length of the one-way section of Inkerman Road. Particularly noteworthy is that under Option 3 conditions there will be minimal discernible difference to the operation of the Alma Road Corridor, with the eastern end of Balaclava Road experience the majority of redistricted traffic volumes and therefore experiencing the greatest impact.

Whilst the Inkerman Road intersections with Orrong Road and Kooyong Road will approach/exceed capacity, the change is fairly minor from the baseline traffic conditions of the design hour plus growth conditions. It can therefore be determined the performance of these intersections is unlikely to be significantly impacted by the Option 3 road network layout.

A summary of the impact that the Option 3 conditions will have on average delays on particular legs and/or intersections as a whole at the key intersections identified in the above results is provided in the following sections.

8.2.2.1 Balaclava Road / Kooyong Road

The Balaclava Road / Kooyong Road intersection will either approach or exceed capacity in the AM Commuter Peak and School Pick-Up Peak hours under Option 3 conditions, with an expected increased average delay across the entire intersection of 12 and 4 seconds respectively.

8.2.2.2 Balaclava Road / Hawthorn Road

The Balaclava Road / Hawthorn Road intersection will either approach or exceed capacity in all three of the weekday peak hours under Option 3 conditions. The AM Commuter Peak, PM Commuter Peak and School Pick-Up Peak will have increased average delay across the entire intersection of 6, 31 and 25 seconds respectively.

8.2.2.3 Balaclava Road / Normanby Road

As mentioned, the vehicles that currently access Inkerman Road from Normanby Road have been distributed to Balaclava Road to enter the road network. As such, the vehicle movements at this intersection will increase but as shown in the results, is still expected to operate within capacity during all peak hours – with the largest increase in average delay expected along the western leg (Balaclava Road leg) during the PM Commuter Peak with an increase of 20 seconds.

9 TRAM IMPACT – BALACLAVA ROAD

As previously outlined in Section 4, the one-way arrangement of Inkerman Road will result in a number of vehicles being redistributed across alternative east-west road in order to complete their journey through the road network – including along Balaclava Road. Balaclava Road currently services two tram routes:

- Route 16: Melbourne University – Kew via St. Kilda Beach
- Route 3/3a: Melbourne University – East Malvern

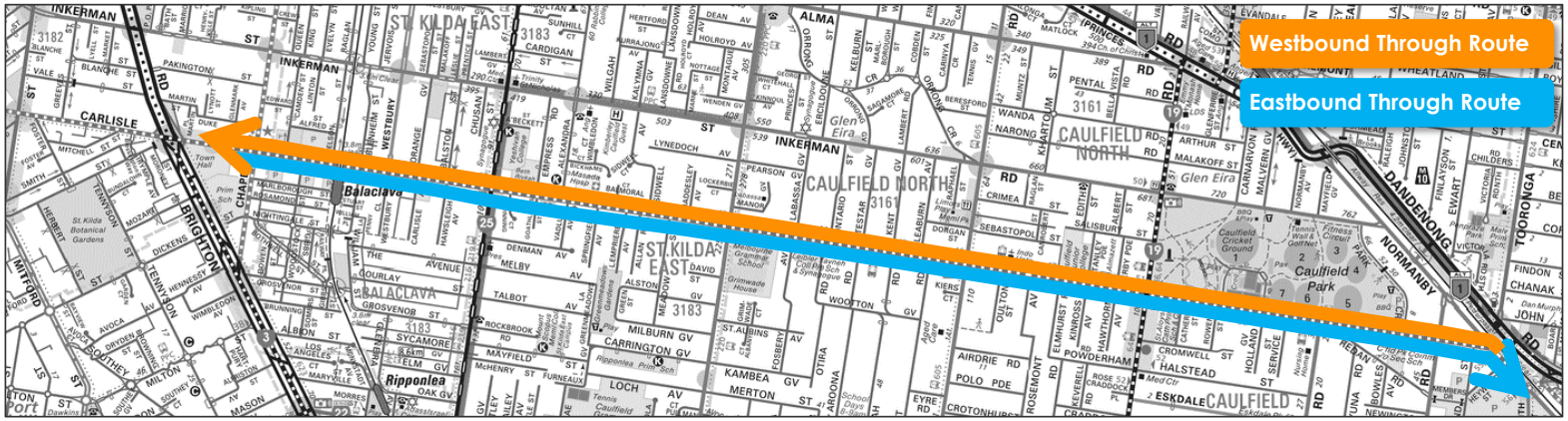
The SIDRA Intersection software package used to model the existing and potential future intersection performances has been developed to provide information on the capacity of an intersection, or a linked network of intersections, with regard to a number of parameters. SIDRA has been utilised to determine the travel time for a vehicle traveling through the network along Balaclava Road in both the westbound (from Normanby Road in the east, to Chapel Street in the west) and eastbound (from Chapel Street in the west, to Normanby Road in the east) directions. The average travel times of the through routes under design hour plus growth conditions have been compared against the average travel time under the conditions for each Safe Cycle Corridor option to better understand the impact the proposed works on Inkerman Road will have on tram operations along Balaclava Road.

It should be noted that due to the limitations of the SIDRA modelling software, the through route movements cannot be limited to just the lane in which the tram travels along. Therefore, travel times may not perfectly represent the actual travel time a tram experiences as cars can change lanes if a right turning vehicle is waiting for a gap in the opposing traffic flow in order to turn where a tram cannot. Regardless, the analysis determines the increased travel time a vehicle experiences under the future conditions compared with the existing conditions which is considered to be an accurate representation of the impact the redistributed traffic movement have on Balaclava Road, including through tram movements.

It is also worth noting that trams have specific detectors and green window extensions at the intersections, which assist in clearing right turning vehicles to ensure trams can continue along Balaclava Road. This may assist in reducing tram delays, but does not take away from the impact analysis undertaken below.

An example of the westbound and eastbound through routes along Balaclava Road analysed in SIDRA is shown in Figure 26 and Table 21 respectively.

Figure 26 Westbound & Eastbound Through Route along Balaclava Road



The average travel time of the routes shown above for the design hour plus growth conditions compared against the proposed option conditions is detailed in Table 21 below. It should be noted that all travel times shown below are in seconds.

Table 21 Tram Impact Analysis

Peak Hour	*Design Hr + Growth (secs)*	*Option 1 (secs)*		*Option 2 (secs)*		*Option 3 (secs)*	
Westbound Route (seconds)							
AM Commuter Peak	462	445	- 17	561	+ 99	471	+ 9
PM Commuter Peak	469	465	- 4	607	+ 138	464	- 5
School Pick-Up Peak	444	452	+ 8	447	+ 3	439	- 5
Saturday Peak	452	457	+ 5	422	- 30	442	- 10
Eastbound Road (seconds)							
AM Commuter Peak	480	626	+ 146	713	+ 233	500	+ 20
PM Commuter Peak	493	543	+ 50	604	+ 111	527	+ 34
School Pick-Up Peak	481	652	+ 171	610	+ 129	535	+ 54
Saturday Peak	490	463	- 27	516	+ 26	502	+ 12

As shown above, both Option 1 and Option 2 result in significant increases to the average travel time along Balaclava Road between Normanby Road and Chapel Street. Option 1 will increase the travel time in the eastbound direction by almost 3 minutes during the School Pick-Up Peak whereas Option 2 will increase the travel time in the eastbound direction by almost 4 minutes in the AM Commuter Peak.

Option 3 will have the least impact on tram travel times along Balaclava Road, with a maximum delay to through movements coming in the School Pick-Up Peak when the eastbound through route will increase by 54 seconds.

10 NORMANBY ROAD UNDERPASS & KAMBROOK ROAD

Consideration should also be given to the wider road impact of making Inkerman Road one-way between Orrong Road and Normanby Road. In particular, it is understood through anecdotal commentary from Council as well as the OD survey results that the central median break along Dandenong Road at the Normanby Road underpass of the train line (between Inkerman Road and Balaclava Road) is heavily utilised by motorists to cross Dandenong Road and access Tooronga Road.

Under all three options explored, Inkerman Road will be one-way at the Normanby Road intersection. This is expected to redistribute one direction of traffic to Balaclava Road to travel east or west, with the shortest distance to achieve this coming via Kambrook Road. Kambrook Road forms an unsignalised T-intersection with Normanby Road and a signalised cross intersection with Balaclava Road and was not surveyed as part of this analysis.

Whilst neither the Normanby Road underpass nor Kambrook Road were included within the scope of this investigation, further investigation will likely be required to understand the impacts a preferred option will have on the operation of both. In regard to Kambrook Road, it is anticipated that turn bans or local access only arrangements may be required to restrict access to/from Normanby Road to prohibit vehicles rat-running to access Balaclava Road. This may also encourage the use of the signalised intersection at Dandenong Road and Smith Street to the south to access Tooronga Road in lieu of the Normanby Road underpass.

A view of the existing and potential future Tooronga Road access routes across Dandenong Road are shown in Figure 27 below.

Figure 27 Tooronga Road Access



11 SUMMARY & RECOMMENDATIONS

The traffic analysis revealed that when factoring up the survey intersection volumes based on the design hour adjustment factor and 10 years' worth of traffic growth in the area, all intersections will experience increased traffic movements in the peak hours which will in turn will impact performance (degree of saturation, queues, delays, level of service, etc.). Several of the intersections across the network approach or exceed capacity in some of the peak hours, whilst the Inkerman Road / Orrong Road intersection, that is already operating close to capacity in the existing conditions analysis, will exceed capacity during all three of the weekday peak hours under the design hour plus growth conditions.

The future traffic growth rate adopted was derived directly from the projected population growth and does not take into account any change in travel mode, such as increased use of public or active transport or reduced trips due to working from arrangements, for existing or new residents in the area from the current conditions. As such, it is considered to be a conservative analysis and represents the worst case scenario in regard to future traffic growth.

A summary of the maximum degree of saturation results from the SIDRA Intersection analysis for each intersection during the four peak hours is provided in Table 22 and illustrated in Figure 28 – Figure 32. The following colours represent that following degree of saturation range of an intersection during its busiest peak hour:

- **Green** = up to 0.89;
- **Orange** = between 0.9 and 0.99; and
- **Red** = at or above 1.0.

Table 22 Summary of DoS Results

Intersection	*Max. Degree of Saturation (any peak hour)*				
	Existing Conditions	*Design Hr + Growth*	*Option 1*	*Option 2*	*Option 3*
Alma Road Corridor					
Alma Rd / Chapel St					
Alma Rd / Hotham St					
Alma Rd / Orrong Rd					
Alma Rd / Kooyong Rd					
Inkerman Road Corridor					
Inkerman Rd / Chapel St					
Inkerman Rd / Hotham St					
Inkerman Rd / Orrong Rd					
Inkerman Rd / Kooyong Rd					
Inkerman Rd / Hawthorn Rd					
Inkerman Rd / Normanby Rd					
Balaclava Road Corridor					
Carlisle St / Chapel St					
Balaclava Rd / Hotham St					
Balaclava Rd / Orrong Rd					
Balaclava Rd / Kooyong Rd					
Balaclava Rd / Hawthorn Rd					
Balaclava Rd / Normanby Rd					

Figure 28 Intersection Performance Results – Existing Conditions



Figure 29 Intersection Performance Results – Design Hour + Growth Conditions



Figure 30 Intersection Performance Results – Option 1 Conditions



Figure 31 Intersection Performance Results – Option 2 Conditions

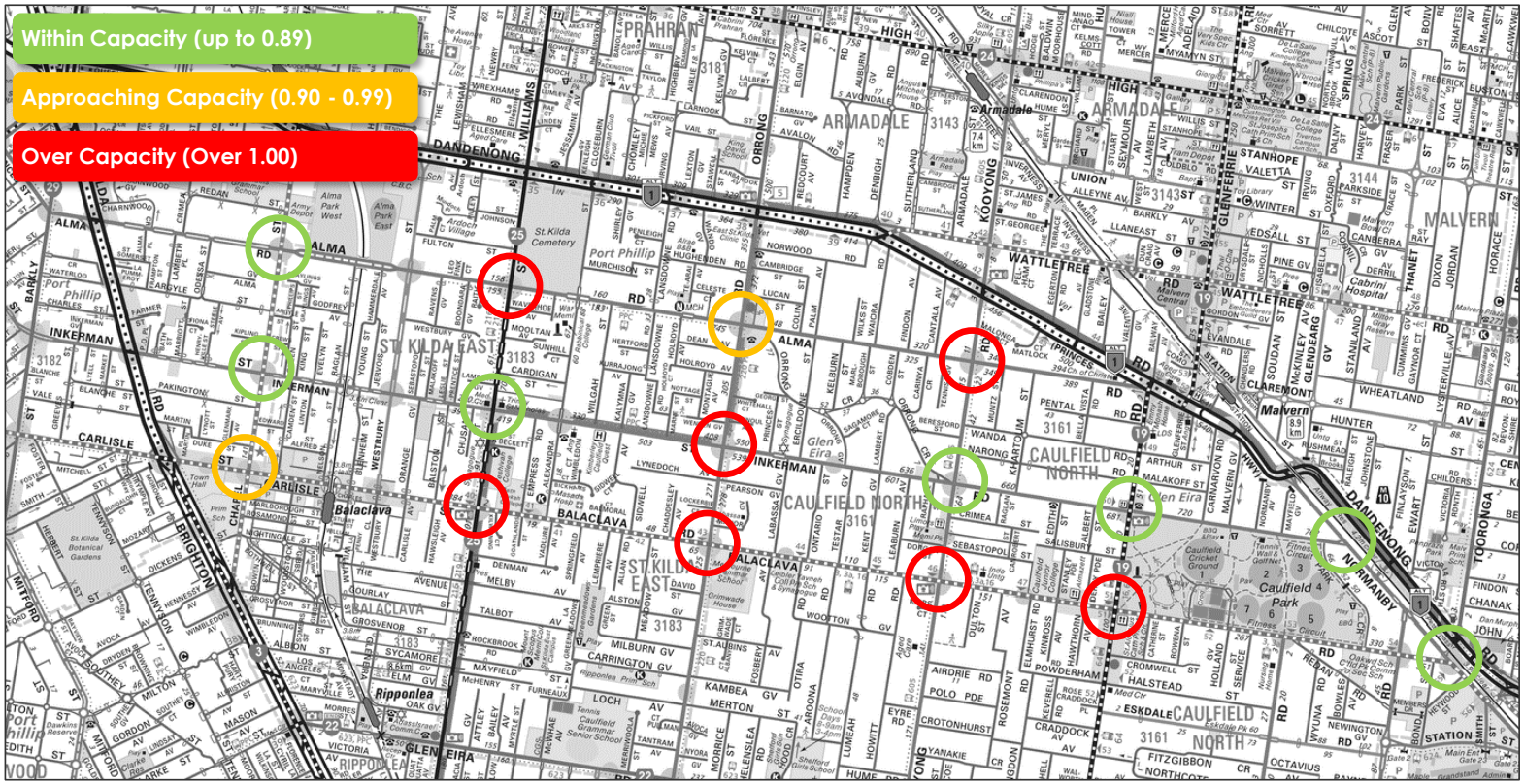


Figure 32 Intersection Performance Results – Option 3 Conditions



Additionally, a summary of some key notes of the three options is outlined in Table 23 below.

Table 23 Safe Cycle Options Summary

Option	*Length of One-Way Road*	*No. Intersections Reconfigured*	*No. Intersections over capacity*	*Max. Tram Delay*
Option 1	2.2 km	5*	6	171 seconds
Option 2	2.2 km	4	7	233 seconds
Option 3	750 m	2	4	54 seconds

**Including minor changes to Balaclava Road / Kooyong Road intersection.*

When looking at the intersection performances under Option 1 & 2 conditions, there are many similarities with the number and specific intersections that exceed capacity during the four peak hours investigated. The design hour plus growth conditions that were used as a baseline for the analysis was a major contributor to the high level of traffic, but the road network changes and traffic redistribution under Option 1 & 2 conditions did increase the total number of intersections that exceeded capacity during at least one of the peak hours. The impact that both Option 1 & 2 will have on travel times along Balaclava Road, and thus the travel times of tram routes along Balaclava Road, make these options undesirable and are not expected to be supported by Yarra Trams or DoT. Regardless, when comparing the two options it is considered that Option 1 is the preferred of the two as it has a lesser impact on the operation of Balaclava Road and therefore a lesser impact on tram routes 16 & 3/3a.

Option 3 presents the least disruption to a road network that is expected to experience growth into the future and has the least impact on the operation of the tram routes along Balaclava Road when compared against the other options. Option 3 is considered viable as it does not result in additional intersections within the network exceeding capacity when compared with the design hour plus growth conditions and contains the impact to one end of the Inkerman Road Corridor.

Based on the above investigation analysis and results, it is recommended that Option 3 – being Inkerman Road one-way eastbound between Hawthorn Road and Normanby Road (along Caulfield Park) – is adopted as the preferred option to consider further for the Inkerman Road Safe Cycle Corridor.

It should be noted that whilst altering Option 3 to have Inkerman Road be one-way westbound could be explored, it is expected to displace a greater number of existing vehicle movements during the School Pick-Up Peak and therefore will likely have a greater impact to the surrounding road network during this period. As such, Option 3 with Inkerman Road being one-way eastbound is recommended.


Inkerman Road
Safe Cycling Corridor Plan: Stage 1 Report
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1. Context

An outline of the project context and timeline for preparation of the Corridor Plan.

ARUP

Context

ARUP

Project Context

Introduction

In December 2019 the Glen Eira City Council (GECC) identified Inkerman Road as the a Pilot for the City's first Safe Cycling Corridor. Arup has been engaged to provide an independent evaluation of the potential design options for Inkerman Road and to develop a Corridor Plan, in response to point No. 8 of the Council's resolution on December 17th, 2019.

"[The Council] will receive a further report at the conclusion of the development of the Corridor Plan. Such report will contain details of a functional layout, indicative costings, and outline how community concerns have been able to be addressed through the design process. No construction will occur without a further resolution of the Council;"

– Glen Eira City Council Resolution, December 17 2019

The identification of options for Inkerman Road has been established as part of its identification through the previous Corridor Assessment prepared by the Glen Eira City Council (GECC). The other route options from that report are no longer being considered.

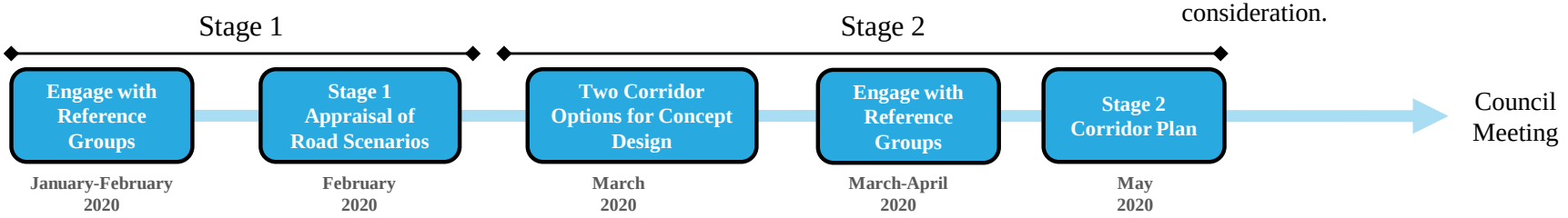


Source: Glen Eira City Council

Scope of this Report

Arup were engaged in January 2020 by the Glen Eira City Council to develop a Corridor Plan for a Safe Cycling Corridor on Inkerman Road.

The purpose of this report is to appraise the five cross section options (herein referred to as 'Road Scenarios') and inform Councils selection of a preferred short-list of two corridor options to progress for Concept Design development. This report is the first of a two-stage engagement in developing the Corridor Plan for Inkerman Report, covering Stage 1 of the process. A further Stage 2 report (referred to as the Inkerman Road 'Corridor Plan') will be developed to document two concept designs for further consideration.



Context

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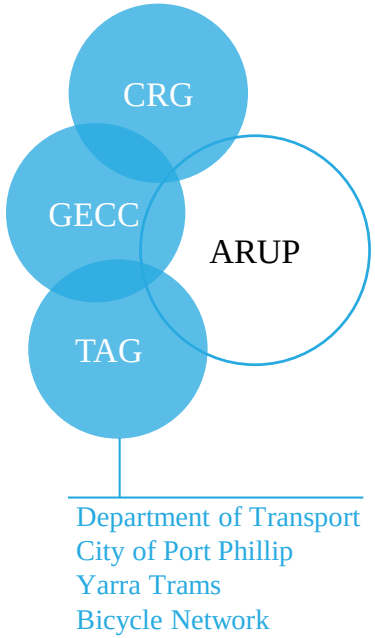
Methodology

Objectives and Method

The objective of this report is to provide an independent assessment of the design and appraisal of previously identified Road Scenario options for the Inkerman Road Safe Cycling Corridor. This has included:

- A site visit and meetings with the Glen Eira City Council
- A review of crash history data, traffic data, aerial photograph and civil services information
- A review of relevant standards and development of a 'Basis of Design' for each Road Scenario
- Defining the key features of each Road Scenario being appraised
- Establishing defined criteria used to measure effects
- A multi-criteria appraisal

Stakeholder and community engagement has also been carried out as part of this project. A Technical Advisory Group (TAG) has been established with an initial workshop held on 28 January 2020. Community engagement is being facilitated through a Community Reference Group (GRG) and led and facilitated by Co-Design as the project's community engagement consultant, documented as part of a separate report.



References

The Glen Eira City Council has provided the following reference documents on the Safe Cycling Corridor Pilot. Collectively these form the basis for the selection of Inkerman Road as the preferred Strategic Cycling Corridor, and establishes the current Road Scenarios being considered.

- Safe Cycling Corridor – A Way Forward (Officer report 19/1313499)
- Assessments of Routes, November 2019
- Community Engagement Report, November 2019
- Concept Designs, November 2019
- Corridor Assessment Report, September 2019
- Glen Eira Safe Cycling Corridor Data Collection, September 2019
- Options Assessment, February 2019
- Inkerman Rd Traffic and Parking Analysis Survey Report, November 2018

Context

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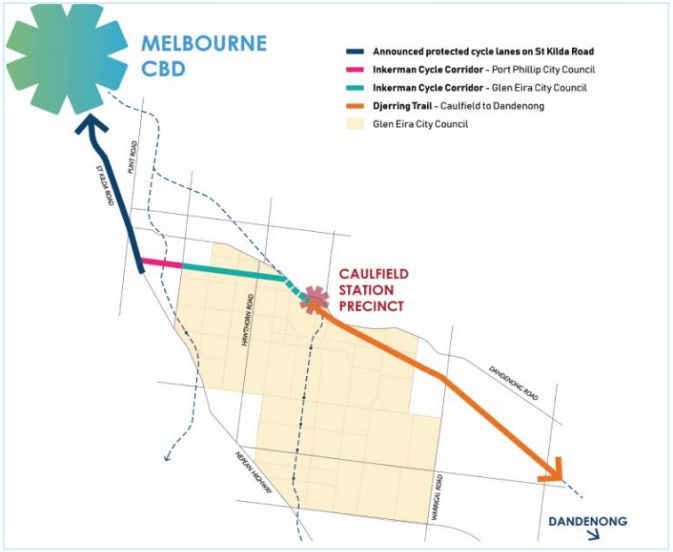
Strategic Context

A Key Connection

Inkerman Road could form part of a broader connection between Melbourne CBD, Caulfield Station, and Melbourne's southeast via the recently constructed Djerring Trail.

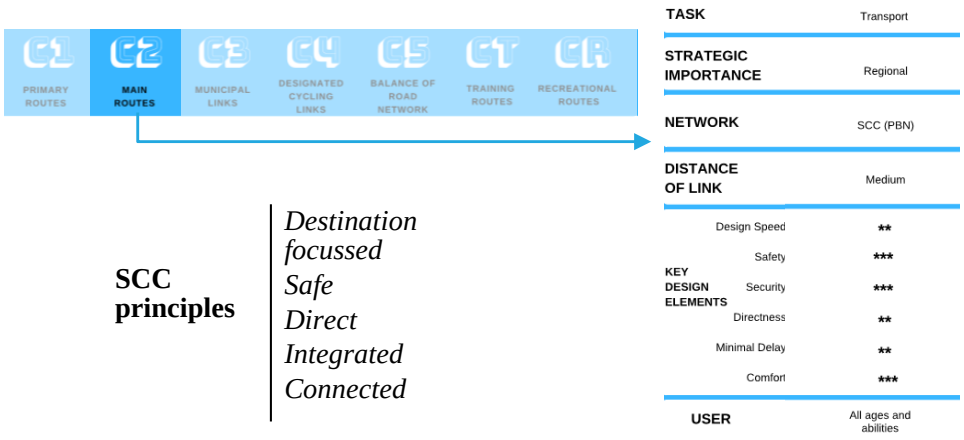


Source: Glen Eira City Council

Strategic Cycling Corridors (DoT, 2019)

Strategic Cycling Corridors (SCC) is part of an initiative under Plan Melbourne to 'Support Walking and Cycling in Melbourne'. The Department of Transport (DoT) advised Council the Inkerman Road route (subject of this study) and the Inkerman Road/Orrong Grove/Orrong Crescent/Alma Road option to be potentially feasible, however does not support Dandenong Road or the Alma/Inkerman split direction route.

The Glen Eira section has been identified as a C2 corridor. It is noted that City of Port Phillip, in its letter dated 14 October 2019 also support a preferred alignment on Inkerman Road. It is also understood that CoPP aspire for Inkerman Road to be a C1 classification Strategic Cycling Corridor.



SCC principles

Destination focussed
Safe
Direct
Integrated
Connected

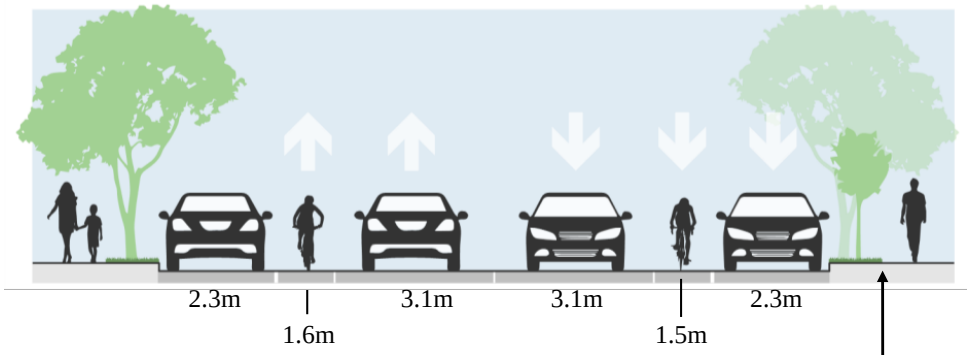
Context

ARUP

Existing Context - Inkerman Road

The current condition of Inkerman Road is variable however can be categorised into two general states - either with a narrow 'on-road bicycle lane' or a 'shared traffic/parking lane'. Section 1 fits into the first category, with 'on-road bicycle lanes' provided in both directions adjacent to the parking lane. There is generally no dedicated provision for cyclists through intersections, where two approach lanes are provided by terminating the parking lane on approaches.

Bicycle lane and car parking lane [Section 1]



Section 1 includes a narrow on-road bicycle lane. Generally the lane is within the zone of car-door opening. Current standards and guidelines require a minimum 0.4m and desirable 1.0m 'safety strip' (Austroads). Many bike riders are likely to feel unsafe riding between the parking lane and moving traffic.

The posted speed limit on Inkerman Road is 50km/hr. Current VicRoads design guidelines for Strategic Cycling Corridor no longer support new installation of cycling lanes without separation on major roads with posted speeds above 40km/h.

A pedestrian footpath of some 1.5m (varies) and a grass nature strip with intermittent canopy trees. There are no pedestrian priority treatments at side roads (i.e. threshold treatments, wombat crossings, etc.).

Example: Hotham to Orrong (facing east)



Context

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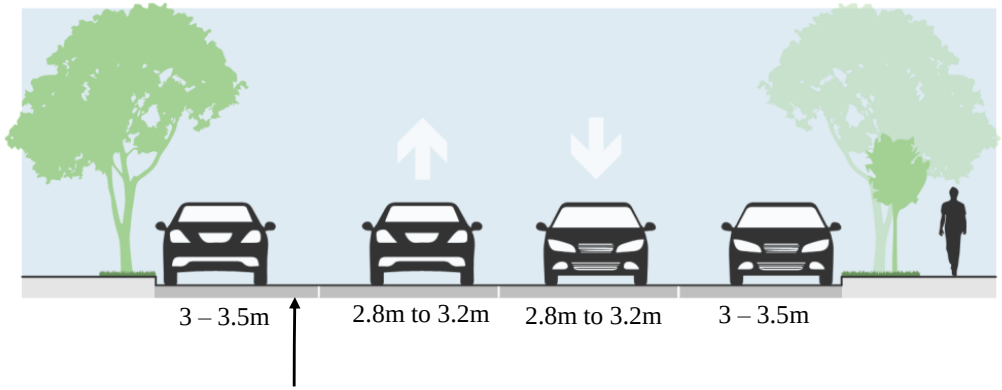
Existing Context - Inkerman Road

All other sections along Inkerman Road fit into the second category, with provision of advisory bicycle treatments in a 'shared traffic/parking lane'. Similar to Section 1, there are no dedicated provisions for cyclists at some intersections in the remaining sections, where two approach lanes are provided by terminating the parking lane on approaches.

Bicycle advisory treatment [Section 2 to 5]



Intermittent bicycle symbol pavement markings exist inside a wide parking lane. Generally, due to narrower widths in these sections, riders are forced to ride within the car-dooring zone. These pavement markings are generally considered advisory in nature only.

On road lanes are measured by 'facility width', being the sum of the car parking lane, safety strip (if existing) and bicycle lane The Austroads 'acceptable range' for 'facility width is 3.7m to 4.5m and the desirable minimum is 4m. The current provision falls short of this.



Orrong to Kooyong (facing east at Orrong Crescent)



Kooyong to Hawthorn (facing west at Khartoum St)

2. Road Scenarios

Following on from previous studies, further define the Road Scenario options to be assessed.

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Road Scenarios

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Future Cross Sections for Consideration

The Glen Eira City Council provided five 'Road Scenarios' (cross sections only) as an input to this study.

Previous investigations had concluded that some options were not feasible or desirable and were not to be considered further. As such, the scope of this study is limited to the 'ticked' options as presented (right) in the Corridor Assessment report (Glen Eira City Council, September 2019).

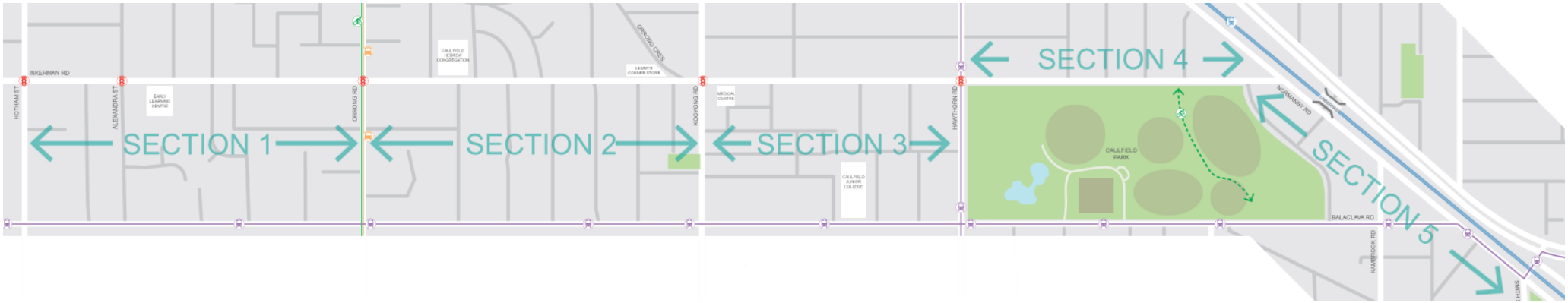
At this stage, a specific side of the road or bicycle lanes and parking lanes has not been nominated.

Source: [Right]
Adapted from Glen Eira City Council

Normanby Road

Inkerman Road

Inkerman Road Scenario description		1 Orrong Rd–Hotham St	2 Kooyong Rd–Orrong Rd	3 Hawthorn Rd–Kooyong Rd	4 Normanby Rd–Hawthorn Rd	5 Inkerman Rd–Balaclava Rd
Scenario 1. Raised cycle track to half footpath level on one side and protected by parking on the other side.		✓	✓	✓	×	×
Scenario 2. Protected bicycle lane (bi-directional) and parking retained in one side.		✓	✓	✓	✓	✓
Scenario 3. Protected bicycle lane (bi-directional) in centre of road and parking retained in one side.		✓	✓	✓	×	×
Scenario 4. One-way traffic and protected bicycle lane (bi-directional). Parking retained in both sides.		×	×	×	✓	×
Scenario 6. Bicycle boulevard – traffic calming and low speed environment.		×	×	×	✓	×



Basis of Design

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Key design parameters and project constraints

Design Requirements

There are numerous standards and guidelines that underpin the appropriate widths for the feasible Road Scenarios being considered. Guidance has been taken from the Austroads, Australian Standards and various VicRoads supplements in determining both the minimum and desirable standards. It is noted the Glen Eira City Council has developed their own preferred design rules which fall within the desirable dimensions, the only exception being the adoption of a narrower than desirable 0.8m separator.

Minimum requirement: the absolute minimum acceptable, and

Desirable standard: the preferred or ideal provision for a given design element

Measure	Parallel parking	Protected Bicycle lane		Separator kerb	Traffic lane
		One way	Two way		
Minimum Requirement	2.1m [+0.5m traffic lane clearance]	1.2m	2.5m	0.6m [1]	3.0m
Desirable Standard	2.3m [+0.5m traffic lane clearance]	2.0m – 2.5m [2]	3.0m – 4.0m	1.0m	3.5m

[1] Whilst not referenced in any relevant design standards, a 300mm wide separation kerb is generally accepted where the bicycle lane is directly adjacent to traffic and there is no risk of car-dooring. Glen Eira preferred is 0.8m
[2] With protected lanes, 2m between face of kerb is recommended to enable comfortable passing opportunities (Austroads)

Project Constraints

Project constraints include:

- Existing parking generally maintained on at least one side
- Generally, the minimum carriageway width of the corridor is:
  - Inkerman Road: 12.0m – 12.5m
  - Normanby Road: 11.5m approx.
- Future tram upgrade on Normanby Road

The following pages describe the ways in which these constraints have been rationalised in determining a feasible cross section for each Road Scenario.



Road Scenario 1 Cross Section

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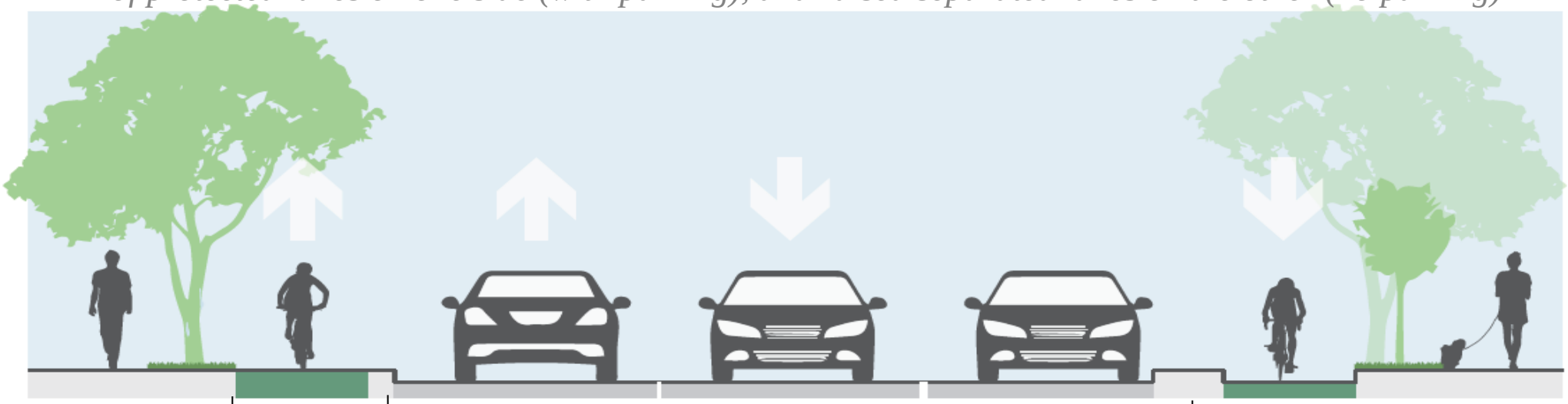
Mix of protected lanes on one side (with parking), and raised separated lanes on the other (no parking)

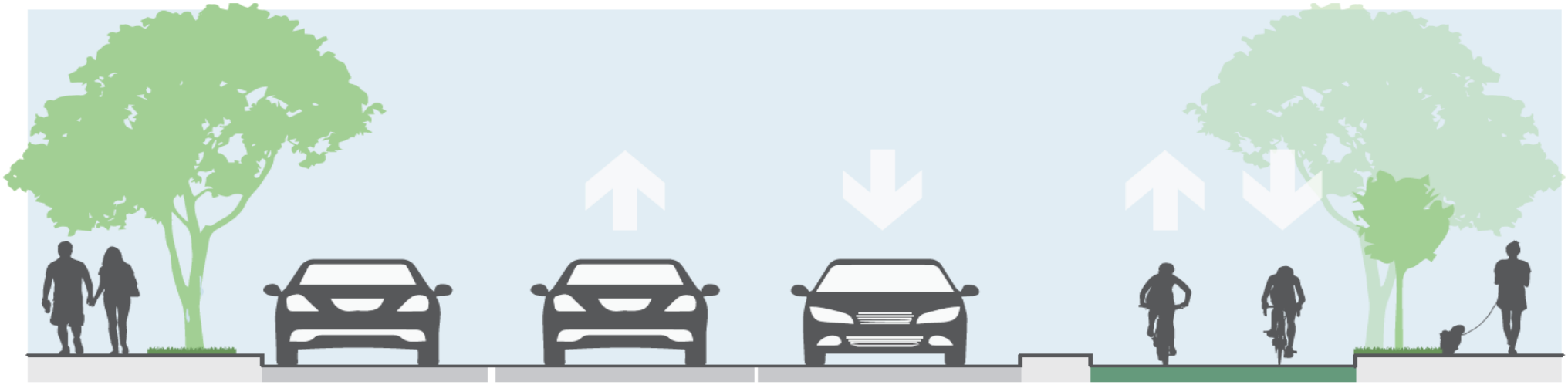


								Total width
Minimum achieved [Section 3]	1.2m	0.4m	3.0m	3.0m	2.6m	0.8m	1.2m	12.2m
Maximum achieved [Section 2]	2m	0.9m	3.0m	3.0m	2.6m	0.8m	2m	14.3m

Road Scenario 2 Cross Section

ARUP

Protected bi-directional bicycle lanes with parking on one side

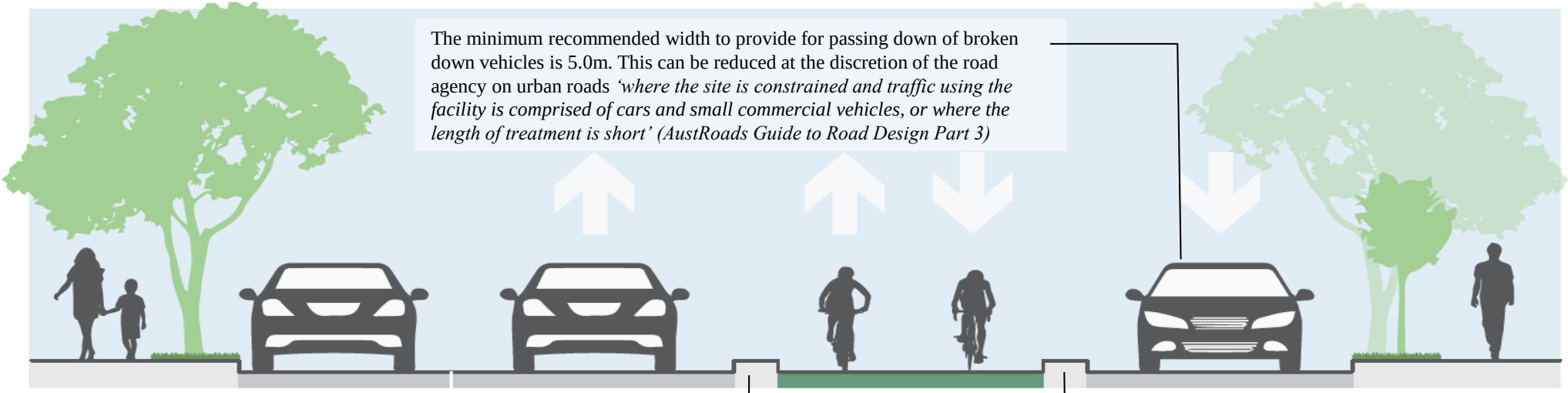


						Total width
Minimum achieved [Section 3]	2.6m	3.0m	3.0m	0.6m	3.0m	12.2m
Maximum achieved [Section 2]	2.6m	3.0m	3.0m	1.7m	4.0m	14.3m

Road Scenario 3 Cross Section

ARUP

Protected bi-directional central bicycle lanes with parking on one side

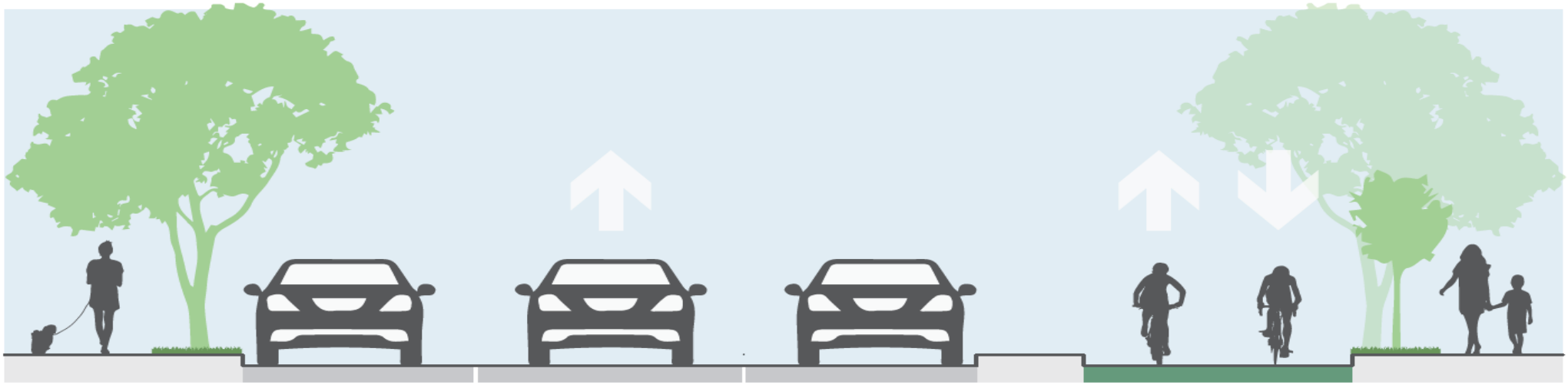


							Total width
Minimum achieved [Section 3]	2.6m	3.0m	0.3m	3.0m	0.3m	3.0m	12.2m
Maximum achieved [Section 2]	2.6m	3.0m	0.8m	4.0m	0.8m	3.0m	14.3m

Road Scenario 4 Cross Section

ARUP

One way traffic with protected bi-directional bicycle lanes with parking on both sides



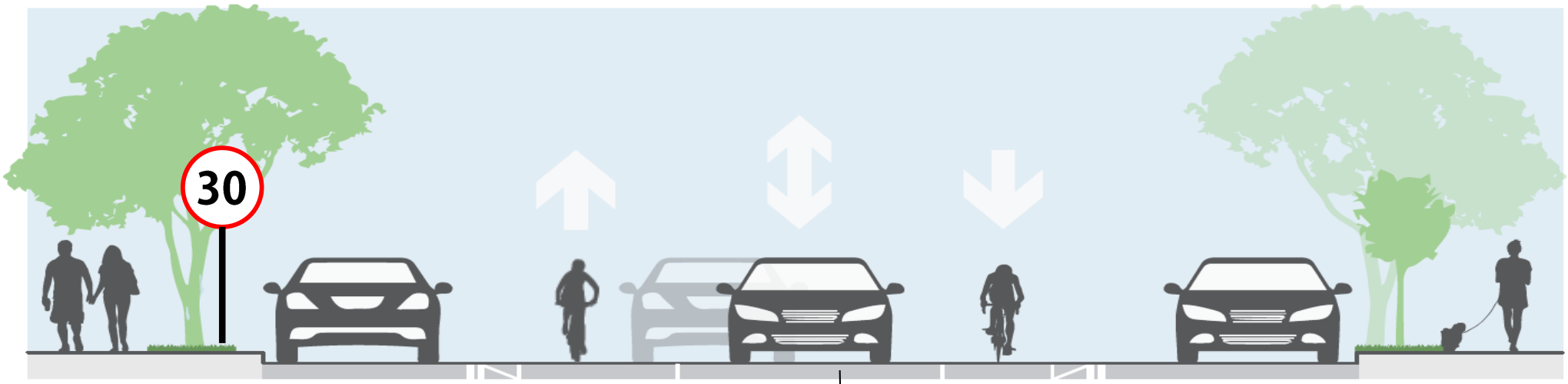
Traffic in the opposing direction to the one-way system would be diverted into the wider area

						Total width
Minimum achieved [Section 4]	2.6m	3.0m	2.6m	0.9m	3.5m	12.6
Maximum achieved [Section 4]	2.6m	3.0m	2.6m	1.1m	3.5m	12.8

Road Scenario 5 Cross Section

ARUP

Bicycle boulevard (single lane for two-way traffic) and parking on both sides



Two way flow within a single traffic lane. Vehicles conflicts are negotiated by use of the bike lane where required. Requires local area traffic calming, significant gateway treatments, or road closures to lower traffic volumes to an appropriate level

								Total width	Section
Minimum achieved [Section 4]	2.1m	0.8m	1.9m	3.0m	1.9m	0.8m	2.1m	12.6m	#4
Maximum achieved [Section 4]	2.1m	0.8m	2.0m	3.0m	1.9m	0.8m	2.1m	12.8m	#4

3. Basis of Assessment

Sets out the key design aspects underpinning the appraisal of each Road Scenario.

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Speed Environment

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Posted and Design Speeds for Vehicles and Bicycles

Posted Speed Limit

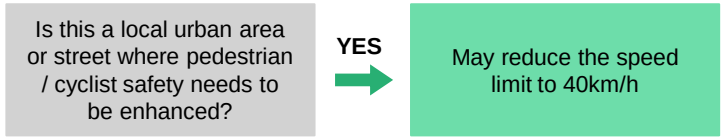


The posted and design speed is assumed to be lowered to 40km/h for all options, except Road Scenario 5 (Bicycle boulevard) which would require 30km/h.

Some road scenarios are likely to be more reliant than others on a 40km/h limit in order to justify the application of minimum width design criteria and to ensure road safety.

A change to 40km/h could be supported under the VicRoads guidelines, which states a 40km/h limit may be applied to local urban streets identified as bicycle priority routes by a plan formally adopted by a council (e.g. Inkerman Road as a Safe Cycling Street).

There is evidence that achieving lower vehicle speeds produces safety benefits particularly for vulnerable road users, and contributes to positive scores in the safety appraisal across all Road Scenarios.

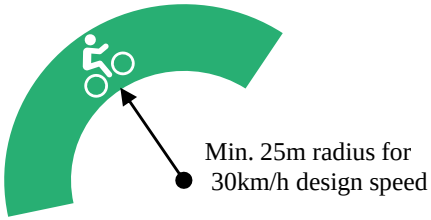


Flow-chart reproduced from Figure 6 of VicRoads Speed Zoning Guidelines (2017). *VicRoads TEM Vol 3: Speed Zoning Guidelines (2017)*

Bicycle Design Speed

It is relevant to understand the potential speed of cyclists as this informs the ability of the bike lane to 'bend in' and 'bend-out' at intersecting side roads for managing conflicts with traffic.

Contemporary guidance requires that a speed of up to 30km/h be considered, which translates to a minimum curve radius of 25m.



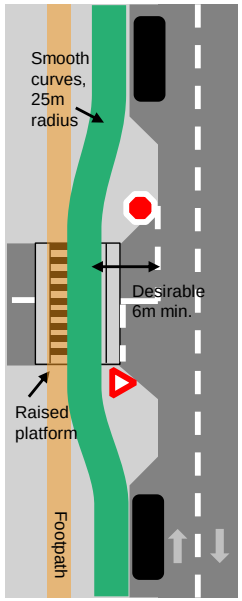
VicRoads TEM Vol 3: Design Guidance for strategically important cycling corridors (2016)

Side Road Treatments

ARUP

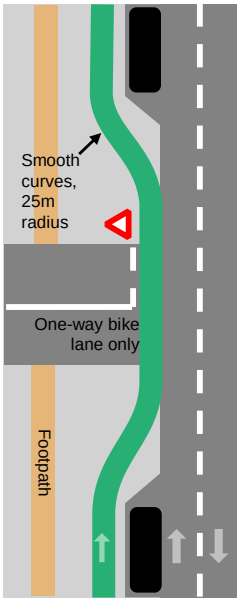
Potential side road treatment typologies for each Road Scenario are outlined below.

Raised



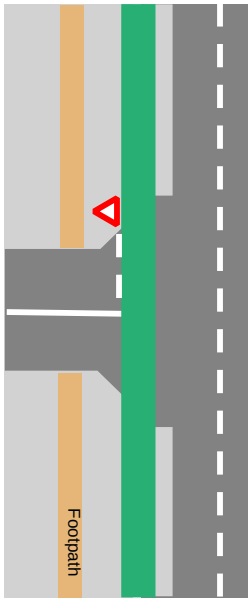
Applicable for:
*Scenario 1 (preferred)**
*Scenario 4 (preferred)**

Bent-in



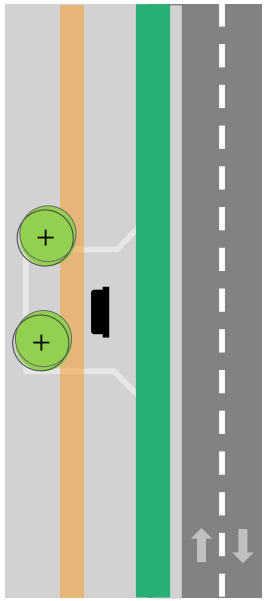
Applicable for:
Scenario 1 (alternative)

Straight



Applicable for:
Scenario 2
Scenario 1 (alternative)

Road Closure



Optional bolt-on for
*any Road Scenario***

* Applicability of this treatment at the design stage will depend on cross sectional width available and presence of services/trees etc.
** Material safety benefit only realised if vehicle movements are displaced to a location with a safer road interface

Side Roads and Sight Distance

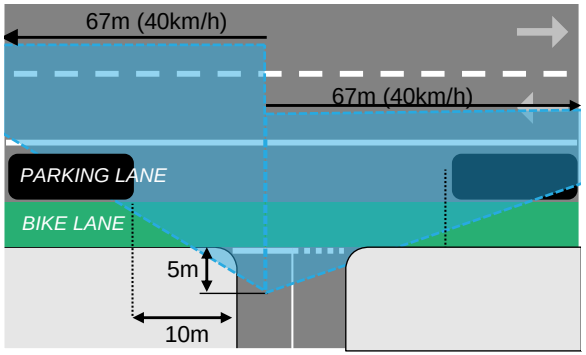
ARUP

The requirements for visibility between road users impacts the extent of parking that can be provided at intersecting side-roads. Below outlines the basis for parking estimates.

Austroads guidelines specify that a 67m safe intersection sight distance should be provided on major side roads. As per Road Rule 170(3), no parking or stopping is permitted 10m on the approach and departure side of an unsignalised intersection. Under the existing condition, the statutory minimums are generally used, with a reliance on visibility of oncoming traffic provided over bonnets, between parked vehicles and through windows.

In-line [Straight and Bent-In typologies]

This applies to Road Scenarios 1 and 4. It is assumed that parking will continue to be exist inside the sight distance triangle, and visibility of oncoming traffic over bonnets and between parked vehicles will continue to be relied upon. Similar to driveways, under an 'in-line' arrangement, there is risk of drivers propping across the bike lane when waiting for a gap to exit the side road.

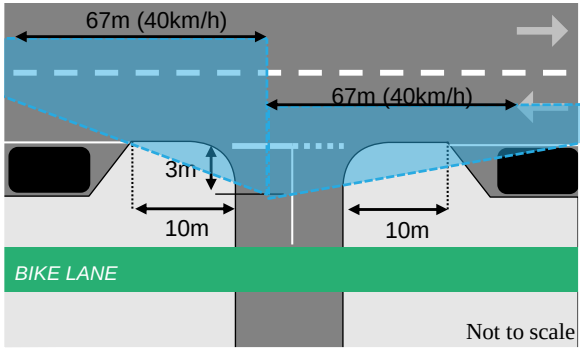


(SISD) *AGRD Part 4a: 2017 Section 3.2.2 Safe Intersection Sight Distance*

Offset [Raised typology]

When bike lanes are offset into the side road, this increases the ability of vehicles to prop clear of the bike lane before entering Inkerman Road.

Compared to the 'Straight' and 'Bent-in' options, sight distance to oncoming traffic is improved, as well as providing space for vehicles to stop clear of the bike lane. This is also an improvement compared with the existing condition.



Side Roads (Offset)

Parking Changes at Side Roads

ARUP

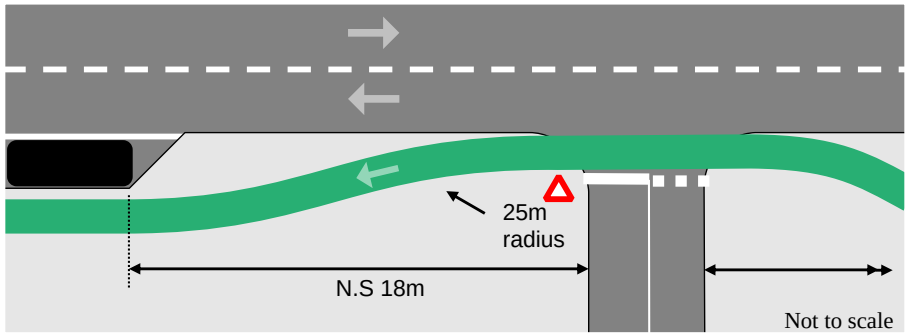
Basis for parking losses where a 'Raised' typology is provided

Side Roads [Raised]

For all side road typologies except the 'Raised' typology, the existing extent of 'no stopping' would be retained.

When a 'Raised' treatment is applied, a greater no stopping distance and loss of parking will be required. This allows the bike lane to transition from behind parked vehicles to be adjacent the traffic lane, and back again. This dictates a No Stopping distance of 18m on either side of the side road, which is the length required based on back-to-back smooth curves of 25m radii.

This provides improved prominence and visibility of cyclists from vehicles entering/exiting the side road, noting that this treatment is only applicable for protected one-way paths adjacent parking (i.e. Road Scenario 1).



Parking requirements at side roads with bent-in treatment

Parking Changes at Driveways

ARUP

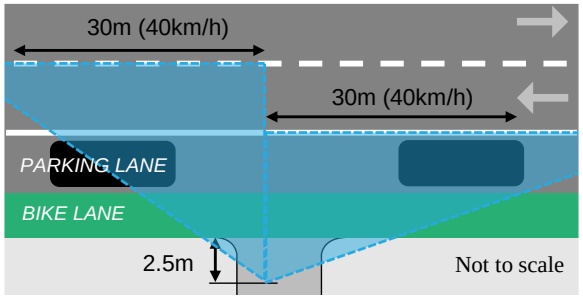
Basis of potential loss of parking at driveways (Road Scenario 1)

Visibility requirements impact the parking provision adjacent driveways, with a balance required between road user safety and minimizing parking impacts. Extensive review of parking conditions (conducted by GECC in selecting Inkerman Road as the SCC) found the corridor occupancy to be typically consistent across the day, with a peak occupancy of ~68% (individual sections vary). Parking impacts will be further considered as part of design development in Stage 2.

Driveway sight distance principles

The Australian Standards specify that at driveways, a sight distance of 30m should be provided in either direction for exiting vehicles. This typically only applies to fixed and permanent obstructions. Currently, parking is permitted in close proximity to driveway entries for most local streets, and this visibility is assumed to be achieved over bonnets, between cars, and through windows and it is not proposed to restrict parking on this basis.

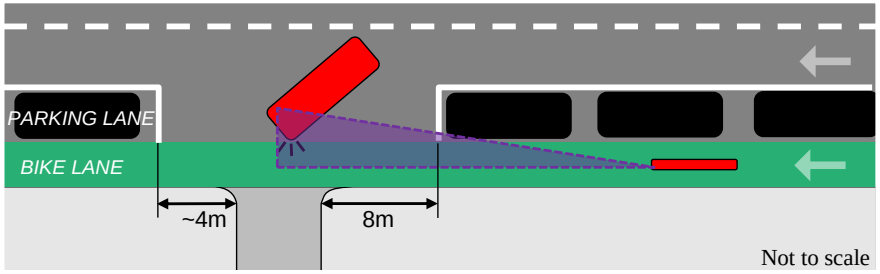
There is a risk that 'flipping' the order of parking and bicycles creates new hazards. For example, that drivers prop across the bike lane when exiting, to sight oncoming traffic, or that entering vehicles do not sight oncoming cyclists. The safety of these interactions may be dependent on both the width of the separator and offset distance between the edge of driveway and parked cars.



Driveway sight distance requirements - *AS2890.1:2004 Off-street car parking Cl 3.2.4 Sight distance at access driveway exits*

Adopted Basis of Assessment

The basis of assessing parking impact is that there will be one less parking space between each consecutive driveway. This would increase the offset from around 1m to around 4m, accommodating vehicle swept paths to/from driveways. It should be noted that this distance is less than would be required to judge a 2.5 second gap in cyclists travelling at 30km/h, and has been adopted to balance safety for all road users and minimize loss of parking. As such, it is assumed that if a cyclist has not been sighted in advance by the driver on approach (based on gaps in parking); that the rider is travelling more slowly or is able to modulate their speed to avoid a collision. The familiarity of residential access along Inkerman Road may aid better driver awareness.



Example application of distance required for a left-turning driver to observe a 2.5second gap to a fast cyclists travelling 30km/hr

Intersections: Side roads with Central Lanes

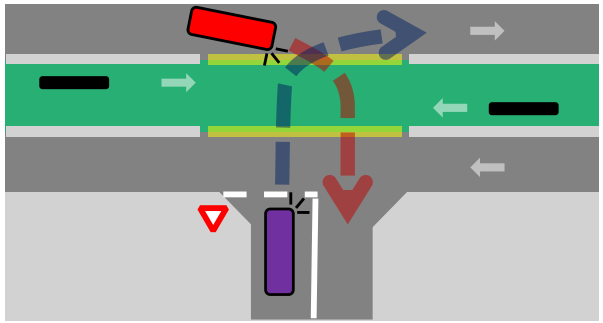
ARUP

Central bike lanes:
Two options for side road treatment typologies for Road Scenario 3

Right turn (kerb breaks): Not supported

To retain access for side roads along Inkerman Road, right turn movements would be required across the central bike lanes. This is considered an unacceptable safety risk given the unexpected and unconventional movements.

Breaks in the separator kerb would be provided at side streets and vehicles would filter across the bike lanes. Under this arrangement, motorists would likely store across the bike lane as they wait for a gap in opposing traffic to complete their turn. With the number of side roads along Inkerman Road, this creates recurring conflict points with cyclists, impacting safety of the cycling facility and is not considered a desirable outcome.



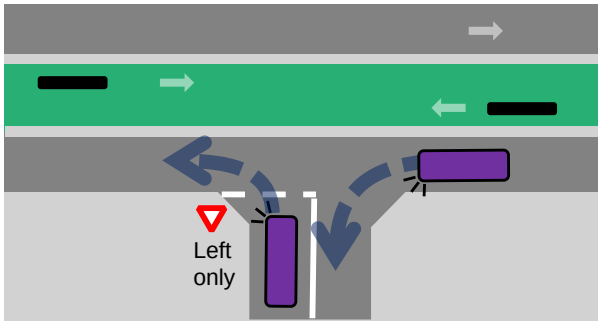
✓ Freedom of access to/from side roads

✗ Poor cyclist safety

No right turn (full height kerb): **Adopted Basis**

To eliminate conflict between vehicles and cyclists at side roads, right turn bans are proposed at side roads. Limiting side road access to left-in/left-out for motorists significantly decreases the permeability of the road network and will generate network traffic redistribution (i.e. there lefts) or U-turning traffic at signalised intersections where possible and along Inkerman Road. This is expected to have a significant impact on intersection performance, noting that decreased capacity would be expected along with these intersection geometry modifications.

It is noted that cyclist access to/from the central bike lanes at side roads could be retained and provided through smaller breaks within the separator.



✓ Preferred for Cyclist Safety

✗ Restricts side road access

Intersections: Signals

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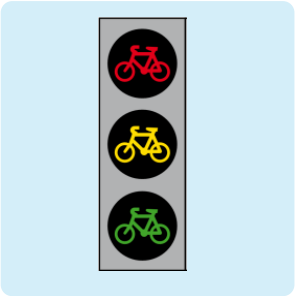
General features for signalised intersections under all scenarios

Bicycle signals

Bike lanterns would be sought at all signalised intersections along Inkerman Road where a separated cycling facility is provided. These will allow head starts to be provided for cyclists at intersections, and allow cyclist green time to be provided separately from vehicle green time in the same direction, to manage conflicts with turning vehicles.

The inclusion of bicycle crossing lights legitimises cyclist priority over left-turn vehicles if both of the signals are green, as outlined in Road Rule 62(1)(b). Signal programming at intersections is ultimately determined by the Department of Transport (VicRoads).

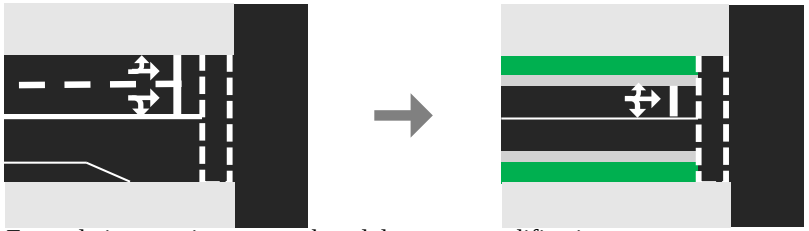


Three aspect bicycle lanterns (AS 1742.14:2004)

Lane configuration

Depending on the proposed Road Scenario, the configuration of lanes at each signalised intersection may require significant modifications, which could include the removal of dedicated turning lanes. These changes will have an effect on the capacity of the intersections for vehicles, in particular for left and right turns.

For the purpose of identifying potential changes to lane configurations, it is assumed the existing centreline for vehicles represents the required space needed for vehicles turning into Inkerman Road.



Example intersection approach and departure modifications

Intersections: Signal layouts

ARUP

General geometric configuration for signalised intersections under specific Road Scenarios

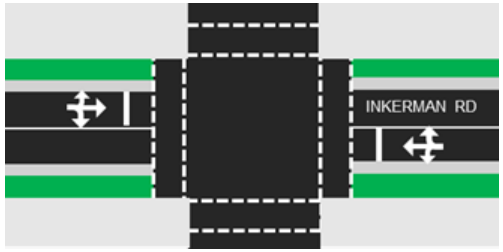
Fundamental to safety is the ability for each Road Scenario to handle cyclists through intersections, particularly including safety against turning motor vehicles. All scenarios are considered below, noting Scenario 4 is a potential one-way system adjacent Caulfield Park. Selection of the traffic direction would be required and needs bespoke design consideration at intersections which may vary depending on adjacent section.

Scenario 1 & 5

A reduction in the number of approach lanes at some intersections will be needed to accommodate kerb separators on either side, which will be maintained up to the intersection stop line.

Turning vehicles may be required to filter across the bike lanes, with head starts and early cut-offs for cyclists to reduce conflicts with vehicles.

In Scenario 1, opportunities exist to maintain two approach lanes prior to Orrong & Kooyong Road. This intersection arrangement could also be applied to Scenario 5 at intersections.

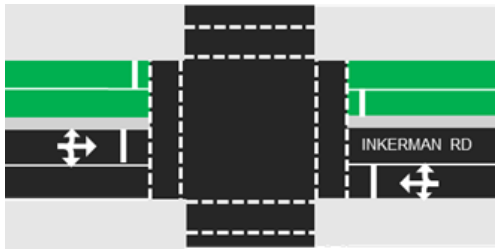


Example: protected bike lanes on either side with removal of approach lanes.

Scenario 2

Providing bi-directional bike lanes on one side results in a reduction to one lane in each direction at most intersections, excluding Alexandra St, where a dedicated right turn lane could be provided to control traffic turning across the bi-directional bike lanes.

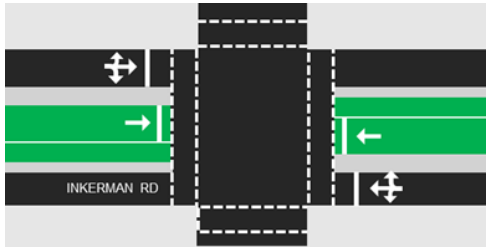
Phasing modifications are required to safely manage conflicts by time-separation of vehicles and cyclists (dedicated bicycle phase). This is largely driven by the unexpected nature of right turn vehicle conflicts against cyclists travelling in the same initial direction.



Example: bi-directional bike lanes (typical)

Scenario 3

Provision of central bike lanes presents a significant shift in intersection geometry, reducing traffic lanes and intersection capacity. The central bike lane facility will be widened at intersection approaches, providing additional width for storage of turning cyclists. A push button facility will also be provided within the median adjacent the bike path for turning cyclists, with crossings to be 'shared crossings'. Modified intersection phasing (e.g. split phasing, controlled turns) to reduce conflicts between cyclists and vehicles will have large impacts on capacity and create delays to all modes, and right turn bans may be needed (particularly at Hawthorn Rd).



Example: central bike lanes

Access and Maintenance

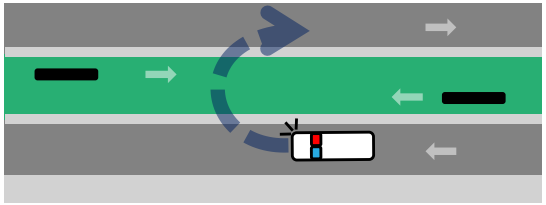
ARUP

Requirements for parking for people with disabilities and considerations for accommodating day to day operational users

Emergency Services

It is critical that emergency vehicles can travel freely along the corridor and are able to access all properties and areas in an efficient manner. Considering central bike lanes (Scenario 3), a mountable kerb option would dilute the merit of protection and allow informal or illegal U-turns.

Some emergency vehicles may be able to mount a separator kerb to turn around quickly and ensure response times, however this may not be the case for some smaller vehicles. Emergency vehicles with reduced clearance may be unable to do so and will need to turn at the nearest signalised intersection or break in kerb.



Kerbs may not be mountable for all emergency services vehicles

Accessible Parking

Australian Standards set requirements for dimensions and access to and from accessible parking spaces. When considering parking adjacent bicycle, accessible parking spaces can be reinstated by:

- breaks in the raised separator alongside the accessible parking space; and
- providing a pram ramp from the bicycle lane onto the footpath that is designed in accordance with Australian Standards.

Users of accessible parking spaces can then access their properties via the footpath as per existing conditions. It is noted that existing accessible parking provision on Inkerman Road is limited to areas adjacent commercial land uses, and is located in side streets where possible.



DDA parking space on Wellington St, Collingwood

Waste Collection & Street Cleaning

Current waste collection vehicles use a side-reach arm to collect bins from the edge of the carriageway, between parked vehicles. With the introduction of bicycle lanes at the kerbside under Scenarios 1, 2 and 4, this method will become a safety hazard for bicycle riders. Waste collection operations would need to consider a change to a traditional rear-loader truck with a runner collecting bins from the kerbside across the bicycle lane.

Street cleaning operations will largely remain the same, excluding narrow protected bicycle lanes where a smaller cleaning vehicle may be required.

Scenario 3 will require scheduling so that waste and street cleaning activities occur during very quiet times. There will be limited abilities for drivers to overtake in the single lane section, which may see drivers become frustrated or attempt to mount the kerb to overtake.

Crash History

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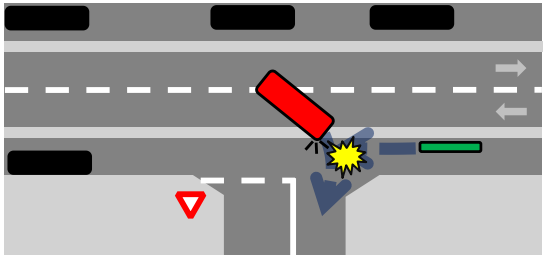
Crash history and change to risk exposure along Inkerman Road.

A total of 78 crashes were recorded along Inkerman Road over the last five years, with 24 crashes involving cyclists and 14 involving pedestrians.

Right through crashes

'Right through' crashes occur when a vehicle turns right and collides with an oncoming vehicle travelling straight. A total of 13 right through crashes, including eight involving cyclists (2 with serious injuries), were recorded over the last five years*, being the most frequent type of crash along the corridor.

To reduce the risk of these crashes occurring, raised and/or coloured treatments can be used to highlight the presence of cyclists. Reducing speeds to 40km/h will also allow road users to react and respond in a shorter distances to avoid collision.

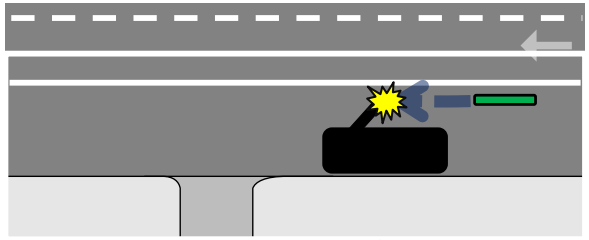


Right through crashes represent the most frequent crashes recorded over the last five year

Dooring crashes

Dooring crashes occur where a vehicle, commonly a bicycle, collides with another vehicle's door. The current exposure is associated with driver-side doors.

These were the second most frequent type of crash – a total of seven recorded over the last five years, all of which involved cyclists and three with serious injuries. Providing separation between parked vehicles and bicycles reduces the risk of dooring crashes occurring. Many Road Scenarios change the conflict to passenger-side doors and may reduce likelihood of collision. A minimum of 0.8m is required; wider separators will further reduce the risk of dooring.

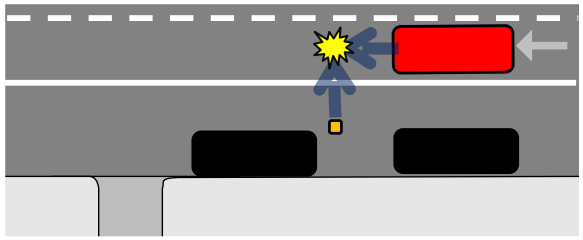


Dooring crashes represent the most frequent crashes involving cyclists over the last five years (seven recorded)

Pedestrian crashes

Serious injury pedestrian crashes have been recorded on Inkerman Road and Normanby Road over the last five years.

The most common recorded crash type for pedestrians (and second most frequent overall) was a pedestrian being struck by a vehicle from the right whilst crossing the street, none of which involved being struck by a cyclist. A total of nine crashes were recorded including three serious injury crashes. Reducing the speed limit along the corridor to 40km/h will reduce the risk of serious injury, particularly for vulnerable road users. Removal of parking from one side may also decrease risk.



Pedestrian crashes like that shown above resulted in six serious injury and eight other injury crashes

*The above analysis is based on recorded crashes only. For a crash to be recorded, emergency services must attend the incident. It is well understood that many crashes, particularly those involving cyclists, go unrecorded and are not able to be analysed.

Impacts to Services

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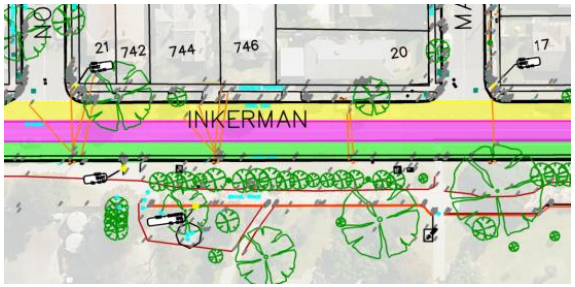
Potential impacts to further consider in detailed design.

Overview

The Inkerman Road corridor has been analysed to assess the impact of the introducing new cycle lanes on existing road infrastructure. These include surface elements of underground utilities (water, gas, sewer, drainage, telecoms, electricity) and other road furniture. Note that the assessment has not considered a 'dial before you dig' enquiry. The analysis was undertaken using the aerial image and the feature survey provided by the Glen Eira City Council. The road was split into three equal zones; north (yellow), middle (pink) and south (green) for the purpose of this analysis.



Key considerations to be taken into account for the bike lanes design are mainly the underground utilities and drainage of the new proposed layouts. It is likely that some utility pits and valves within the Inkerman Road corridor will require raising of covers (levels) to match the new surface level (where applicable). The location of these assets might require horizontal adjustment as well to suit the new bike lane separation kerb layout.

Sewer

Sewer assets are generally on the southern side with a few on the north. Similar to the stormwater, it is anticipated that the introduction of separator kerbs will lead to raising of pits and manholes where required. The local horizontal location of pits might also need to be adjusted accordingly to co-ordinate with new kerb layouts. No change is anticipated to the sewer pipes. Impacting sewer assets is a minor risk for cost and construction.

Water Supply

A 900mm water main runs along the northern length of Inkerman Road. The water main along the southern length of road east of Hawthorn Road falls outside the road corridor and is unlikely to be impacted.

Valves and pits were observed on the northern side of the road, which might be impacted (cover levels and location) by the construction of the bike lanes on the north side. These will need to be adjusted to suit the proposed new kerbs layout and bike lane levels.

Even though the water main itself is not anticipated to be affected, easement requirements shall apply. However, these typically vary with the nature of construction, and since the construction of the bike lanes is generally shallow, it is not considered of particularly high risk this will be build over requirements.

Impacts to Services

ARUP

Potential impacts to further consider in detailed design.

Drainage (Stormwater)

Currently Inkerman Road is relatively flat with a crown in the middle draining to pits on either side. It is not anticipated that the falls will change and therefore the general drainage configuration would require only minor modifications. If the bike lane pavements are to be raised, conversion of side entry pits to grated pits may be required. This configuration will also require an assessment of the impact on overland flow on adjacent footpaths and properties.

If bike lane separator kerbs are required, additional drainage infrastructure may be required to provide compliant cycleway safety during high rainfall events. Detailed design shall also take into account any change in levels that might affect the flood levels. New infrastructure will be required to be co-ordinated with exiting underground utilities, which will add complexity to the design. These assets have a medium risk.

Roadside Furniture

Electricity appears to be located in overhead cables. The poles for these (incl. street lighting), though outside the road corridor, are in close proximity to the road kerb. Depending on the final configuration of the bike lanes these may present as a hazard for cyclist clearances, so any localised adjustments to the kerb layouts (if any) will have to be coordinated with the electrical poles. The same exists for tree planting along the corridor.

Similar to overhead electricity poles, trees and other roadside furniture can present as hazards, depending on the context.



Overhead electricity cables along Inkerman Road

Gas Supply

Council advice indicates there is a large high pressure 750mm gas main (APA asset) that passes centrally through Inkerman Road. The survey shows that the features (chambers and valves) are generally located to the south – however, mostly on the verge and outside of the road corridor. A couple of valves are located on the northern side, which will have to be considered when adjusting the kerbs and the levels in the surrounding area. In addition, it is likely that the utility provider (APA) will have stringent requirements for construction near or over their mains (easements).

The detailed location of this asset requires confirmation, however it may present a high risk for Road Scenario 3 (central bike lanes) and a medium risk for all Road Scenario 1 and 2.

Telecommunications

Telecommunication assets were observed along Inkerman Road. However, they are mostly in the verge and outside the road corridor.

Normanby Road | Caulfield Village

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Tram Route 3/3a | Caulfield Racecourse and Caulfield Village

Future Tram Stop Upgrade

Council has advised that a Section 173 agreement has been entered into between the developer for Caulfield Village and the State, for reconstruction of the Caulfield Racecourse tram stop.

At the initial TAG workshop with Council, Department of Transport (DoT) and Yarra Trams it was confirmed that a bi-directional protected bicycle facility was not possible adjacent the tram stops due to the potential for conflict between alighting tram passengers and contra-flow cyclists.

DoT has subsequently provided their Integrated Transport Journey Review (ITRJ) appraisal of options for easy access tram stops that considered the Movement and Place classifications for Normanby Road and a C2 cycling corridor.

The design includes separated bicycle lanes on each side of Normanby Road that become elevated as they traverse the easy access tram stop, similar to the treatment provided at existing tram stops along High Street, Northcote and at Balaclava Station. DoT has endorsed the design for application to Normanby Road between Balaclava Road and Smith Street (i.e. in the section of corridor managed by DoT).



Existing easy access tram stop treatment on High Street, Northcote
Bicycle path separated from through traffic
Source: Google Maps

Normanby Road | Inkerman to Balaclava

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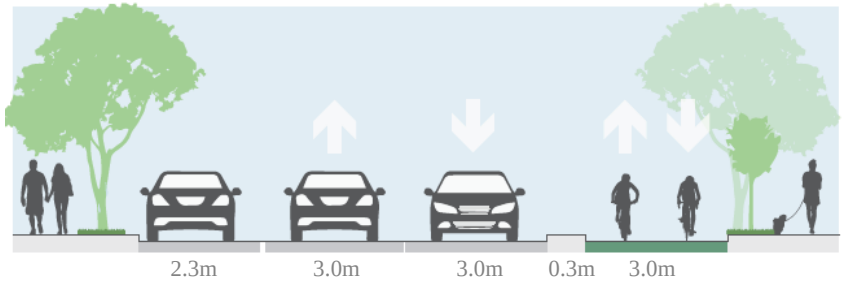
Review of Road Scenarios for Normanby Road (Inkerman Road to Balaclava Road).

Scenario 2

Council's Corridor Assessment Report shows the proposed Road Scenario for Normanby Road as Scenario 2: a bi-directional protected bicycle facility between Inkerman Road and Balaclava Road (the section under Council management).

Based on the minimum 11.6m approx. kerb-to-kerb width, the achievable cross section is shown below. A desirable width bicycle facility and separator can be accommodated with standard traffic lanes and a narrowed parking lane (noting this required a relaxation from the clearance requirements of the Australian Standards for on-street car-parking). It is noted that a transition will be required to tie this facility into the endorsed design for tram stops at Balaclava Road, which will diverge cyclists onto separated bicycle lanes on either side.



Proposed cross-section for Normanby Road between Inkerman Road and Balaclava Road

Review of Alternatives

Given DoT's endorsement of separated bicycle lanes between Balaclava Road and Smith Street, a review of alternative treatments was undertaken for the northern section of Normanby Road managed by Council.

A continuation of separated bicycle lanes on both sides of the corridor was considered to align with the tram stop treatment, however the corridor narrows north of Balaclava from approximately 13.0m to 11.6m, with a narrow point of 10.4m south of the Dandenong Road underpass. This width would not accommodate an acceptable cross section that:

- Provides a safe and functional cycling lane width **and** safe parking separator width, as well as;
- Provides a safe and functional parallel parking lane **and** a standard 3.0m-wide traffic lane.

This requires several elements of the cross section to have a constrained width, which was considered to result in compromised safety outcomes and poor cycling comfort. Accordingly, a continuation of the separated bicycle lane treatment north of Balaclava Road is not considered feasible and has not been assessed in the appraisal process.

4. Appraisal Framework

Explains how each of the Road Scenario options have been assessed.

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Appraisal Process

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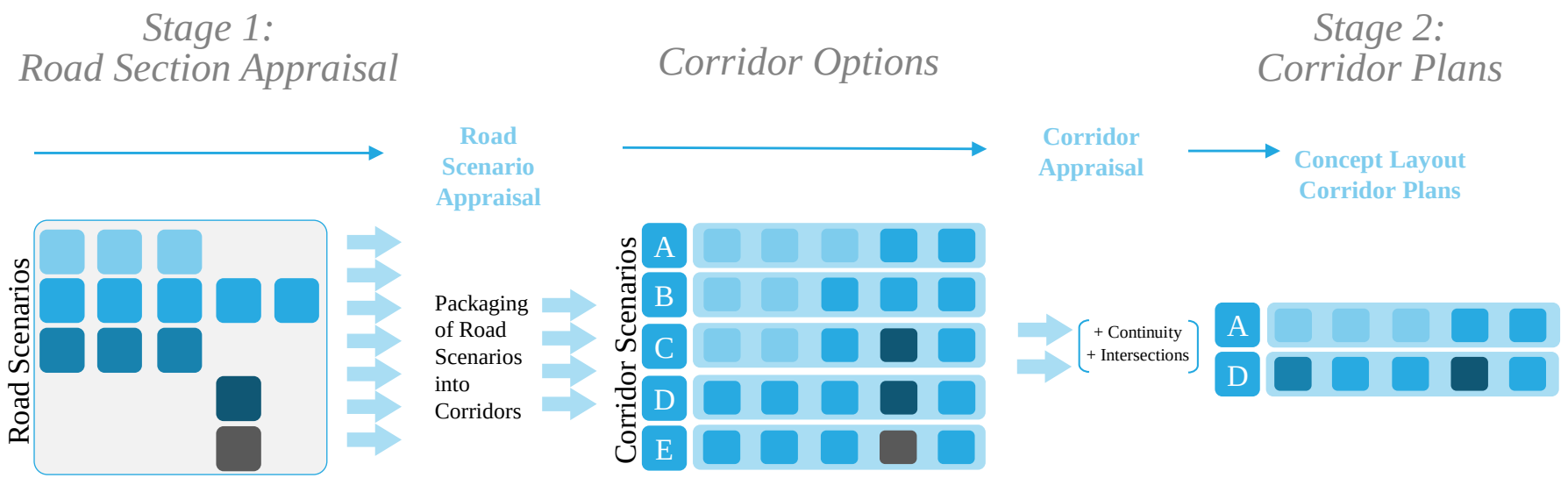
The appraisal process involves first assessing all Road Scenario cross sections in isolation, for each section of the corridor as relevant, using discretely defined criteria. This allows options to be shortlisted, before packaging them up across the corridor as continuous bicycle facilities. The corridors are then subject to further appraisal with respect to their continuity and other considerations at intersections, before selecting two preferred Corridor Plans for design in Stage 2.



Appraisal Criteria

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Three themes have been used to develop a set of appraisal criteria.

Safety

The corridor plan should provide a safe transport system for all, and enable people of all ages and abilities to ride a bicycle. It should be easy to understand, manage conflicts with intersecting driveways and streets, and should not negatively impact the safety of other vulnerable road users (elderly, children, people with disabilities).



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Neighbourhood

The corridor plan should provide connectivity to key land uses and destinations, limit the impact to property access, traffic operations, public transport and the streetscape. It should strike a balance with other community needs (i.e. car parking), and support broader streetscape opportunities where possible.



Photo: Sandeep Parekh (Caulfield Reserve, 2016)

Feasibility

The corridor plan be deliverable, meeting relevant best-practice design standards, permit reasonable waste collection processes, street cleaning operations and emergency services access, align with objectives of local and state authorities, and be of reasonable cost to construct.



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Safety

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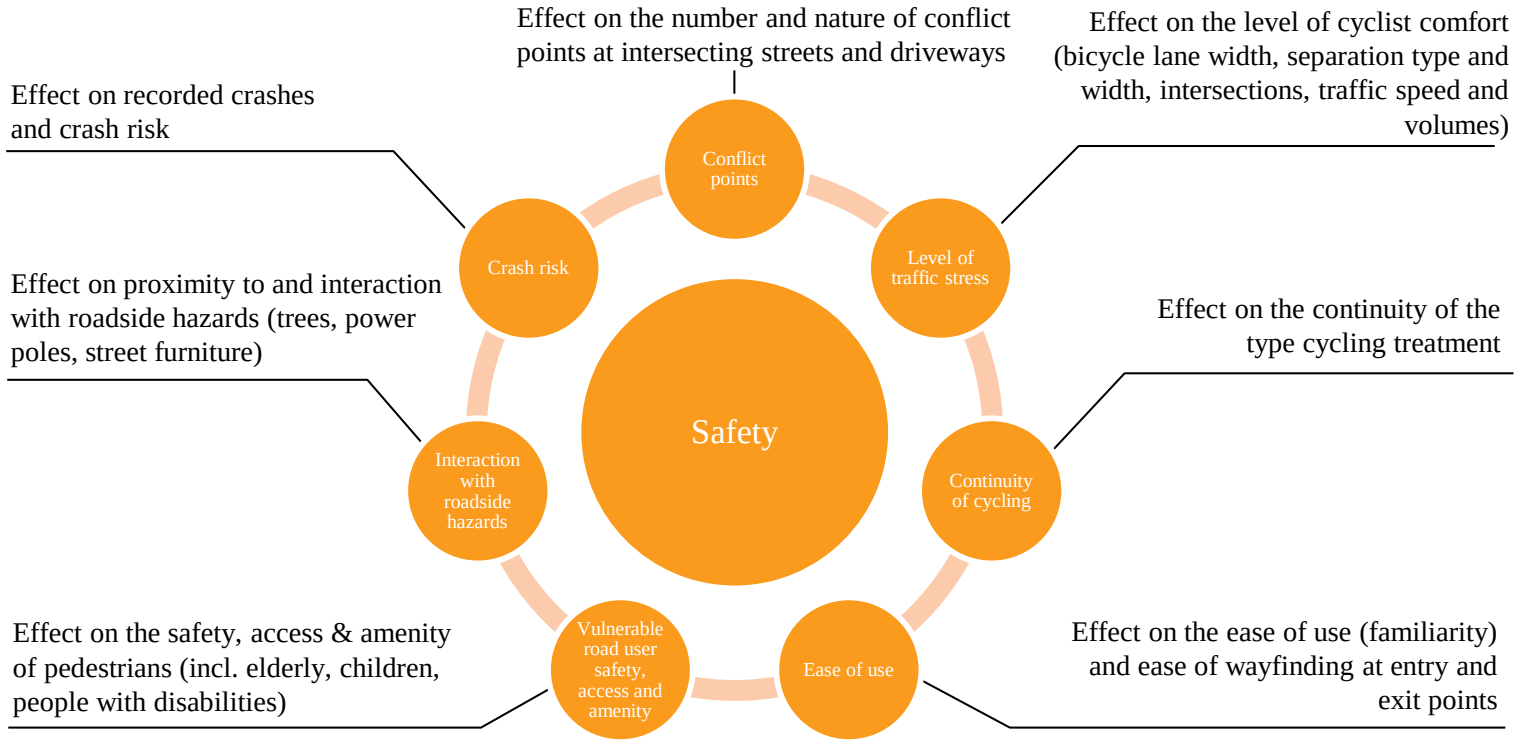
The appraisal criteria for Safety are identified below. Each Road Scenario has been assessed using these criteria, considering the effect they have relative to the existing, base case.



Neighbourhood

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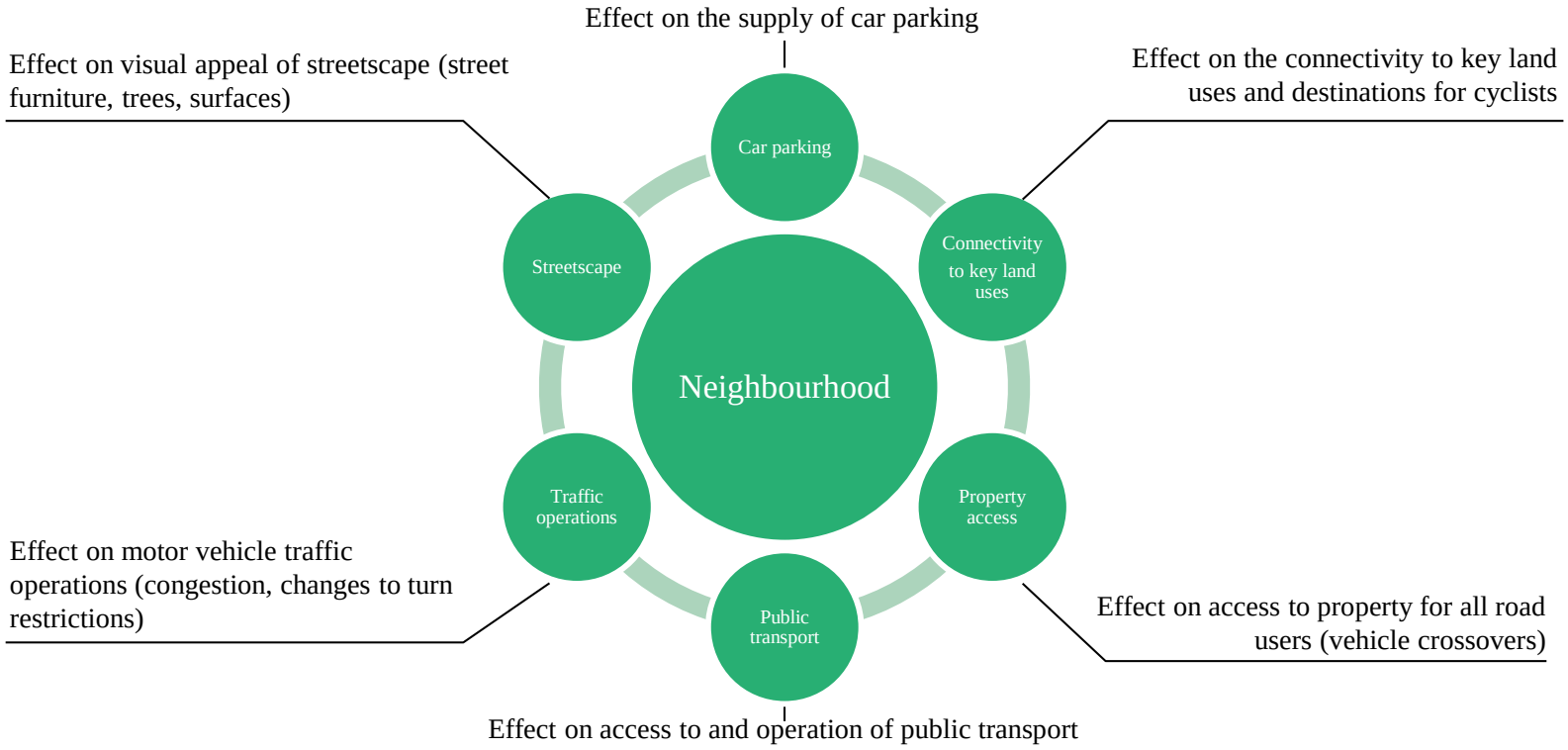
The appraisal criteria for Neighbourhood are identified below. Each Road Scenario has been assessed using these criteria, considering the effect they have relative to the existing, base case.



Feasibility

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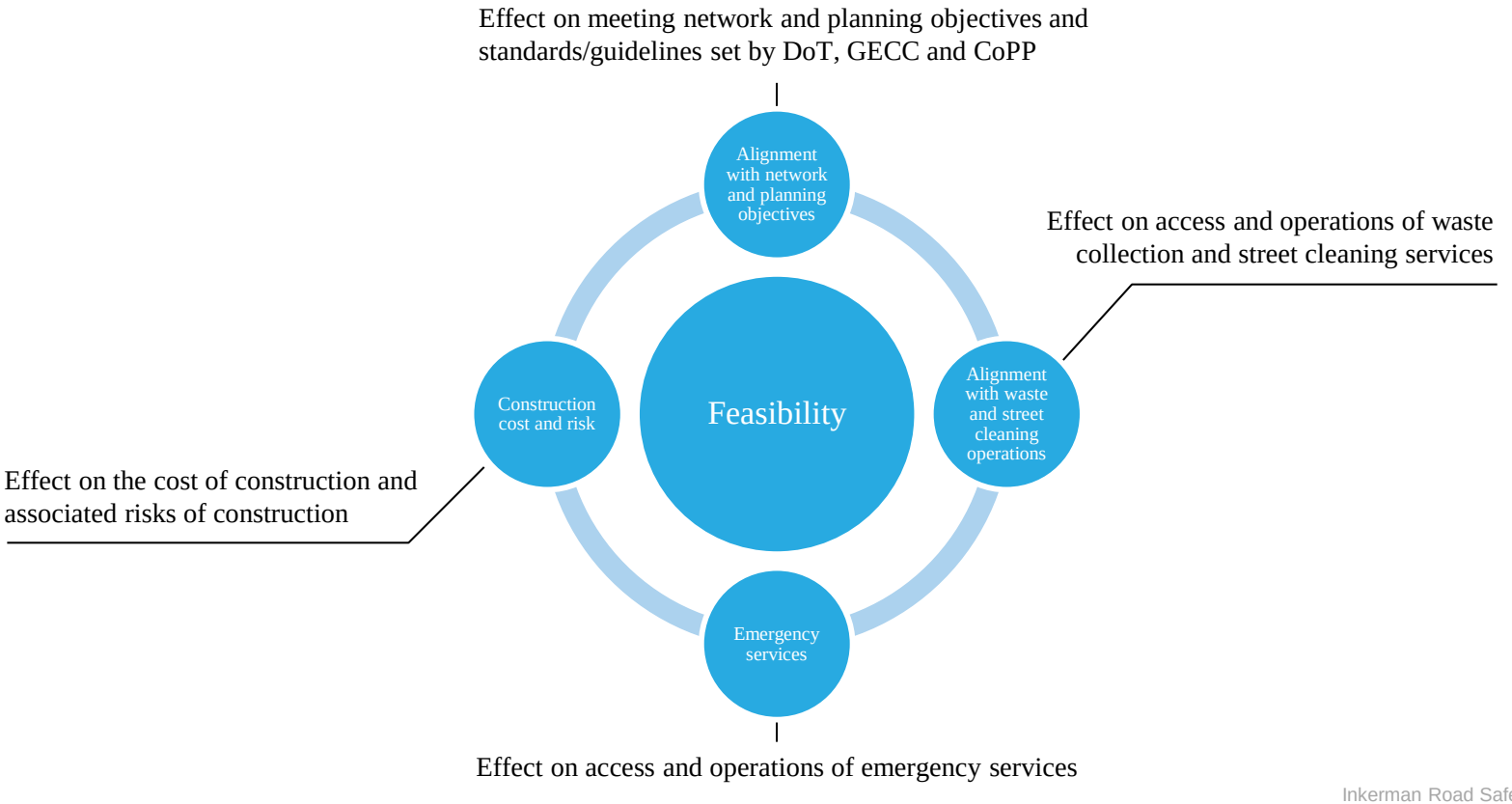
The appraisal criteria for Feasibility are identified below. Each Road Scenario has been assessed using these criteria, considering the effect they have relative to the existing, base case.



Summary of Appraisal Criteria

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A table with all criteria for each of the three appraisal categories is provided below.

Appraisal Criteria and Definitions

Category	Criteria	Outline
Safety	Conflict points Traffic stress Continuity of cycling infrastructure Ease of use Pedestrian safety, access & amenity Roadside hazards Crash history	Effect on the number and nature of conflict points at intersecting streets and driveways Effect on the level of cyclist comfort (lane width, separation and width, traffic speed and volumes) Effect on the continuity of the type cycling treatment Effect on the ease of use and ease of wayfinding at entry and exit points Effect on the safety, access & amenity of pedestrians (incl. elderly, children, people with disabilities) Effect on proximity to and interaction with roadside hazards (trees, power poles, street furniture) Effect on recorded crashes and crash risk
Neighbour-hood	Car parking Connectivity Property access Public transport Traffic operations Streetscape	Effect on the supply of car parking Effect on the connectivity to key land uses and destinations for cyclists Effect on access to property for all road users Effect on access to and operation of public transport Effect on motor vehicle traffic operations (congestion, changes to turn restrictions) Effect on visual appeal of streetscape (street furniture, trees, surfaces)
Feasibility	Alignment with authority objectives Emergency services Waste collection and street cleaning Construction cost and risk	Effect on achieving network and planning objectives set by DoT, CoGE and CoPP Effect on access and operations of emergency services Effect on access and operations of waste collection and street cleaning services Effect on the cost of construction and associated risks of construction

Evaluation Ratings

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A 5-scale rating system has been developed drawing upon guidance from the Australian Transport Assessment and Planning Guidelines. For the nominated criteria, the performance of each road scenario is assessed against of the existing condition or base case. The results of the multi-criteria analysis are shown for each Road Scenarios in Section 5 of this report. A detailed summary is also provided in Attachment A.

Table of Adopted Evaluation Ratings

Rating level	Description
Large positive	Major positive effects resulting in significant and long term improvements / enhancements for the physical, social or economic environment. Benefits may extend beyond the scope of the project.
Moderate positive	Moderate positive effects with potential short or medium term benefits to the existing physical, social or economic environment. Benefits may be in terms of new opportunities or outcomes of enhancement or improvement.
Neutral	No discernible or predicted positive or negative effects.
Moderate negative	Moderate negative effects with potential short or medium term consequences. May require management strategies to mitigate negative effects.
Large negative	Major negative effects with significant and long term consequences for the physical, social or economic environment. May require considering concept, design or location re-scope and extensive management strategies to mitigate negative effects.

5. Road Scenario Appraisal

This section takes the Road Scenarios and applies the appraisal criteria to arrive at a shortlist.

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Road Scenario Appraisal

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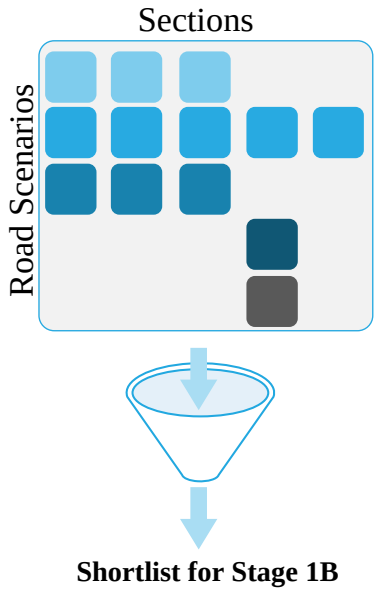
Stage 1

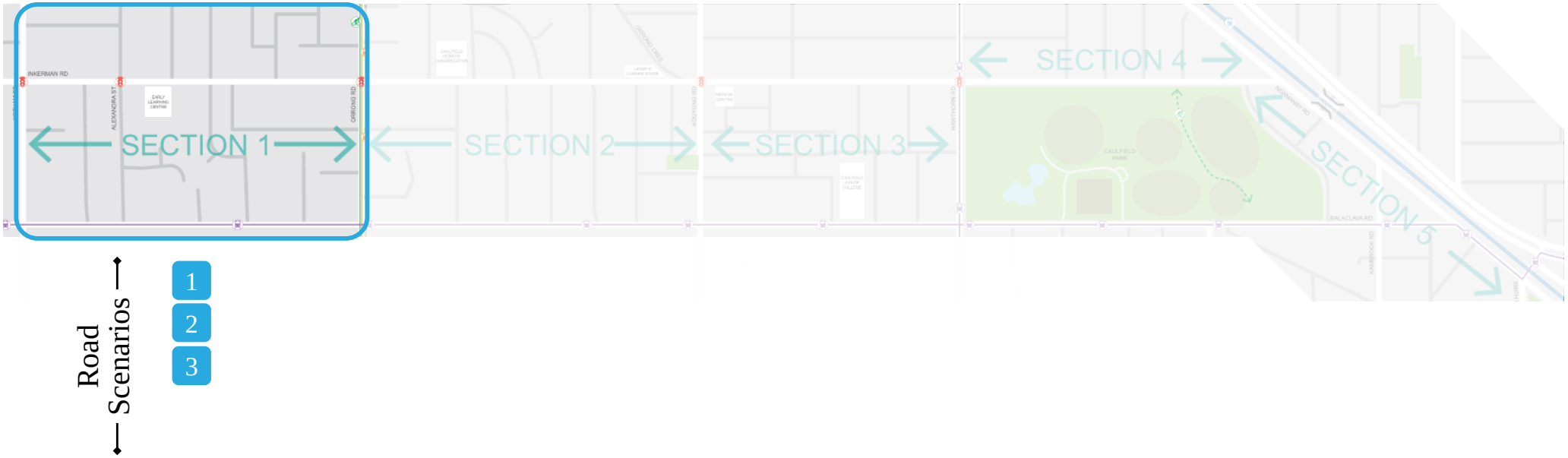
Road Scenario Appraisal
Road Scenarios are appraised individually and ranked into a shortlist

The following pages present 13x sheets giving a summary of each Road Scenario, its key features, and outcome of the evaluation, starting at Section 1 and ending at Section 5.



Road Scenario Appraisal

Section One – Hotham Street to Orrong Road



ROAD SCENARIO 1 - PROTECTED

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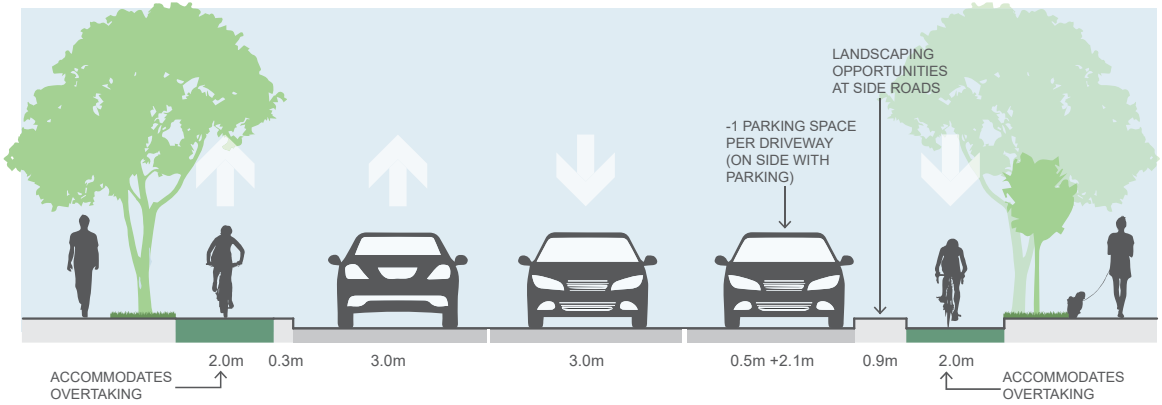
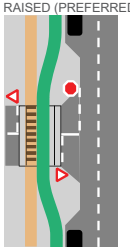


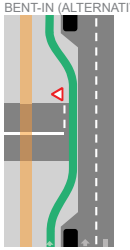
Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

SIDE ROAD TREATMENTS

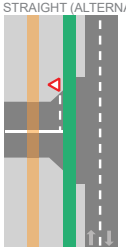
RAISED (PREFERRED)



BENT-IN (ALTERNATIVE)

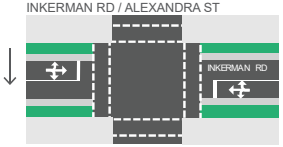


STRAIGHT (ALTERNATIVE)

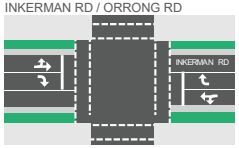


INTERSECTIONS

INKERMAN RD / ALEXANDRA ST



INKERMAN RD / ORRONG RD



PARKING PROVISION METRICS

IF PARKING ON NORTH SIDE ONLY



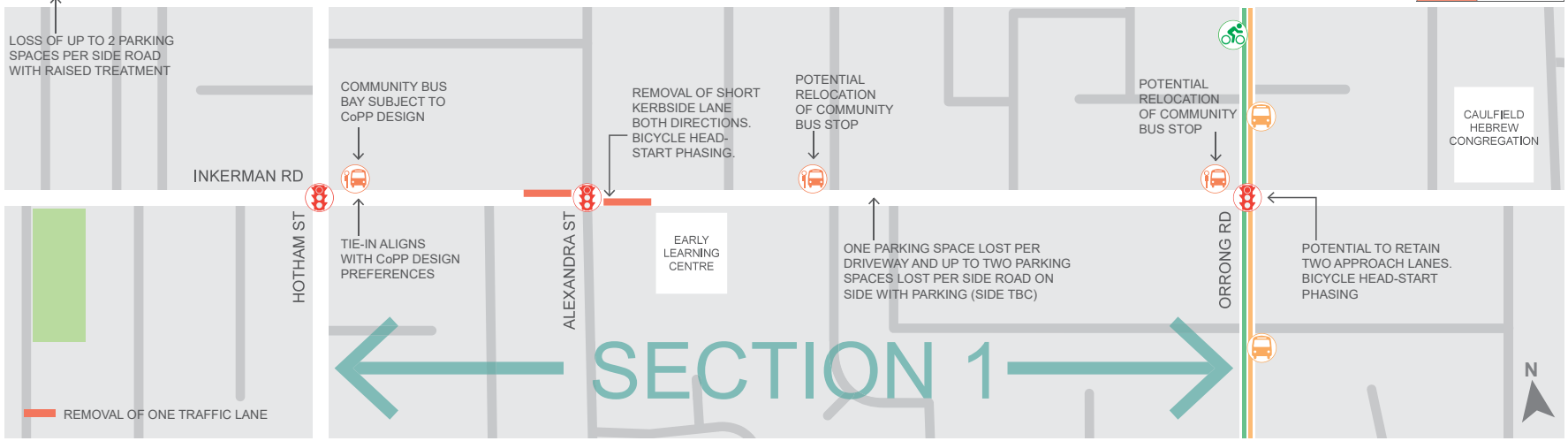
20% - 30% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY



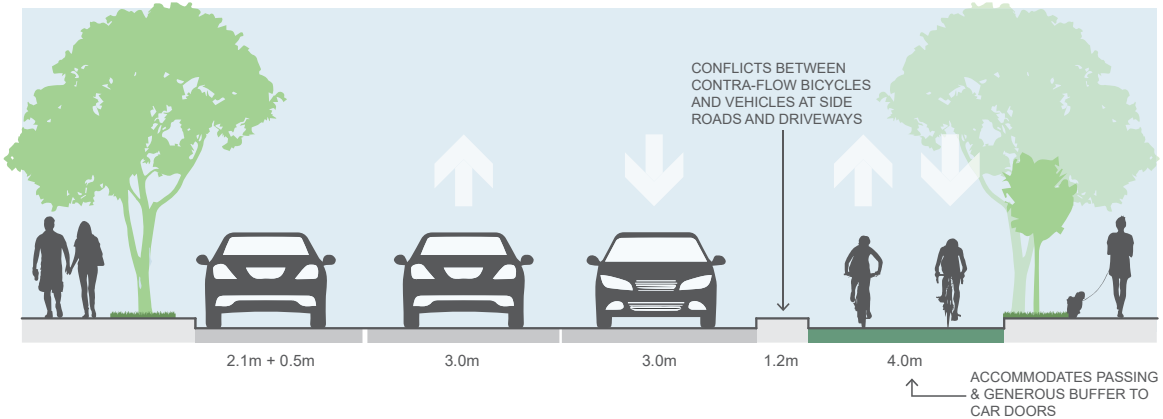
25% - 35% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



ROAD SCENARIO 2 - BI-DIRECTIONAL

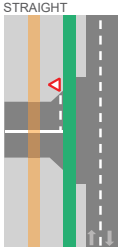
ARUP



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

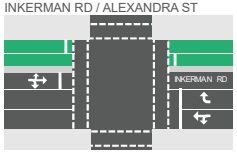
SIDE ROAD TREATMENTS

STRAIGHT

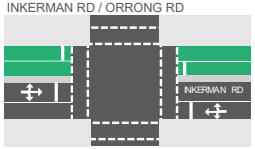


INTERSECTIONS

INKERMAN RD / ALEXANDRA ST



INKERMAN RD / ORRONG RD



PARKING PROVISION METRICS

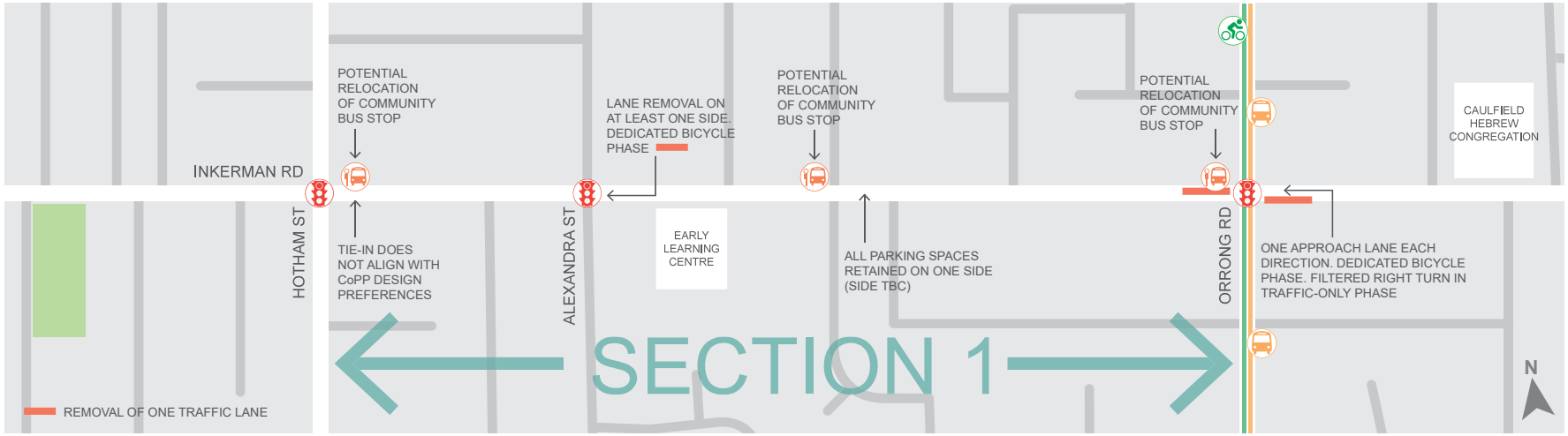
IF PARKING ON NORTH SIDE ONLY

45% - 55% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY

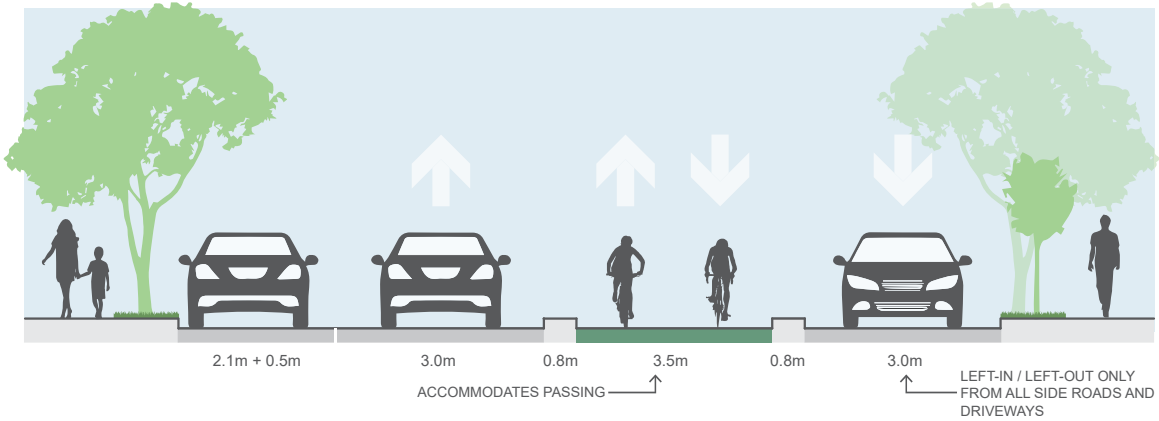
40% - 50% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



ROAD SCENARIO 3 - CENTRAL

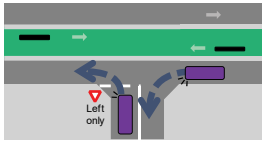
ARUP



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

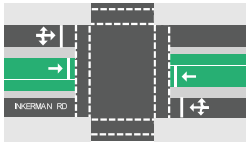
ALL SIDE ROAD TREATMENTS

LEFT-IN / LEFT-OUT ONLY



INTERSECTIONS

INKERMAN RD / ALEXANDRA ST AND ORRONG ST



PARKING PROVISION METRICS

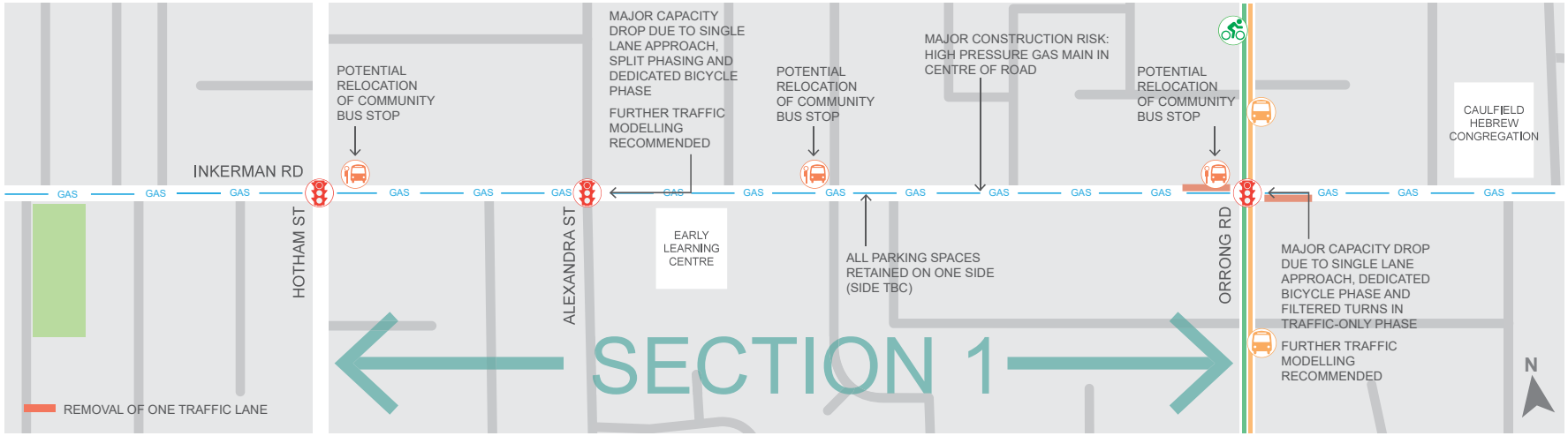
IF PARKING ON NORTH SIDE ONLY

40% - 50% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY

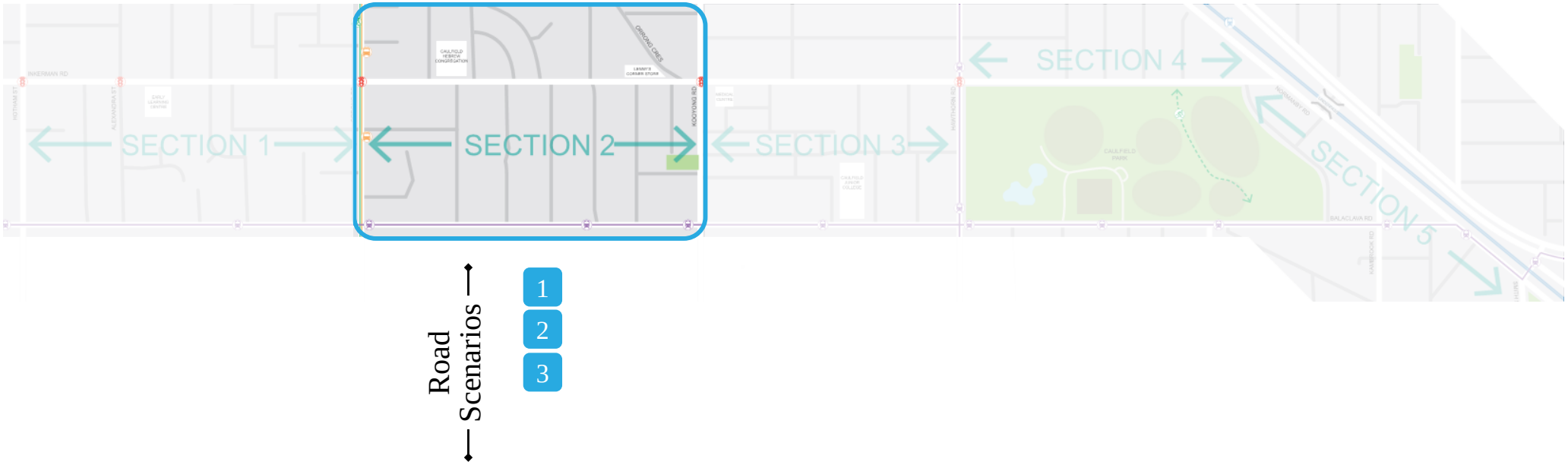
45% - 55% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



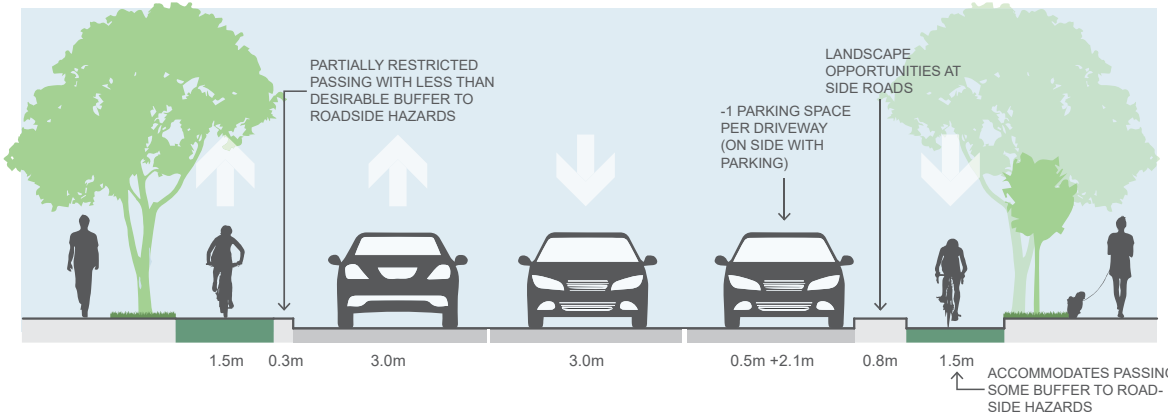
Road Scenario Appraisal

Section Two – Orrong Road to Kooyong Road



ROAD SCENARIO 1 - PROTECTED

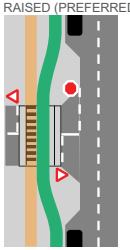
ARUP



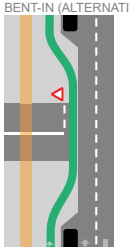
Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

SIDE ROAD TREATMENTS

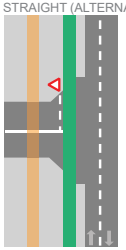
RAISED (PREFERRED)



BENT-IN (ALTERNATIVE)

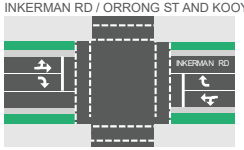


STRAIGHT (ALTERNATIVE)



INTERSECTIONS

INKERMAN RD / ORRONG ST AND KOOYONG ST



PARKING PROVISION METRICS

IF PARKING ON NORTH SIDE ONLY



20% - 30% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY



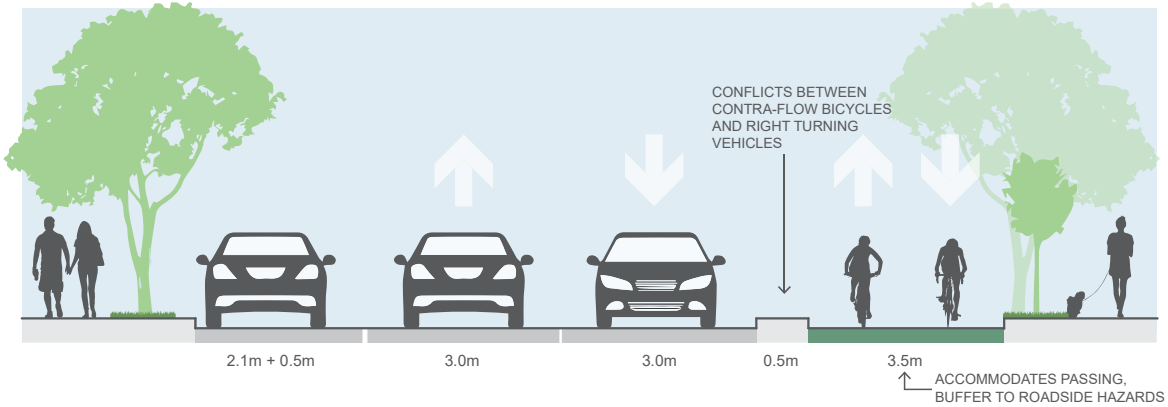
15% - 25% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



ROAD SCENARIO 2 - BI-DIRECTIONAL

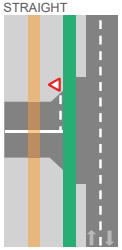
ARUP



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

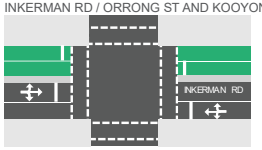
SIDE ROAD TREATMENTS

STRAIGHT



INTERSECTIONS

INKERMAN RD / ORRONG ST AND KOOYONG ST



PARKING PROVISION METRICS

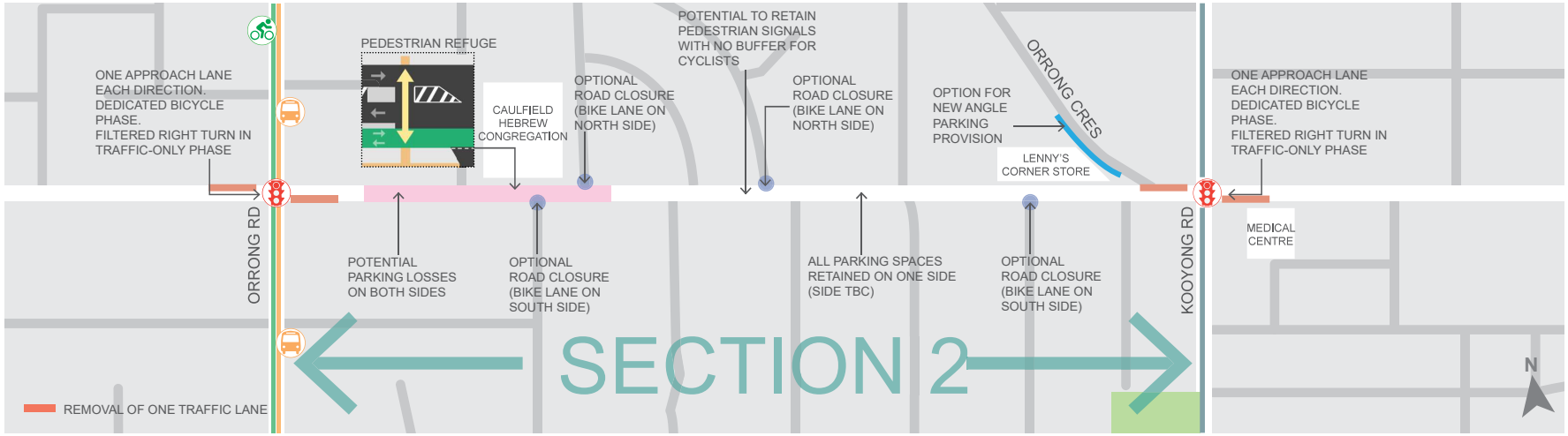
IF PARKING ON NORTH SIDE ONLY

45% - 55% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY

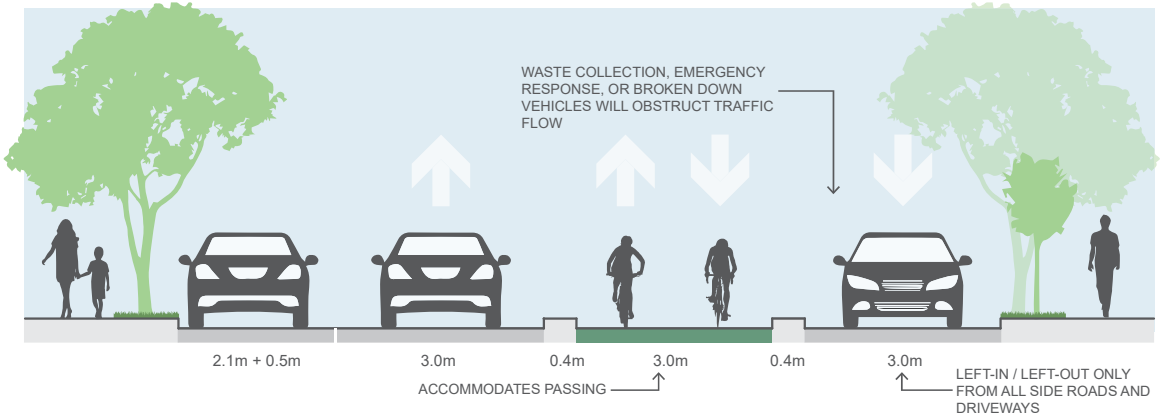
45% - 55% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



ROAD SCENARIO 3 - CENTRAL

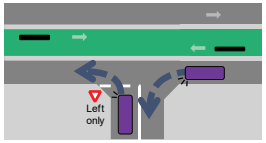
ARUP



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

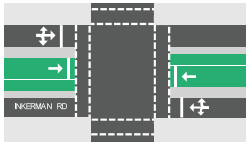
SIDE ROAD TREATMENTS

LEFT-IN / LEFT-OUT ONLY



INTERSECTIONS

INKERMAN RD / ORRONG ST AND KOOYONG ST



PARKING PROVISION METRICS

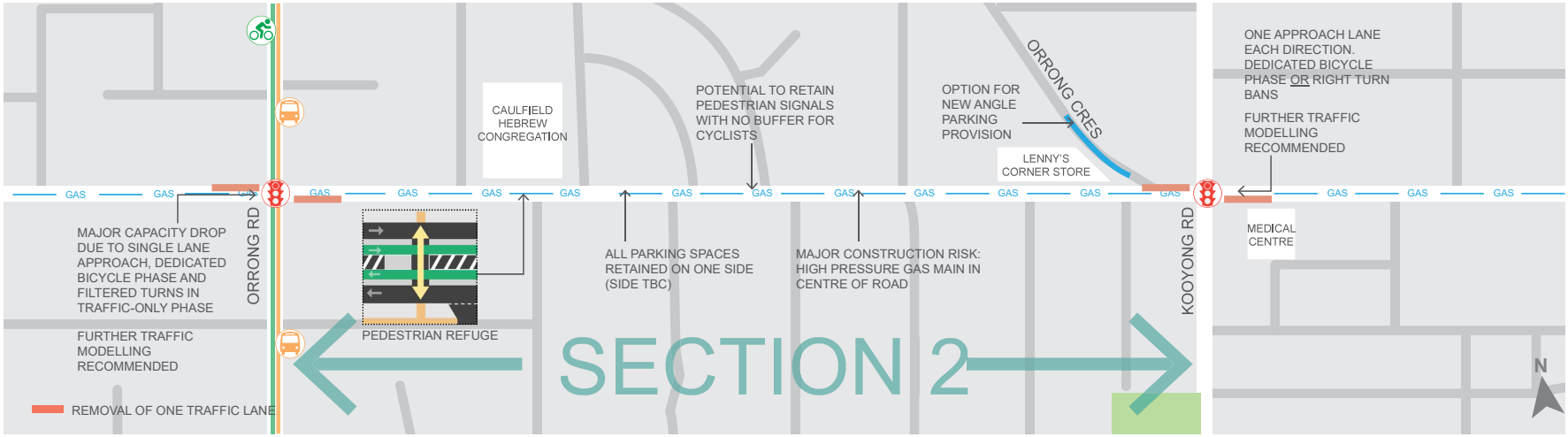
IF PARKING ON NORTH SIDE ONLY

45%-55% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY

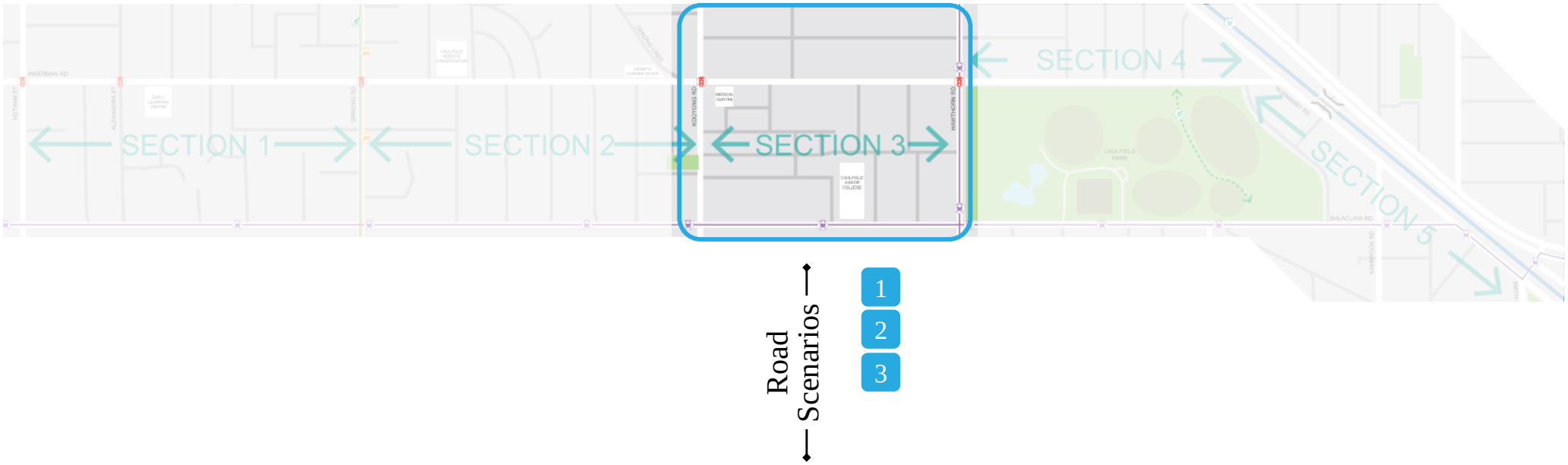
45% - 55% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



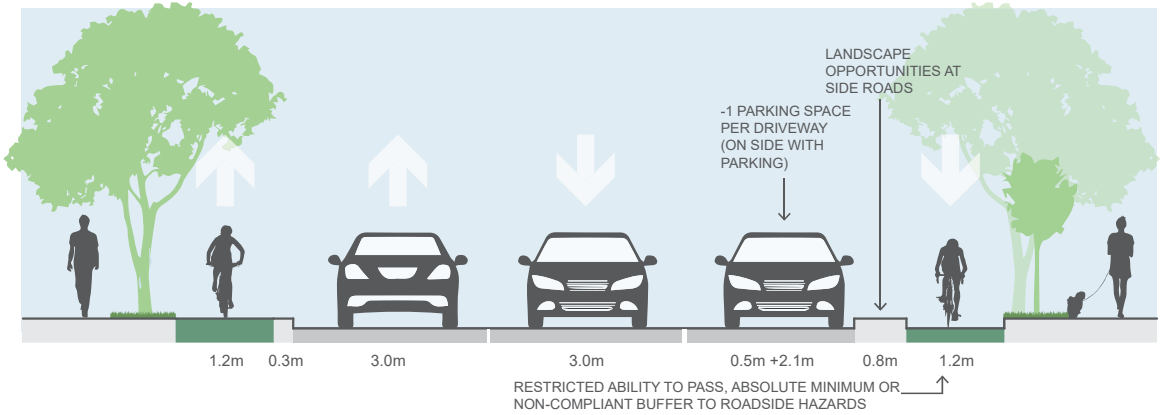
Road Scenario Appraisal

Section Three – Kooyong Road to Hawthorn Road



ROAD SCENARIO 1 - PROTECTED

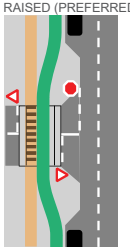
ARUP



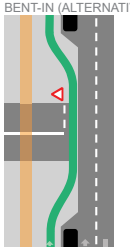
Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

SIDE ROAD TREATMENTS

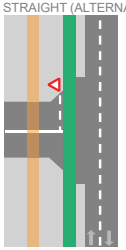
RAISED (PREFERRED)



BENT-IN (ALTERNATIVE)

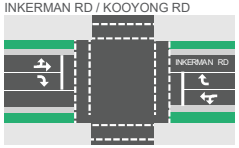


STRAIGHT (ALTERNATIVE)

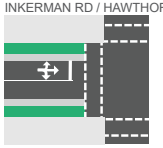


INTERSECTIONS

INKERMAN RD / KOOYONG RD



INKERMAN RD / HAWTHORN RD



PARKING PROVISION METRICS

IF PARKING ON NORTH SIDE ONLY



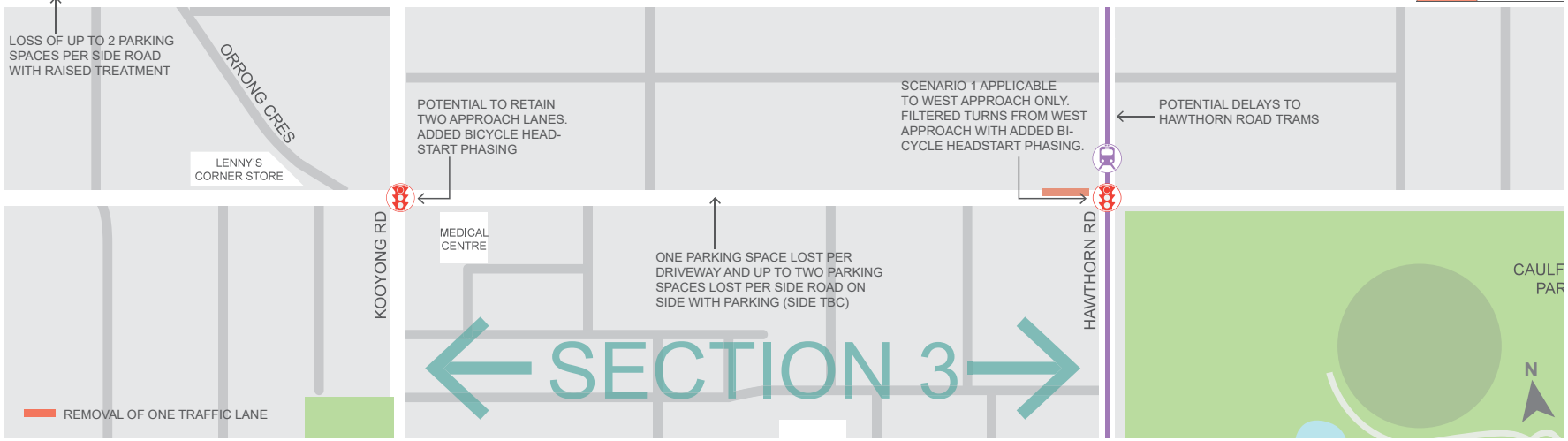
25% - 35% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY



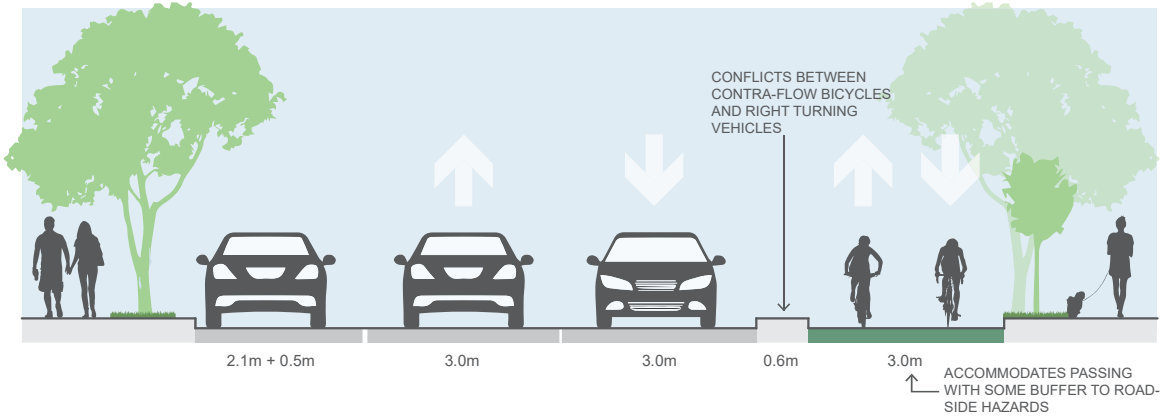
15% - 25% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



ROAD SCENARIO 2 - BI-DIRECTIONAL

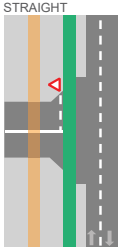
ARUP



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

SIDE ROAD TREATMENTS

STRAIGHT

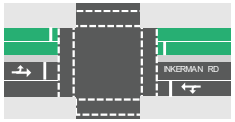


INTERSECTIONS

INKERMAN RD / KOOYONG RD



INKERMAN RD / HAWTHORN RD



PARKING PROVISION METRICS

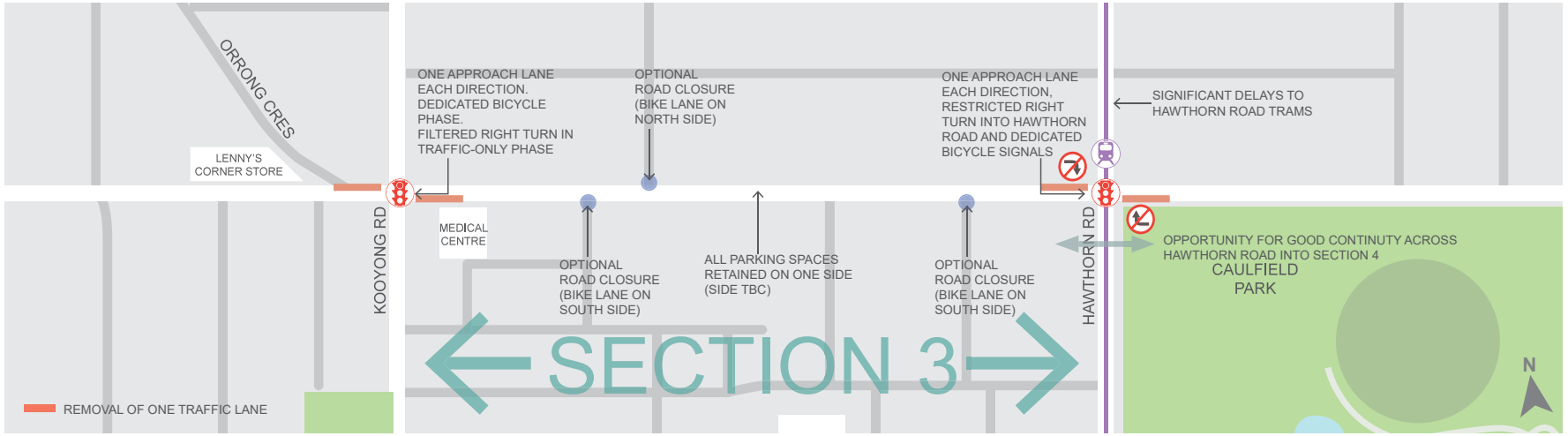
IF PARKING ON NORTH SIDE ONLY

40%-50% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY

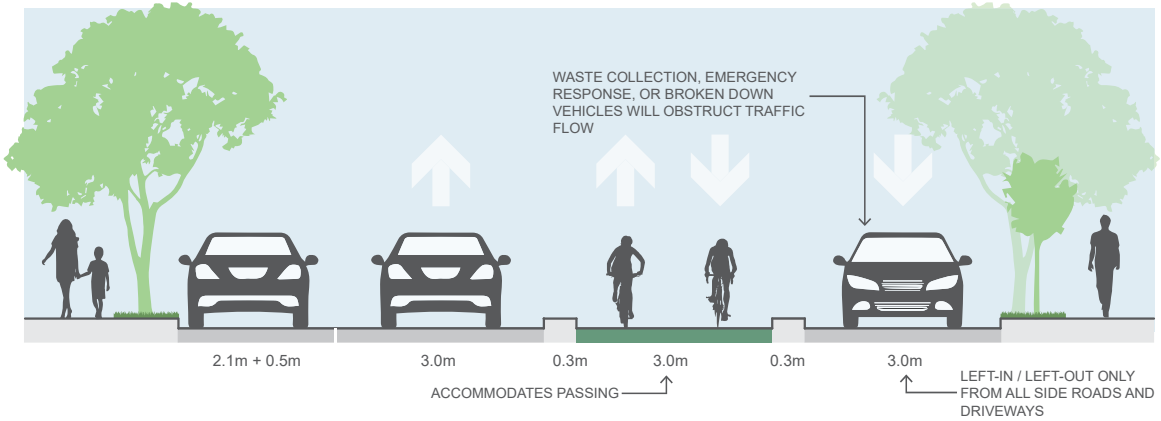
50% - 60% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



ROAD SCENARIO 3 - CENTRAL

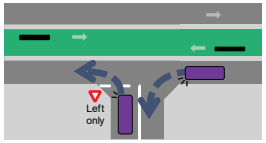
ARUP



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

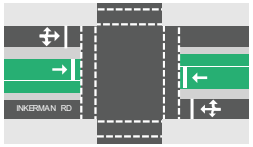
SIDE ROAD TREATMENTS

LEFT-IN / LEFT-OUT ONLY

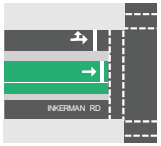


INTERSECTIONS

INKERMAN RD / KOOYONG RD



INKERMAN RD / HAWTHORN RD



PARKING PROVISION METRICS

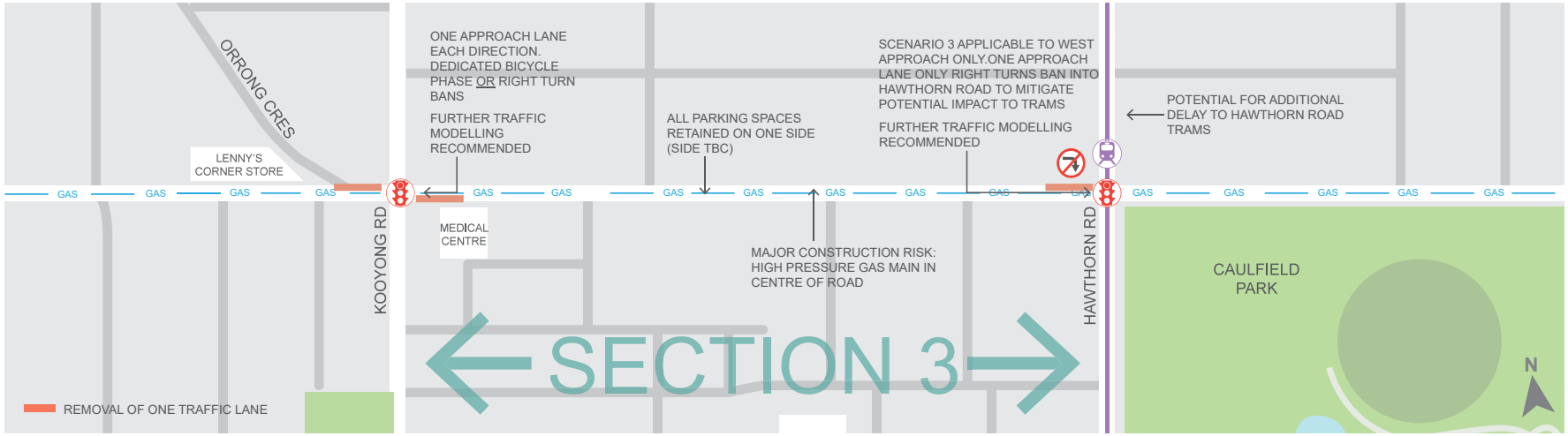
IF PARKING ON NORTH SIDE ONLY

50% - 60% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY

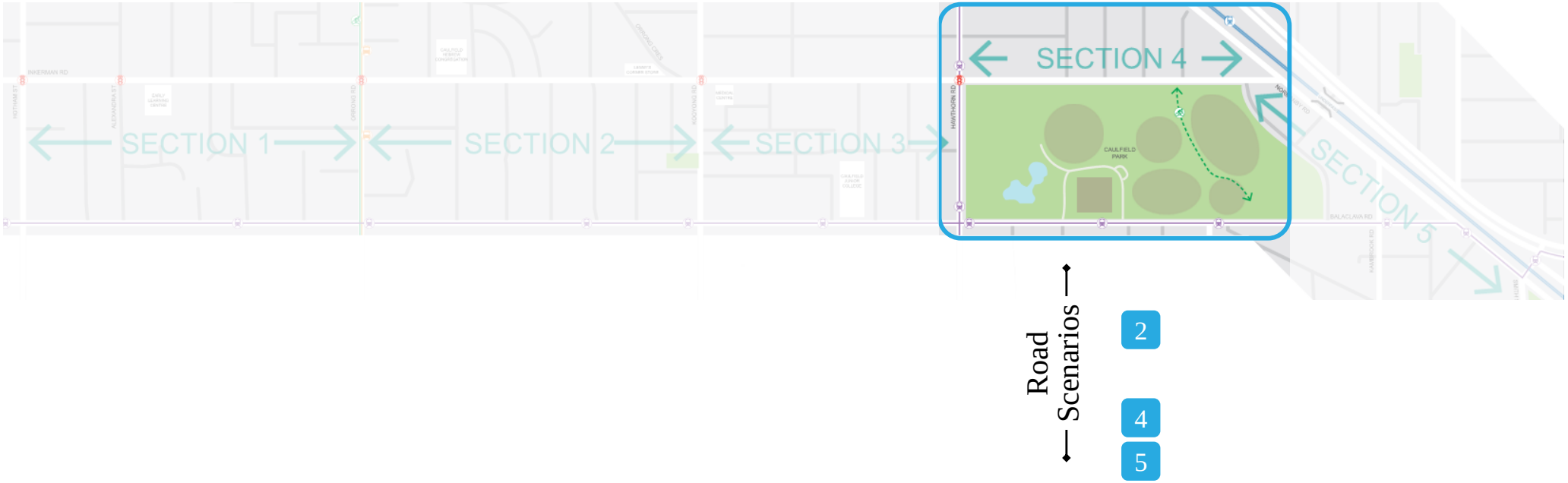
40% - 50% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



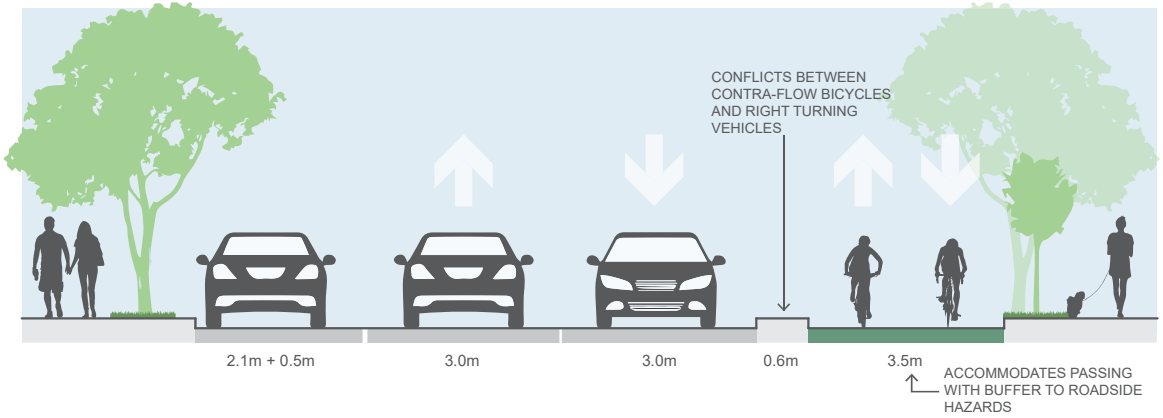
Road Scenario Appraisal

Section Four –Hawthorn Road to Normanby Road



ROAD SCENARIO 2 - BI-DIRECTIONAL

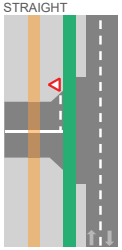
ARUP



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

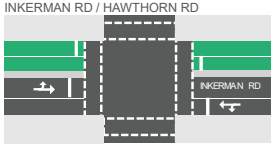
SIDE ROAD TREATMENTS

STRAIGHT



INTERSECTIONS

INKERMAN RD / HAWTHORN RD



PARKING PROVISION METRICS

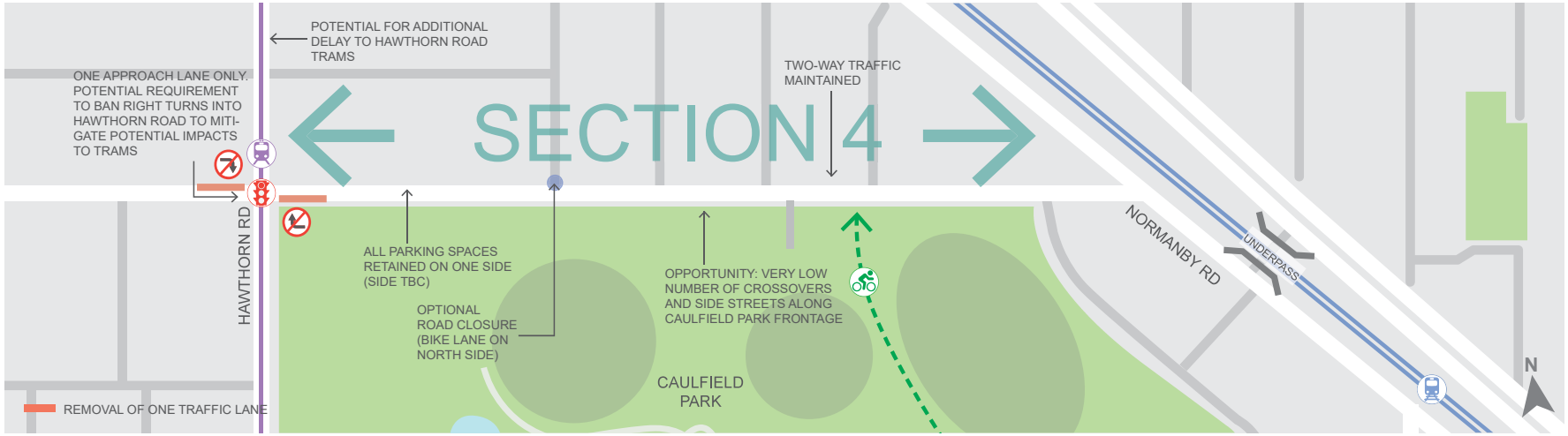
IF PARKING ON NORTH SIDE ONLY

55% - 65% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY

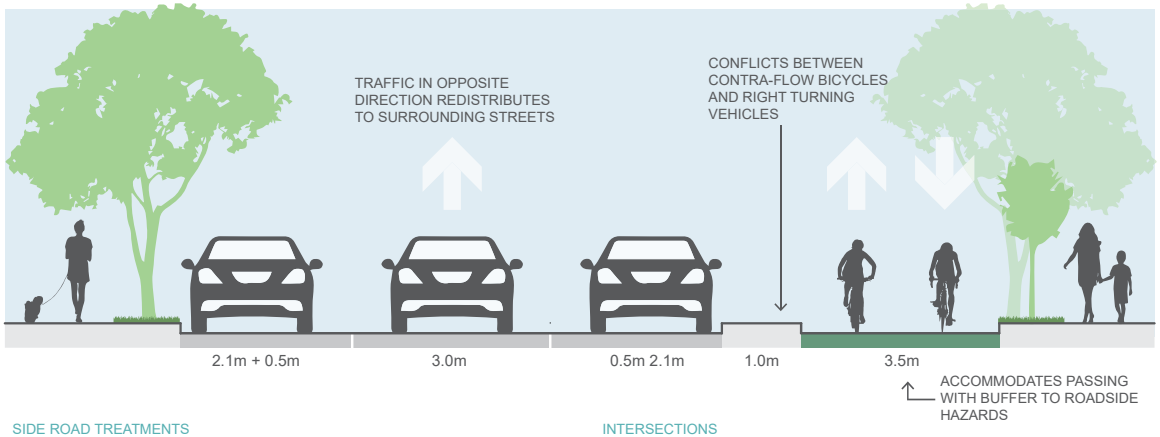
35% - 45% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



SCENARIO 4 - ONE-WAY TRAFFIC

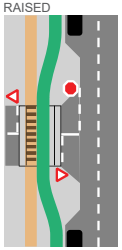
ARUP



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

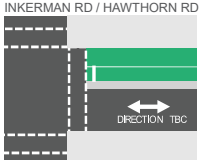
SIDE ROAD TREATMENTS

RAISED



INTERSECTIONS

INKERMAN RD / HAWTHORN RD



PARKING PROVISION METRICS

IF PARKING ON NORTH SIDE ONLY



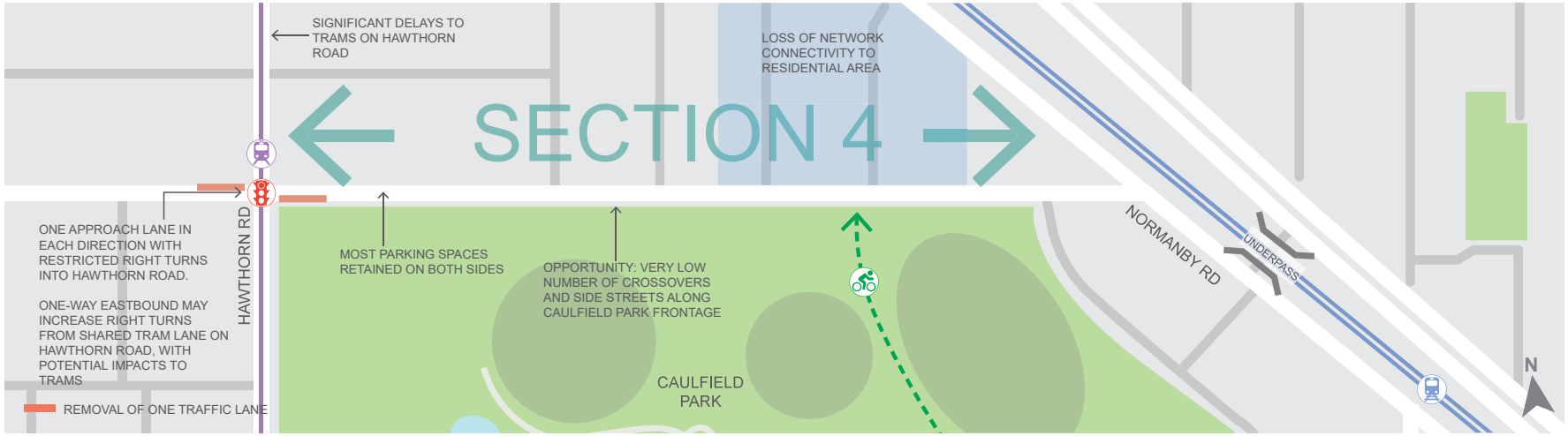
75% - 85% of existing parking retained

IF PARKING ON SOUTH SIDE ONLY



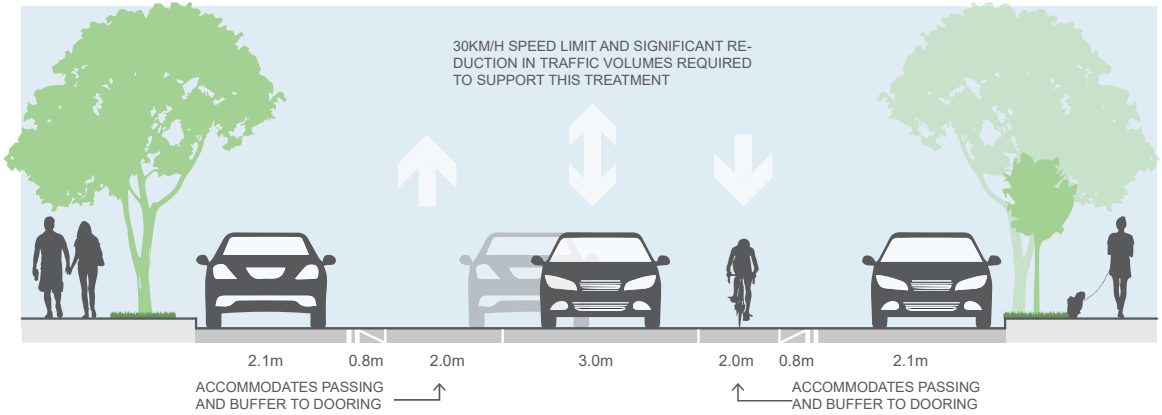
75% - 85% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



SCENARIO 5 - BIKE BOULEVARD

ARUP

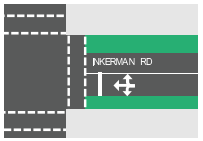


SIDE ROAD TREATMENTS

NO CHANGE - AS EXISTING

INTERSECTIONS

INKERMAN RD / HAWTHORN RD



Criteria	Criteria	Effect
Safety	Conflict points	
	Traffic stress	
	Continuity	N/A
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

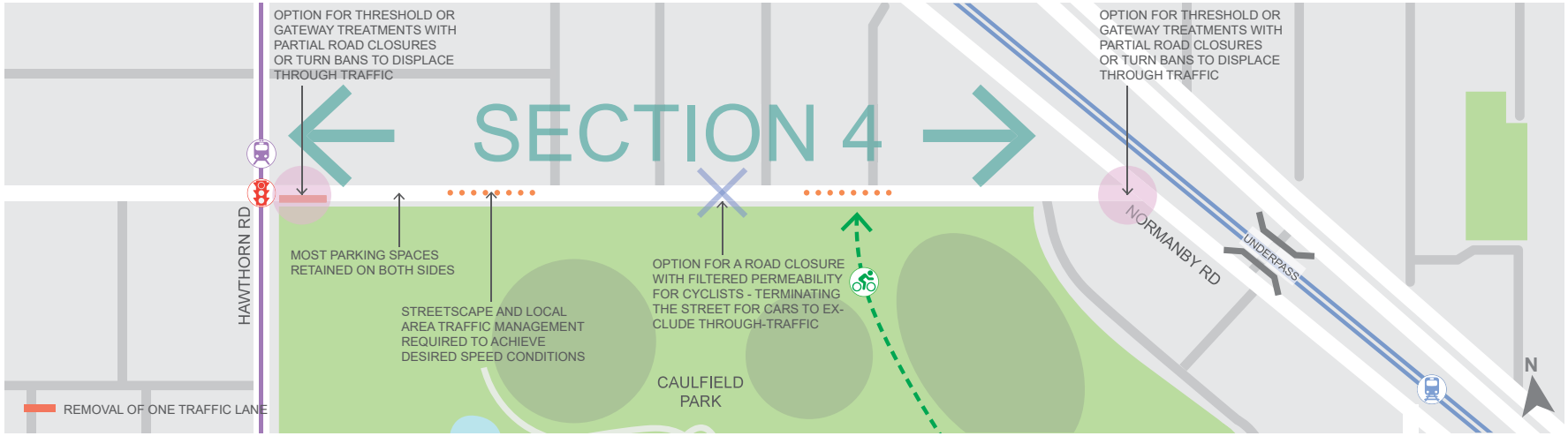
PARKING PROVISION METRICS

PARKING ON BOTH SIDES



80% - 90% of existing parking retained

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



Road Scenario Appraisal

Section Five – Inkerman Road to Balaclava Road

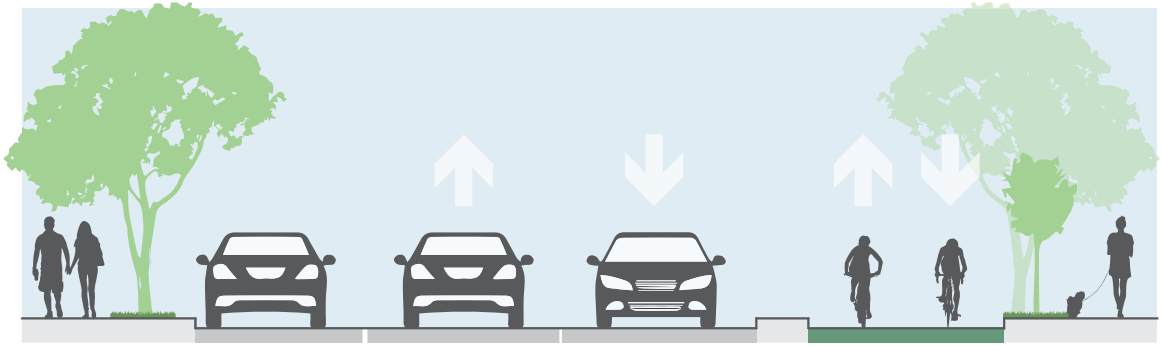


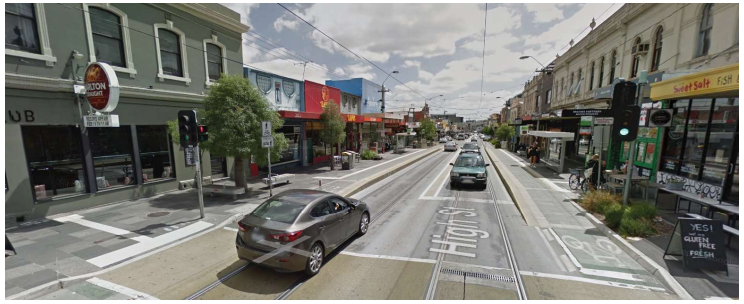
Note: This section is provided for information and discussion purposes only. There is only one feasible option under consideration for this Section, and as such a multi-criteria appraisal has not been carried out.

Road Scenarios 2

ROAD SCENARIO 2 - BI-DIRECTIONAL

ARUP

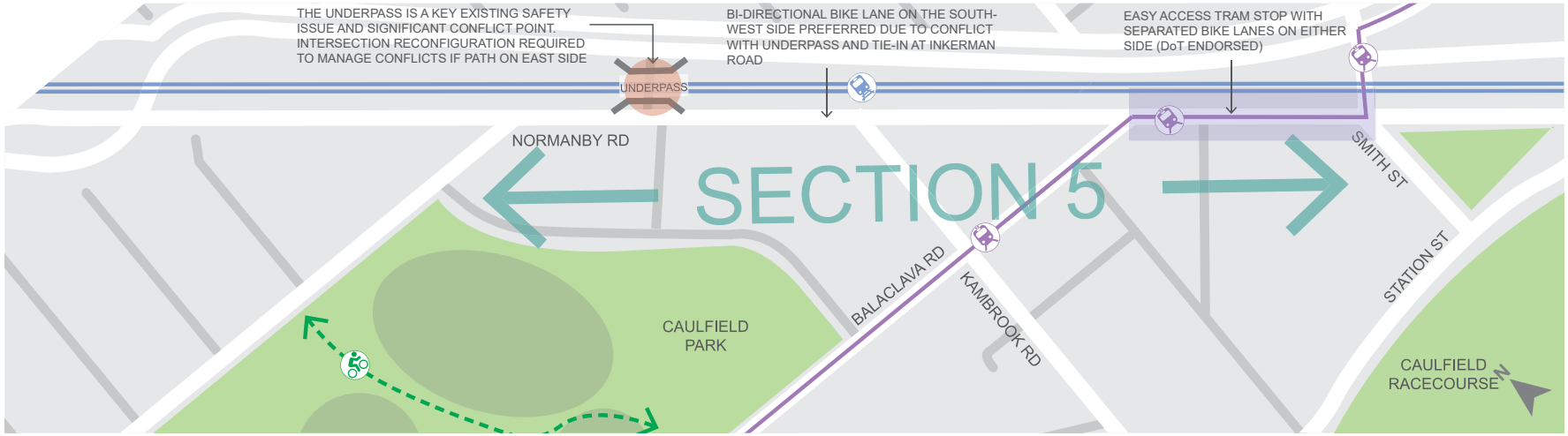




EASY ACCESS TRAM STOP
(HIGH STREET, NORTHCOTE)

Criteria	Criteria	Effect
Safety	Conflict points	NOT ASSESSED
	Traffic stress	
	Continuity	
	Ease of use	
	Pedestrian safety, access and amenity	
	Roadside hazards	
	Crash risk	
Neighbourhood	Car parking	
	Connectivity	
	Property access	
	Public transport	
	Traffic operations	
	Streetscape	
Feasibility	Alignment with authority objectives	
	Emergency services	
	Waste collection and street cleaning	
	Construction cost and risk	

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative



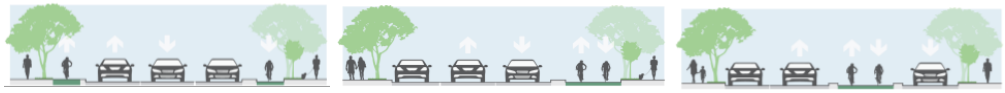
Appraisal Outcomes

ARUP

Road Scenario Appraisal: Hotham to Hawthorn (Section 1 to 3)

This table shows the multi-criteria appraisal of all feasible Road Scenarios along Inkerman Road between Hotham Street and Hawthorn Road.





Category	Criteria	Scenario 1			Scenario 2			Scenario 3		
		Hotham to Orrong	Orrong to Kooyong	Kooyong to Hawthorn	Hotham to Orrong	Orrong to Kooyong	Kooyong to Hawthorn	Hotham to Orrong	Orrong to Kooyong	Kooyong to Hawthorn
Safety	Conflict points - side streets									
	Conflict points - crossovers									
	Traffic stress									
	Continuity									
	Ease of use									
	Pedestrian safety, access and amenity									
	Roadside hazards									
	Crash history									
Neighbourhood	Car parking									
	Connectivity									
	Property access									
	Public transport									
	Traffic operations									
	Streetscape									
Feasibility	Alignment with road and transport authority objectives and requirements									
	Emergency services									
	Waste collection and street cleaning									
	Construction cost and risk									

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative

Appraisal Outcomes

ARUP

Road Scenario Appraisal: Hawthorn to Normanby (Section 4)

This table shows the multi-criteria appraisal of all feasible Road Scenarios along Inkerman Road between Hawthorn Road and Normanby Road.









Category	Criteria	Scenario 2 Hawthorn to Normanby	Scenario 4 Hawthorn to Normanby	Scenario 5 Hawthorn to Normanby
Safety	Conflict points - side streets			
	Conflict points - crossovers			
	Traffic stress			
	Continuity			
	Ease of use			
	Pedestrian safety, access and amenity			
	Roadside hazards			
	Crash history			
Neighbourhood	Car parking			
	Connectivity			
	Property access			
	Public transport			
	Traffic operations			
	Streetscape			
Feasibility	Alignment with road and transport authority objectives and requirements			
	Emergency services			
	Waste collection and street cleaning			
	Construction cost and risk			

Colour	Rating
	Large positive
	Moderate positive
	Neutral
	Moderate negative
	Large negative

6. Next Steps [Stage 2]

Translating the Road Scenarios into Concept Designs for the Corridor Plan

ARUP

Next Steps

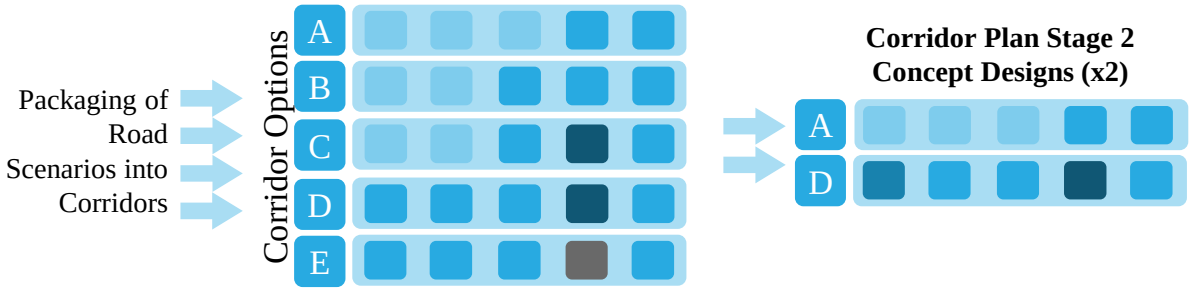
ARUP

Stage 2

Corridor Options and Concept Design

Road Scenarios will be packaged up across the corridor into 'continuous' Corridor Options with inputs and feedback from the CRG, the TAG, and Council Officers.

Two Corridor Options will be selected to proceed into Concept Design and will be documented in a Corridor Plan Stage 2 report.



Attachment A

Detailed Road Scenario Appraisal Outputs

ARUP

GLEN EIRA CITY COUNCIL

Inkerman Safe Cycling Corridor – Community Engagement Outcomes Report

[OCTOBER 2022]

GECC TITLE

TABLE OF CONTENTS

PURPOSE OF ENGAGEMENT 3
ENGAGEMENT APPROACH 3
STAGES OF ENGAGEMENT 4

PURPOSE OF ENGAGEMENT

To invite and collect stakeholder input on the Safe Cycling Corridor along Inkerman Road and ensure that views and concerns are reflected in the development of the Corridor Plan design option/s.

By doing so, we will ensure that a design is developed that considers stakeholder input and standards of safety for cyclists.

Through this phase of engagement, we aim to:

- Review the findings from phase one and phase two of community engagement findings as well as research and data gathered by Council with groups.
- Ensure development of the Draft Corridor Plan reflects community values and priorities.
- Provide feedback and advice on potential issues and opportunities.

ENGAGEMENT APPROACH

This stage of engagement involved targeted engagement via three stakeholder groups. Community engagement activities were organised so that input would build and contribute toward the development of concept designs for a Safe Cycling Corridor along Inkerman Road.

These stakeholder groups involved were:

Community Reference Group (CRG)
A group made up of local community members, whose purpose was to represent diverse community views in providing advice and input on the Safe Cycling Corridor Project. Convened in an advisory role, with no decision-making capacity. Meetings were independently chaired.

Technical Advisory Group (TAG)
A group that included technical experts from road management authorities and key stakeholders including; the Department of Transport, Major Road Projects Victoria, Yarra Trams, Bicycle Network and City of Port Phillip.
The group was made up of members with decision-making roles independent of Council.

Strategic Transport Advisory Committee (STAC)
A group consisting of Councillors and community members. The group is a decision-making body of Council with a reviewing and recommending capacity for strategic transport projects.

STAGES OF ENGAGEMENT

There were three meetings across this stage of community engagement with the same subjects and aims with each of the different stakeholder groups. For detailed meeting minutes, notes, design responses and responses to questions please refer to appendix 1.

MEETING 1

Aim of first meeting with stakeholder groups

To discuss previous community engagement findings, research and information, and prioritise corridor designs and help determine preferences of these before moving to design.

CRG meeting date – 17 February 2020

CRG 'dotmocracy' exercise

Following introductions and icebreakers, the facilitator led a 'dotmocracy' exercise that involved each group member assigned three dots to sub-criteria themes they thought were most important, results below:

Safety criteria	Neighbourhood criteria	Feasibility criteria
Conflict points - 12	Car parking – 16	Construction cost & risk – 11
Traffic stress - 9	Property access – 11	Emergency services – 5
Pedestrian safety, access & amenity - 8	Traffic operations – 5	Alignment with network and planning objectives – 4
Continuity of cycling infrastructure - 3	Streetscape – 3	Other** – 3
Crash history - 2	Connectivity to key landmarks – 2	Alignment with waste and street cleaning operations - 0
Ease of use – 1	Public transport - 0	
Roadside hazards – 0		

Other** – In feasibility it should also consider people directly affected, those on the corridor. Emergency services access etc.

Road scenarios workshop

Following an overview of road scenarios from consultant ARUP, CRG members provided comments on each of the road scenario options.

Road scenario	Arup - key points	CRG - Overall comments
Road scenario 1. Mix of protected bicycle lanes on one side (with parking), and raised separated lanes on the other (no parking).	• A familiar type of bicycle facility for road users, with opportunities for landscaping and pedestrian priority at side roads. • Lowest impact to traffic and public transport operations. • Least amount of on-street parking retained due to sight distance requirements at driveways (25–30% retained). • Safety and comfort for cyclists is reduced in narrow section (Kooyong Road to Hawthorn Road) with 1.2m wide bicycle lanes.	• Considered the most workable scenario by one of the three small CRG groups. • Positive aspects of this scenario included greater cyclist protection, more intuitive traffic flow, and greater safety for pedestrians to cross. • Negative aspects included the potential for greater impacts on parking, greater opportunity for conflict between cars and bikes, as well as cost.
Road scenario 2. Protected bi-directional bicycle lanes with parking on one side	• A low stress, and continuous bicycle facility is possible, maintains at least a 3m width. • All parking on one side of the corridor is retained (45–55%). • Higher risk of conflict at side streets and driveways. • Moderate impacts to traffic and mitigation works required to avoid impacts to public transport. • Restricted right turns at Hawthorn Road.	• Considered the most (or second most) workable scenario by all CRG small groups. • Note that in considering this, some members had caveats around preferred side of the road for parking and other aspects of the design. • Positive aspects of this scenario included the width of the bike lane, the retention of two-way traffic and limitations on parking loss. • Negative aspects included the potential conflict between cyclists travelling in different directions, a less intuitive arrangement for cyclists, and issues with right/left turning lane.
Road scenario 3. Protected bi-directional central bicycle lanes with parking on one side	• No conflicts at side roads or driveways, however, access on and off the path is less intuitive. • All parking on one side of the corridor is retained (45–55%). • Large impact to traffic and public transport operations. • Carriageway width may impact on emergency services and vehicle break down events.	• Considered least workable scenario by two of the three small groups. Considered second most workable by one of the three small groups. • Positive aspects included the level of access to property by vehicle and the removal of risks from driveways and side streets. • Negative aspects included issues with entry and exit to centre lane (too hard to get to), less turning capacity for vehicle and access to property.

Road scenario 2. Protected bi-directional bicycle lanes with parking on one side	• A low stress, and continuous bicycle facility is possible, maintaining (at least) a 3m width. • Two-way traffic is maintained. • Ability to place the protected bike lane next to Caulfield Park to reduce conflict points. • All parking on one side of the corridor is retained (40–60%). • Moderate impacts to traffic and mitigation works required to avoid impacts to public transport.	• Considered the most workable scenario by one of the three small groups. • Positive aspects of this scenario included the width of the bike lane, the retention of two-way traffic, and limitations on parking loss. • Negative aspects included the conflict potential between cyclists travelling in different directions, less intuitive arrangement for cyclists, and issues with right/left turn lane.
Road Scenario 4. One-way traffic and protected bi-directional bike lane (kerbside)	• Most parking spaces are retained on both sides (80–90%). • A low stress, and continuous bicycle facility is possible, maintaining (at least) a 3m width. • Very low risk of conflict if bicycle facility located along Caulfield Park. • Traffic is reduced to one-way, affecting traffic direction to property access and potential impact to wider traffic network.	• Considered most workable scenario by two of the three small groups. The third group considered it least workable scenario. • Positive aspects of this scenario included the retention of parking in both sides of the road, attractiveness of cyclists, and maintenance of traffic flow through intersection.
Road scenario 5. Bike boulevard (speed reduction and traffic calming)	• Most parking spaces are retained on both sides (80–90%). • Significant improvements to pedestrian and cyclist safety with reduced speed limit to 30km/h. • Creates opportunities for streetscape enhancement. • Changes to the road environment required to reduce traffic volumes and speeds. • Traffic redistribution may impact surrounding roads and streets.	• Generally, not considered most workable – however, some CRG members were interested to see a more detailed design of this and considered that it could be workable if heavy vehicles were banned and/or significant traffic calming measures implemented. • Negative aspects of this scenario considered to include frustration by park users, risks for riders (low attractiveness for less confident riders), more conflict potential.

TAG meeting date – 20 February 2020

Following an overview of road scenarios from consultant ARUP, TAG members provided comments on each of the road scenario options.

Road scenario	Arup - key points	TAG - Overall comments
Road scenario 1. Mix of protected bicycle lanes on one side (with parking), and raised separated lanes on the other (no parking).	• A familiar type of bicycle facility for road users, with opportunities for landscaping and pedestrian priority at side roads. • Lowest impact to traffic and public transport operations. • Least amount of on-street parking retained due to sight distance requirements at driveways (25–30% retained). • Safety and comfort for cyclists is reduced in narrow section (Kooyong Road to Hawthorn Road) with 1.2m wide bicycle lanes.	• The preferred scenario for City of Port Phillip. • Also, perceived as a preferred option by the Department of Transport in terms of safety for cyclists. • This scenario was recognised as one that would have major impacts on on-street parking.
Road scenario 2. Protected bi-directional bicycle lanes with parking on one side	• A low stress, and continuous bicycle facility is possible, maintains at least a 3m width. • All parking on one side of the corridor is retained (45–55%). • Higher risk of conflict at side streets and driveways. • Moderate impacts to traffic and mitigation works required to avoid impacts to public transport. • Restricted right turns at Hawthorn Road.	• Overall, perceived as a feasible scenario. The design would need to address potential conflict points at side streets, where drivers would need to look both ways for approaching cyclists. • The main advantage was the higher retention (45–55%) of parking on one side of the road, which could mean more community acceptance. • It could provide a continuous link to the bi-directional scenarios proposed for the Caulfield Park Section and Normanby Road. • Since Port Phillip Council is considering the implementation of scenario 1, a transition would need to be provided either at the intersection of Hotham Street or Orrong Road.
Road scenario 3. Protected bi-directional central bicycle lanes with parking on one side	• No conflicts at side roads or driveways, however, access on and off the path is less intuitive. • All parking on one side of the corridor is retained (45–55%). • Large impact to traffic and public transport operations. • Carriageway width may impact on emergency services and vehicle break down events.	• Overall, this scenario was not considered feasible for implementation. • Key limitations are related to cyclist accessibility to the centre road bike lanes, the traffic impacts (vehicles will not be able to make right turns), low clearance emergency vehicle impact and not being a familiar treatment for cyclists.

Road scenario 2. Protected bi-directional bicycle lanes with parking on one side	• A low stress, and continuous bicycle facility is possible, maintaining (at least) a 3m width. • Two-way traffic is maintained. • Ability to place the protected bike lane next to Caulfield Park to reduce conflict points. • All parking on one side of the corridor is retained (40–60%). • Moderate impacts to traffic and mitigation works required to avoid impacts to public transport.	• Overall, this scenario was considered as feasible. • The key advantage is positioning the bi-directional cycle lane next to Caulfield Park to reduce conflict points. • Retains parking on one side of the road. • Provides a seamless connection to a bi-directional protected bike lane on Normanby Road.
Road Scenario 4. One-way traffic and protected bi-directional bike lane (kerbside)	• Most parking spaces are retained on both sides (80–90%). • A low stress, and continuous bicycle facility is possible, maintaining (at least) a 3m width. • Very low risk of conflict if bicycle facility located along Caulfield Park. • Traffic is reduced to one-way, affecting traffic direction to property access and potential impact to wider traffic network.	• Overall, this scenario was considered feasible. • Like scenario 2, one advantage is positioning the bi-directional cycle lane next to Caulfield Park to reduce conflict points. • Retains parking on both sides of the road. • If traffic volumes can be reduced to convert this section of Inkerman Road, seems to be the preferred option to retain parking in both sides of the road.
Road scenario 5. Bike boulevard (speed reduction and traffic calming)	• Most parking spaces are retained on both sides (80–90%). • Significant improvements to pedestrian and cyclist safety with reduced speed limit to 30km/h. • Creates opportunities for streetscape enhancement. • Changes to the road environment required to reduce traffic volumes and speeds. • Traffic redistribution may impact surrounding roads and streets.	• This scenario was not considered a feasible option. The level of protection to cyclists does not achieve the criteria for a Safe Cycling Street (Glen Eira) or a Strategic Cycling Corridor (DoT).

STAC meeting date – 20 February 2020

Assessment of road scenarios

Council Officers provided elements of the methodology assessment:

- Technical Appraisal ARUP
- Feedback received from the CRG and TAG

Following an overview of road scenarios from consultant ARUP and feedback received from the CRG and TAG, STAC members provided the following broad comments on each of the road scenario options:

- Overall, it was agreed that Road Scenario 5 did not provide the levels of protection for cyclists that the project is seeking to achieve.
- Both Road Scenarios 2 and 4, were considered feasible. Further, it was concluded that the bi-directional protected bike lane should be located next to Caulfield Park (south side of the road) to avoid conflict points with driveways crossovers and side streets.

- STAC preferred options for Sections 1 to 3 (Hotham Street to Normanby Road) are Road scenario 1 and Road Scenario 3. However, it was also noted that Road Scenario 4 would be preferable for keeping parking on both sides of the road.
- STAC preferred options for section 4 (Caulfield Park) are Road Scenario 2 and Road Scenario 4. It was raised the need to consider a north-south bike connection through Caulfield Park.
- No major issues were raised for the implementation of Road Scenario 2 along Normanby Road. It was suggested to explore enhancing the underpass that links Normanby Road–Dandenong Road–Tooronga Road as part of this project.

<u>Recommendations from meeting 1 of CRG, STAC and TAG meetings:</u>

Considering feedback from stakeholder groups, it is suggested that Council further explores the following:

- ***Road Scenario 4. One-way traffic and protected bi-directional bike lane (kerbside)***

Providing the opportunity to retain parking on both sides of the road. Further, the provision of a bi-directional protected bike lane next to Caulfield Park reduces conflict points while providing a seamless transition to a bi-directional bike lane on Normanby Road.

Section 5 – Normanby Road



Scenario 1 was explored as an alternative for Normanby Road, however, the corridor narrows north of Balaclava from approximately 13.0m to 11.6m, with a narrow point of 10.4m south of the Dandenong Road underpass. This width would not accommodate an acceptable cross section that provides a safe and functional cycling lane width and safe parking separator width as well as a safe and functional parallel parking lane and a standard 3.0m-wide traffic lane as presented in scenario 1.

For this reason, Scenario 2 is considered the only feasible option to consider on Normanby Road.

This information was provided to all key stakeholder groups and no major issues were raised.

EXTRA REFRESHER MEETING FOR THE CRG

CRG Meeting: 16 February 2022

Following a lengthy pause in the project during the rolling Covid-19 lockdowns, an extra meeting was held online for CRG members on 16 February 2022, re-introducing community members to the project and providing them with an update on the status of the project since meeting in 2020.

This virtual meeting involved Council Officers updating on the progress of technical consultants and setting the scene for the upcoming draft Corridor Plan workshop with technical consultants.

MEETING 2
Aim of second meeting with stakeholder groups
To discuss and group feedback on a draft Corridor Plan and parking opportunities.

CRG Meeting: 28 April 2022
Council's project team updated the CRG that it had been asked to prepare a report for Council on two corridor design options with a clear recommendation. The report would capture the views from a number of sources, including the Community Reference Group.
Two design options:

- Hybrid: Two way to the park, then one way at the park. Parking on one side.
- One way: Westbound all the way, parking on both sides and eastbound all the way.

Design workshop
Arup pointed out the following design principles before presenting corridor options:

- Scope of design is to generally retrofit within existing carriageway, given the cost and constructability impacts (outside the carriageway).
- Parking retention is a key priority. However, where adjacent the bike path, parking is set back from the edges of driveways, to accommodate vehicle manoeuvring and visibility.
- Bi-directional bike paths are adopted to optimise efficiency where road width is constrained. They minimise space taken up by car door buffer zones and provide space for passing.
- Bicycle lanterns and dedicated traffic signal phases assumed to be provided to manage conflicts at intersections.
- A whole of street project – consider neighbourhood placemaking opportunities.

Road scenario	CRG comments
Option 2 workshop: two-way traffic, bi-directional bike lane design	Key comments included: • Concerns around the safety of right-turning cyclists at intersections. • Questions around bin storage. • Safety concerns for cars backing out across bike lanes. • Discussion on location of crossings on Inkerman Road. • Concerns around impact to vehicle access and parking for elderly and carers. • Discussion on the importance of maintaining emergency services. • Ensuring consistency for utility access.
Option 1 workshop: one-way traffic, bi-directional bike lane	Key comments included: • Considerations for pedestrian crossing locations. • Concerns around intersection problems at Inkerman Road / Normanby Road. • Request for no impact to Caulfield Park. • Benefits to the community and the importunity to increase vegetation to enhance the neighbourhood (opportunity for tree planting and 'miniparks' along the corridor). • Concerns around the impact to congestion on the network.

	• Concerns for the safety of pedestrians and cyclists and the impact to roads that will carry additional traffic if the proposed design occurred. • Impact to public transport causing tram delays. • Impact of rat running on local streets. • Unsure about the cost vs benefit and whether the return on investment is there. • Concern that the design will impact property values due to impact on access. • Concerns for sight lines when reversing.

Traffic Modelling Outcomes
Onemilegrid (OMG) presented on the findings from the traffic report.

Following the presentation, the CRG provided the following discussion points:

CRG
• Discussion on how growth was applied to the model to assess a worst-case scenario (in accordance with Department of Transport requirements) • Discussion on the impact of rat-running on how this would be resolved. Discussion included the requirement for Local Area Management Plans to be considered if the impact of the cycling corridor resulted in rat running.

Other things discussed by the CRG during the second meeting:

- The question was asked: "In terms of the neighbourhood and how it feels to experience the corridor, what would you like to see?" Responses included:
  - Adequate parking and parking near shops
  - Protected pedestrian crossings
  - Amenity access
  - Safe pedestrian crossings
  - Safe sight lines
  - Mini parks
  - Ease of travel and access

- Asked whether based on the information available to date whether there was a preferred corridor option. The results were:
  - One-Way: 1 vote
  - Two-Way: 2 votes
  - Hybrid (two-way to park, one-way at park): 2 votes

- Asked how strongly would they like the project team to advocate to Council for the one-way option? The response was:
  - 'Not at all, I prefer the two-way option': 4
  - 'Somewhat': 1

CRG members questioned whether the number of cyclists likely to use the proposed bike facility was assessed and included within the feasibility study. Council Officers confirmed that this had not been assessed yet.
The CRG raised concerns that this information is important to assess the safety implications and the likely impact to people accessing their homes via Inkerman Road (specifically backing out of their driveways and crossing the proposed path).
Council Officers commented that the number of cyclists likely to use the proposed design had not been determined. However, this would be addressed before presented to Council for consideration.

STAC Meeting: 2 May 2022
Design workshop
Arup pointed out the following design principles before presenting corridor options:

- Scope of design is to generally retrofit within existing carriageway, given the cost and constructability impacts (outside the carriageway).
- Parking retention is a key priority. However, where adjacent the bike path, parking is set back from the edges of driveways, to accommodate vehicle manoeuvring and visibility.
- Bi-directional bike paths are adopted to optimise efficiency where road width is constrained. They minimise space taken up by car door buffer zones and provide space for passing.
- Bicycle lanterns and dedicated traffic signal phases assumed to be provided to manage conflicts at intersections.
- A whole of street project – consider neighbourhood placemaking opportunities.

Road scenario	STAC comments
Option 2 workshop: two-way traffic, bi-directional bike lane design	Key comments included: • Concerns for cyclist conflicts with turning vehicles. • Consideration for hook turns for bikes. • Concerns about rat running and how this will be managed – through Local Area Traffic Management (LATM's) programs. • Concerns on visibility and how vegetation will be maintained and managed. • How will drivers and cyclists be educated on how to coexist. • Questions around the interaction of garbage trucks and cyclists. • Will the design of the infrastructure be adaptable if car ownership decreases? • Concerns around safety and dooring.
Option 1 workshop: one-way traffic, bi-directional bike lane	Key comments included: • Group discussion on the risk of door opening and ensuring this was incorporated into the design. • Cr Zyngier noted that additional modelling would need to be undertaken for Alma Road if a future one-way reversed direction (to Inkerman) street was considered for Alma Road. Council Officer's took this on notice, noting that it was outside the scope of the current project, but if Council determined to look at any future corresponding one-way network of streets if Inkerman Road was to be made one-way, that they could undertake this task.

	• Discussion around turning including considering holding boxes for bikes for right hook turn in the middle of the intersection. • Design considerations to resolve issues with blind spots. • Location of pedestrian crossings. • Sightline and visibility considerations. • Considerations around dooring. • Vegetation considerations (impact to visibility / sightlines and benefits to public space). • Maintenance / cleaning – ensuring bike lane is maintained to be free of debris and glass. • With increases in e-bike and scooters, need to factor in safety issues of different speeds and competencies of those travelling in bike lanes. • Will the design consider children, kids in town or will it be designed specifically for commuters?

In their meeting, the STAC raised the importance of turning visibility at intersections and discussed whether there were opportunities / technologies for cyclists to trigger awareness for drivers.

Traffic Modelling Outcomes

Onemilegrid (OMG) presented on the findings from the traffic report.

Following the presentation, the STAC provided the following discussion points:

STAC
• Discussion on why the worst-case scenario was assessed for traffic modelling and whether this was required. Council Officers and OMG confirmed that this was a requirement from the Department of Transport (DoT). • Discussion on the possibility of changing Alma Road to one direction if Inkerman Road was to be successfully implemented (one-way). OMG confirmed that this would change the distribution and would need to be assessed at the time. • Discussion on whether making changes to the Normanby underpass would change the traffic modelling. OMG confirmed it would. • Discussion raised to consider modelling exercise using the 50/50 mode share target from the Integrated Transport Strategy (ITS), as this would reduce vehicle volumes. Officers noted that a design note could be provided to DoT to consider a reduction in future vehicle growth based on the ITS. • Discussion on whether Council Officers could remodel without growth. Note that this was done by OMG in the first iteration of the traffic modelling and impacts to intersections were largely reduced.

TAG Meeting: 5 May 2022

Design workshop

TAG comments
Key comments included: • Road rules around left turns at intersections may be changing which may change the way intersections operate. Unsure if this will impact the project but should be considered. • Reason for southern side of the road was due to the northern side having more crossovers (especially Section 4 of the design). However, an official assessment had not been done beyond that decision. • City of Port Phillip indicated a shared section not designed yet but confirmed preference is to continue unidirectional through to the shared section. • Normanby / Dandenong – was raised as a major issue in STAC. However, closing would put more traffic onto Balaclava and Smith St

Traffic Modelling Outcomes
Onemilegrid (OMG) presented on the findings from the traffic report.

Following the presentation, the TAG provided the following discussion points:

TAG
• Yarra Trams indicated tram turning phases not included in the traffic modelling – Balaclava and Hawthorn have a lot of tram turning phase – so the traffic modelling report might not be fully representative. • Yarra Trams – disagrees with option 1. Next steps could be to get Option 2 tram delay down to zero. Options discuss peak period turn bans. • Discussion – is there scope to broadening project beyond cycling and address trams in line with the ITS? • COPP – traffic modelling will be shared with GECC • COPP completed a Movement and Place assessment but the safety review only reached a level B rather than an A because the cycleway is in an urban area and the difficulty with driveways.

MEETING 3
CRG Meeting: 8 August 2022

Aim of third meeting with the CRG
To discuss and get group feedback on a draft independent safety report and discuss and get feedback on the approach to engaging the wider community on draft Corridor Plan.

Project update
Council officers provided a recap on the previous Community Reference Group meetings and how feedback from the group has been used to inform the project to date.

Some of the most common feedback included considerations of:

- Safety of right-turning cyclists at intersections
- Questions around bin storage
- Safety concerns for cars backing out across bike lanes
- Discussion on the location of crossings on Inkerman Road
- Concerns around the impact of reduced parking for the elderly and carers
- Benefits to the community and the opportunity to increase vegetation to enhance the neighbourhood.

Draft Independent Safety Review
Salt3 presented the findings from the Independent Safety Review.
As identified in the report, the assessment determined that both design options offer a safety improvement for all modes of transport compared with existing conditions, with the exception of vehicles for Option 1. The reason for this is because the on-street parking provided in Option 1 restricts some sightlines. However, the review also raised concerns regarding the Inkerman Road / Kooyong Road intersection and recommends that before the concept option proceeds to detailed design, a detailed concept configuration for this intersection should be prepared.

Design Responses
Arup presented on the design responses to the safety review and an overall update on the designs.

Community Engagement Plan
Council officers provided the community engagement plan for the next phase if it goes ahead and requested feedback from the CRG on groups to engage with. The CRG was asked to provide recommendations to include in the community engagement plan.

STAC Meeting 3

A STAC meeting was scheduled for the 4th of August 2022. However, due to lack of availability the meeting was cancelled. An email was sent to all STAC members to inform them about the cancellation and request written feedback on the draft Independent Safety Report.

Feedback received was incorporated where possible. Key points from the feedback include:

- Clarifications on Crashstats used within the report:
    - where appropriate these were updated in the report
- Significant safety concerns regarding the Normanby Road and Dandenong Road / Princess Highway underpass
- Concerns were recognised. Further safety assessment / design responses will be required if the project proceeds to further stages. Concerns on bicycle treatments at intersections
    - Concerns were recognised and the report updated were appropriate

TAG Meeting 3

TAG Meeting: 12 September 2022

Aim of third meeting with the TAG: To discuss and get group feedback on a draft independent safety report and refine technical aspects of the corridor design options.

Project update
Council officers provided a recap on the previous TAG meetings and how feedback from the group has been used to inform the project to date.

Officers from the City of Port Phillip provided an update on the progress of their corridor design.

Draft Independent Safety Review
Officers presented the findings from the Independent Safety Review.
As identified in the report, the assessment determined that both design options offer a safety improvement for all modes of transport compared with existing conditions, with the exception of vehicles for Option 1. The reason for this is because the on-street parking provided in Option 1 restricts some sightlines. However, the review also raised concerns regarding the Inkerman Road / Kooyong Road intersection and recommends that before the concept option proceeds to detailed design, a detailed concept configuration for this intersection should be prepared.

Design Update & Responses
Design consultants Arup led a discussion on:

- Update of design since the last meeting – integration of DoT, Yarra Tram's comments.
- Design responses to suggested changes (safety report)

Design consultant Arup lef a focuded workshop on:

- Opportunity to signalise Dandenong Rd/Normanby Rd
- Feasibility of one-way option and alignment with M&P

Confirmation of support for capacity reductions at intersections along the corridor

APPENDICES

SAFE CYCLING CORRIDOR PILOT COMMUNITY REFERENCE GROUP - MEETING MINUTES

Date: 17 February 2020
Time: 6.15 to 6.30pm arrival to 9.30pm, extended to 10pm by Group agreement
Location: Caulfield Park Pavilion

ATTENDEES

Community Reference Group	Glen Eira Council	Guests	Apologies
[redacted]	Cr Margaret Esakoff Cr Joel Silver Cr Jamie Hyams Four members of the Council project team	Two representatives from ARUP Facilitator from CoDesign	Nil

AGREED ACTIONS

- Terms of Reference
- Material be shared 5 business days prior to each meeting
- Real life examples of scenarios
- Extra 30 mins for meeting 1

MATERIALS PROVIDED/DISCUSSED

- ARUP Report
- Group roles
- Terms of Reference
- Working together as a group survey results
- Project overview & engagement overview

AGENDA

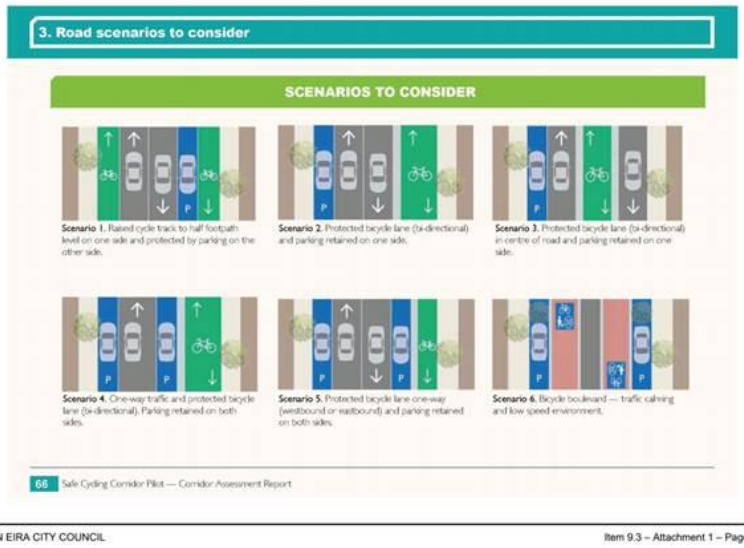
Welcome	Welcome provided by Council officer, introductions to Council team members present. Introduction made to independent facilitator

Housekeeping	Facilitator provided an overview of the purpose of the session and how the session will run
Icebreaker	Group engaged in 'hobbies' activity to get to know one another. Group members introduced themselves, and their interest in the project and in participating in the CRG
Role of the Group	Facilitator discussed role of the Group, as per document previous sent to CRG members. Group reviewed the Terms of Reference and agreed to these
How we work together	Group reviewed the results of the survey sent around prior to the meeting. Group engaged in small table discussions to develop 5 rules per table for working together. These were: Table 1 - Listening - Respectful language and behaviour - Open mindedness - Willingness to compromise - Challenge status quo to achieve best community outcomes Table 2 - Treat each other with mutual respect - Keep focused on topic - Encourage debate, listen and keep an open mind - Everyone needs to have a say - Recommend the best overall outcome for the community Table 3 - Open mind - Solution focused - Respecting others' opinions - Listen to others - Manners, common courtesy Facilitator noted that these will be written up into draft Group rules for future discussion.
Short project overview	Council officers provided an overview of the project to date, and the engagement undertaken. Questions were raised and discussed. Facilitator provided an introduction to criteria and sub-criteria. Group engaged in 'dotmocracy' exercise (placement of dots on sub-criteria considered most important when considering road scenarios for a corridor). Each member had 3 dots for 'safety' criteria, 3 for 'neighbourhood' criteria and 2 for 'feasibility' criteria. Sub-criteria priorities of the Group (in order of highest to lowest) are: Safety criteria - Conflict points - 12

	- Traffic stress - 9 - Pedestrian safety, access & amenity - 8 - Continuity of cycling infrastructure - 3 - Crash history - 2 - Ease of use – 1 - Roadside hazards – 0 Neighbourhood criteria - Car parking – 16 - Property access – 11 - Traffic operations – 5 - Streetscape – 3 - Connectivity to key landmarks – 2 - Public transport - 0 Feasibility criteria - Construction cost & risk – 11 - Emergency services – 5 - Alignment with network and planning objectives – 4 - Other** – 3 - Alignment with waste and street cleaning operations - 0 ***Other – In feasibility it should also consider people directly affected, those on the corridor. Emergency services access etc.*
Road scenarios workshop	ARUP team provided an overview of their commissioned work for the project. ARUP builds on the previous work that has been done before. Stage 1 is really about doing the desktop assessment of what has been done to date and incorporates a site visit. Initial findings have included the context of the road. Two prevalent conditions of the corridor, western section is wider and eastern section not as wide. Approach has included breaking the road down into 'sections' to assist the design process. Sections 1-3 (Inkerman Road) share similarities. Section 4 runs along Caulfield Park and is a bit different. Section 5 is Normanby Road. An overview of the road scenarios was provided. Questions were raised and discussed. In table groups, members discussed their ideas on the pros and cons of each scenario. Members then identified their preferred scenario for Sections 1-3 of the route and engaged in small groups to identify preferences of each table. This same process was repeated for Section 4 of the route. Table preferences below.

<table>
<tr>
<td></td>
<td>
See the document ‘CRG Meeting 1 Road Scenarios Table Notes’ (in the document library of https://www.haveyoursaygleneira.com.au/safe-cycling) for observations and conditions expressed by members of table groups around these selections.
<table>
<tr><th>Table 1</th><th>Table 2</th><th>Table 3</th></tr>
<tr>
<td>- 1st preference: Scenario 2
- Second preference: Scenario 3
- Third preference: Scenario 4
- (Fourth preference: Scenario 1)</td>
<td>- First preference: Scenario 1 and 4
- Second preference: Scenario 2
- Third preference: Scenario 3</td>
<td>- First preference: Scenario 2
- Second preference: Scenario 4
- Third preference: Scenario 3</td>
</tr>
</table>
Table preferences for Section 4 of the route are:
<table>
<tr><th>Table 1</th><th>Table 2</th><th>Table 3</th></tr>
<tr>
<td>- First preference: Scenario 2
- Second preference: Scenario 3
- Third preference: Scenario 4</td>
<td>- First preference: Scenario 4
- Second preference: Scenario 5</td>
<td>First preference: Scenario 4</td>
</tr>
</table>
</td>
</tr>
<tr>
<td>Workshop wrap up and close</td>
<td>Facilitator thanked all Members for their participation and reminded all members that the next meeting will be held on Monday 23 March 6.30-8.30pm, Caulfield Park Pavilion</td>
</tr>
</table>

Q: When was it decided that we would only be considering the proposal from kerb-to-kerb? Why are we not looking property-to-property, putting all options on the table?
A: Council's Corridor Assessment Report (noted by Council during the 3 September 2019, Ordinary Council Meeting) established an assessment framework to enable the four possible routes to be directly compared with one another. This assessment framework, together with ten road design scenarios to consider (and four not to consider), was presented in the Council Agenda, and noted in Council's resolution. Below is an excerpt from the report attachment:



GLEN EIRA CITY COUNCIL Item 9.3 – Attachment 1 – Page 189

The assessment methodology set out three key criteria:
Safety for Cyclists, Impact on Neighbourhood, and Feasibility of Construction.
The *Feasibility of Construction* criterion is particularly relevant to requests to explore a front-fence to front-fence design. This criterion is to "ensure that the **corridor can firstly be realistically built and funded** and secondly does not finish at a dead-end at Council's boundary". The Corridor Assessment Report goes on to say, "A variety of scenarios to provide a safe cycling corridor were explored. Taking into account feedback from the community and the feasibility of construction**, the scenarios that require the removal of all parking or impacts on existing nature strip, are not considered".**

For this reason, under the section of Feasibility of Construction for Inkerman Road, the report presents a combination of five road scenarios that are kerb to kerb scenarios. These are the same Road Scenarios that have been further explored by Arup Consultants and were presented to the Community Reference Group.

During the development of the Corridor Assessment Report, officers explored a variety of Road Scenarios (including the consideration of the entire road reserve; front-fence to front-fence). However, after considering the implications on existing services such as the power poles, nature strip, and established trees, only road scenarios within the road (kerb to kerb) were considered. This consideration was noted in the Council Report from 3 September 2019.

Importantly, both the Corridor Assessment Report and the Council Report from 3 September 2019, informed Council's decision to proceed with the development of a Corridor Plan for Inkerman Road. Whilst the suggested one-way traffic scenario was not originally presented as a scenario, given the Community Reference Group's interest in exploring this scenario, and that this option fits within the kerb-to-kerb boundary, this option (including all possible bike lane arrangements that could fit kerb to kerb) will be included for consideration.
Q: The Integrated Transport Strategy '50:50 mode share split' – is that just relating to journeys to work? ie - not incidental trips, short trips around the community etc. A: No, the 50:50 mode split goal is about all trips that people make (travel generally). 'Journey to work' is a measure of travel, discussed further below.
Q: If it is journey to work, this is very different. The Council message has been about local benefits, local congestion busting. What is the measure of 50:50? The way people go to work is very different to how they travel around their community. The measure for 'social' is different to 'community'. What are we designing for? Commuters or community. Why not shared paths, pedestrian/cyclists? Who is the end user? People who commute to work may not want to ride with kids riding to school? A: Council's *Integrated Transport Strategy (ITS)* puts an integrated approach to transport planning by recognising both different transport corridors and places, with the goal of achieving a 50:50 mode split between car and non-car trips by 2031. Corridors aim to maximise the potential of particular roads for moving particular types of travel (driving routes, walking streets, cycling streets, and public transport routes). 'Places' projects are wholistic initiatives that aim to promote and support particular travel habits whilst providing safer conditions for all road users to move around Glen Eira (such as Pedestrian Safe Neighbourhoods). 'Corridors' and 'places' projects contribute (in different ways) to the 50:50 mode split goal. The Safe Cycling Corridor pilot is a corridor project. It aligns with, and aims to contribute towards, the *ITS* 50:50 goal, together with other *ITS* projects. Understanding how people move around the community, and the overall achievement of the 50:50 goal, is complex as people choose different methods for different types of trips, at different times. Council draws on information from 'journey to work', which is a Census measure that asks people how they got to work on a particular day prior to the Census survey. This measure has limitations in terms of what it captures, but it is what we have available to get an understanding. For transport projects, we also draw on traffic (car, rider, pedestrian) counts, parking information which can provide a measure of car use, and surveys which ask people about their views and habits.
Q: Is Pilot a 'trial'? How will you quantify its success? What happens if it fails and disrupts the road system/local community? Will the finished product be permanent from the on-set? A: The pilot is an initial project. Council has not made a decision to proceed to construction at this design stage. Should the project proceed, Council will be looking at ways to review and understand use and impact. In moving to explore design, Council resolved that we partner with a research body to conduct a longitudinal qualitative and quantitative study of the project, to collect information on impact. The Community Reference Group has a role in supporting the scoping and selection of this body.

ROAD SCENARIOS PRESENTATION
Q: Lane in the middle of road scenario, how would a car turn at the intersection? A: To eliminate conflict between vehicles and cyclists at side roads, right-turn bans are proposed at side roads. If this option is selected to proceed to further design right turns and U-Turns at signalised intersections will need to be carefully designed. A more detailed explanation is provided in pages 22-24 of Arup's report.
Q: Will any new traffic controls be put in place for any of the scenarios? Such as new lights or pedestrian crossings. A: We have not yet gotten to this stage of the design process. These aspects may be on the table.
Q: Is the separation put in for the cycle lane, also intended to be for pedestrian refuge as well? Or just for cyclist separation/protection? A: It's not designed specifically as a pedestrian refuge per se. The intent is for separation from vehicles for riders. However, its use doesn't exclude providing a refuge point for pedestrians crossing.
Q: Is there an opportunity to make the retained or reinstated parking angled parking, so more parking can be included? A: This will be explored further into the design stage depending on scenario and location.
Q: Understanding the section where one side is raised and the other lowered? Should it just be all raised if it is better/easier? Why one over the other? Please explain (scenario 1) A: Ideally it is more cost effective to build the protected bike lane at the road level. However, due to road width constraints in some sections of Inkerman Road, it was proposed to raise the bike lane on one side of the road. This allows providing a wider bike lane by reducing the width of the protection/separation from vehicles. Where the corridor width is wider, lowering both sides can be explored.
Q: Middle lane scenario has a road lane with raised kerb either side, does this meet standards? How would this work? A: While the width of separation between cyclists and moving traffic is not referenced in any relevant design standards, a 300mm wide separation kerb is generally accepted where the bicycle lane is directly adjacent to traffic and there is no risk of car-dooring. For this reason, the minimum width for the protection considered is 300mm for the most constrained sections and reaching 800mm in the widest section.
Q: How do bikes turn in the middle road option? Does the separation continue through intersections? A: Cyclists will be able to conduct right-turns at signalised intersections. A bike phase will need to be explored for traffic lights. To eliminate conflict between vehicles and cyclists at

side roads, right-turn bans are proposed at side roads. If this option is selected to proceed to further design right turns and U-Turns at signalised intersections will need to be carefully designed. A more detailed explanation is provided in pages 22-24 of Arup's report.

Q: Why was the one-way option only considered for one section of the corridor? The one-way option would reduce the congestion issues at intersections (less conflicts). Should we consider one-way the entire length of the corridor? All options compromise the road in some way, so why not this option that retains most parking?

A: While the suggested one-way traffic scenario was not originally presented as a scenario due to the larger traffic volumes this section of the road carries, given the Community Reference Group's interest in exploring this scenario, and that this option fits within the kerb to kerb boundary, this option (including all possible bike lane arrangements that could fit kerb to kerb) will be included for consideration.

It is worth noting that for this Road Scenario to be feasible for implementation, further traffic modelling needs to be conducted and approvals from the Department of Transport will need to be sought.

Q: Is Scenario 5 essentially making Inkerman Road a one-way street? Is this feasible?

A: Scenario 5 is a 'bike boulevard', where parking is retained on both sides of the road, flanked by non-separated uni-directional bike lanes. Two-way vehicle traffic would travel within a single traffic lane, with interaction between cars and bikes managed by reduced traffic speeds and significant traffic calming measures.

Scenario 5 would operate like a one-way street. It has not been considered feasible for Inkerman Road, because of the degree of traffic that uses Inkerman Road currently, and the likely level of impact significant traffic calming, plus very low speed limits, would have on residents and users.

Q: Why have you already not considered some scenarios for some sections? Did you reassess what was decided from Corridor Assessment Report? Can we pick one of these discarded scenario options as our preferred?

A: Some scenarios have been ruled out for particular sections in the route, as was presented to the community in the Corridor Assessment Report. This is because some scenarios do not meet design rules, drawn from safety for cyclists, impact on neighbourhood and feasibility considerations. The Community Reference Group has been presented with an overview of the scenarios, and the scenarios that are considered feasible in each section.

The Community Reference Group can put forward their ideas on what would be workable in areas along the route. The CRG advice will be noted and included for consideration by Council.

Q: Where is the Crown land boundary of Caulfield Park. Edge of park or kerb/road?

A: Crown land boundary goes to the edge of the park. The footpath, kerb and road are part of the Road Reserve and are managed by Council.

GLEN EIRA CITY COUNCIL

STRATEGIC TRANSPORT ADVISORY COMMITTEE (STAC) **Minutes** 6:30 - 8:00 pm 20 February 2020 **Glen Eira Town Hall: Labassa Room**		
Councillors	Cr Tony Anthanasopoulos	P
	Cr Jim Magee	P
	Cr Clare Davey	A
Council Staff	Tom Haysom – Coordinator Transport Planning and Place Design	P
	Guillermo Gomez – Transport Planner	P
Community representatives	[redacted]	P
	[redacted]	P
	[redacted]	P
	[redacted]	A

1. Welcome

- Cr Magee to chair – meeting commenced 6:40pm

2. Safe Cycling Corridor Update

- Guillermo provided an update on key aspects of the project including:
  - Council's resolution 17 December
  - Corridor Plan (stages 1 and 2)
  - Stakeholder engagement

3. Road scenarios for Inkerman Road

- Guillermo presented the road scenarios for Inkerman Road to be further discussed.

4. Appraisal of Road Scenarios

- Guillermo presented the following elements of the methodology appraisal:
  - Technical Appraisal ARUP
  - Feedback received by Community Reference Group
  - Feedback received by Technical Advisory Group

5. Discussion on Corridor Options to be further explored

- STAC preferred options for Sections 1 to 3 (Hotham Street to Normanby Road)

are Road scenario 1 and Road Scenario 3. However, it was also noted that Road Scenario 4 would be preferable for keeping parking on both sides of the road.

- STAC preferred options for section 4 (Caulfield Park) are Road Scenario 2 and Road Scenario 4. It was raised the need to consider a north-south bike connection through Caulfield Park.

- No major issues were raised for the implementation of Road Scenario 2 along Normanby Road. It was suggested to explore enhancing the underpass that links Normanby Road–Dandenong Road–Tooronga Road as part of this project.

6. Next steps

- A further meeting will be held to discuss the Draft Corridor Plan with STAC members.

7. The meeting was closed at 8:20pm

Safe Cycling Corridor Pilot Community Reference Group (CRG) – Meeting Minutes

Date: 16 February 2022
Time: 6pm to 7.30pm
Location: Zoom (online)

Attendees

Community Reference Group	Glen Eira Councillors	Council Officers	Apologies
[redacted]	Cr Simone Zmood Cr Anne-Marie Cade Cr David Zingier Cr Jim Magee Cr Li Zhang Cr Sam Parasol Cr Margaret Esakoff Cr Tony Athanasopoulos	Ron Torres Matt Slavin (Chair) Tom Haysom Saskia Noakes Chris Soderstrom (Minute taker)	[redacted] Cr Neil Pilling

Action items

- Council officers will re-circulate the meeting minutes from the first CRG meeting (February 2020).
- Council officers will provide the data report to CRG members when available.
- Council officers will circulate the Council officer presentation to the CRG.
- Council officers will provide a map or list of significant trees along the Inkerman Street corridor.
- Council officers will re-circulate the previous (September 2019) data collection report.

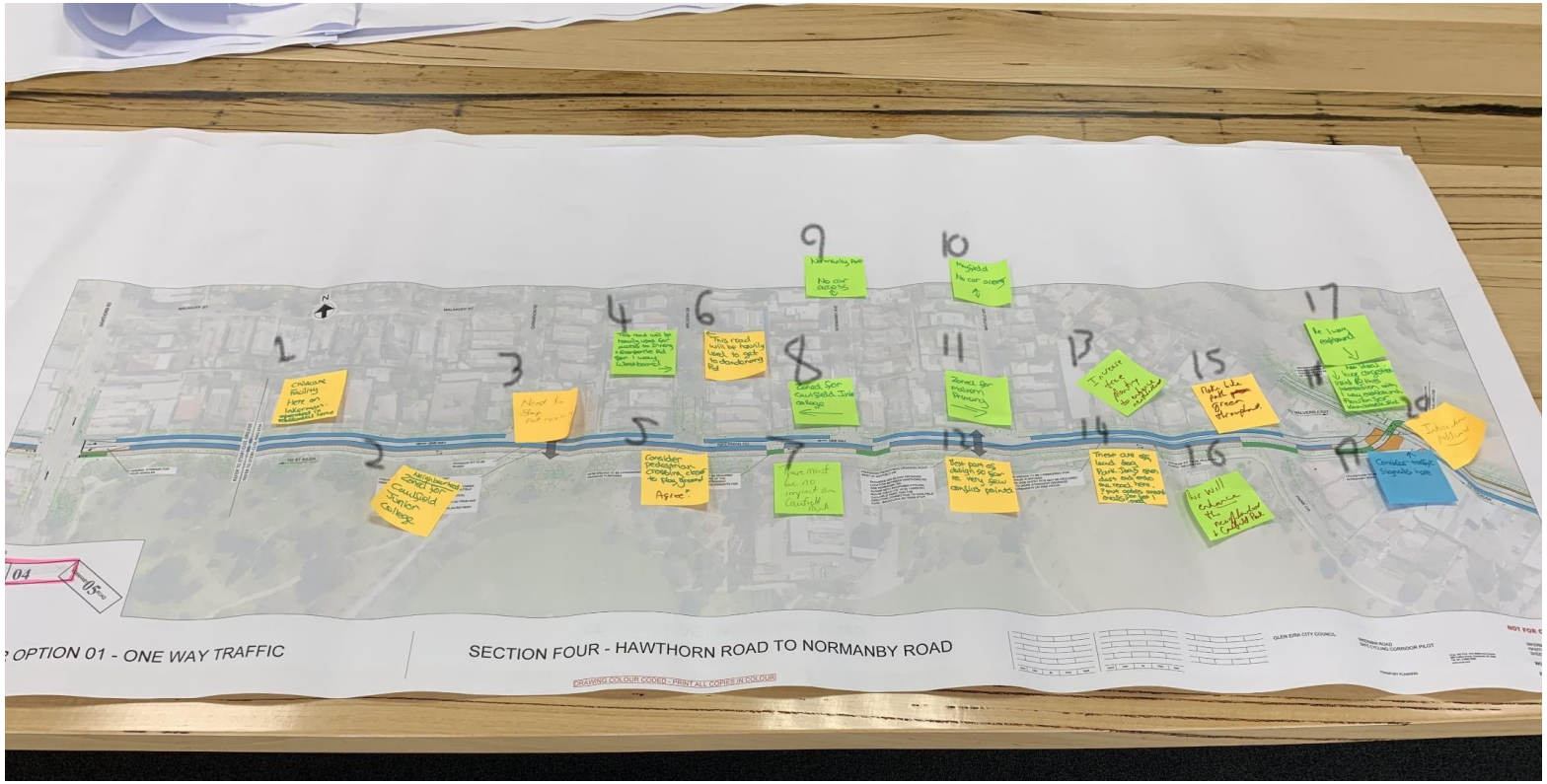
Meeting notes

Welcome	Manager City Futures Matt Slavin led: • Acknowledgement of Country • Official welcome and introduction
Introductions	Matt Slavin led: • Introduction of Council team • Introduction of Community Reference Group Members • Allowed Councillors the opportunity to introduce themselves if they wished

Documents	Matt Slavin spoke about important documents that were sent to the CRG members ahead of the meeting: • Terms of Reference • Key roles Matt noted: • The CRG is working in an advisory capacity to aid the progression of a preferred Safe Cycling Corridor option. • All materials presented during CRG meetings are not to be communicated externally. • That Councillors will use feedback from the various advisory groups to inform their decision-making later in 2022.
Presentation	Coordinator of City Transport and Place Design Tom Haysom led an update of the project that included: • A recap of where the project is currently at • The upcoming program of activities • Details around expected timeframes Tom noted: • Traffic modelling results will be provided to the CRG and they will be workshopped at a future meeting likely in late April. • Would prefer that future CRG meetings be held in-person rather than virtually to make workshopping of designs easier.
Questions	Subsequent discussions noted: • Corridor concept design scenarios that Council are now developing follow on from the previous CRG meeting (February 2020), where they were discussed and ranked. • Once completed, the consultants' data report will be made available to CRG members. • Road safety experts will carry out a safety assessment to determine the safety of each design and whether they're safer than the existing road environment. • COVID has caused changes in community behaviors: more people are working from home; more people have taken up cycling instead of taking public transport; and it's expected that people would take up cycling (latent demand) when the time comes. • There are more scooters around Melbourne as part of a trial in several Councils and it is currently legal to ride a scooter in the bike lane. • Project costs for designs are unknown as Council is still carrying out feasibility studies, however, technical work will help determine costings.

	• The Safe Cycling Corridor proposed for Inkerman Street is part of a larger network of cycling routes identified in Glen Eira's Integrated Transport Strategy (one of 15 safe cycling routes). • Several Council policies seek to retain and increase tree canopy cover. Committing to curb-to-curb designs will help avoid tree loss and significant expenses of interrupting utilities rendering the project unfeasible. • Council implement's State Government car parking planning requirements for development applications as part of the urban planning process, which includes for example; one parking space for a one-to-two-bedroom apartment.
Meeting close	Matt Slavin closed the CRG meeting • Matt encouraged CRG members to forward anything they wanted to cityfutures@gleneira.vic.gov.au

Safe Cycling Corridor Community Reference Group Option Annotations

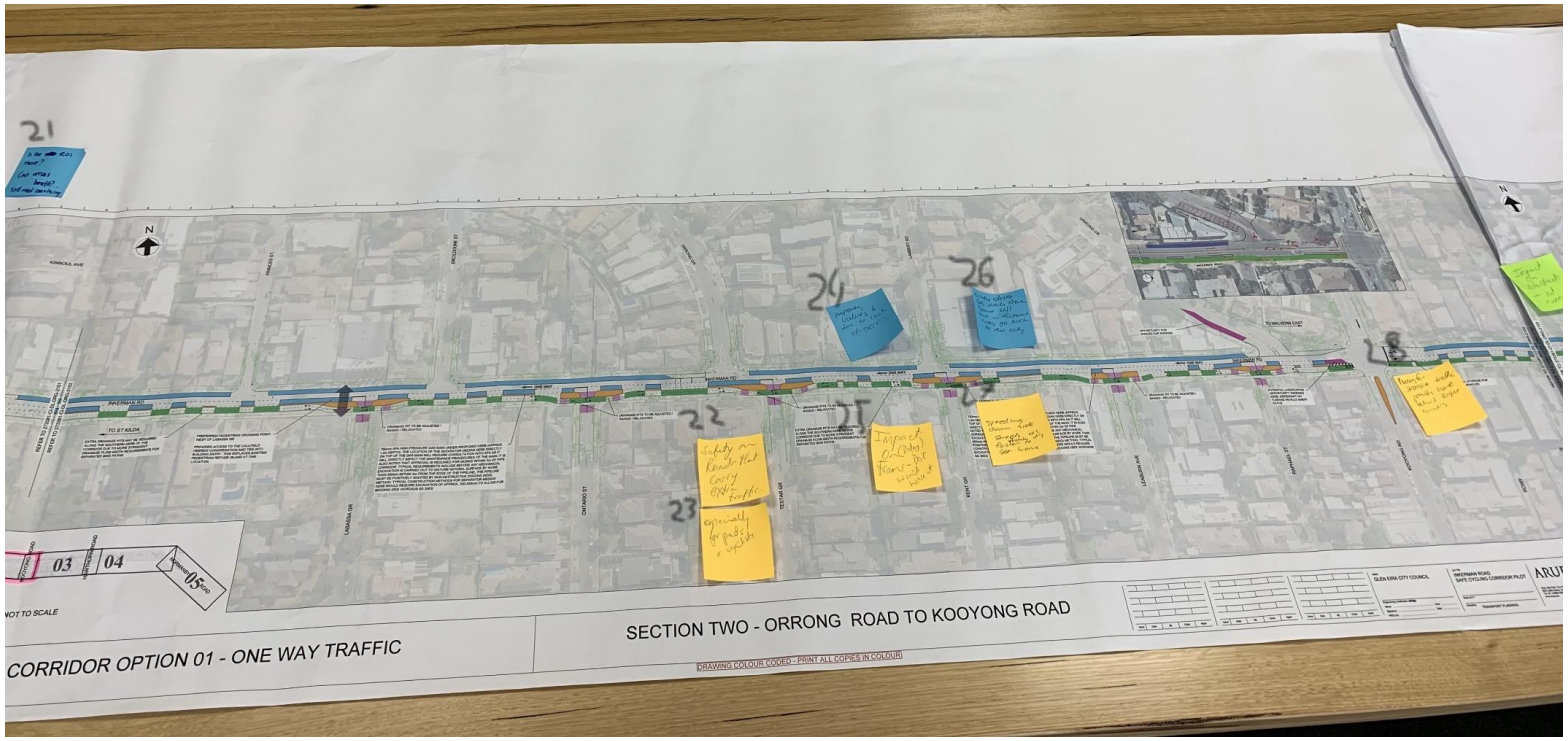


Corridor Option 01 – One Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
1	Childcare facility here on Inkerman in house.			ARUP to add any missing key destinations onto the plans.
3	Need to stop rat-running			Noted – to consider local area traffic management if project is implemented
5			Consider Pedestrian Crossing closer to Playground (at Caulfield Park). – second CRG member agreed.	ARUP to relocate wombat crossing east closer to Malvern Grove 
6	This road (Malvern Grove) will be heavily used to get to Dandenong Rd.			Noted – to consider local area traffic management if project is implemented
12		Best Part of design so far (new crossing location). Re very few conflict points		Comments noted.
14			These are off lead dog parks. Dogs often dart out onto the road here. Put gates around ovals?	Noted – comments will be passed on to open space and recreation team to assess the necessity fencing if the project is implemented.
15			Make bike path green throughout	ARUP report to explain typical line marking approach - only at conflict points as per Austroads.
20	Intersection problems (Inkerman & Normanby)			Changes to on-road conditions as a result of cycle lane implementation have been considered as part of the ARUP report and safety assessment.

Option 01 – One Way Traffic				Neighbourhood
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
2	Zoned for Caulfield Junior College (east)			Comment noted.
4	This road (Malvern Grove) will be heavily used for access to Dandenong & Glenferrie Rd for 1 way westbound			Comment noted. Further work such as traffic calming may be considered for surrounding streets and environs if deemed necessary.
7	There must be no impact on Caulfield Park			Disruption to Caulfield Park will be minimised. The proposal at present seeks to alter the road corridor (kerb to kerb) and therefore run alongside the park rather than run through the park itself.
8	Zoned for Caulfield Junior College (west)			Comment noted.
9	Normanby Ave, no car access (to Dandenong Rd.)			Comment noted.
10	Mayfield Gr, no car access (to Dandenong Rd.)			Comment noted.
11	Zoned for Malvern Primary (east)			Comment noted.
13			Increase tree quantity to enhance neighbourhood	ARUP to annotate indicative opportunities for tree planting on the plans (project wide)
16		This will enhance the neighbourhood & Caulfield Park		Comment noted

17 & 18			Re 1 way eastbound. Not Ideal. Huge congestion point at this intersection (Inkerman & Normanby) with 1 way eastbound flow for Kambrook Rd.	Noted. The traffic modelling report reflects congestion at this intersection.

Option 01 – One Way Traffic				Feasibility
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
19			Consider traffic signals here.	Discussed approach to Normanby/Inkerman intersection on roll plot. Agreed ARUP to retain POS crossing for the one-way westbound option. Noted that the two-way option in Section 4 may require signalised intersection. ARUP to prepare variation for additional design.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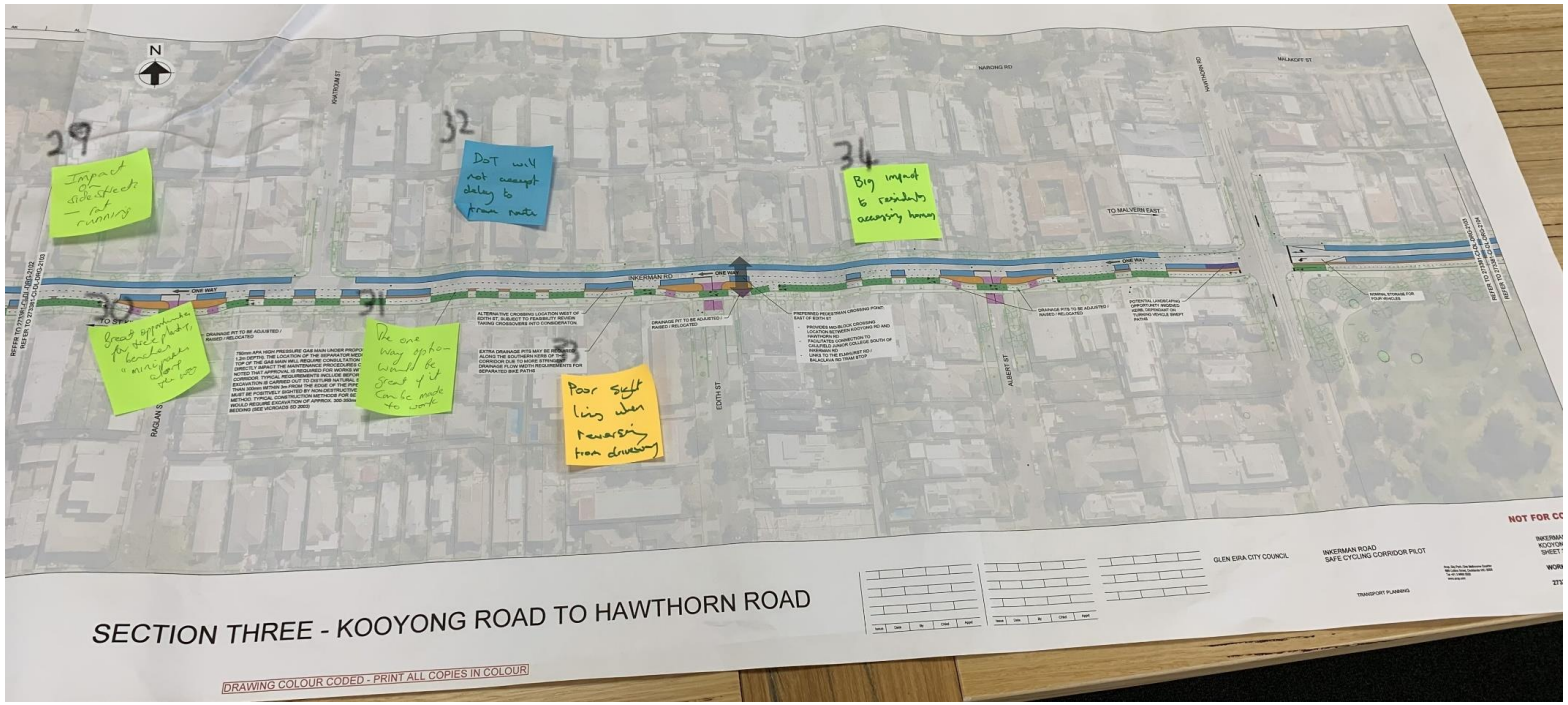
CORRIDOR OPTION 01 - ONE WAY TRAFFIC
SECTION TWO - ORRONG ROAD TO KOOYONG ROAD
DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR!

Corridor Option 01 – One Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
22 & 23	Safety – especially for peds and cyclists - on roads that carry extra traffic.			Comment noted.
25	Impact on public transport causing tram delays – DoT won't have it.			Discissions regarding minimising impact on public transport have been conducted between DoT/Yarra Trams and Glen Eira Council. Discussions are ongoing.
27	Speeding down side streets is perceived as a faster way to get home.			ARUP to include report content on potential for rat running / speed issues on local streets, including high-level review of potential problem areas including and how these could be addressed with traffic calming, as per existing GECC policy. ARUP to check vols/speed on key streets, pending availability of tube count data.
28			Delay for straight west-bound traffic at Kooyong / Inkerman Rd behind right turners.	Traffic flow has been considered as part of the traffic impact assessment by external consultants.

Option 01 – One Way Traffic				Feasibility
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
21	Still need convincing about the cost vs benefit, and whether the return on investment is there.			Council will be presented with a range of reports including, estimated costings, safety reports, environmental impact report, estimated cyclists report and a

				parking impact assessment to help inform their decision on the project.
24	Sense that property values will decrease due to lack of access.			There is no evidence that the implementation of a separated cycle lane will decrease or increase property prices along the corridor.
26			Query survey data - while many people still work from home, they may go back to the city in the future.	Trends have shown that central city workplace uptake has been increasing. Whilst this is a generally slow increase, this shows that working and commuting patterns are continuing to evolve.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Impact on side-streets – rat running
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DoT will not accept delay to tram route
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Big impact to residents accessing homes
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Great opportunities for tree plants, benches "mini-parks" along the way
31
The one way option would be great if it can be made to work
33
Poor sight lines when reversing from driveway
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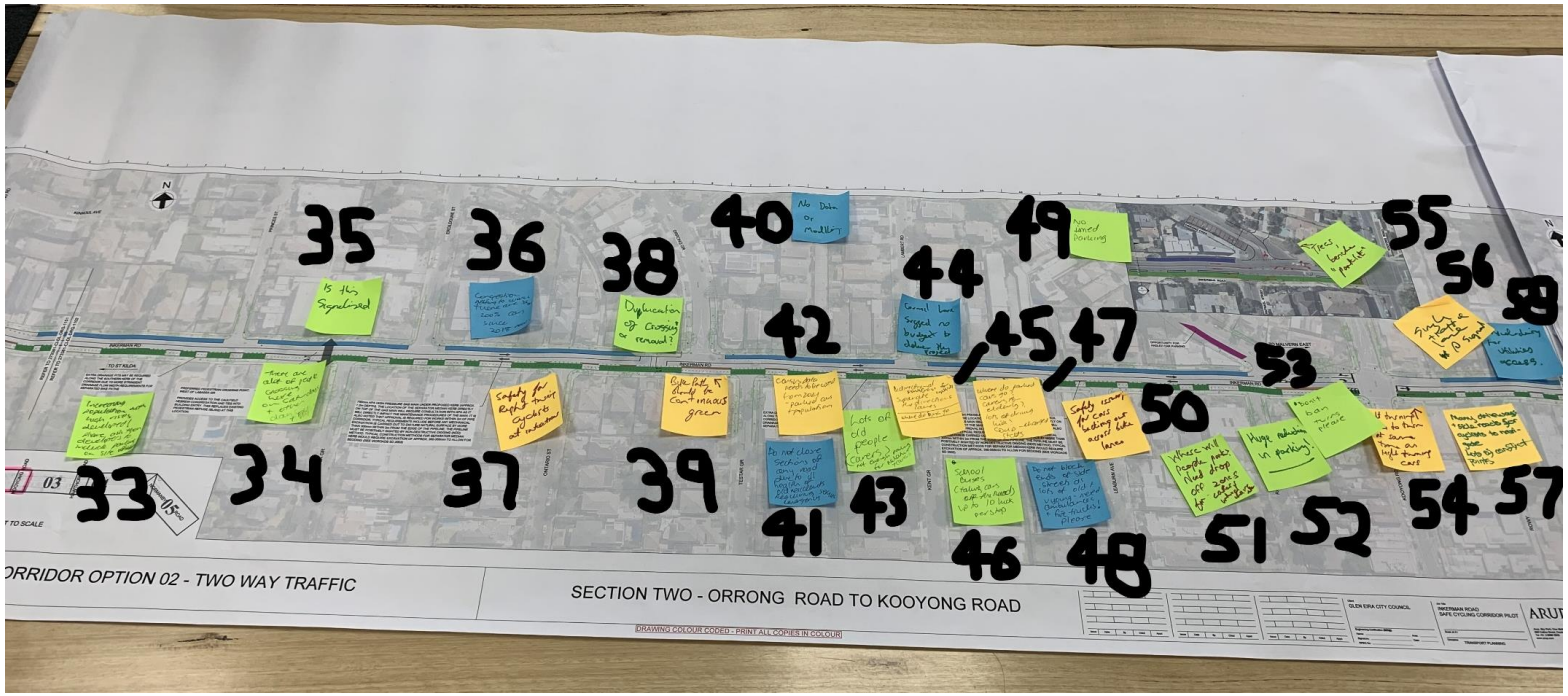
Corridor Option 01 – One Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
33			Poor sight lines when reversing from traffic.	ARUP to produce typical sight distance diagram in report - illustrating visibility when reversing out of driveways.

Option 01 – One Way Traffic				Neighbourhood
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
29	Impacts on side streets due to rat running.			Traffic impacts on streets abutting Inkerman Road have been considered as part of the concept designs.
30			Opportunity for tree planting, benches and 'miniparks' along the corridor.	Street assets such as furniture and planting will be considered along the length of the corridor where viable.
31		The one-way option would be great if it can be made to work.		Comment noted.
34	Big impact to residents accessing homes.			Road conditions will change, including for residents accessing their homes via cars, however the safety audit has determined that both the one way and two way solution will largely lead to enhanced safety outcomes as compared to existing conditions.

Option 01 – One Way Traffic				Feasibility
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
32	Doubt Department of Transport will accept any delays to tram route.			Discussions have been conducted between DoT, Yarra Trams and Glen Eira Council regarding this proposal.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ORRIDOR OPTION 02 - TWO WAY TRAFFIC
SECTION TWO - ORRONG ROAD TO KOOYONG ROAD
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Corridor Option 02 – Two Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
37			Safety for right-turning cyclists at intersections.	ARUP report to include some discussion of opportunity to trial demand activated warning signs or technology similar to 'green wave' but for safety. High level only given these are not common practice.
39			Bike path should be continuously green at Orrong Cr/Inkerman?	The bike path will be marked in green in higher conflict areas, such as intersections, pedestrian crossings, and driveway/crossovers.
42	Census data needs to be used from 2021 – to determine parked cars and population.			ARUP to review information included in previous assessment of routes – which applied 2016 car ownership rates to calculated theoretical residential parking demand. Then consider including in the assessment.
45			Bidirectional dangerous for cyclists. Separate the directions of lanes. Also, where do bins go?	ARUP to address this in the report – no change to bins / side lift arm can collect from bike lane under two-way option. One way option may require rear-loading waste collection (for westbound with bikes on south)
47			Where do parked cars go? Carers for elderly? Lots of driving of kids – COVID has changed stats.	Parking will be retained on one side of the road for residential use as part of the current design. COVID-19 impacts have also extended to transport and cycling, where there was a notable uptake of cycling across inner Melbourne suburbs.

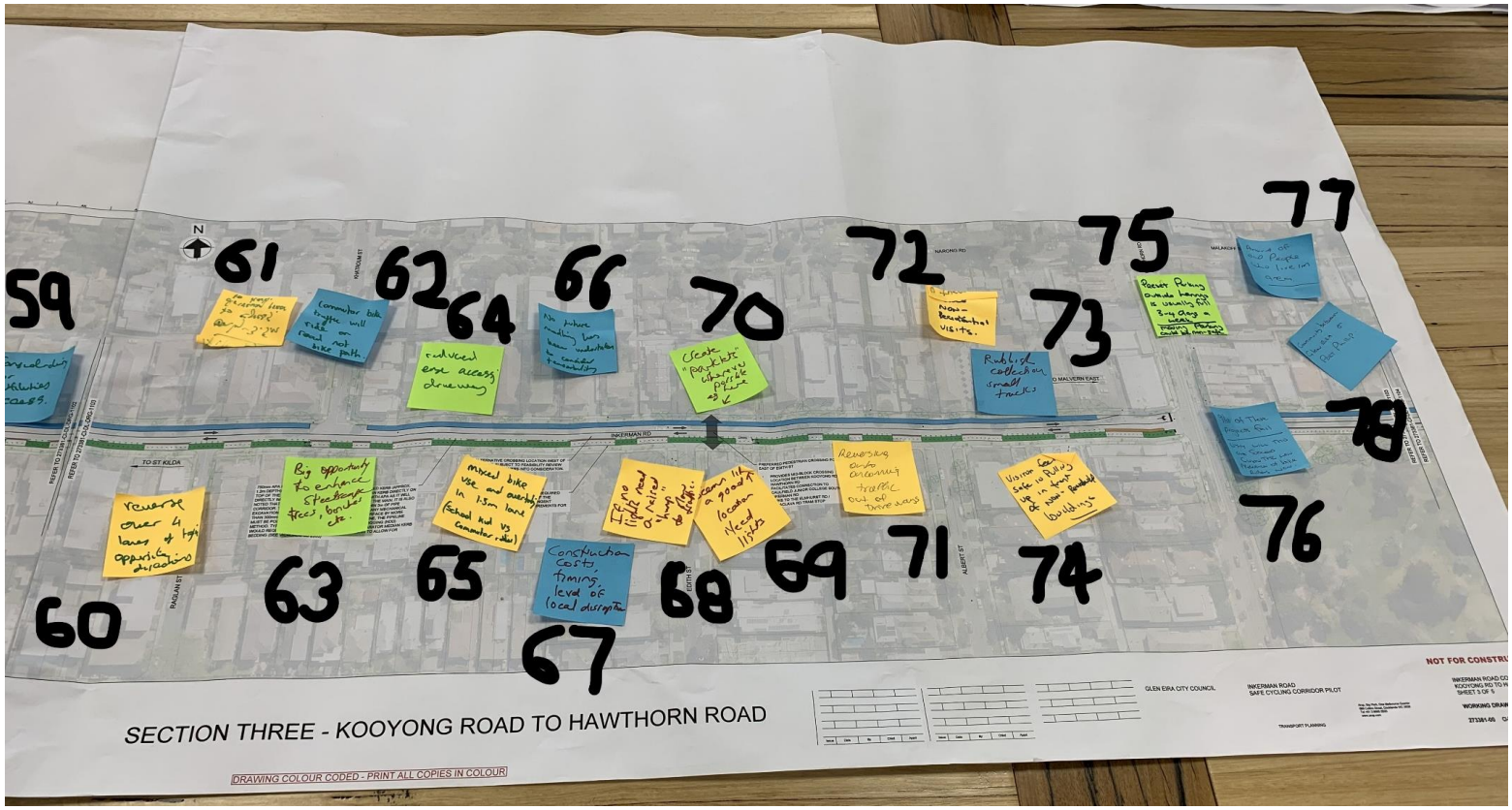
50	Safety issues for cars backing out across bike lanes.			Cars backing across bike lanes is already an issue along any road with driveways and a bike lane. This will be considered by an independent safety report.
54			Timing of right turning bikes with right turning cars at Inkerman/Kooyong.	ARUP to add HOOK TURN BOX EAST TO NORTH, and at other locations across the corridor as needed. Explanation of user perspective to be included within report.
56	Single traffic lane @ signal			Changes at intersections are required to include separated cycling lanes.
57	Many driveways and side roads for cyclists to navigate. Lots of conflict points.			Whilst there will always be a level of on-road conflict between cyclists and motorists, the design will aim to provide a safer and more attractive corridor to use. This will be considered by an independent safety report.

Option 02 – Two Way Traffic				Neighbourhood
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
33	Increasing population with high rises developed. Please ask developers to include parking on-site.			All developments must supply a certain level of parking as determined by Cl 52.06 in the Glen Eira Planning Scheme.
34	There are a lot of people crossing Inkerman Rd between Princes St and Ercildoune St on Saturdays and other days.			Comment noted.
35			Is this signalised – crossing Inkerman Rd between Princes St and Ercildoune St?	Clarified to be a proposed wombat crossing. Crossing to be kept west of Labassa Grove.
38			Duplication of crossing or removal near to Orrong Gr and Inkerman Rd?	Existing POS to be retained.
43	Lots of old people (carers) and not enough parking for relatives and carers near to Inkerman/Kent Gr.			Comment noted. Officers are aiming to minimise car parking reduction while balancing safety outcomes.
46	School buses (taking cars off the road) up to 10 kids per stop.			Comment noted. School buses will still be able to traverse Inkerman Road as lane widths will meet Australian standards.
49	No timed parking.			Comment/suggestion noted.
51			Where will people park? Need drop-off zones for carers, wheelchairs etc. around Inkerman/Leaburn Ave.	GECC can consider short term parking restrictions in side streets in the closest side roads for deliveries / removalists etc.

52	Huge reduction in parking			Officers are aiming to minimise car parking reduction while balancing safety outcomes. Opportunities are also being sought to offset carparking loss in other local sites nearby, such as Orrong Crescent.
53			Don't ban turns please.	Comment/suggestion noted.
55			Trees, benches at 'parklet' at Inkerman/Orrong Cr intersection?	ARUP designs to incorporate the One Mile Grid geometry and 90deg parking configurations and highlight the 'OPPORTUNITY AREA' for urban design elements.

Option 02 – Two Way Traffic				**Feasibility**
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
36	Congestion getting to work and there are 200% cars since 2018 to now.			There are more cars on the road in Glen Eira, which is why its important for Council to plan ahead for other modes to ease congestion and to make cycling a more attractive and safer option.
40	No data or modelling.			Modelling has been undertaken for a base (existing) scenario. The two-way traffic option is reflective of this existing condition. Future intersection analysis will be required if the project is determined to proceed.
41	Do not close sections of any road due to ill health of old residents requiring emergency service access.			Comment/suggestion noted. The current design outcome show that streets will continue to connect with Inkerman Road.

44	Council have no budget to deliver the project.			Discussion will be ongoing around funding, however Council still has a responsibility to plan for future projects.
48	Do not block ends of side streets as lots of old and very young need ambulances and fire trucks.			Comment/suggestion noted. The current design outcome show that streets will continue to connect with Inkerman Road.
58	Consistency for utilities access			Noted, utility access will be unimpeded.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Corridor Option 02 – Two Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
60	Reverse over 4 lanes of traffic in opposite directions.			ARUP to provide diagram showing sight distance reversing out of driveways, and note that road rules require reversing into nearest lane (i.e. crossing 2x directions of bike traffic and 1x traffic lane)
61	Unknown			
65			Mixed bike use and overtaking in 1.5m lane (school kid vs commuter rider)	ARUP to include cross section diagram of passing opportunities / cyclist envelope. Clarify if 3-abreast works on a 3m vs 3.5m path?
68 & 69			Inkerman Rd/Edith St seems like a good location for lights or a raised 'hump' to slow traffic?	ARUP to document wombat crossing as shown indicatively on previous plans.
71	Reversing onto oncoming traffic out of driveways			Cars backing across bike lanes is already an issue along any road with driveways and a bike lane. This will be considered by an independent safety report.
72	Parking for non-residential visits			Officers are aiming to minimise car parking reduction while balancing safety outcomes. Opportunities are also being sought to offset carparking loss in other local sites nearby.
74	Visitor feeling safe pulling up infront of non-residential buildings.			Safety impacts and perceptions of safety are being reviewed under a Gender Impact Assessment for the project, which will look at the outcomes associated with reduced parking requiring further walking distances.

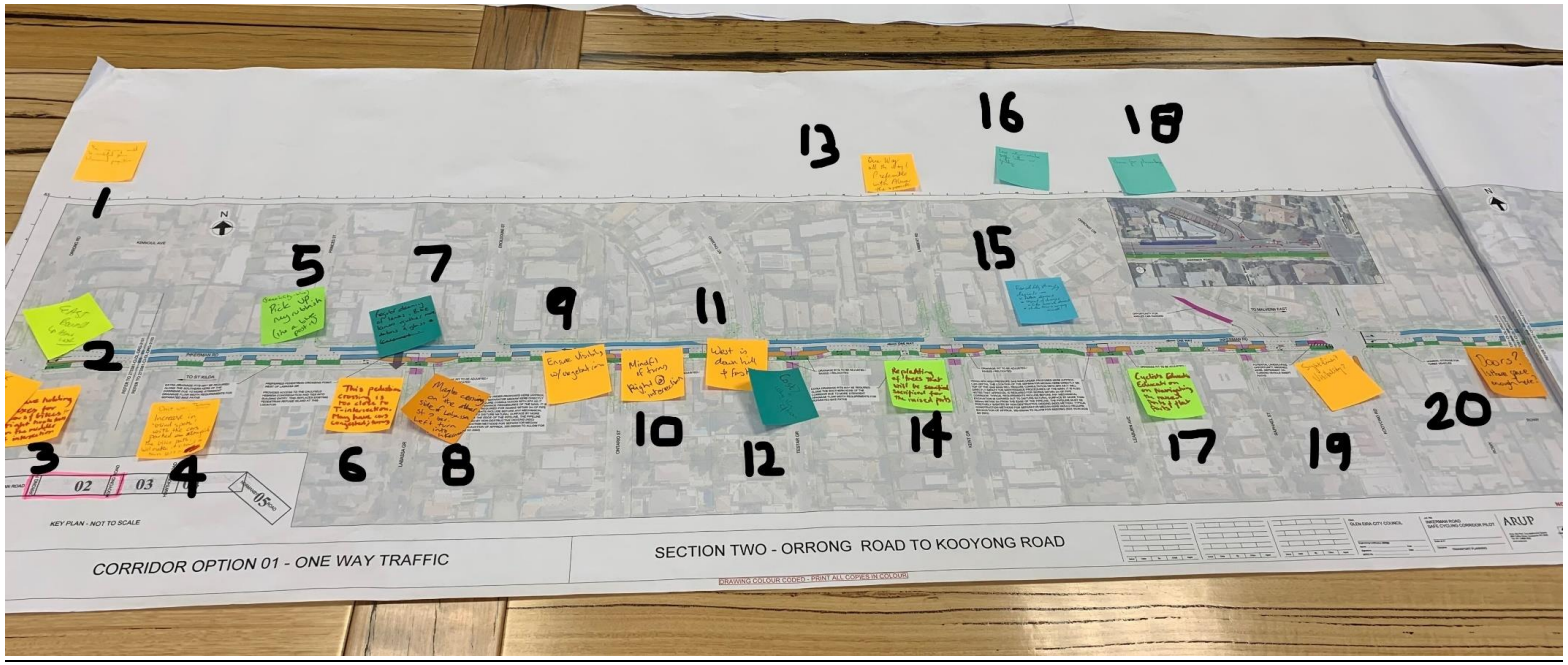
Attachment 11

Option 02 – Two Way Traffic				Neighbourhood
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
63			Big opportunity to enhance streetscape, trees and benches etc.	Comment/suggestion noted.
64	Reduced ease accessing driveway.			Access to driveways will be unimpeded.
70			Create 'parklets' wherever possible e.g., at Inkerman Rd / Edith St	ARUP to design pedestrian crossing as shown. Urban design drawings may go beyond this, but to be treated as opportunities and won't further impact the parking count.
75	At present, parking outside Lenny's (on Inkerman Rd) is usually full 3-4 days per week. Moving parking could be unsafe.			The current two-way vehicle design will retain parking on the northern side of the road. This parking is not intended to be removed in the current design.

Option 02 – Two Way Traffic				Feasibility
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
59	Consistency for utilities access			Noted, utility access will be unimpeded.
62	Commuter bike traffic will ride on road, not on bike path.			ARUP report to provide additional discussion on Geller's user types / all ages + abilities design approach and how this has been incorporated. Mention road rules re: bike riders must ride in lane unless not practical to do so.
66	No future modelling has been undertaken to consider feasibility.			Modelling has been undertaken for a base (existing) scenario. The two-way traffic option is reflective of this existing condition. Future intersection analysis will be required if the project is determined to proceed.
67	Construction costs, timing, level of local disruption.			An estimated construction cost will be provided to Council. A project of this nature which seeks to alter the road corridor will always lead to some level of disruption, however council will work to ensure that this is minimised.
73	Rubbish collection and small trucks.			Suggestion noted
76	9/10 of these project fail – why will this succeed given the low presence of bike riders now?			Noted
77	Amount of old people who live in the area.			The project is aiming to improve safety and amenity outcomes for people of all ages and abilities.

78		Continuity between Glen Eira and Port Phillip.		Glen Eira is working with the City of Port Phillip who are also planning for a bike connection via Inkerman Street.

STAC annotations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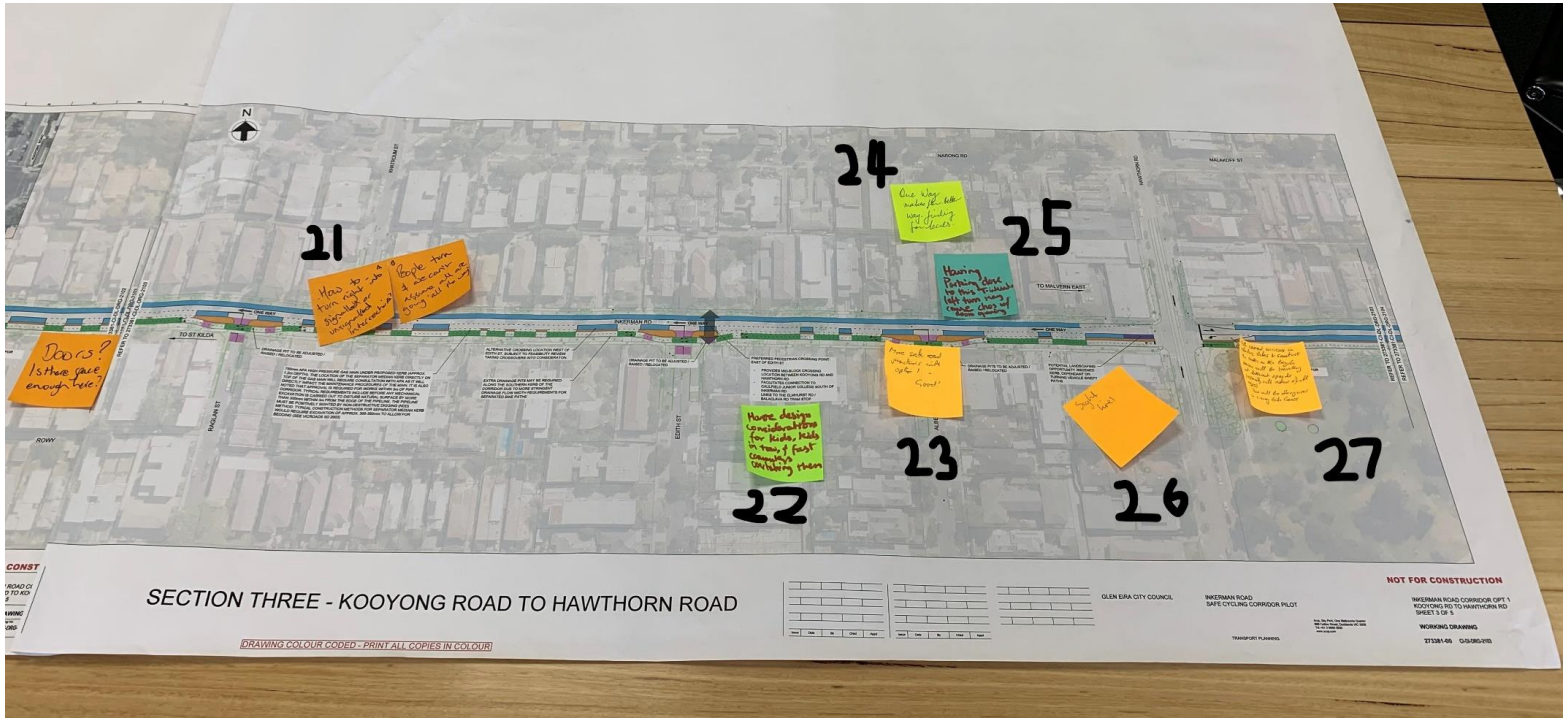
Corridor Option 01 – One Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
1		Yes, one-way would be wonderful from behavioural perspective		Comments noted
2	East bound (Inkerman). Alma West (bound)			Comments noted
3			Consider holding boxes for bikes for right hook turn in the middle of intersection	Comment noted.
4	Driveway turning – increase in 'blind spots' with the cars parked alongside the bike path will make it hard to turn left.			This will be considered by an independent safety report.
6			This pedestrian crossing (Inkerman/Labassa Gr) is too close to T-intersection. May have congestion of turning cars	Suggestion noted, additional comments will be sought through discussions with ARUP.
8			Maybe crossing on the other side of Labassa St? Due to left turn in to Inkerman.	ARUP to design crossing west of Labassa and generally as per activation space D drawing (but bent out for 1-way) and to align to congregation entrance.
9			Vegetation important, but maintain visibility.	Comments noted, lines of sight and visibility will remain a key component of improved safety outcomes.
10			Mindful of turning right at intersection (Inkerman/Ontario St?)	This will be considered by an independent safety report.

11	West is downhill and faster.			Comment noted.
13		One way all the way! Preferable with Alma the opposite.		Subject to ongoing consultation
19			Sightlines? Visibility? (around Orrong Cr and Kooyong Rd intersections with Inkerman)	This will be considered by an independent safety report, noting that a two-way corridor, will reduce the problem of obscured lines of sight by parked cars on one side of the road.
20			Doors? Is there enough space here? (east of Kooyong Rd)	This will be considered by an independent safety report.

Option 01 – One Way Traffic				Neighbourhood
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
2	East bound (Inkerman). Alma West (bound)			Suggestion noted
14			Replanting of trees that will be sacrificed for the raised parts.	Planting and location of street trees will be considered as part of refined final designs.
17	Cyclists educated on navigating the raised parts and flat parts.			Comment noted.

Option 01 – One Way Traffic				Feasibility
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
5	Pick up my rubbish			Rubbish will still be collected along Inkerman Road, however consideration will need to be given to the cycle land when placing bins out for curbside collection.

7	Regular cleaning of lanes. Bike lanes gather more debris and glass.			Cleaning of streets will be conducted in accordance with the usual street sweeping roster.
12			Cost? Why the option.	Final estimated costings will be subject to the conclusion of the design stage and presented to Council
15	Feasibility strongly depends on: future demand, impact of changes in bike lanes on demand, whether Alma is one-way as well!			A corridor demand report will be prepared to estimate cycling volumes along the Inkerman Road corridor. There are no present changes suggested for Alma road through the existing design.
16		Less motor traffic, better air quality		Comments noted – by giving residents safer options to commute by cycling around the municipality, a positive outcome will be reduced emissions from car travel.
18			Chance for placemaking	Comments noted – designs will continue to be refined based on council adoption.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Good!
Sight lines
SECTION THREE - KOOYONG ROAD TO HAWTHORN ROAD
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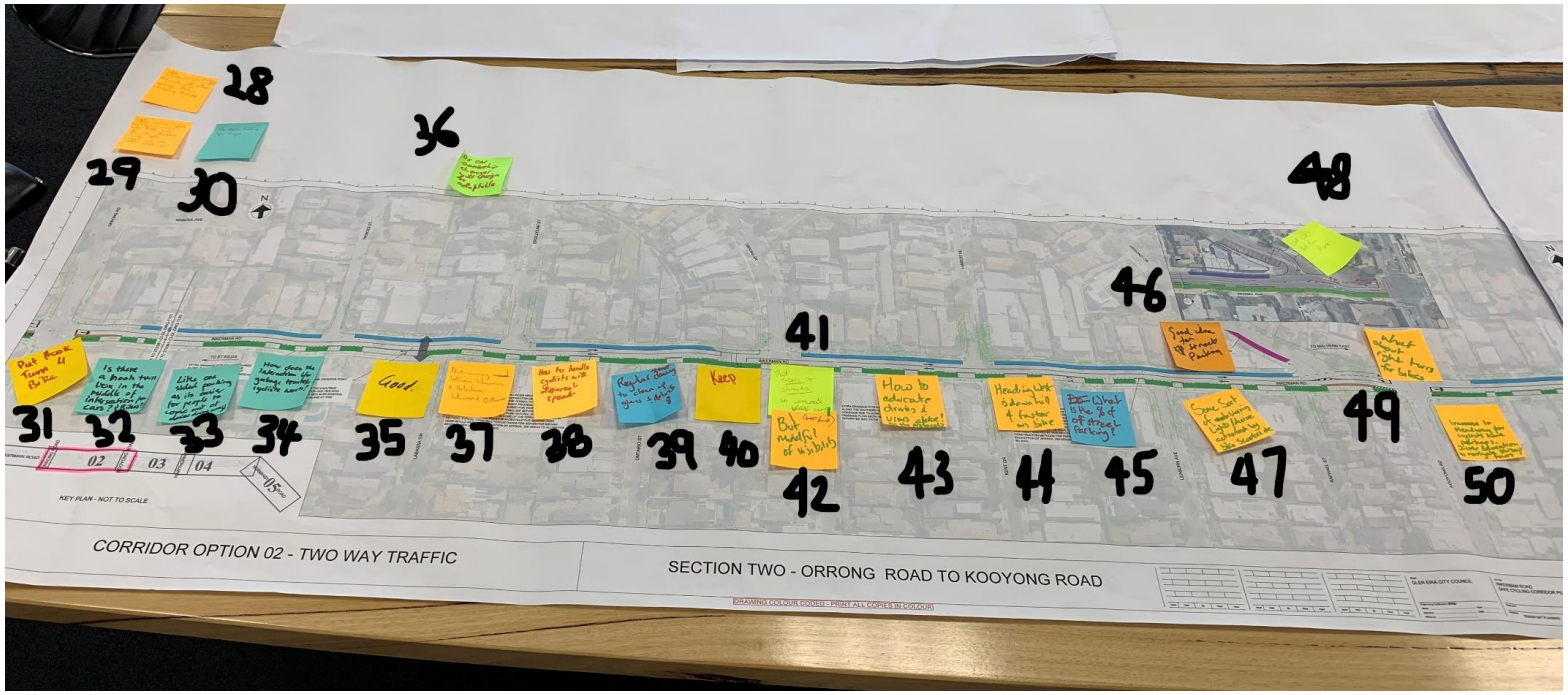
INKERMAN ROAD
SAFE CYCLING CORRIDOR PILOT
TRANSPORT PLANNING
WORKING DRAWING

Corridor Option 01 – One Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
21	How to turn right into signalled or non-signalled intersections. People can't assume they will go 'all the way'			ARUP to provide diagram in report outlining how to enter/exit the bike path from side roads – hook turns etc.
23		More safe road junctions with option 1 – Good!		Comments noted
24		One way makes for better way-finding for locals.		Comments noted
26	Sight lines			As an important safety aspect, lines of sight have been considered throughout the detailed design stage.
27	With increases in e-bike and scooters, need to factor in safety issues of different speeds and competencies of those travelling in bike lane.			ARUP report to acknowledge e-mobility as driver of future demand etc. now these are legal. Also that this project creates future proofing infrastructure for emerging modes.

Option 01 – One Way Traffic				Neighbourhood
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
22	Have design considerations for kids, kids in tow, and fast commuters overtaking them.			The cycleway will be designed for all ages and abilities and in accordance with Australian standards. There will be space for bikes to travel in each direction, although space for larger cargo bikes overtaking may be limited, however more opportunity will be afforded due to having a bi-directional bike lane.

Option 01 – One Way Traffic				Feasibility
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
25			Having parking close to this T-intersection left turn may cause conflict of door opening.	Noted – parking distanced from this intersection will be reviewed.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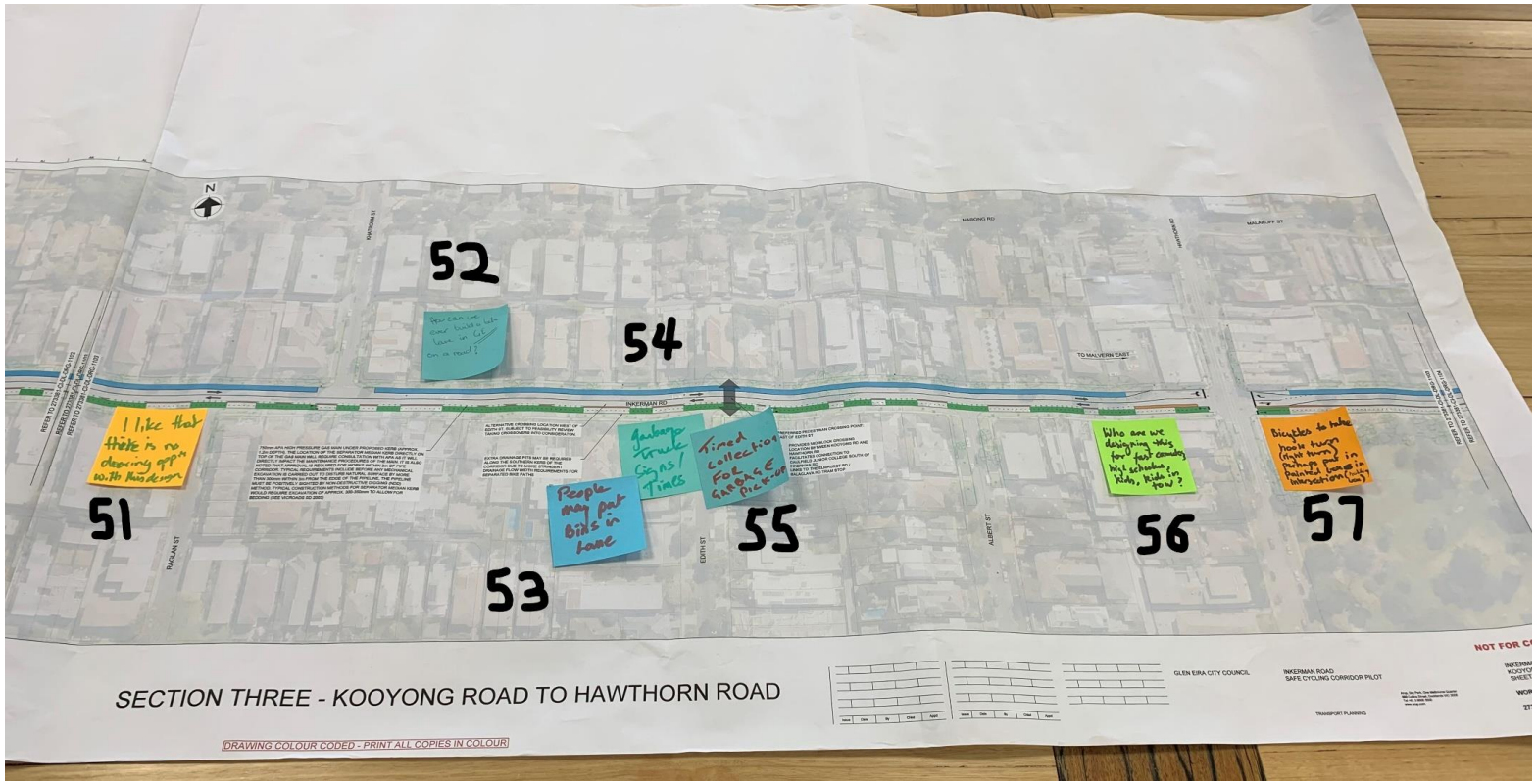
Good.
Keep
How to educate drivers & vines alike!
Good idea for Increase Parking
02
03
04
KEY PLAN - NOT TO SCALE
CORRIDOR OPTION 02 - TWO WAY TRAFFIC
SECTION TWO - ORRONG ROAD TO KOOYONG ROAD
DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR

Corridor Option 02 – Two Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
28	Concerns about: old people with walkers, garbage collection, emergency vehicles.			Emergency services are permitted to stop where applicable in the case of emergencies, so access will not be hindered due to a removal of car parking. The project is aiming to improve safety and amenity outcomes for people of all ages and abilities.
29	Concerns for cyclists: side street cars, turning right at major intersections, major east-west streets for cyclists and cars			This will be considered by an independent safety report.
31			Put hook turn for bike at Orrong Rd/Inkerman	Comment/Suggestion noted.
35		Good (crossing beside Labassa Gr?)		Noted
37	Rat running between Inkerman and Balaclava, Labassa and Ontaria.			Traffic calming initiatives within the surrounding areas may be considered to mitigate traffic in surrounding streets.
38	Has to handle cyclists with different speeds.			Provided there are no cyclists coming towards the rider, there should be ample space for cyclists to overtake on the right-hand side of the slower rider. Space is limited along the corridor and all road users need to be mindful of their surrounds and ride/drive to the conditions.
40		Keep		Comment noted.

41			Put trees or shrubs in concrete curb at Orrong Gr.	Comment/suggestion noted, however lines of sight and visibility will take precedent on the grounds of safety.
42	Mindful of visibility at Orrong Gr.			Comment noted.
43			How to educate drivers and users of a bike on the protocols?	Signage will be installed where appropriate. In advance, local cyclists and residents along Inkerman Road will be informed of the changed road and cycle path layout, which will remind all road users to drive and ride to the changed conditions.
44	Heading downhill is faster on a bike.			Comment noted.
46		Good idea for street parking.		Comment noted.
47			Some sort of warning lights/device activated by bikes, scooters etc.	Comment/suggestion noted. This detail will be discussed with ARUP as part of ongoing dialogue to refine designs before councillor adoption.
48			Can we do this more? (Orrong Cr/Inkerman design)	Comment/suggestion noted. This detail will be discussed with ARUP as part of ongoing dialogue to refine designs before councillor adoption. Corridor space constraints have impeded certain aspects of the scope of the project.
49			What about right turns for bikes? (Kooyong/Inkerman)	Bike boxes for right hand turning cyclists will be installed.
50			Increase in headway for cyclists here perhaps (Kooyong/Inkerman). Driver deducation to navigate this turn.	Traffic light signalling will be worked though with the Department of Transport if the project is approved to go to detailed design.

Option 02 – Two Way Traffic				Neighbourhood
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
30	Side street bending type design.			In the two-way opting this cannot be provided due to space constraints.
32			Is there a hook turn box in the middle of intersections for cars and bikes?	Bike boxes for right hand turning cyclists will be considered where appropriate.
33	Like one-sided parking as its easier for people to come out of driveways.			Comment noted, the two-way design will remove parking from one side of the road and retain it on the other side.
34			How does the interaction between garbage trucks and cyclists work?	Rubbish bins shall not be placed on the cycleway or roadway. Discussions will take place between council and garbage contractors to make drivers and operations managers aware of changes to the road conditions.
36			If car ownership changes , will design be adaptable?	Percentage of car ownership per household is predicted to gradually decline in Glen Eira between now and 2036 (ITS.)

Option 02 – Two Way Traffic				Feasibility
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
39	Regular street cleaning to clean up glass and debris.			Council's regular street cleaning program will apply to Inkerman road and the cycleway.
45			What is the % of off-street parking?	This will be included in the parking assessment report.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I like that there is no clearing appt with this design
People may put bins in lane
Garbage Truck Signs/ Times
Timed collection FOR GARBAGE PICK-UP
Who are we designing this for fast cemetery high schools, kids, kids in tow?
Bicycles to take
SECTION THREE - KOOYONG ROAD TO HAWTHORN ROAD
DRAWING COLOUR CODED - PRINT ALL COPIES IN COLOUR
GLEN EIRA CITY COUNCIL
INKERMAN ROAD
SAFE CYCLING CORRIDOR PILOT
TRANSPORT PLANNING

Corridor Option 02 – Two Way Traffic				Safety
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
51		I like that there is no dooring opportunities with this design.		Comment noted – risk of dooring incidents are a significant aspect behind the lack of safety for existing bike lanes, and the implementation of protected cycleways helps to correct this.
57			Bicycles to take hook turn (right turn), perhaps put in painted boxes in intersection? (Hawthorn/Inkerman intersection)	Bike boxes for right hand turning cyclists will be considered where appropriate.

Option 02 – Two Way Traffic				Neighbourhood
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
56			Who are we designing this for? Who are we designing this for fast commuters, high school kids, kids in tow?	ARUP to include content on Geller's four user types and we safe, protected lanes are needed to accommodate bike trips . How this influences the type of design / widths etc.

Option 02 – Two Way Traffic				Feasibility
CRG Feedback	**Comment**	**Support**	**Question / Design Consideration**	**Project Team Response**
52			How can we ever build a bike lane in GE on a road?	Due to constrained space in the municipality, on road cycleways are the only option for delivering new protected cycle corridors. There are many global and some local examples of similar implementation.

53	People may put bins in lane.			Comment noted – if implemented, residents will be reminded on the need to keep the cycleway clear from bins.
54	Garbage truck signs/times			Comment noted – will be considered by council officers if projected is implemented.
55	Timed collection for garbage pick-up around Inkerman/Edith St.			Comment noted – will be considered by council officers if projected is implemented. Discussions will take place between council and garbage contractors to make drivers and operations managers aware of changes to the road conditions.

Inkerman Road Community Reference Group

MINUTES

6:00-8:30

Thursday, 28 April 2022

Caulfield Cup Room, Glen Eira Town Hall

Attendees	**Councillors** Cr David Zyngier Cr Simone Zmood Cr Jim Magee Cr Tony Athanasopoulos (Via Zoom) **Community Members** [redacted] **Council Staff** Ron Torres, Tom Haysom, Matt Slavin (Via Zoom) Saskia Noakes, Christopher Edmond Brown **Consultants** [redacted]
Apologies	[redacted]

1. **Welcome**
   - Meeting chaired by ([redacted] WSP)
   - Acknowledgement of Country
   - House Keeping
     - The Council Officer project team has been asked to prepare a report for Council on the two corridor design options with a clear recommendation.

- The report will capture the views from a number of sources including the Community Reference Group.
- Design options for discussion include:
  - Hybrid: Two-way to the park, then one-way at the park. Parking on one side
  - One Way: Westbound all the way, parking on both sides & Eastbound all the way
  - Two Way: All the way - note designed but possible

2. Design Principles – Arup

- Rory and Paul (Arup) presented on the design principles and considerations for the corridor plans. Key discussed that influence the designs were:
  - Scope of design is to generally retrofit within existing carriageway, given the cost and constructability impacts.
  - Parking retention is a key priority. However, where adjacent the bike path, parking is set back from the edges of driveways, to accommodate vehicle manoeuvring and visibility.
  - Bi-directional bike paths are adopted to optimise efficiency where road width is constrained. They minimise space taken up by car door buffer zones and provide space for passing.
  - Bicycle lanterns and dedicated traffic signal phases assumed to be provided to manage conflicts at intersections.
  - A whole of street project – consider neighbourhood placemaking opportunities.

3. Option 2 Design Overview (Two-Way Design) – Arup

- Arup presented on the two-way traffic, bi-directional bike lane.

4. Virtual Reality - Christopher Edmond Brown

5. Option 2 Workshop

- Key comments included:
  - Concerns around the safety of right-turning cyclists at intersections
  - Questions around bin storage
  - Safety concerns for cars backing out across bike lanes
  - Discussion on location of crossings on Inkerman Road
  - Concerns around impact to vehicle access and parking for elderly and carers
  - Discussion on the importance of maintaining emergency services

- Ensuring consistency for utility access

- See Figures 5 and 6 below for Option 2 notes.

6. Traffic Modelling Outcomes (Onemilegrid)

- Samuel (OMG) presented on the findings from the traffic report (provided to the CRG on 12th of April)
- Discussion on how growth was applied to the model to assess a worst-case scenario (in accordance with Department of Transport requirements)
- Discussion on the impact of rat-running on how this would be resolved. Discussion included the requirement for Local Area Management Plans to be considered if the impact of the cycling corridor resulted in rat running.

7. Option 1 (1-1-way design piece) (Arup)

- Arup presented on the one-way traffic, bi-directional bike lane.

8. Option 1 Workshop

- Key Comments included:
  - Considerations for pedestrian crossing locations
  - Concerns around intersection problems at Inkerman Road / Normanby Road
  - Request for no impact to Caulfield Park
  - Benefits to the community and the importunity to increase vegetation to enhance the neighbourhood (opportunity for tree planting and 'miniparks' along the corridor)
  - Concerns around the impact to congestion on the network
  - Concerns for the safety of pedestrians and cyclists and the impact to roads that will carry additional traffic if the proposed design occurred.
  - Impact to public transport causing tram delays.
  - Impact of rat running on local streets.
  - Unsure about the cost vs benefit and whether the return on investment is there.
  - Concern that the design will impact property values due to impact on access
  - Concerns for sight lines when reversing
- See Figures 1 to 3 for Option 1 notes.

9. General Discussion

- Question was asked to the CRG 'In terms of the neighbourhood and how it feels to experience the corridor, what would you like to see?' Responses included:

- Adequate parking and parking near shops
- Protected pedestrian crossings
- Amenity access
- Safe pedestrian crossings
- Safe sight lines
- Mini parks
- Ease of travel and access

- CRG was asked whether based on the information available to date whether there was a preferred corridor option. The results were:
  - One-Way: 1 vote
  - Two-Way: 2 votes
  - Hybrid (two-way to park, one-way at park): 2 votes
- CRG members were asked how strongly would they like the project team to advocate to Council for the one-way option? The response was:
  - 'Not at all, I prefer the two-way option': 4
  - 'Somewhat': 1
- CRG members questioned whether the number of cyclists likely to use the proposed bike facility was assessed and included within the feasibility study. Council Officers confirmed that this had not been assessed yet. The CRG raised concerns that this information is important to assess the safety implications and the likely impact to people accessing their homes via Inkerman Road (specifically backing out of their driveways and crossing the proposed path). Council Officers commented that the number of cyclists likely to use the proposed design had not been determined. However, in order to assess the safety implication a number of scenarios will be considered as part of the Peer Safety Review (taking into account the safety impact of low, medium and high usage of the path).

10. Meeting Closed – 8.35

11. Next Meeting TBC

Figure 1: Option 01 Section 02



Figure 2: Option 01 Section 03

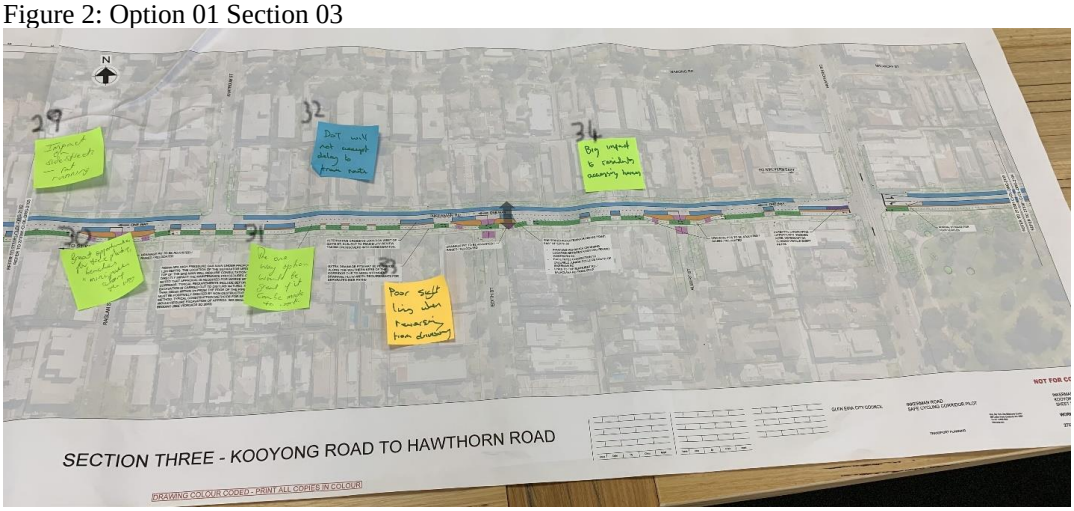


Figure 3: Option 1 Section 04

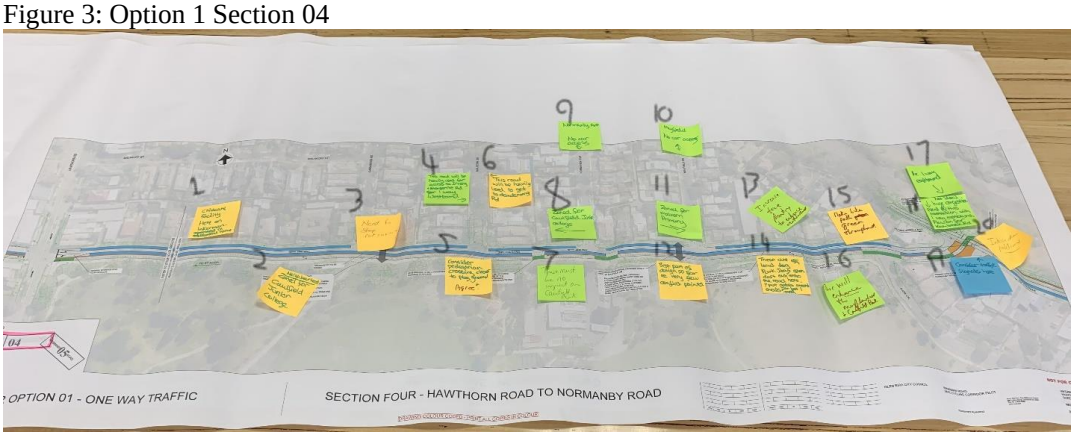


Figure 4: Option 2 Section 2

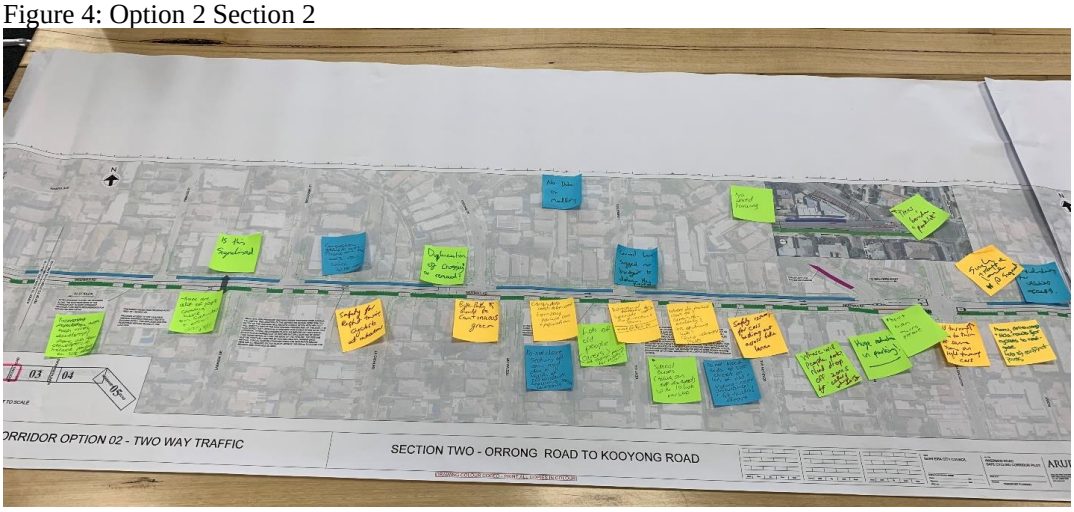
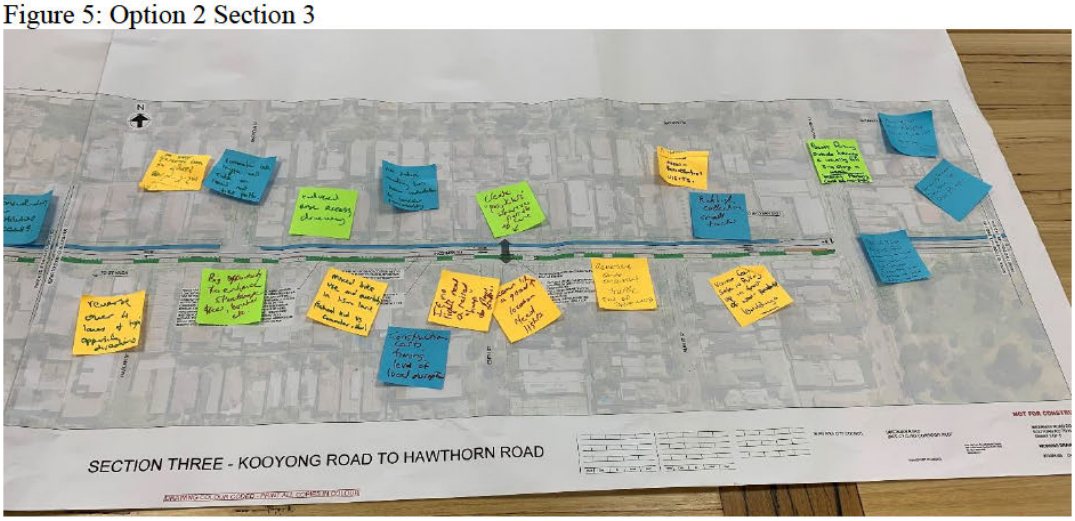


Figure 5: Option 2 Section 3



STRATEGIC TRANSPORT ADVISORY COMMITTEE

MINUTES

6:00-8:30

Monday, 2 May 2022

Caulfield Cup Room – Glen Eira Town Hall

Attendees	**Councillors** Cr David Zyngier Cr Simone Zmood Cr Jim Magee Cr Tony Athanasopoulos **STAC Members** [redacted] **Council Staff** Ron Torres, Tom Haysom, Saskia Noakes, Declan Martin, Christopher Edmonds-Brown **Consultants** [redacted]
Apologies	[redacted]

12. Welcome

- Meeting chaired by Cr David Zyngier
- Acknowledgement of Country

13. Purpose of the design workshop (Tom)

- **House Keeping**
  - The Council Officer project team has been asked to prepare a report for Council on the two corridor design options with a clear recommendation.
  - The report will capture the views from a number of sources including the STAC.
  - Council Officers met with the Community Reference Group on 28 April 2022 and held a similar workshop to gather feedback on design options.
  - Design options for discussion include:

- Hybrid: Two-way to the park, then one-way at the park. Parking on one side
- One Way: Westbound all the way, parking on both sides & Eastbound all the way
- Two Way: All the way

14. Design Principles – Arup

- Rory (Arup) presented on the design principles and considerations for the corridor plans. Key discussed that influence the designs were:
    - Scope of design is to generally retrofit within the existing carriageway, given the cost and constructability impacts (outside the carriageway).
    - Parking retention is a key priority. However, where adjacent the bike path, parking is set back from the edges of driveways, to accommodate vehicle manoeuvring and visibility.
    - Bi-directional bike paths are adopted to optimise efficiency where road width is constrained. They minimise space taken up by car door buffer zones and provide space for passing.
    - Bicycle lanterns and dedicated traffic signal phases assumed to be provided to manage conflicts at intersections.
    - A whole of street project – consider neighbourhood placemaking opportunities.
- The STAC raised the importance of turning visibility at intersections. Discussion on whether there were opportunities / technologies for cyclists to trigger awareness for drivers.

15. Option 2 Design Overview (Two-Way Design) – Arup

- Arup presented on the two-way traffic, bi-directional bike lane.
- STAC discussed opportunities for raised crossings.
- STAC discussed impact to parking with different design options.

16. Option 2 Design Workshop

- Key comments included:
    - Concerns for cyclist conflicts with turning vehicles
    - Consideration for hook turns for bikes
    - Concerns about rat running and how this will be managed – through Local Area Traffic Management (LATM's) programs.
    - Concerns on visibility and how vegetation will be maintained and managed
    - How will drivers and cyclists be educated on how to coexist
    - Questions around the interaction of garbage trucks and cyclists

- Will the design of the infrastructure be adaptable if car ownership decreases?
- Concerns around safety and dooring

17. Traffic Modelling Outcomes

- [redacted] One Mile Grid (OMG) presented on the findings from the traffic report (provided to the STAC on 12th of April)
- Discussion on why the worst-case scenario was assessed for traffic modelling and whether this was required. Council Officers and OMG confirmed that this was a requirement from the Department of Transport (DoT)
- Discussion on the possibility of changing Alma Road to one direction if Inkerman Road was to be successfully implemented (one-way). OMG confirmed that this would change the distribution and would need to be assessed at the time.
- Discussion on whether making changes to the Normanby underpass would change the traffic modelling. OMG confirmed it would.
- Discussion raised to consider modelling exercise using the 50/50 mode share target from the Integrated Transport Strategy (ITS), as this would reduce vehicle volumes. Officers noted that a design note could be provided to DoT to consider a reduction in future vehicle growth based on the ITS.
- Discussion on whether Council Officers could remodel without growth. Note that this was done by OMG in the first iteration of the traffic modelling and impacts to intersections were largely reduced.

18. Option 1 (1-way design) (Arup)

- Arup presented on the one-way traffic, bi-directional bike lane.
- Group discussion on the risk of door opening and ensuring this was incorporated into the design.
- Cr Zyngier noted that additional modelling would need to be undertaken for Alma Road if a future one-way reversed direction (to Inkerman) street was considered for Alma Road. Council Officer's took this on notice, noting that it was outside the scope of the current project, but if Council determined to look at any future corresponding one-way network of streets if Inkerman Road was to be made one-way, that they could undertake this task.

19. Option 1 Design Workshop

- Key comments included:
  - Discussion around turning including considering holding boxes for bikes for right hook turn in the middle of the intersection
  - Design considerations to resolve issues with blind spots
  - Location of pedestrian crossings

- Sightline and visibility considerations
- Considerations around dooring
- Vegetation considerations (impact to visibility / sightlines and benefits to public space)
- Maintenance / cleaning – ensuring bike lane is maintained to be free of debris and glass
- With increases in e-bike and scooters, need to factor in safety issues of different speeds and competencies of those travelling in bike lanes
- Will the design consider children, kids in town or will it be designed specifically for commuters?

20. Wrap-up and next steps

- Next STAC to be held June 16 and will focus on the 4 Year Cycling Program of Works.

21. Meeting Closed – 8:35pm

22. Next Meeting June 16, 2022

Figure 1: Option1, One Way Traffic – Section Two

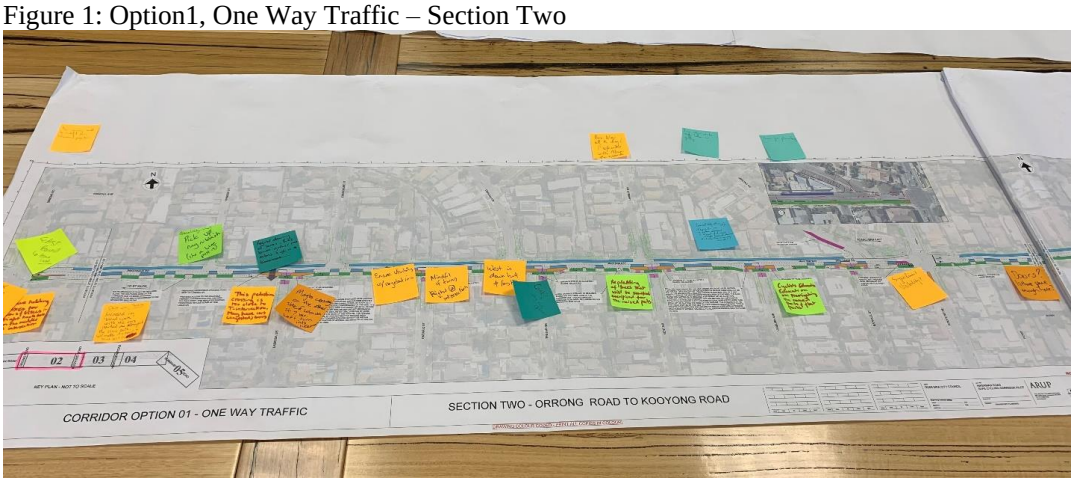


Figure 2: Option 1, One Way Traffic – Section Three

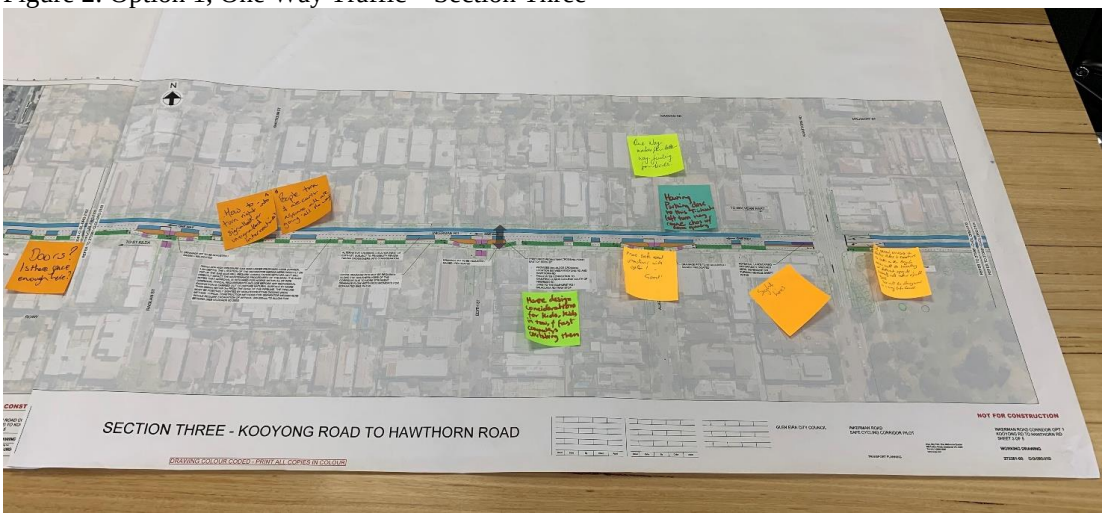


Figure 3: Option 2 – Two Way, Section 2

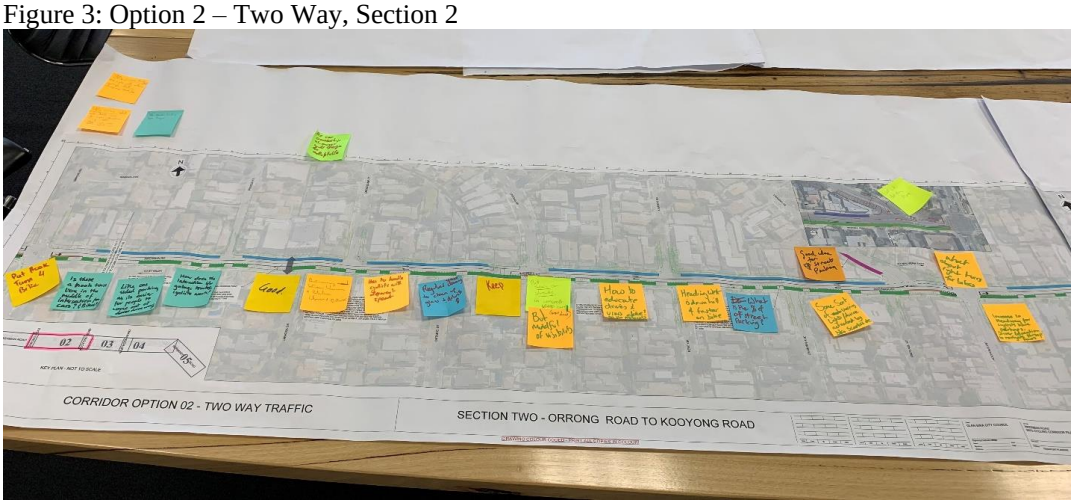
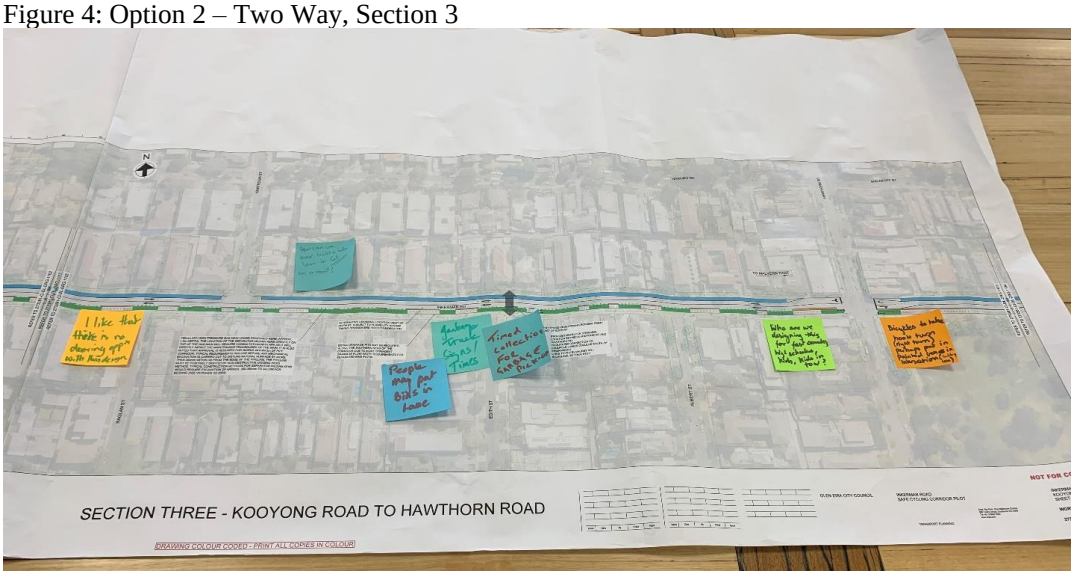


Figure 4: Option 2 – Two Way, Section 3



TECHNICAL ADVISORY GROUP

MINUTES

3:00-4:30

Thursday, 5 May 2022

840 Dandenong Road, Caulfield

Attendees	**Glen Eira** Matt Slavin, Tom Haysom, Christopher Edmonds-Brown, Saskia Noakes **City of Port Phillip** [redacted] **Bicycle Network** [redacted] **Yarra Trams** [redacted] **Onemilegrid** [redacted] **Arup** [redacted]
Apologies	Department of Transport attendees

23. Welcome

- Meeting chaired by Tom Haysom
- Acknowledgement of Country
- Official welcome and introduction

24. Option 2 Design Overview (Two-Way Design) - Arup

- *Presentation*

- *Road rules around left turns at intersections may be changing which may change the way intersections operate. Unsure if this will impact the project but should be considered.*
- [redacted]*Normanby Road Tram Stop – Funding was set aside to do the work but it was deferred waiting for the design for the cycling corridor to be confirmed. Action: Glen Eira to discuss with Department of Transport*
- *Reason for southern side of the road was due to the northern side having more crossovers (especially Section 4 of the design). However, an official assessment had not been done beyond that decision.*
- *City of Port Phillip Update*
  - *Shared section not designed yet but confirmed preference is to continue unidirectional through to the shared section*
- *Normanby / Dandenong – was raised as a major issue in STAC. However, closing would put more traffic onto Balaclava and Smith St*

- *Will there be a reduction in driveways in Inkerman? – Unlikely for a long time.*
- *Glen Eira has a policy to reduce crossovers*
- *CRG raised major concerns about reversing from driveways*
- *Managing waste collection needs to be resolved. Timing and types of vehicles.*
- *Deliveries will be managed through side streets*

25. OMG Traffic Modelling Presentation

- [redacted]*Yarra Trams flagged – tram turning phases not included in the traffic modelling – Balaclava and Hawthorn have a lot of tram turning phase – so the traffic modelling report might not be fully representative.*
- [redacted] *Yarra Trams – disagrees with option 1. Next steps could be to get Option 2 tram delay down to zero. Options discuss peak period turn bans.*
- *Discussion – is there scope to broadening project beyond cycling and address trams in line with the ITS?*
- *COPP – traffic modelling will be shared with GECC*
- *COPP completed a Movement and Place assessment but the safety review only reached a level B rather than an A because the cycleway is in an urban area and the difficulty with driveways.*
- *Action: GECC to liaise with DoT directly*

26. Meeting Closed – 4.30

Safe Cycling Corridor Pilot Community Reference Group (CRG) – Meeting Minutes

Date: 8 August 2022
Time: 6pm to 7.30pm
Location: Zoom (online)

Attendees

Community Reference Group	Glen Eira Councillors	Council Officers	Apologies
[redacted]	Cr David Zingier Cr Jim Magee Cr Sam Parasol Cr Sue Pennicuik	Ron Torres Matt Slavin (Chair) Tom Haysom Saskia Noakes Kate Jackson Chris Soderstrom	Cr Tony Athanasopoulos Cr Simone Zmood [redacted]

Action items

- CRG members to send feedback on the Independent Safety Review to Council Officers
- Council Officers to review feedback from the CRG to consider incorporating into the Safety Report
- Council Officers to send Safe System Solution Report to the CRG
- Council Officers to provide Cycling Demand Study to the CRG
- Council Officers to circulate responses to questions raised in CRG meeting

Meeting notes

Welcome	WSP: • Acknowledgement of Country • Official welcome and introduction
Introductions	WSP: • Meeting purpose and agenda • Terms of Reference

Project Update	Tom Haysom (GECC) provided a recap on the previous Community Reference Group meetings and how feedback from the group has been used to inform the project to date. Some of the most common feedback included considerations of: • Safety of right-turning cyclists at intersections • Questions around bin storage • Safety concerns for cars backing out across bike lanes • Discussion on the location of crossings on Inkerman Road • Concerns around the impact of reduced parking for the elderly and carers • Benefits to the community and the opportunity to increase vegetation to enhance the neighbourhood
Draft Independent Safety Review	Salt3 presented on the findings from the Independent Safety Review. As identified in the report, the assessment determined that both design options offer a safety improvement for all modes of transport compared with existing conditions, with the exception of vehicles for Option 1. The reason for this is because the on-street parking provided in Option 1 restricts some sightlines. However, the review also raised concerns regarding the Inkerman Road / Kooyong Road intersection and recommends that before the concept option proceeds to detailed design, a detailed concept configuration for this intersection should be prepared.
Design Responses	Arup presented on the design responses to the safety review and an overall update on the designs.
Community Engagement Plan	Kate Jackson on the community engagement plan and requested feedback from the CRG on groups to engage with. The CRG were asked to provide recommendations to Kate to include in the community engagement plan.
Questions	See Table 1 below.
Meeting Close	7:30pm

Table 1: Questions and Responses from August CRG

CRG Comments / Questions	Responses
Do we have the number of cyclists over the last 5 years? To understand the % of incidences per users per year.	This will be included in the updated Independent Safety Report.
The report looks at all transport modes but only looks at cycling crashes – why?	Noted. We will update the final report to include all transport modes in the crash stats section.

Dooring for vehicles / vehicles isn't an issue that exists so shouldn't be a consideration in the report.	The report considers the possible safety implications if changes were to be made based on the proposed designs. As traffic lane and parking lane dimensions would be altered under the proposed design options, dooring for vehicles / vehicles was considered. It was noted in the meeting that additional feedback on this point would be provided to Council Officers. This will be reviewed when we receive it.
Has a travel demand forecast been done?	This is currently being worked on and will be provided to CRG members once completed. The report is anticipated to be finalised by early September.
Can we please receive the safe system solution report?	This item has been actioned (sent to CRG members on 11/8/22).
Have you re-run Sidra analysis with the additional phasing?	Sidra analysis has not been completed for the additional phasing. However, we recognise that this would need to be done at a future stage of the project if it proceeds. This will be recognised in the design report.
Why are pedestrian crossings only considered for option 1?	Pedestrian crossings are considered for both design options 1 and 2.
Is the underpass onto Dandenong Road from Normanby Road (near Inkerman) being included as part of the safety assessment? This a terrible intersection for cars and bikes.	Yes, this has been captured in the safety assessment. We recognise that if the project proceeded to further design stages, more safety scoping would be required for this intersection.
Will the long plot of the design with changes be made available?	We can make them available for all CRG members who wish to come in and see them. Please contact us to make an appointment.
Have you used other apps to trace where these cyclists are already going? Strava etc.?	Please refer to the '*corridor assessment report*' which contains cyclists' numbers and likely destination considerations. Strava data was considered. https://www.haveyoursaygleneira.com.au/safe-cycling/widgets/233939/documents
Arup – have any of the discussion points / queries / concerns from the last session been incorporated yet in the prelim designs?	Yes, feedback from the previous CRG meeting was reviewed and incorporated where appropriate. Broadly this includes, but is not limited to:

	• The location of a new pedestrian crossing at Malvern Grove to improve access to the nearby playground in Caulfield Park) • Exploring the opportunity to trial demand-activated warning signs or technology like 'green wave' but for safety at local intersections. • Alternative considerations for bin collection so bins can remain in their current location (not dragged across the bike lane) • The addition of hook turn box to better accommodate cyclists moving eastbound wanting to turn North at major intersections. • The addition of more side street parking opportunities – with the configuration of more parking in Orrong Grove being adopted into the design and the identification of 'opportunity sites' for others and landscaping / urban design improvements.
Can you please send the design review report?	Yes, when this is completed it will be made available to CRG members (this will be ahead of the Council report).
What do you mean by the stakeholder group in target?	A 'stakeholder' is a person, or group with an interest or concern in the project. For example, the sporting clubs that use Caulfield Park are stakeholders for this project.
Suggestion for different user groups require separate sessions.	Noted.
What is the consultation timeline?	If the project progresses to consultation it would be for a minimum of 6 weeks and would start early 2023.
Can we provide a list of what's in an RSA?	A road safety audit (RSA) is a formal examination of proposed or existing roads and road related areas from the perspective of all road users with the intention of identifying road

	safety deficiencies and areas of risk that could lead to road crashes. It is conducted by an independent, qualified team of professionals. RSA's are carried out at different stages but most commonly on the functional design, detailed design, pre-opening, post-opening and existing conditions. An RSA typically includes: • Detailed day and night-time inspection of the site by a team of at least two accredited Road Safety Auditors. • Review of all relevant information and material, and project background summary. • Identification of all potential road safety deficiencies, beyond assessing conformance to standards. • Explanation of the potential road safety impact in relation to crash type. • Risk assessment considering the likelihood and severity of the identified crash types. • Recommendations for mitigating treatments. • A column for the client to respond to each identified road safety risk (i.e. will the recommendation be accepted and if not, why). If the project were to proceed to more detailed design stages, an RSA would be undertaken on any updated and more detailed design.
With regard to the Cycling Demand Study, what is the demand attributed to?	1. Comparison method: analysis of observed counts from similar cycling projects in Victoria, Queensland and Western Australia. 2. Uplift factors: current demand along Inkerman Street is expanded by uplift factors derived from intercept surveys of bicycle riders at completed cycling projects across Australia. This report is currently being completed and will be provided when complete.

In the professional opinion of the Safety Consultants are there a lot of unreported cycling crashes?	Yes, the crash statistics only represent crashes that were reported to the police.



Inkerman Road

GECC x CoPP Shared Design for Section 1 – Hotham St to Orrong Road

20 NOVEMBER 2020

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1 | Introduction

An outline of the project context, work to date and timeline demonstrating the relationship between this report and the preparation of a Corridor Plan for Inkerman Road.

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Introduction

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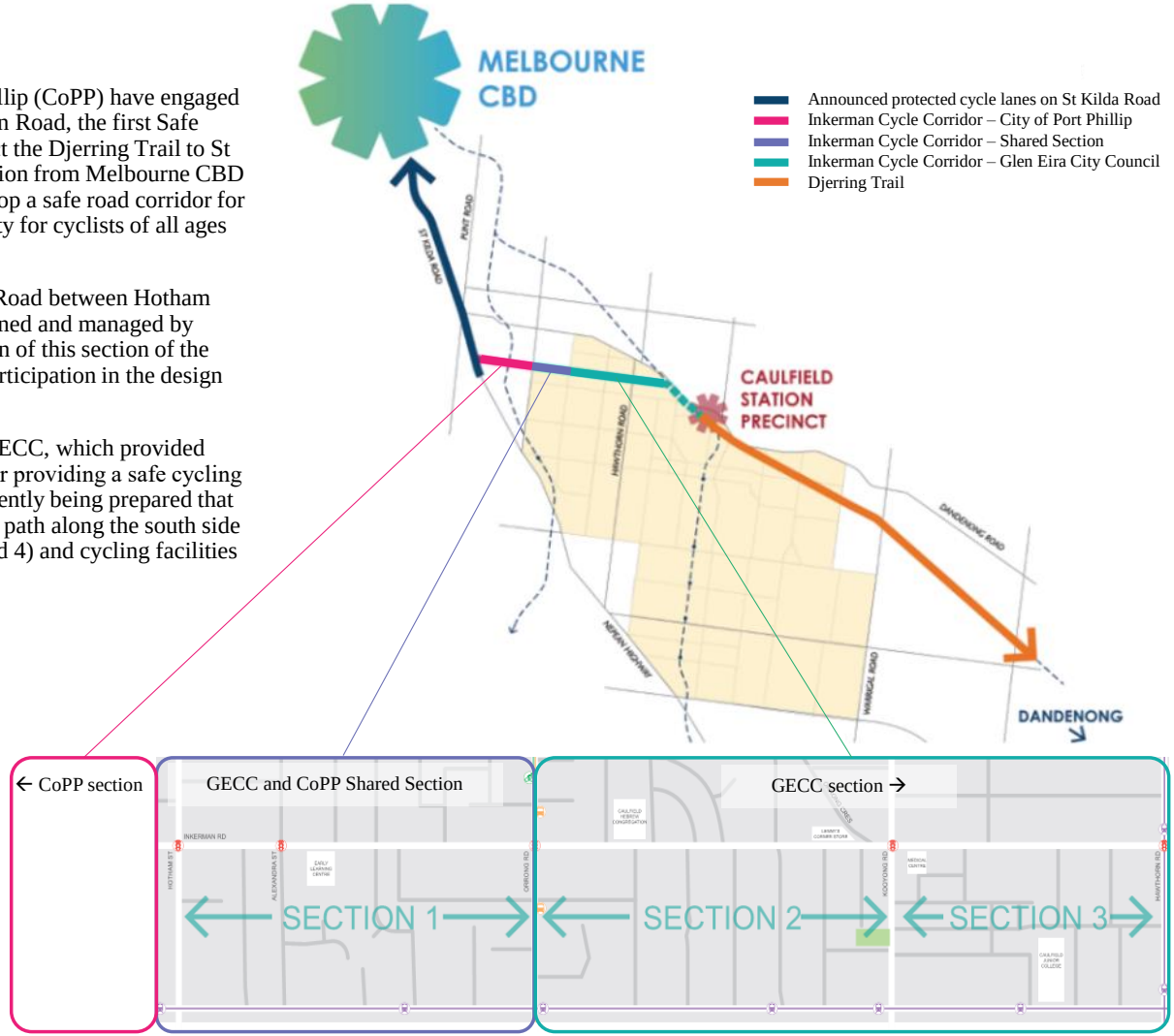
Background

Glen Eira City Council (GECC) and City of Port Phillip (CoPP) have engaged Arup to provide input to a Corridor Plan for Inkerman Road, the first Safe Cycling Corridor in the municipality that will connect the Djerring Trail to St Kilda Road and provides a complete cycling connection from Melbourne CBD to Dandenong. The vision for the corridor is to develop a safe road corridor for all road users, by including a separated cycling facility for cyclists of all ages and abilities.

The subject of this report is the section of Inkerman Road between Hotham Street and Orrong Road (Section 1) and is jointly owned and managed by GECC (south side) and CoPP (north side). The design of this section of the corridor is co-funded by both councils, with equal participation in the design development process.

Arup has previously prepared a Stage 1 Report for GECC, which provided exploration and appraisal of five 'Road Scenarios' for providing a safe cycling corridor on Inkerman Road. A Stage 2 Report is currently being prepared that presents two design options for a bi-directional cycle path along the south side of the corridor east of Orrong Road (Sections 2, 3 and 4) and cycling facilities on Normanby Road (Section 5).

The purpose of this Shared Section Report is to explain the design development process of the shared section (Section 1) of the Inkerman Road safe cycling corridor. This report outlines key design features for each option, considering issues such as safety, neighbourhood, and feasibility of construction. This report should be read in conjunction with the Stage 1 and Stage 2 Reports and with the functional layout plans produced by Arup.



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Introduction

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Timeline and process

The development of the design for the shared section of Inkerman Road has been led by GECC and CoPP with the input and support of the Department of Transport. Three workshops have been held to discuss and agree on design considerations and resolve misalignment of design objectives between councils. Project staging as shown in the figure below summarises the timeline for different parts of Inkerman Rd and the respective council responsible. The shared section, which this report summarises, is shown in blue below. Following the stage 1 GECC work, a shared design process was commenced, consisting of the following workshops culminating in an agreed design for protected lanes:

Workshop 1: Agreeing a fundamental cross section and basis of design

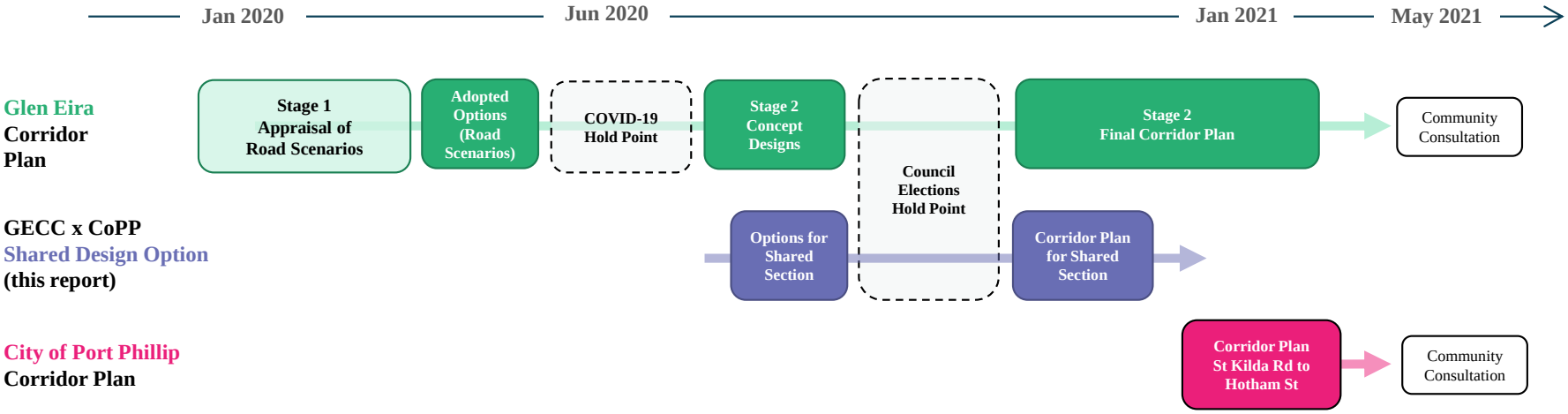
Workshop 2: Consideration of conflict points such as side road treatments, side of road for on-street parking and major intersection treatments

Workshop 3: Early consultation with DoT for design feedback and advice focusing on intersections.

References

The Stage 1 and Stage 2 Reports list the key reference documents that more generally support the Inkerman Road Safe Cycling Corridor Pilot project and its history of planning. Collectively, those documents justify the selection of Inkerman Road as the preferred Strategic Cycling Corridor, and establish the Road Scenarios considered in previous stages.

This Shared Section Report focuses on design development, and takes guidance from the documents outlines at the end of this report (References) into account for the Inkerman Road Corridor Plan.



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2 | Design options & adopted cross section

A summary of the design options considered, and the selection of a typical cross section for the design.

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Design options

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Based on the GECC Stage 1 Corridor Plan, two options were identified that aligned with CoPP's objectives for the corridor:

- Road Scenario 1 (RS1, top): Protected bicycle lanes on both sides of the road with parking on one side and two-way traffic flow; and
- Road Scenario 4b (RS4b, bottom): Protected bicycle lanes on both sides of the road, parking on both sides and one-way traffic flow.

A workshop with GECC and CoPP was held to discuss key considerations for each road scenario, including:

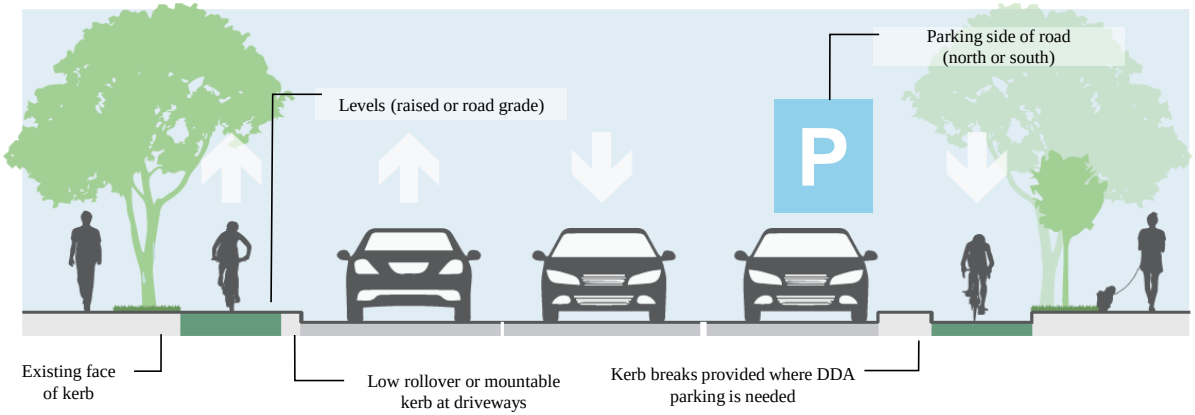
- The side of the road most appropriate for parking (north or south) under RS1;
- The direction of the one-way traffic flow (east or west) under RS4b; and
- The level of the bicycle lanes (raised or at road grade) under both scenarios.

Following the workshop, it was determined that RS1 would be progressed to concept design. Noting the benefit of retaining parking on both sides, the impacts of one-way traffic flow under RS4b were not preferred by CoPP due to:

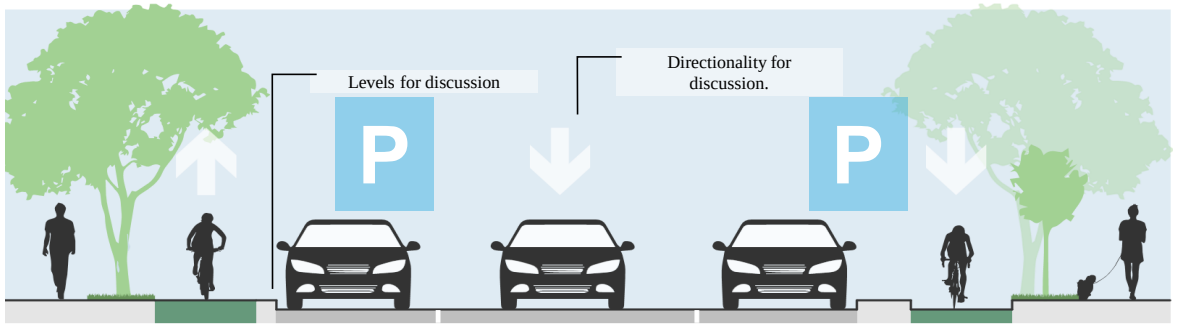
- The impact to the capacity of the surrounding road network and the potential to increase congestion; and
- The subsequent potential impact to tram operations on Balaclava Road resulting from re-directed traffic and increased congestion.

The following sections discuss the key design parameters in relation to the road scenarios and present the final concept design cross section.

Road Scenario 1: Protected lanes on both sides, parking retained on one side, two-way traffic flow



Road Scenario 4b: Protected lanes on both sides, parking retained on both sides, one-way traffic flow.



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Design criteria

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Lane widths and buffers

Minimum lane width requirements for both vehicular and bicycle traffic have been taken from Austroads, Australian Standards and various VicRoads supplements in determining both the minimum and desirable standards.

Minimum requirement: the absolute minimum acceptable, and
Desirable standard: the preferred or ideal provision for a given design element

Measure	Parallel parking	One way	Separator kerb	Traffic lane
Minimum Requirement	2.1m [+0.5m traffic lane clearance]	1.2m	0.6m [1]	3.0m
Desirable Standard	2.3m [+0.5m traffic lane clearance]	2.0m – 2.5m [2]	1.0m	3.5m

[1] Whilst not referenced in any relevant design standards, a 300mm wide separation kerb is generally accepted where the bicycle lane is directly adjacent to traffic and there is no risk of car-dooring. GECC preferred is 0.8m
[2] With protected lanes, 2m between face of kerb and separator is recommended to enable comfortable passing opportunities (Austroads)

The two potential designs, Road Scenario 1 and Road Scenario 4b, generally satisfy the desirable design criteria, with the exceptions being:

- Parking lane adopts minimum – supportable based on long term etc.
- Traffic lanes are 3.0m wide, however this is context specific and complies with the VicRoads / DoT standard that specifies a 3.0m width for a local road
- Separator kerb width is less than 1.0m where required to achieve other dimensions, however is only reduced below the 1.0m desirable where no adjacent car parking is provided.

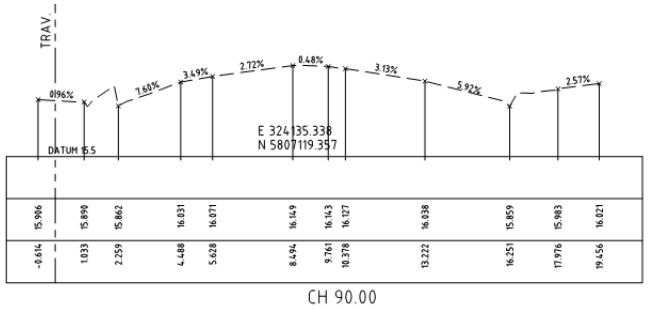
Bicycle envelope

The typical bicycle envelope under Austroads guidance is accepted to be 1.0m, with 0.1m of manoeuvring space on either side. In discussions with CoPP, it was determined that for uphill sections, 2x 1.1m rider envelopes should be achieved, with a resultant desirable width for an uphill bicycle lane of 2.2m to accommodate safe passing.

Bicycle path levels

The level of the bicycle path, either raised or matching the road grade, has implications for the functionality of the corridor. The table below outlines the key considerations when determining the appropriate design approach. An indicative cross section of the Inkerman Road corridor is also shown to indicate the crossfall at the kerbside where a kerbside, protected bicycle lane would be located.

Level	Comments
Raised	• Slightly higher riding position may improve visibility between riders and traffic entering driveways (i.e. visible above parked cars). • Previously considered for one side, due to width constraints in other sections. • Rollercoaster effect if buffer depth limited and levels not design appropriately • Quality outcome may require regrading driveways and/or bespoke kerb profile (or rollover style kerb). • Critical overland flow paths may require further flooding studies
Road Grade	• Short sections of kerb separator perceived as hazards (aesthetics, tripping hazards, accessibility) • Cost / constructability benefits. Flexible option for type of separation and tactical approach to short term delivery / piloting (bollards, planter boxes etc.)



Existing road profile of Inkerman Road near Hotham St

In discussions with GECC and CoPP, it was determined that the shared section would adopt the level of the road grade, with raised sections at side roads (detailed further in Section 4).

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Adopted cross section

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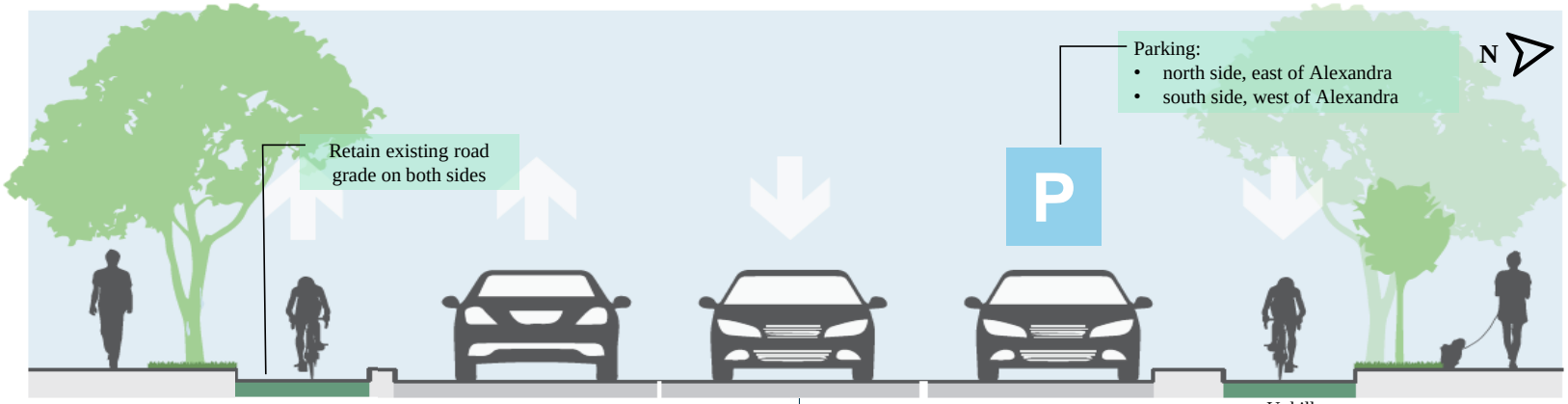
Concept design

The agreed design reflects RS1 with two-way traffic flow and parking retained on one side of the corridor, with protected bicycle lanes at existing road grade level on each side. The side of the road parking is located on alternates from south (west of Alexandra Street) to north (east of Alexandra Street), the rationale for which is outlined in Section 3. Further details of the agreed typical cross section for the shared section is shown in the below diagram, including the general widths achieved for each component of the section.

Agreed cross section for Inkerman Road, facing west



Path varies 1.8m to 2.2m as road widens

Adopt 500mm buffer – constant width

2x 1.1m bicycle riders (passing envelopes) on uphill direction

	WB Bike	B	Westbound traffic	Eastbound traffic	Parking lane	B	EB bike	**Total width**
Minimum achieved	1.8	0.5	3	3	2.1	1	2.2	13.6m
Maximum achieved	2.2	0.5	3	3	2.1	1	2.2	14m

Parking lane reduced to 2.1m (CoPP request).

Maintain desirable buffer width adjacent parking

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3 | Mid-block design

Once a typical cross section has been agreed, various design decisions were required to resolve the design at mid-block location, including which side of the road parking should be located, treatment of uphill vs. downhill sections, the treatment of the bicycle path at driveways.

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Vertical alignment

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Mid-block design elements determine the longitudinal appearance and make-up of the safe cycling corridor between intersections. The design elements in this section were considered with reference to the identified priority themes of safety, neighbourhood and feasibility, to arrive at appropriate design decisions.

Impact of steepness on design elements

The gradient of Inkerman Rd (right) was a key input to the design decisions due to its impact on likely cyclist speeds. The following elements of the design were influenced by the prevailing road gradient:

Path width
- Increases difference in speed between types of cyclists.
- More important to accommodate passing for incline (eastbound).
- Wider paths adopted on the north side.

Cyclist turn radius
- A 30km/h design speed was still considered suitable for side road treatments with curves, even if there is a chance some sports cyclists might exceed this speed.
- If bent-out treatments proposed on south side, advisory treatments might be considered to caution sports cyclists, and ensure motorists have sufficient gap sight distance. Some concerns were raised regarding the interface between faster cyclists and pedestrians if a 'bent-out' treatment were provided on the down hill section.

Driveway interfaces
- On the side of the road that parking is provided, parked vehicles can limit sight distance between drivers and cyclists. For Road Scenario 1 - retaining parking on the north side is better for the safety of interaction at driveways.

Side road interfaces
- On the downhill segments, cyclists are more likely to be able to reach an equitable speed with vehicles, reducing the likelihood that vehicles will speed up or make aggressive left-turn movements in front of cyclists.

Passenger-side car dooring
- Faster speeds on downhill grades adjacent parking may exacerbate risk of conflict with boarding/alighting passengers and car dooring.

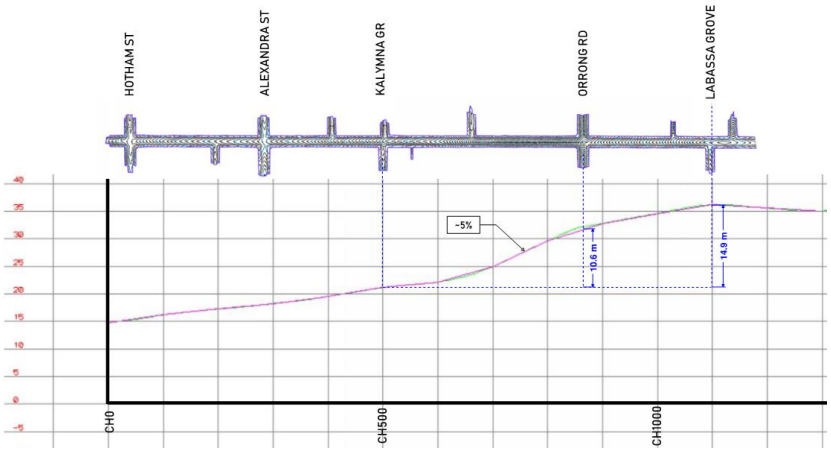

Figure: Vertical road profile of Inkerman Rd between Hotham St and Orrong Rd showing the. Cyclists heading eastbound will ride up an incline at lower speeds than cyclists heading downhill westbound, particularly between Kalymna Gr and Orrong Rd.

Table: Turn radius based on design speed for bicycle paths – Austroads. A design speed of 30km/h has been adopted for horizontal path geometries.

Design speed (km/h)	Minimum turn radius (m)
20	10
30	25
40	50
50	94

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Parking adjacent driveways

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Design Guidance

The offset distance between on-street parking and driveways is an important design consideration to maximise on-street parking without compromising safety. There is no prescriptive design guidance for sight distance in instances where protected bicycle paths, driveways and parking interact, however.

The two main considerations for determining approach and departure side offsets are:

- Cyclists' ability to stop having seen a vehicle crossing their path
- Drivers' ability to see an oncoming bicycle

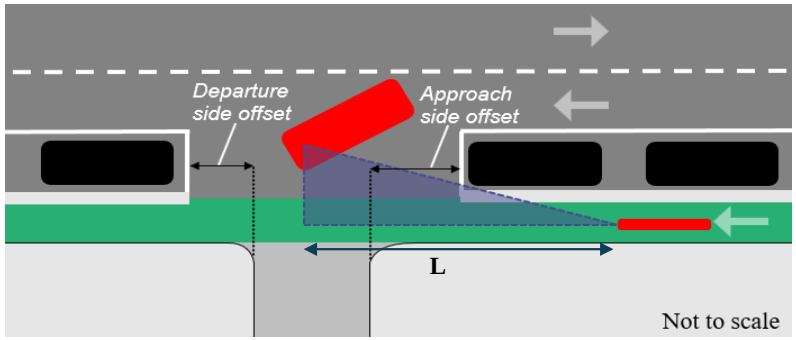


Illustration of line of sight between a cyclist and left-turning vehicle, demonstrating the benefit of the 'approach side offset' to parked cars.

The Victorian road rules provide some basis for determining driveway offsets stating that cyclists must give way to the vehicle turning left if it has indicated intention to do so ahead of the bicycle (Road Rule 114.1).

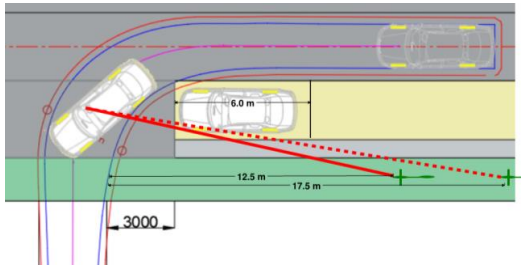
The implications of the road rules for designers are that:

- Firstly, **safe stopping distance** for cyclists should be achieved, allowing them to yield for a vehicle entering a driveway.
- Secondly, that **gap sight distance** should be achieved for right turning vehicles entering a driveway, as well as to allow left-turning vehicles to give way to cyclists which may occur regardless of the road rules which may not be reflected in common driver behaviours.

Sight distance

Gap sight distance

Minimum Gap Sight Distance (MGSD) is the distance corresponding to the critical acceptance gap that drivers are prepared to accept when undertaking a crossing manoeuvre. The achieved gap sight distance (12.5m and 17.5m in figure below) and corresponding gap times at various cyclist speeds are provided below.

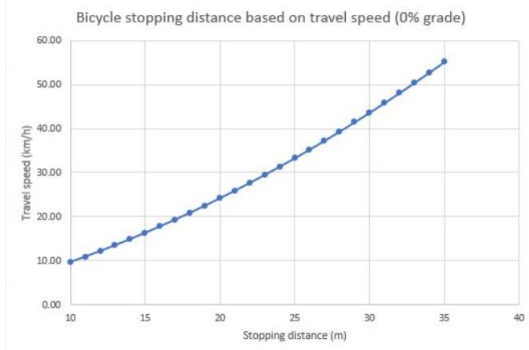


Example of Gap sight distance achieved with 3m offset

Cyclist Speed	Clear of vehicle (12.5m)	Over bonnet (17.5m)
Key	———	·····
15km/h	3.0 sec	4.2 sec
20km/h	2.3 sec	3.2 sec
25km/h	1.8 sec	2.5 sec
30km/h	1.5 sec	2.1 sec
40km/h	1.1 sec	1.6 sec

Stopping sight distance (SSD)

SSD refers to the distance required for a 'normally alert' cyclist to see perceive, react and brake to a stop before reaching the hazard (a vehicle entering a driveway).



Source: AASHTO

Inkerman Road Corridor Plan: Shared Design Section 1 12

Parking adjacent driveways

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Vehicle Access and Manoeuvrability

Vehicular access to/from driveways is also a relevant consideration informing how closely parking should be permitted adjacent to driveways.

Swept paths have been carried out of a 99th percentile passenger vehicle ('B99') as shown below for both entering and exiting a 3m wide driveway, assuming a 10km/h speed for forwards manoeuvres and 5km/h for reverse manoeuvres speed.

The swept paths demonstrate a range between 2-4m offset being generally sufficient for vehicles to access driveways safely, with only marginal overlap of clearance lines into the marked corner of the bay.

Crossovers to commercial premises or driveways with off-street car parks, would be reviewed on a case-by-case basis at detailed design, so that any particular needs are considered.

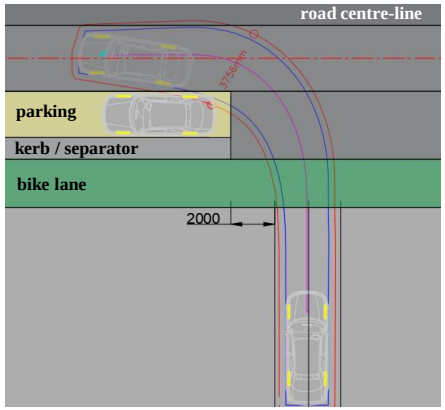
Adopted Parking Offset to Crossovers

The table below shows adopted approach and departure offsets for each council area considering sight distance and manoeuvrability constraints discussed in this section.

Preferred offsets between crossover and car parking.

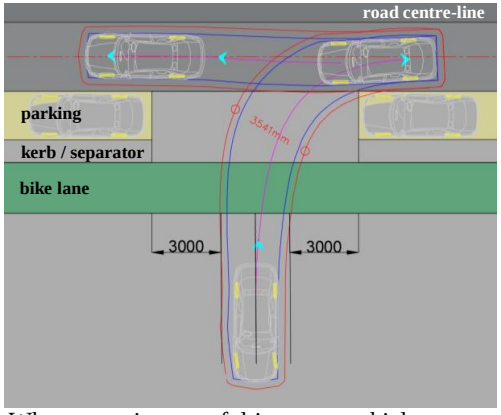
Council area	Approach side offset (m)	Departure side offset (m)
CoPP	4m	2m
GECC	3m	3m

Left out of driveway



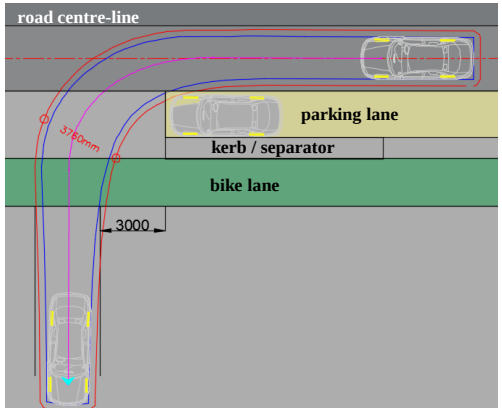
On exiting driveways, vehicles may need to cross the centreline slightly when exiting, unless vehicles leave a gap at the rear of the parking space.

Reverse out of driveway



When reversing out of driveways, vehicles have maintained lane discipline and not crossed the centre line.

Left in to driveway



Vehicles can enter driveways with ease when a 3m offset to parking spaces.

Placement of car parking: criteria assessment

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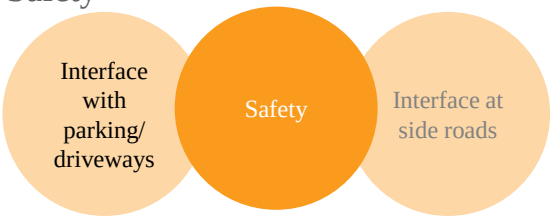
To determine the most appropriate side of Inkerman Road to accommodate parking, a multi-criteria assessment was undertaken based on the three key themes identified in the Stage 1 Report: Safety, Neighbourhood and Feasibility. The following section details the assessment under these themes and their criteria.

Safety



- Parking on the north side will be against the uphill direction of travel. The reduced speed of cyclists uphill in turn reduces severity and likelihood of crashes with vehicles turning in/out of driveways. Motorists will have an improved ability to judge gaps as cyclists will be travelling more slowly compared to the downhill direction, and parked cars have a lesser affect.
- There are more driveways on the north side (45 vs. 36), but they are all residential. The south side includes accessways to off-street car parking that are likely to attract more traffic..
- Short-term parking next to the downhill bike lanes increases the risk exposure for conflicts between pedestrians accessing their vehicle and cyclists, meaning it is less safe to have parking on the south side. While 'desirable' design standards could be achieved to lower the risk of car-dooring accidents, some risk will always remain.
- A 'bent-out' treatment could be provided on the side of car parking. This allows a higher standard of protection for cyclists and priority over left-turners entering. However, there are also concerns that it could result in higher speed conflicts as cyclists navigate the curves near pedestrians. Similarly, approaching motorists will need greater visibility to oncoming cyclists if they are travelling at higher speeds, and sight lines for exiting side-roads could be limited by fences or vegetation inside properties. On the balance, a bent-out treatment is neutral as to which side parking is provided.
- The downhill direction enhances the ability of cyclists to achieve 'equitable speed' and blend with traffic. This means there is less likelihood that vehicles will assume priority over cyclists for left-turns, but rather wait for them to pass before entering. This makes the 'straight' treatments safer on the south side.

Neighbourhood



- Land uses on the south side have a more significant visitation element (e.g Childcare etc.) that might benefit from on-street parking. There is also a medical clinic on the northeast corner Inkerman/Alexandra with little to on-site parking, and may rely upon on-street parking.
- However, similar to most households, non-residential uses on the south side appear to have off-street car parking that might accommodate these parking demands. For those that can't park off-street, strong pedestrian links can be provided to ensure Inkerman Rd isn't a barrier to access.
- Most users of on-street parking will be regular users (i.e. residents, visitors to Chabad House, or parents/guardians of the Kindergarten). They'll likely become accustomed to using the most efficient driving route for optimal access to on-street parking, with a relatively minor inconvenience caused.
- More parking could be retained on the south side primarily because the existing supply is higher on this side. However the difference was estimated to be relatively minor assuming -1 space lost per driveway. Concerns the safety of the interface between downhill cyclists and on-street parking was contemplated to be resolved by assuming a higher design speed, which in-turn results in more thinning out of car parking to achieve sightlines. In that instance, parking on the south side would not have advantageous.

Placement of car parking: criteria assessment

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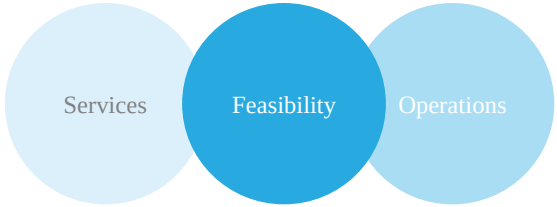
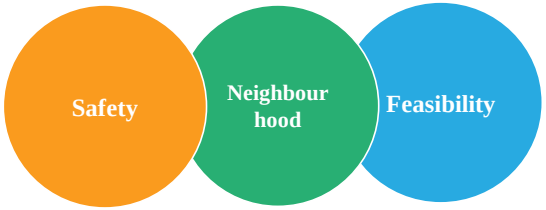
Feasibility



- There are more significant existing underground services on the south side, most notably a gas main that could complicate detailed design and approvals risk for any bent-out treatments. This could limit excavation depth and the ability to achieve new street planting zones or water sensitive urban design.
- If Inkerman Road, east of Orrong Road proceeds as per GECC 'Corridor Option 1' (westbound only), then it might be more convenient to have parking on the south side. However directionality has only been assumed as a 'feasible base case' and there is no commitment from GECC on the directionality of the one-way system. There was considered to be minimal difference between the north and south sides from a traffic operations perspective.

Summary



In summary, having considered all criteria, the northern side of the corridor ***east of Alexandra Street*** was adopted for on-street car parking due to:

- Less risk of conflict with car dooring or car passenger movements, due to lower speeds/ is reduced.
- Given cyclists are travelling more slowly on the northern side, the potential user conflict interface will be safer including:
  a) Pedestrian and cyclist conflicts due to slow speeds decreasing the likelihood that cyclists will err onto the footpath under at bent-out treatment, and
  b) vehicles turning in and out of side streets will have an improved sight distance outcome and enhanced ability to judge gaps in cyclist-traffic.
  c) a bent-out treatment can be provided on the uphill segment to maintain cyclist momentum as they will not be required to yield for side-road traffic.
- Some parking can be retained near the medical clinic on the north east corner of Inkerman St/Alexandra Street.

To the ***west of Alexandra Street***, the southern side is adopted as the for car parking, as it flattens out significantly with signals likely to interrupt cyclist momentum. This provide a more equitable outcome to have some parking on both sides of the road, and allows access to on-street parking for non-residential land uses on the south side. This section also has a lesser number of driveways.

4 | Side road treatment

An overview of the side road treatment assessment and design development process.

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Side road treatments

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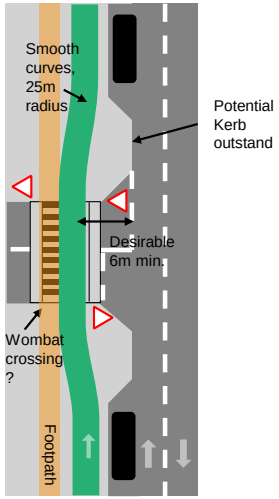
Summary of potential treatments

The potential side road treatments for the corridor are outlined below. There are generally two categories for treatments that cross side roads (excluding road closure):

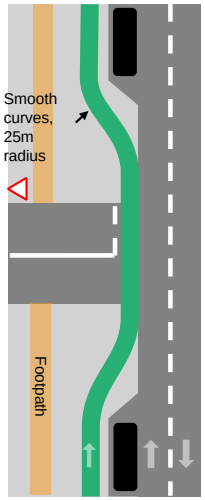
- **In-line treatments:** includes bent-in and straight treatments. Parking remains within the side road sight distance triangle, and visibility of oncoming traffic over bonnets and between vehicles is needed. Risk of drivers propping across bicycle lane when waiting to enter main road.
- **Offset treatments:** includes bent-out treatment. Increases space available for vehicles to prop clear of the bicycle lane when waiting to enter main road. Sight distance to oncoming traffic is improved over in-line treatments.

Bent-out



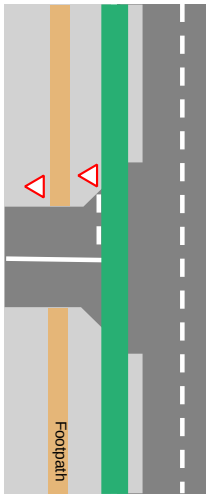
- Not suitable on the side of road without on-street car parking (depth limitations)

Bent-in



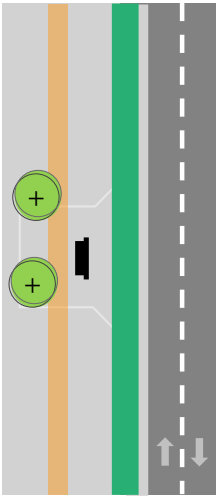
- Only relevant where parking retained (effectively a 'straight' treatment if no parking provided)

Straight



- Minimal intervention and low cost treatment.
- Left-turn vehicles can have priority over cyclists

Road Closure



- Considered but eliminated due to impacts to property access and traffic flow.

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Side road treatments

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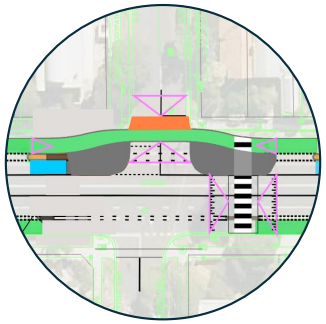
Road user assessment

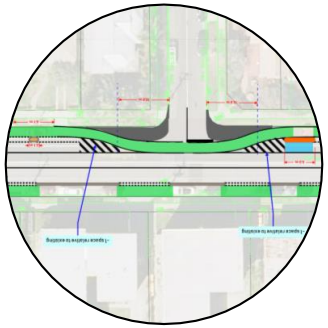
Based on the three potential side road treatments under consideration, concept sketches were workshopped to consider the perspectives of all road users.

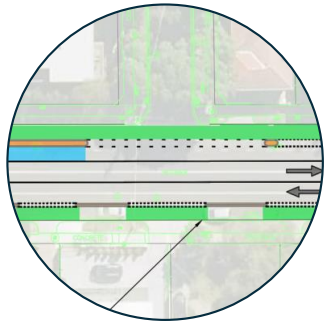
Following discussions with GECC and CoPP, the bent-out treatment was chosen for the concept design for the side of the road with parking, as:

- Cyclists experience minimal deviation from their desire line;
- Sight lines between cyclists and drivers is improved;
- Pedestrian safety and amenity is improved; and
- Vehicle safety is improved as this treatment supports a reduced speed limit of 40 km/h.

The straight treatment was chosen for the concept design for the side of the road without parking, as sight lines are unaffected.







	Bent-out	Bent-in	Straight
	• Kerb extensions assist in narrowing Inkerman roadway to support the 40kph speed limit. • Staged crossing may make it more comfortable for motorists to judge a safe gap	• Kerb extensions assist in narrowing Inkerman St road way to support the 40 kph speed limit. • Improves sight distance for exiting vehicles/	• No kerb extensions, treatment more reliant on visual narrowing cause by car parking. • Worst option for vehicle sight distance when exiting onto Inkerman St.
	• Clear priority to cyclists when they are crossing traffic. • Minimal deviation from cyclist route. • Drivers and cyclists have a good view of one another at conflict point, however there may be some limited sight distance across property boundaries with vegetation, high fences, or where built-up to the boundary.	• Greatest deviation for cyclist from desired path • Drivers have reduced view of cyclists at conflict point compared to bent-out and travel paths are converging at the conflict point. • Higher potential for conflict for cyclists in driver blind spot. • Treats cyclists more like vehicles than pedestrians – may be preferred for high-speed / confident cyclists.	• No deviation for cyclists. • Cyclists and vehicles have clear view of each other. • Vehicles may prop across the bike lane when exiting side road and attempting to turn onto Inkerman St. • No additional priority or amenity for cyclists.
	• Safest for pedestrians crossing minor side streets due to storage zone for vehicles turning. • Highest amenity for peds crossing side road traffic (pedestrian priority). • Restricted sight distance between southbound pedestrians emerging from side road and cyclists. • Least safe for pedestrian and cyclists interactions. • Staged crossing across bicycle lane then traffic lane.	• Good separation of pedestrians and bicycles. • Pedestrians might wait in bicycle lane when crossing Inkerman Rd at the kerb outstand. • Pedestrians crossing Inkerman Rd have to cross up to four streams of vehicle/cyclist traffic. • Vehicles propped waiting to enter Inkerman Rd from side street may obscure pedestrian crossing (same as existing).	• No added priority for pedestrians crossing the side road. • Likely to force vehicles waiting to enter Inkerman to prop over pedestrian crossing point. • Pedestrians may wait in bike lane when waiting to cross Inkerman St.
	• Most expensive option • Possible delay from lighting upgrades • Potential impact to some trees	• Potential additional impacts to on-street parking • Moderately expensive	• Least expensive to install

Side road treatments

ARUP

Proposed bent-out side road treatment

Bent-out treatments have been applied to all side road approaches along the side of the shared section with parking (south side to the west of Alexandra Street, north side to the eat of Alexandra Street).

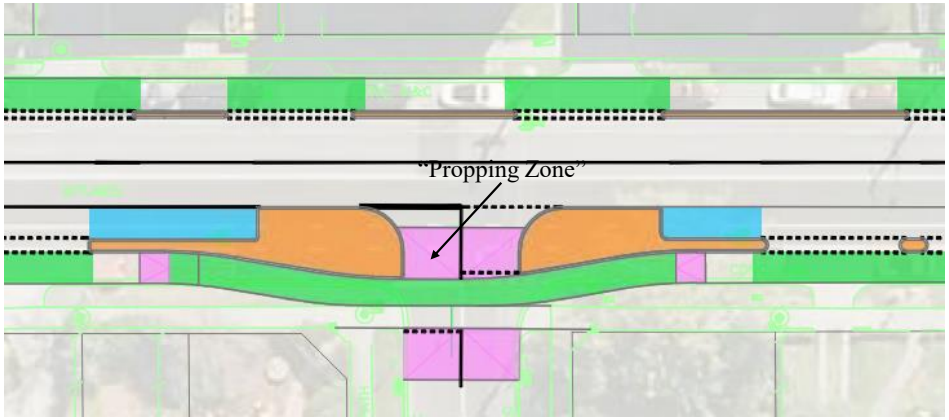
An example of the proposed side road treatment is shown below, taken from the corner of Empress Road and Inkerman Road, as well as an example of an existing bent-out side road treatment taken from O'Hea Street, Coburg.



Example of existing bent-out side road treatment O'Hea St, Coburg

Key features in the proposed design include:

- A raised, protected bicycle lane across the side road conflict point with green pavement through the conflict zone;
- Ramps on the approach and departure up to a safety platforms where vehicles cross the bicycle lane;
- Kerb outstands to limit vehicle turning speeds and improve sight lines between vehicles and cyclists by removing parking close to the intersection. These kerb outstands can accommodate pedestrian kerb ramps for informal crossing of Inkerman Road; and
- Vehicle propping zone (varies, approx. 4.8m shown below) between the stop line and the bicycle lane, providing space for a vehicle to prop whilst waiting to enter Inkerman Road. Given this is lower than the desirable 6.0m propping zone, there is a chance that some vehicles will partially obscure the bike lane or traffic lane when waiting for gaps. The benefits of the bent-out treatment for cyclists and pedestrian safety and amenity are expected to outweigh this minor drawback. The proposed 40 km/h speed, and the side-roads being local streets with low traffic volumes and very low heavy vehicle volumes, is considered to warrant the use of an extended design domain below the 'desirable' value.



Proposed bent-out side road treatment at Empress Road (Draft)

5 | Pedestrian crossings

The process of pedestrian crossing location and facility design

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Pedestrian crossings

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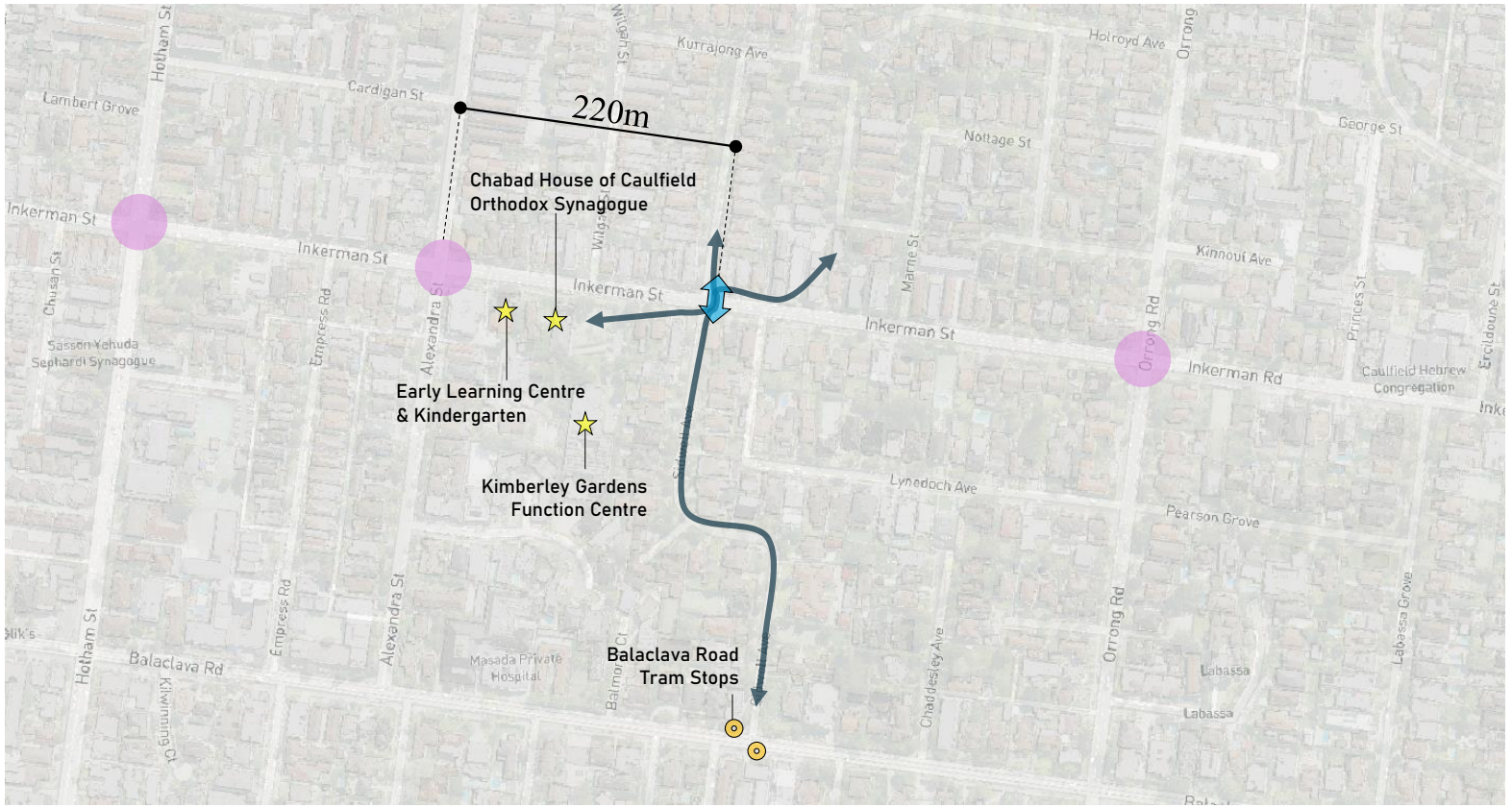
Selecting a pedestrian crossing location to enhance mid-block connections

Key land uses, residential catchments and public transport nodes were considered in the developing pedestrian crossings Inkerman Road corridor, as shown below. Residents to the north of Inkerman Road may access the Balaclava Road tram stops via Sidwell Avenue, and there are desire lines from the Orthodox Synagogue and Kindergarten to the residential areas to the northeast. To support these desire lines, a safe pedestrian crossing in the vicinity of Sidwell Avenue / Kalymna Grove was identified. The located was agreed east of the intersection, making it more equidistant between the traffic signals at Alexandra Street and Orrong Road.



Pedestrian crossings

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Proposed pedestrian crossing at Kalymna Grove

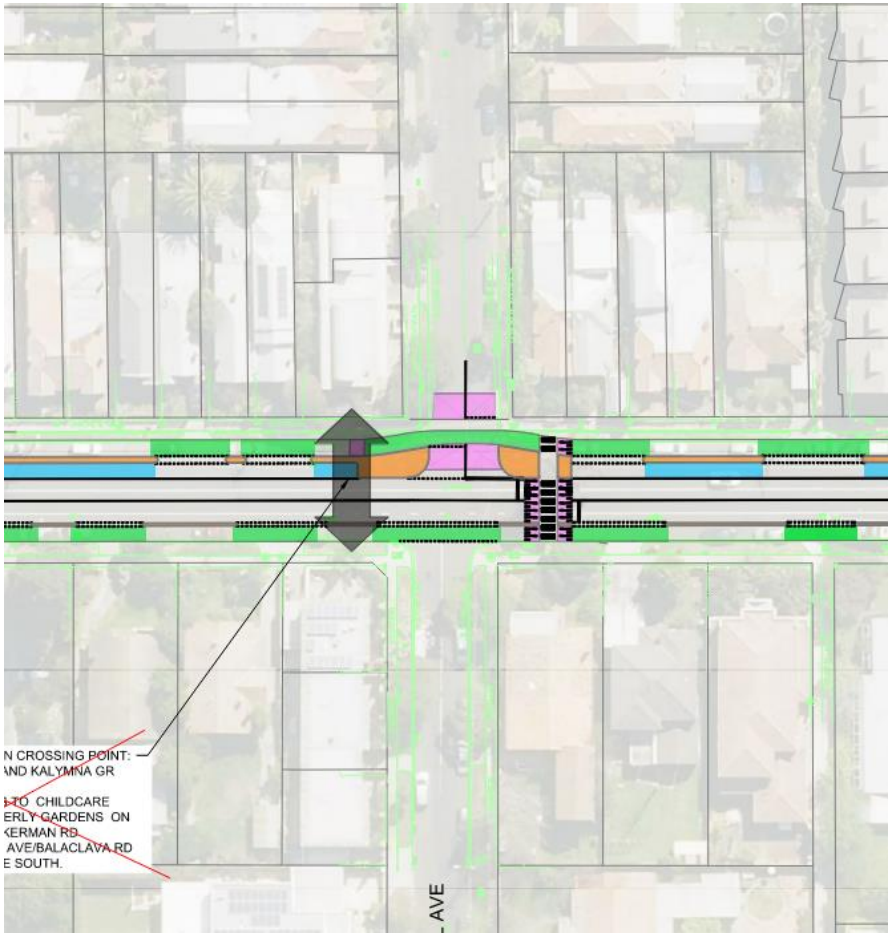
The proposed pedestrian crossing at Kalymna Grove is shown to the right, and an example from Wellington Street in Collingwood is shown below.

Key design features and considerations include:

- A staged crossing across the bicycle lane to allow pedestrians to store adjacent the road, improving sight lines between pedestrians and drivers;
- The bicycle lane ramps at the same point as the traffic lane in the westbound direction;
- Further design consideration is required with respect to drainage, noting the stormwater catchment pit adjacent the raised pedestrian crossing on the south-eastern corner of the intersection



Example raised pedestrian crossing at Wellington Street, Collingwood



6 | Intersections

An overview of the intersection design development process.

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Major intersections

Overview

The shared section of the Inkerman Rd Corridor passes three major intersections each with its own unique design requirements and network integration considerations. Major intersections can also become significant conflict points and must be treated appropriately to ensure safe operation for all road users. Modifications to major intersections also need to align with future vision and objectives of each Council. The location of the three major intersections in Section 1 described below.

1 Inkerman St / Hotham St

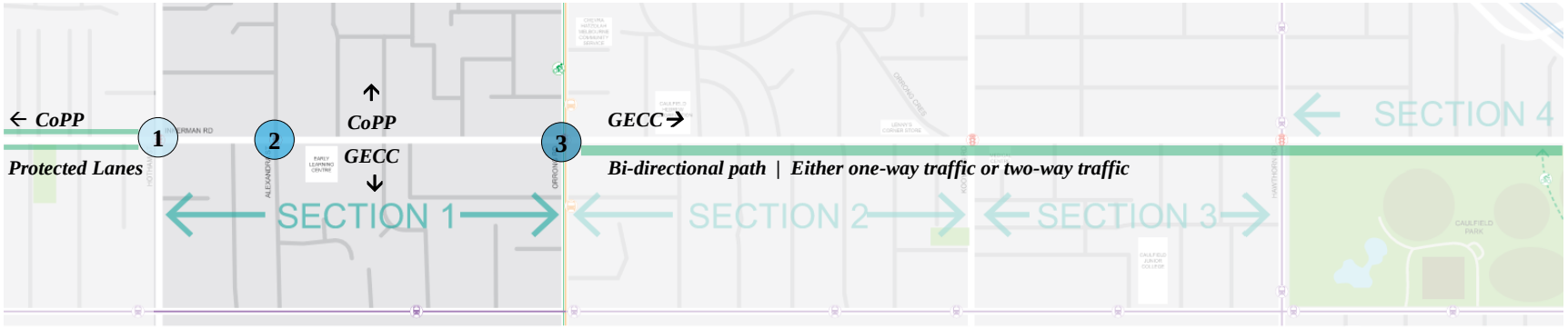
- West limit for this stage of works
- Proposed future work for CoPP design of protected one-directional bicycle lanes from Hotham St to St Kilda Rd to complete the Cycling Corridor from Caulfield Station precinct to St Kilda Rd
- Intersection designed to accommodate future integration with protected bicycle lanes continuing west.
- Community bus stops on the northeast corner.

2 Inkerman St / Alexandra St

- Future vision from CoPP for Alexandra St to be a low stress cycling route, as well as urban design objectives to increased tree canopy.
- Historical changes at Alexandra St / Alma Road means Alexandra St is not a significant traffic route.
- Key opportunity offset lost parking on Inkerman Rd with additional parking on Alexandra St.
- Alexandra St to the south only continues one more block before terminating.

3 Inkerman St / Orrong Rd

- A key intersection as it will host a transition between uni-directional protected bike lanes west of Orrong Rd to bi-directional bike path on south side of Inkerman Rd further east.
- Orrong Road is a busy corridor and there are approach-side bus stops close to the intersection.
- Two intersection options have been developed. These options are subject to a GECC decision on wether Inkerman Rd east of Orrong Rd will be either one or two-way for vehicle traffic.



Cycling network context

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Future low-stress cycling route, north of Inkerman

1. **Chapel St** is the North-South Strategic Cycling Corridor.

   There are longer term initiatives under the Stonnington Cycling Strategy 2019-2024 (draft). In the longer term Chapel Street is picked to become a more significant cycling route for the local community, connecting Inkerman Road with the Capital City Trail further north.

2. **Orrong Rd** is a GECC ITS safe cycling route (and Strategic Cycling Corridor) highlighted as a future Safe Cycling Corridor.

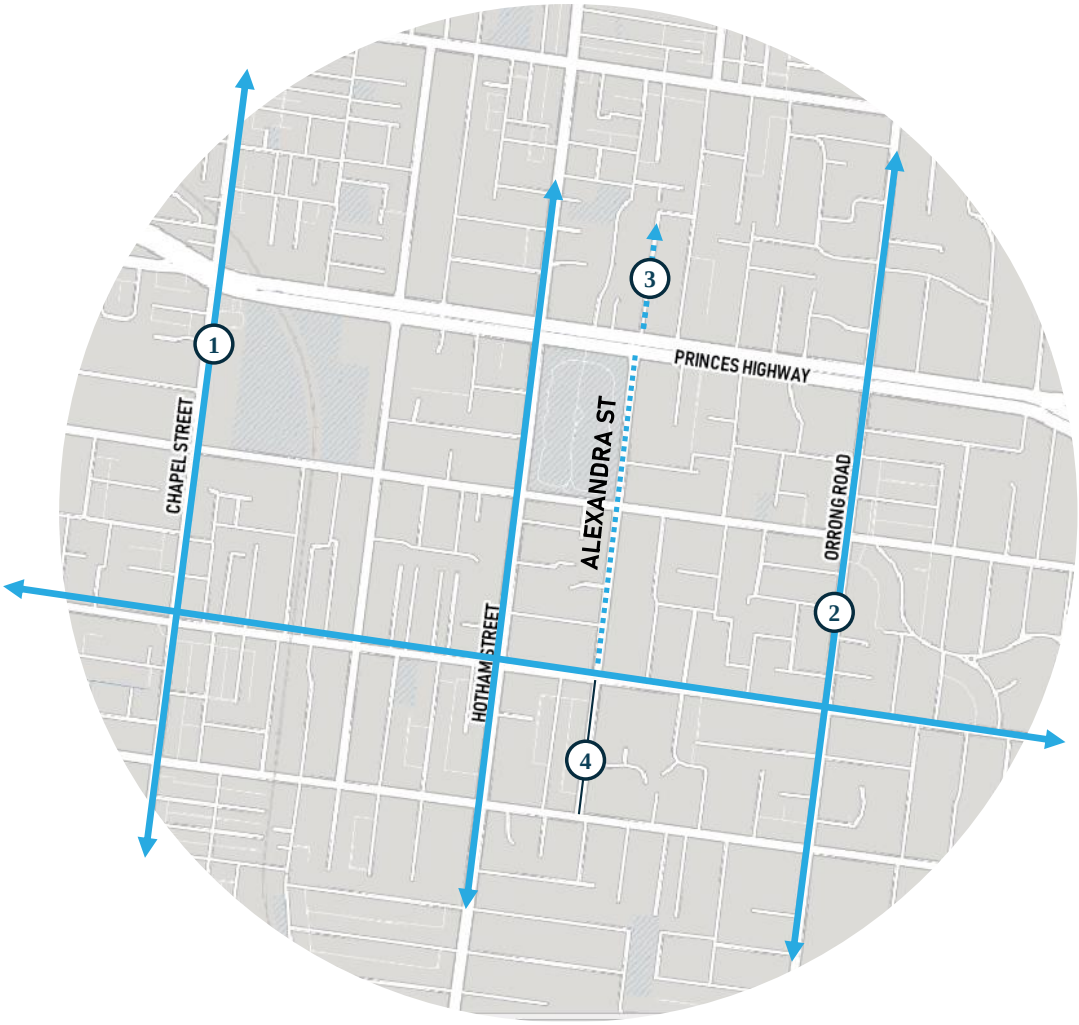
   North of Inkerman Road, Orrong Road ownership is shared between CoPP (west) and GECC (east). CoPP also has a desire to improve the pedestrian and cycling amenity of Orrong Road by improving tree coverage and undertaking other urban realm improvements.

3. **Alexandra St to the north** connects across Princes Hwy to the Stonnington mixed traffic route 'St Kilda Como bicycle route'.

   It is a lower order road that does not serve an important traffic function with an opportunity to redesign the Alexandra St / Inkerman Rd intersection for an appropriate level of density/permeability for all road users as part of this project.

   Given the limited traffic function of Alexandra St to the north of Inkerman St, CoPP has nominated that the number of lanes at the approach could be reduced from two lanes to one.

4. **Alexandra St to the south** is discontinuous in GECC, terminating at Balaclava Rd. GECC has no current plans to changes its role or function.



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Inkerman Rd / Hotham St

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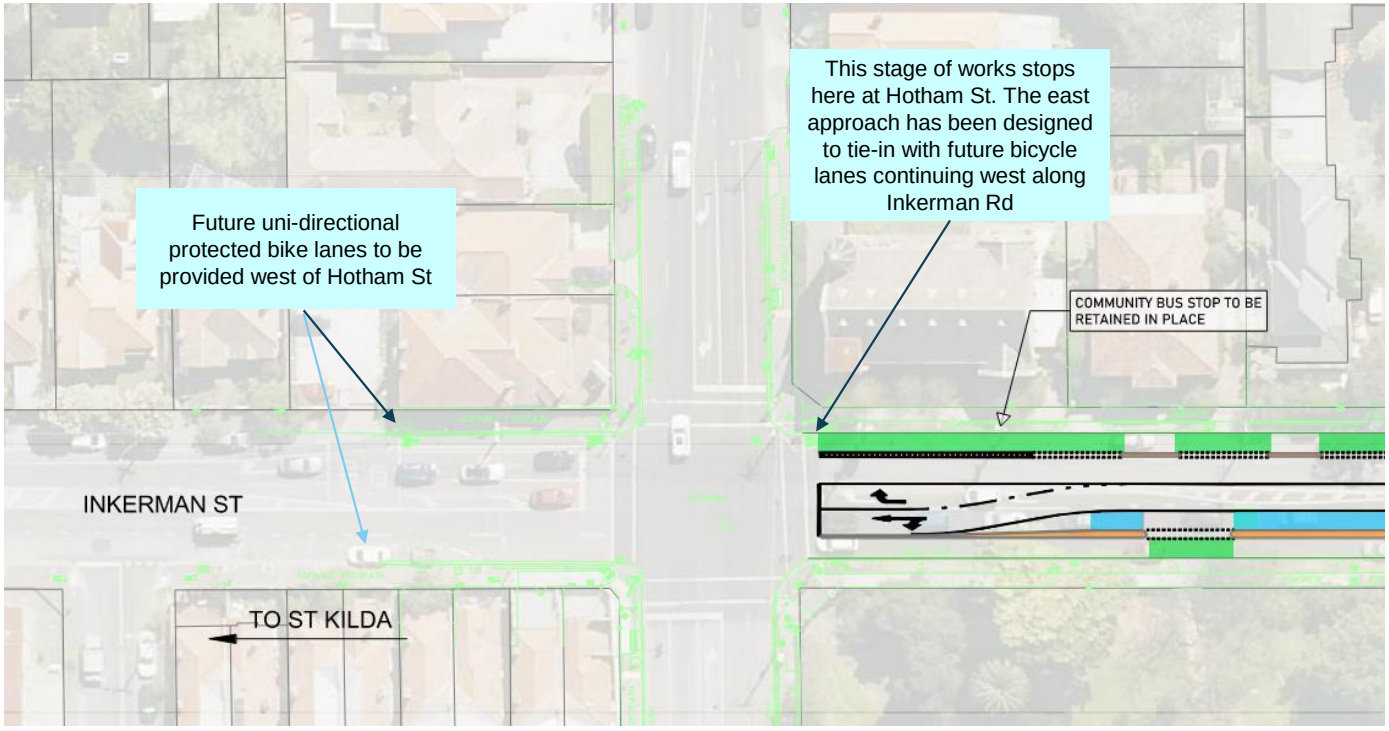
Proposed design

The proposed design for the intersection of Inkerman Road and Hotham Street, at the western boundary of the shared section, is shown below.

The proposed design includes:

- A shortened right turn lane to accommodate the proposed bicycle lanes and parking on the south side, and combines the existing two left hand lanes into a single lane on the eastern leg.
- The existing community bus stop is to be retained.
- Bicycle lanes up to the eastern leg stop line, which will tie into future protected lanes on the western leg of the intersection in CoPP. The phasing of the intersection can generally be retained as per the existing conditions.



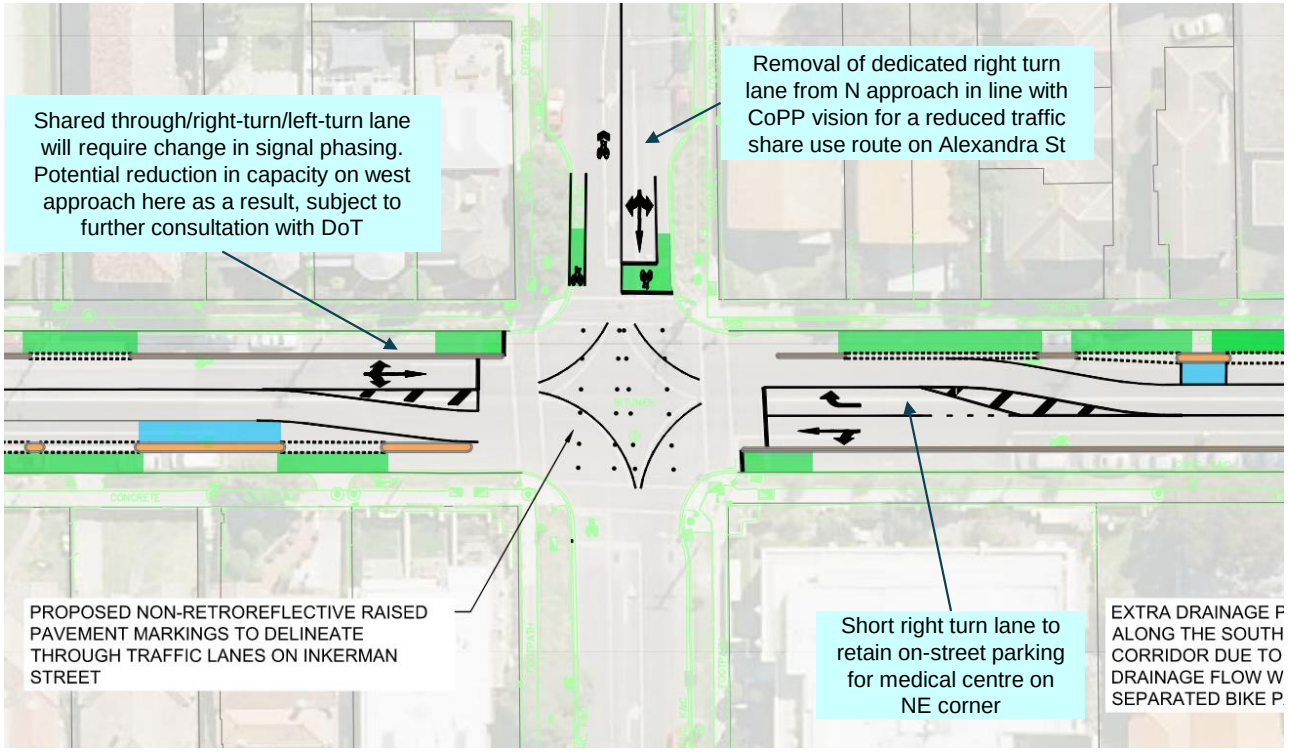
Inkerman St / Alexandra St

ARUP

Proposed design

The proposed design for the intersection of Inkerman Road and Alexandra Street is shown below. The proposed design includes:

- Consolidating the two existing lanes into a single shared left/through/right lane on the western leg. This is likely to reduce the capacity on the western approach and may require amending the existing signal phasing. A reduced demand on this movement would be expected in the event that GECC proceeds with the option for a one-way westbound traffic option.
- Removing the right turn lane on the northern leg and adding bicycle treatments in alignment with CoPP's vision for Alexandra Street as a low stress bicycle boulevard; and
- Reducing the length of the right turn lane on the eastern leg to retain a car parking space near to the medical centre on the northeast corner.



Inkerman Rd / Orrong Rd transition

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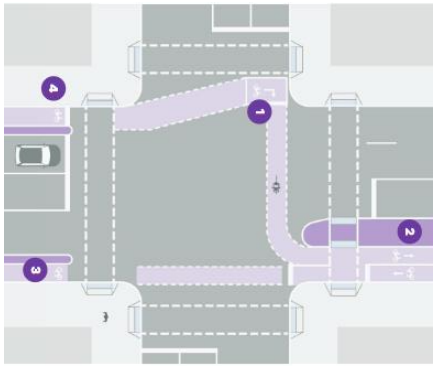
Transition from Protected Lanes to Bi-directional Lanes

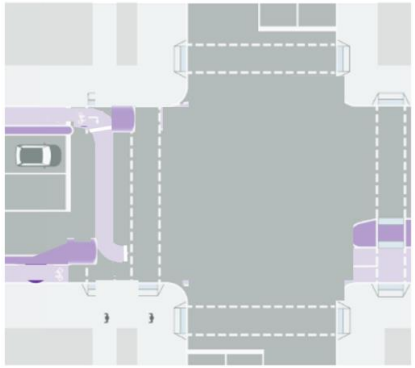
Several options were put forward in workshops with CoPP and GECC for the transition at Orrong Rd, from uni-directional to bi-directional protected bicycle lanes, as shown below.

1. Hook-turn transition



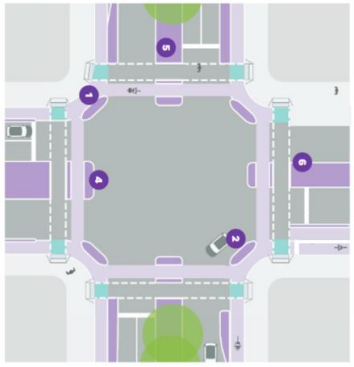
- Conflict with traffic / buses on north approach. Mitigate with bicycle head start.
- Geometry works well with one-way westbound option in Section 2 (carriageway narrowing)
- Potential for significant conflict between eastbound cyclists and left-turns to the north if Section 2 is westbound one-way (subject to signal phasing)
- Potential longer-term queue interference with pedestrian crossing / phase start-up.

2. Approach side crossing



- Considered as an option to place the cyclist hook-turn in a location that is more protected from traffic.
- Limited impact to bus stops.
- The location of the storage area would likely complicate signal phasing due to the conflicts with other movements.

3. Protected intersection



- Existing approach side bus stops on Orrong Road would need to be relocated
- Limited space for pedestrians.
- Connecting Orrong St bike lanes through the intersection requires drop to 1x lane and may impact traffic capacity or delay bus services.

4. Mid-block



- Requires co-ordination with kerb outstands (parking impacts)
- Island desirable and long enough for bikes (ideally non-standard bikes too). However, if the transition occurs Section under a one-way option, the island may not be needed.
- May have capacity limitations and struggle to deal with potential future cyclist demands.
- May result in high-risk gap acceptance and potential safety issues.

Inkerman Rd / Orrong Rd transition

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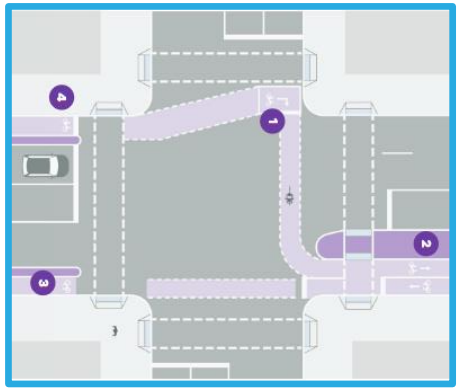
Preferred option

The preferred option for the transition, as identified in Workshop 1, was the hook turn transition. This option was adopted for the concept design in two different ways.

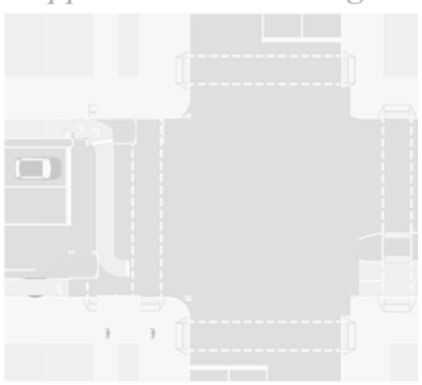
1. Hook-turn transition



Feedback from Workshop 1:

- Common.
- Familiar to cyclists.
- Inexpensive.
- Signal controlled left-turn to mitigate conflict with eastbound bikes.

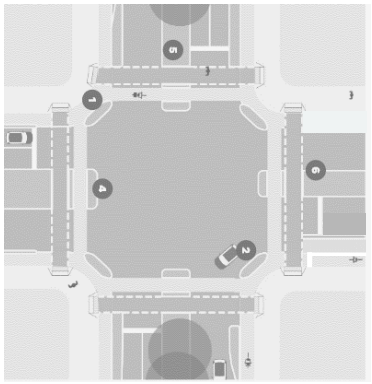
2. Approach side crossing



Feedback from Workshop 1:

- Awkward / uncommon.
- A rider arrival on green phase is likely to hook turn anyway.
- Unfamiliar to cyclists
- Storage and signal phasing complications.

3. Protected intersection



Feedback from Workshop 1:

- Expensive
- Bus stop complications
- Difficult for smaller intersections to achieve effective layout.
- Can't achieve staged pedestrian crossings that would normally form part of a protected intersection.

4. Mid-block



Feedback from Workshop 1:

- May require signals for rider safety
- Needs a kerb outstand.
- Increases parking impacts.
- No suitable location to implement the transition.

Inkerman St / Orrong Rd Transition

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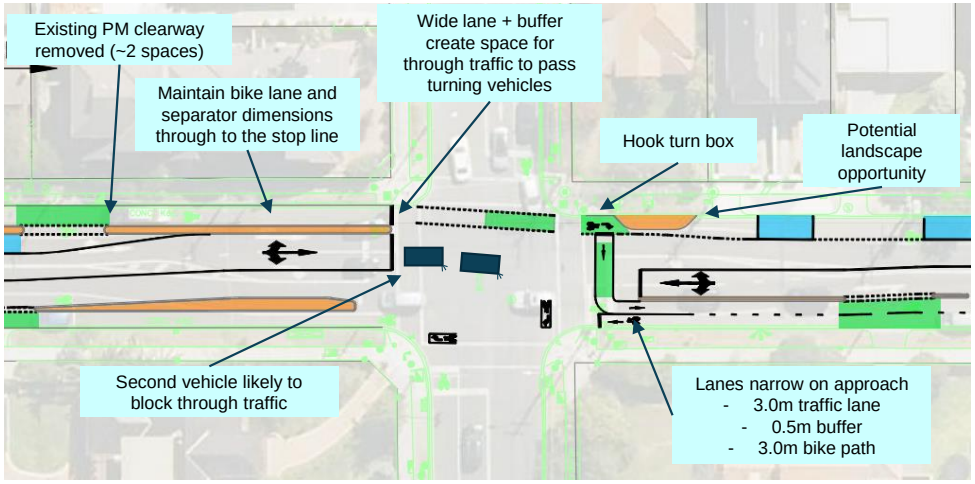
Proposed designs and hook turn transition options

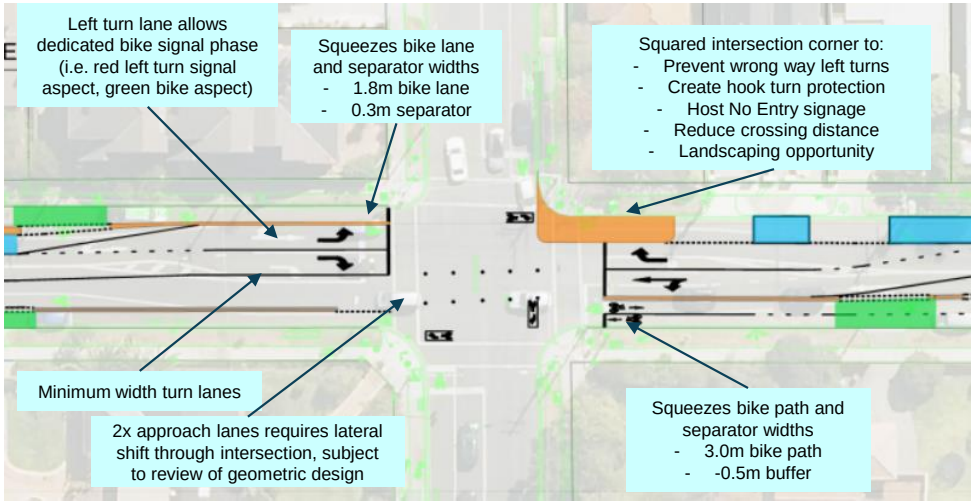


Option 1A: Hook turn and tie in to two-way traffic

Both approaches provide a single shared left/through/right turn lane. Split phasing may be required, or otherwise turning the 2nd turning vehicles would likely block the intersection.

The hook turn box is positioned to store turning cyclists clear of traffic, and limited the amount of cyclists filtering across the pedestrian crossing. A head start cyclist phase could be incorporated to clear out the queue prior to start of pedestrian phase.

It should be noted that a variation of this option is possible with two lanes on the western approach, to accommodate queueing for either a left turn or right turn dedicated movement (similar to Option 1B). Traffic lanes under this arrangement would be reduced to 2.8m wide, the minimum acceptable width for larger vehicles, and the bicycle lane and separator would be narrowed to minimum dimensions (1.8m lane, 0.3m separator).



Option 1B: Hook turn and tie in to one-way traffic

The western approach requires incorporates a left and right turn lane, and the eastern approach is able to provide two lanes to support left, through and right turn movements across a wider pavement..

The bicycle lane and separator on the western leg are narrowed under this option to provide two minimum width traffic lanes. A protected bicycle signal phase for eastbound cyclists (i.e. a red left turn arrow for cars) is possible under this option. The hook turn box is more exposed to traffic, however is protected by a downstream kerb outstand that also limits wrong way left-turns from the north.

Further design development would be required to develop the signal phasing arrangements and ensure swept paths are accomodated by the design where movements occur simultaneously.

Inkerman Rd / Orrong Rd

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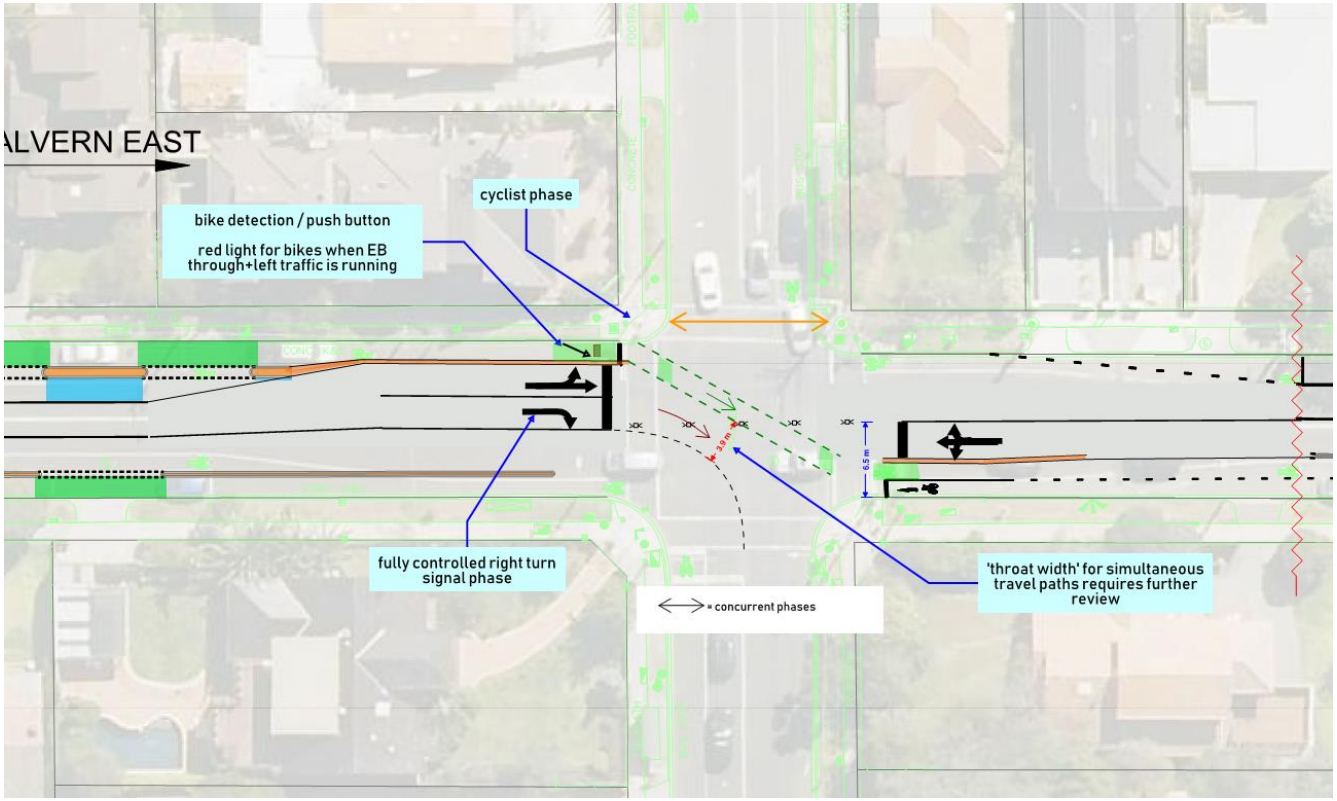
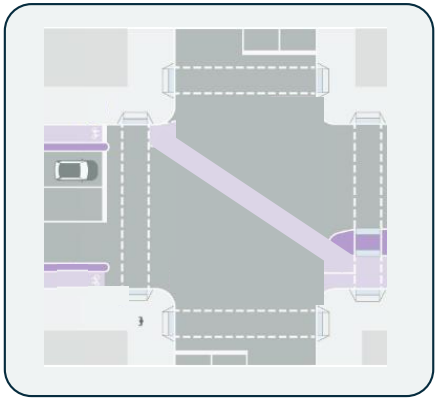
Potential option: direct cyclist crossing

An option raised through workshops (however not being designed) was the provision of a direct crossing phase for cyclists to transition at Orrong Road. The intersection layout for this option would likely be geometrically similar to existing hook turn designs, but would be quite different operationally.

As this arrangement requires a dedicated cycling phase, it is likely that the amount of time required to run every signal movement would increase, taking green time away from other phases and likely causing delays to traffic (and possibly pedestrians). The extent of the impact on intersection efficiency would depend on the frequency that the cyclist phase is called, assuming that it would be demand activated (either by pavement detection loops or by a push-button. Safety concerns have also been raised associated with the non-standard geometry and risks of non-observance of the bicycle signals. For the reasons above, this option is not being taken forward.





Diagonal cyclist crossing sketch

7 | Parking assessment

Overview of the parking conditions on Inkerman Road and assessment of parking offset options.

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Parking assessment

ARUP

Existing conditions

The existing parking conditions on Inkerman Road from a survey conducted by One Mile Grid (refer supporting information for more detail) are summarised in the table below. Peak times generally occur in the evening.

Date	Side of Road	Peak time	Maximum utilisation (%)	Overall utilisation (%)
Friday 24 May 2019	N	11:00PM	84%	76%
	S	7:00PM	69%	
Saturday 25 May 2019	N	8:00PM	89%	80%
	S	12:00PM	72%	
Tuesday 28 May 2019	N	10:00PM	84%	74%
	S	7:00PM	65%	
3-day average peak utilisation (demand = 100 vehicles)				

GIS estimates conducted by Arup indicate that approximately **136 spaces** are currently available along Inkerman Road, 64 on the north side and 72 on the south side, as shown below.

This is slightly higher than the reported parking supply of 130 utilised for the One Mile Grid reports, however it must be noted that interpretation of the existing parking supply will vary given spaces are not individually line marked. The 3-day average **peak demand is 100 spaces**, or approximately **74% utilisation** based on the Arup-sourced supply.

Future Parking

Based on the **draft** concept plans, the future supply of car parking on Inkerman Road has been determined. Key information regarding the changes to car parking supply are outlined in the table below.

Measure	Concept Design
Parking supply (# of spaces) [1]	31 spaces
Parking retention (% of existing 136 spaces)	23%
Parking loss (# of spaces)	- 105 spaces
Future theoretical utilisation	323%
Displaced demand	69 vehicles

[1] Existing parking supply based on GIS analysis.
[2] Utilisation is lower than reported by One Mile Grid, which assumed a lower existing parking supply of 130 spaces and therefore higher occupancy.

An overall loss of 105 parking spaces is proposed, and a displaced demand of 69 vehicles (the surplus demand for parking that will not be accommodated by the future supply, and would either park in unused garages or surrounding streets) is expected.

Opportunities for increasing parking in side-roads has been considered in the following slides.



Summary of existing parking supply

Inkerman Road Corridor Plan: Shared Design Section 1 33

Parking assessment

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Opportunities to offset parking loss

To offset parking losses and accommodate parking demand that would be displaced into side-roads, opportunities have been explored to provide additional parking spaces for up to 200m along the connecting side streets via re-orientation of parking (i.e. changing from parallel to angled parking). The width of these side streets was determined and compared with the required widths for angled parking within the Australian Standard for On Street Car Parking (AS2890.5:2019).

Of the several connecting streets, most were concluded to be too narrow, with the exception of Alexandra Street. As outlined in the table shown to the bottom right, Alexandra Street has a sufficient road width to accommodate 90 degree parking spaces on one side to the north of Inkerman Road (within CoPP), and might be possible for 60 degree angled parking on one side to the south of Inkerman Road (within GECC). An assessment has south to quantify the additional parking that could be provided.



Analysis of potential side streets connected to Inkerman Road to accommodate additional parking spaces

Side Road	Road width	Viable
Empress St	7.8	No
Alexandra St NORTH	14.5	Yes - 90 deg
Alexandra St SOUTH	12.6	Maybe - 60 deg*
Wilgah St	9.6	No
Kalymna St	9.6	No
Sidwell Ave	7.8	No
Marne St	7.3	No

* Not recommended. Subject to further design review.

Alexandra Street

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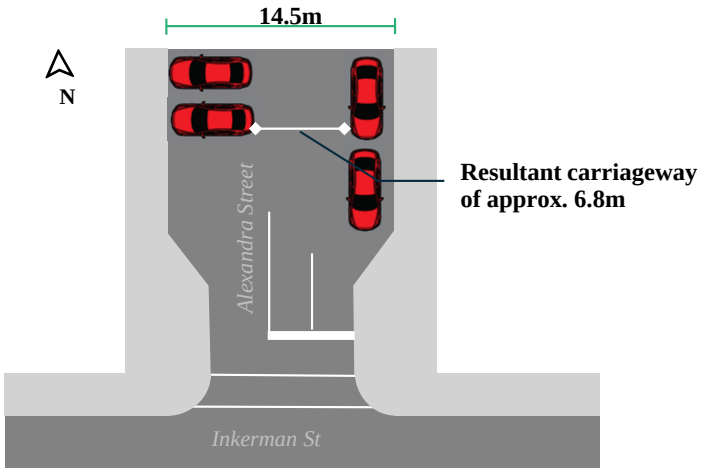
Review of additional parking feasibility

The Australia Standard for On Street Parking (AS2890.5:2019) specifies that the design of angled parking spaces are subject to traffic volume thresholds (200vph). This allows recognition that reversing across both lanes is appropriate on local streets. The volumes on Alexandra Street are outlined below.

Side of Inkerman	AM Peak Hour (vph)	PM Peak Hour (vph)
North	187	123
South	259	224

North of Inkerman Street (City of Port Phillip)

Alexandra St **north** of Inkerman is wider than the south side at around 14.5m, and satisfies the conditions for 90 degree parking on one side - manoeuvring can occur across most of the carriageway. If 90 degree parking were provided, a carriageway width of some 6.8m would remain.



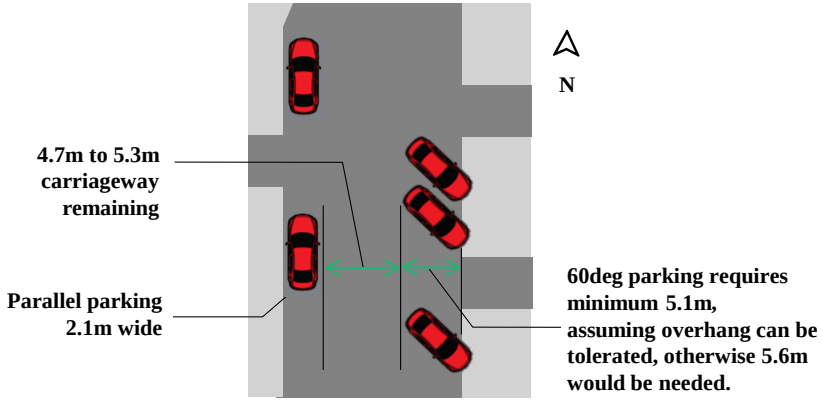
90 degree option north of Inkerman (CoPP)

Southern of Inkerman Street (Glen Eira City Council)

For Alexandra Street **south** of Inkerman, the road width is narrower in the immediate vicinity of Inkerman but widens further south. While feature survey has not been available to verify the dimensions, it appears that the kerb to kerb width is around 12.5m.

On the above basis, the road may not be wide enough to comfortably accommodate a 60 degree parking layout. The design basis would need to assume parked vehicles are permitted to overhang the kerb by at least 600mm, however some parking locations may also be compromised by trees that exist close to the road. Even under this design standard, the resultant carriageway width between parking spaces would be 5.3m and vehicles would require a degree of driver negotiation for passing utilising the area at driveways, and may not be appropriate given the volumes exceed the threshold.

Additionally, the frequency of driveways will limit increase in parking possible under a 60 degree angle arrangement. The table below specifies the kerbside length required for 60 degree paring spaces. In summary, while conversion to angled parking may be possible, it would not be recommended at this stage without a detailed design review.



60 degree parking south of Inkerman (GECC) is not recommended

Alexandra Street

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Potential parking supply north (CoPP) and south (GECC) of Inkerman Road

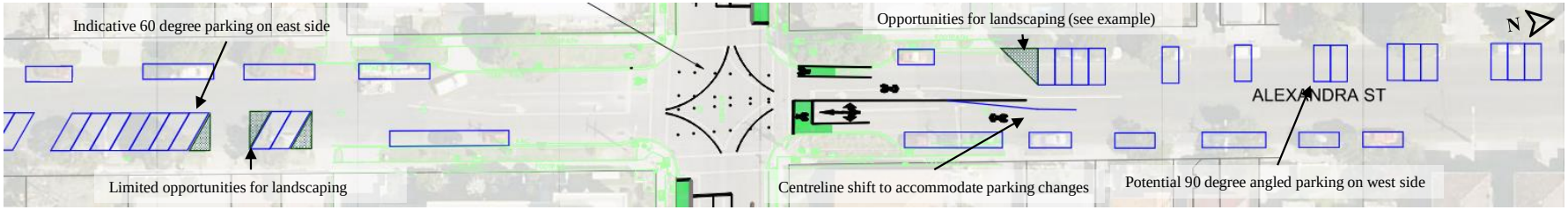
The parking options for Alexandra Street north and south of Inkerman Road are shown in the sketch below and detailed in the table to the left. In summary, the preliminary assessment indicates that re-orienting the parking on Alexandra Street up to 200m from Inkerman Road could potentially from 28 to 42 additional parking spaces, which reduces the displaced demand from 69 to as low as 27 vehicles. Opportunities also arise from this conversion for landscaping as shown in the sketch and the example image. Further refinement to this concept and to the Alexandra Street intersection approaches will be required to confirm the actual supply possible under this scheme.

Summary table of parking supply opportunities on Alexandra Street

Measure	Alexandra Street (south) converted to 60 degree angled parking on east side	Alexandra Street (north) converted to 90 degree angled parking on west side
Existing parking supply (# of spaces) [1]	30	48
Maximum potential parking supply (# of spaces)	44	76
Parking gain (# of spaces)	0 to +14	+28
Displaced demand from Inkerman Road (# of vehicles)	69	
Remaining displaced demand to be absorbed by existing vacancies	27	



Example kerb outstand with landscaping adjacent perpendicular parking at Stanley Street, Collingwood



Illustrative sketch showing potential parking re-orientation on Alexandra Street north and south of Inkerman Road.

8 | Summary

Conclusions and next steps

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Summary

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Conclusions

Arup in consultation with GECC and CoPP has embarked upon a design development process for of shared section of Inkerman Road between Hotham Street and Orrong Road.

A series of workshops have been held to seek alignment and make key decisions for a potential design for protected bike lanes on either side of the road. Key outcomes documented throughout this report include:

Workshop 1: Agreement reached on a typical cross section that accommodates a protected bicycle lane on each side, parking on one side and two-way traffic flow.

Workshop 2: Considered conflict points and made key design decisions:

- Agreed on adopting 'bent-out' side road treatments on the side of Inkerman Road with parking, and a 'straight' side road treatments for others.
- Agreed on a driveway offset approach for the northern and southern sides of the corridor respectively.
- Agreed to adopt parking on the northern side of the road to the east of Alexandra Street, and on the southern side of the road to the west of Alexandra Street.
- Agreed on a series of major intersection treatments at:
    - Inkerman Road / Hotham Street: shortened turn lanes, to be tied into future works on Inkerman Street west of Hotham Street.
    - Inkerman Road / Alexandra Street: consolidated turning lanes and added bicycle treatments for Alexandra Street (north).
    - Inkerman Road / Orrong Road: agreed on two options to accommodate one-way or two-way traffic flow from Inkerman Road east of Orrong Road, agreed on a hook turn transition from uni-directional to bi-directional.

Workshop 3: Consulted and informed DoT on the design development for the midblock, side road and three major intersection treatments. While no specific formal comments have been provided, high-level feedback was provided and is documented in meeting minutes. It is expected that detailed feedback would be provided in future design stages.

Next steps

A set of concept designs is provided as an attachment, which captures the design development decisions made to date. These concept plans are understood to form an input to future community consultation on the broader Inkerman Road Safe Cycling Corridor in 2021.

Supporting information

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References

Movement and Place Cycling Design Guide (DoT)

AASHTO Guide for the Development of Bicycle Facilities (2012)

Austraffic Traffic and Parking Data, 2018

Australian Standards for On-Street Car Parking AS2890.5:2019

Austroads Guide to Road Design (AGRD) Part 4 Intersections and Crossings: General (2017)

Austroads Guide to Road Design Part 4A – Unsignalised and Signalised Intersections (2017)

Austroads Guide to Road Design Part 6A – Paths for walking and Cycling (2017)

Austroads Guide to Traffic Management (AGTM) Part 10: Traffic Control and Communication Devices (2019)

AS1742.9:2018 Manual of Uniform Traffic Devices

Cycling Aspects of Austroads Guides (2017)

NACTO Urban Bikeway Design Guide

MassDOT Separated Bike Lane Planning & Design Guide

Road Rules Victoria

VicRoads Supplement to AS1742.9 (2015)

VicRoads Supplement to Austroads Guide to Road Design (AGRD) Part 4a (2017)

VicRoads Guidance on Treating Bicycle Car Dooring Collisions (2016)

VicRoads Strategic Cycling Corridor Design Guidelines (2016)

VicRoads Speed Zone Guidelines (2017)

Traffic volumes at side-road intersections

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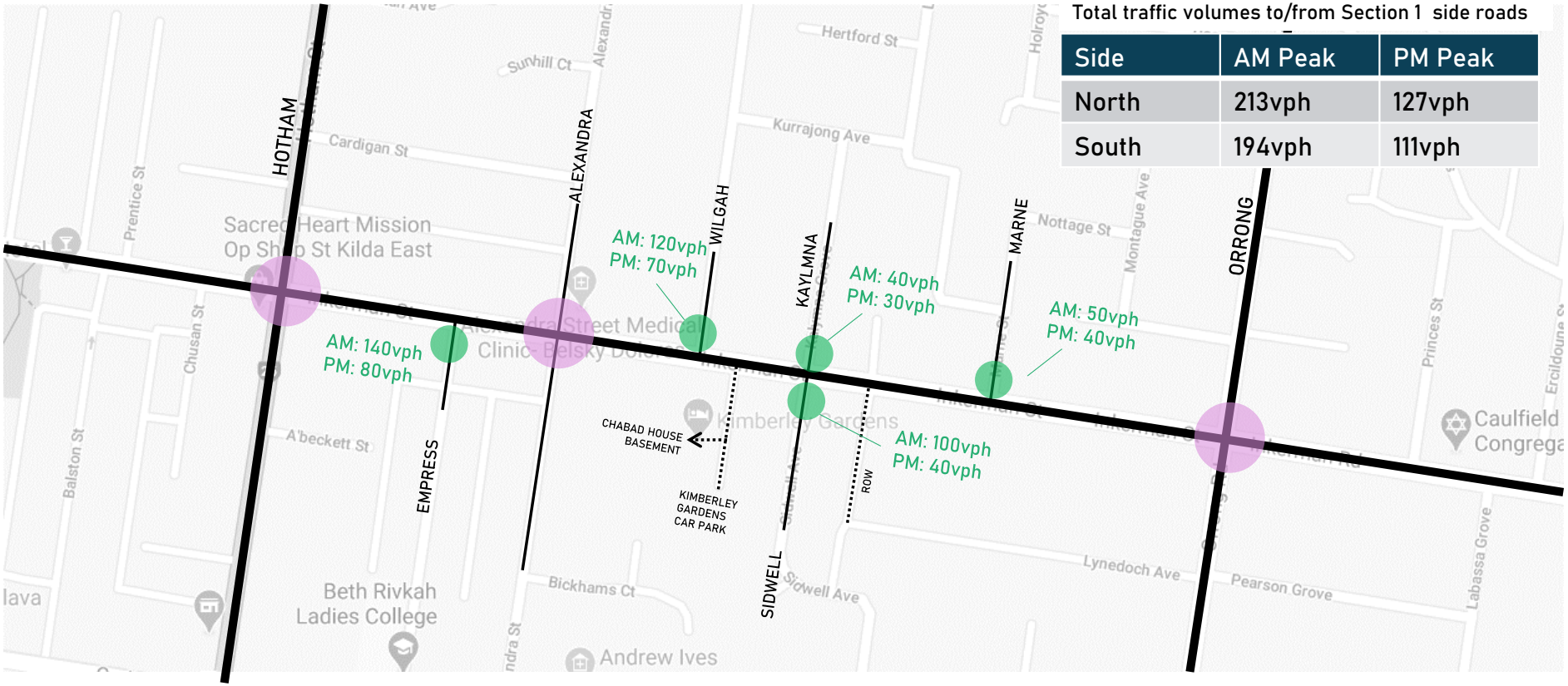
Traffic volumes determine risk exposure and should be considered in selection of side-road treatments (which in turn, may also influence parking outcomes).



Total traffic volumes to/from Section 1 side roads

Side	AM Peak	PM Peak
North	213vph	127vph
South	194vph	111vph

Signals

Side road

XXXvph Two-way peak weekday demand (rounded)

Off-street car park entrance (non-residential) or Access Lane

Inkerman Road Corridor Plan: Shared Design Section 1 41

Car Parking Data

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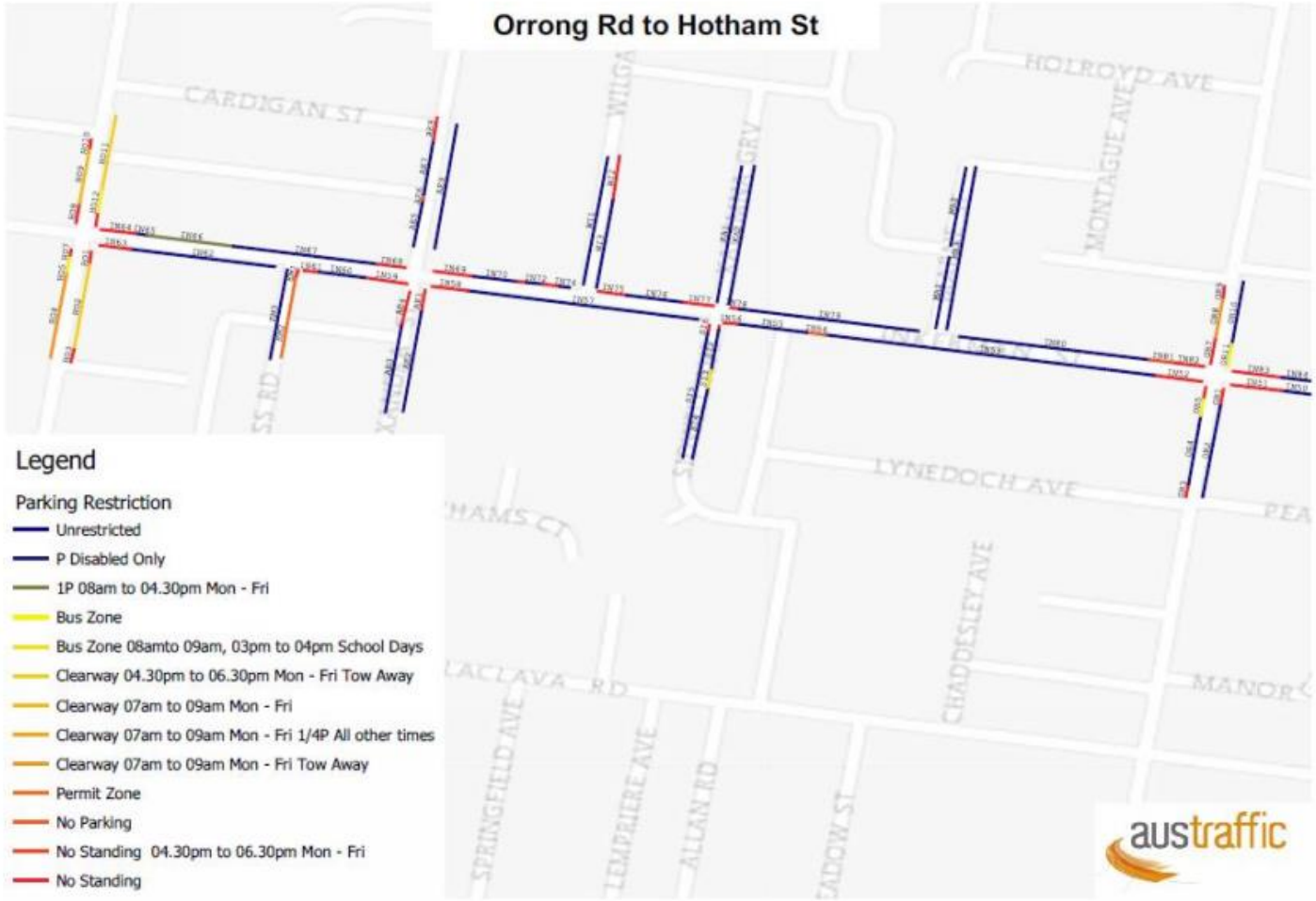
Map 4 Parking Availability from Orrong Rd to Hotham St



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Map 8 Parking Occupancy from Orrong Rd to Hotham St for Saturday 10 November 2018 at 10am



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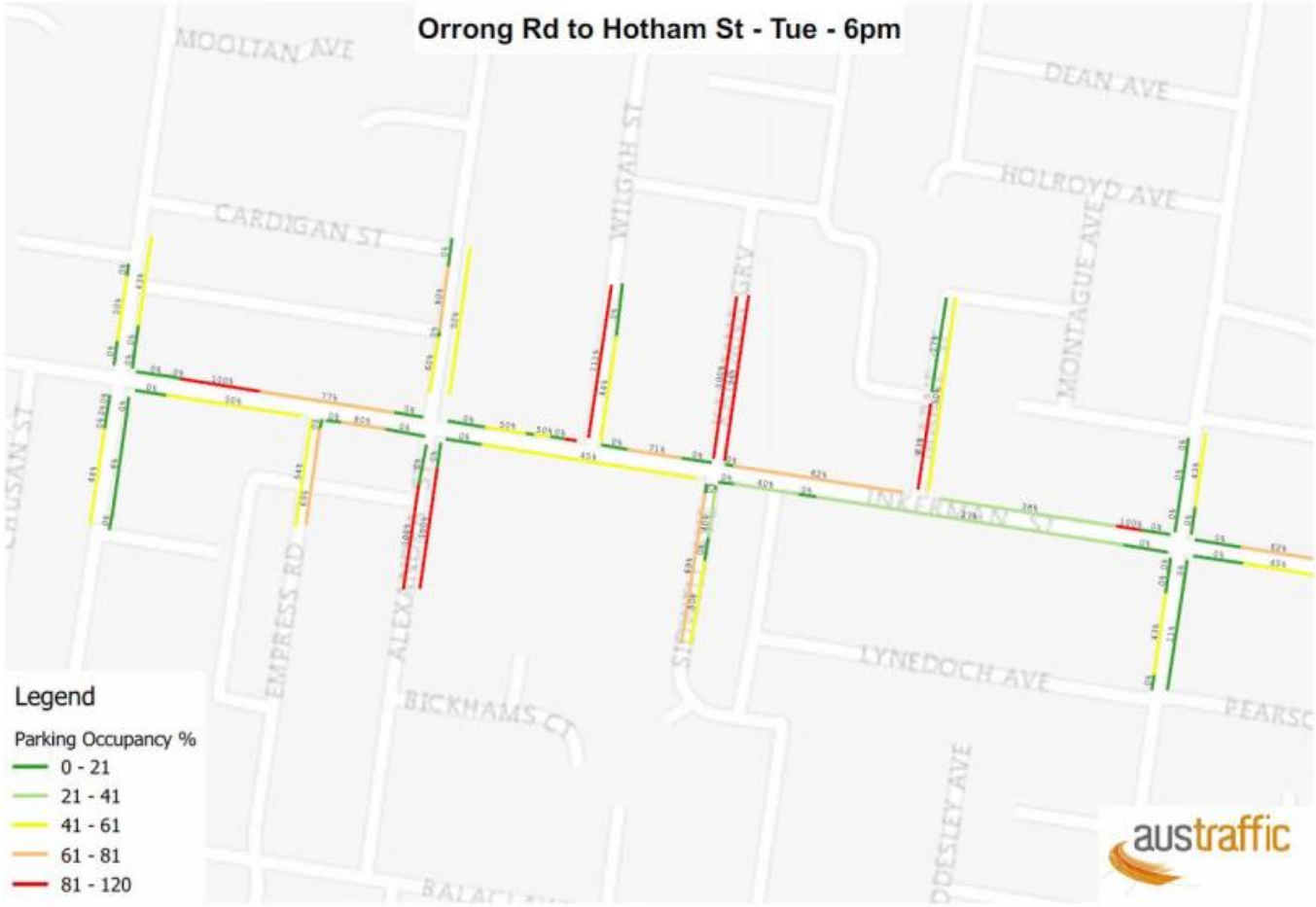
Map 12 Parking Occupancy from Orrong Rd to Hotham St for Tuesday 13 November 2018 at 6pm



Attachments

Concept plans

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