regional roads victoria

3 Project alternatives

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Tables

Figures

3.1 Overview

The Beaufort Bypass scoping requirements set out the matters to be addressed in the EES, including the project alternatives:

The EES should document consideration of alternatives by the proponent and include an explanation of how alternatives were shortlisted for evaluation within the EES. The EES should investigate and document the likely social, strategic, economic and environmental effects of the alternatives, particularly where an alternative(s) offer(s) a potential for superior environmental, social or economic outcome and are capable of meeting the objectives of the proposed project. The discussion of relevant alternatives should include:

- *an explanation of how alignment alternatives and design alternatives were initially identified and what evaluation process was used to select feasible alternatives for more detailed examination;*
- *a comparative integrated assessment of the feasible alignment alternatives identified for the proposed project, as well as any potentially suitable design variants to these, particularly with respect to key social, economic and environmental effects;*
- *a description of the environmental, social and economic effects of alternatives, including justification as to why a preferred alternative is selected through the development of the EES; and*
- *a description of how the "avoid and minimise principle" for clearing native vegetation and the occurrence of threatened flora and fauna species has been considered in the assessment of alignment alternatives, as well as the feasibility and costs of likely offset requirements.*

The depth of investigation of alternatives should be proportionate to their potential to avoid and minimise potential adverse effects as well as meet the proposed project objectives.

This chapter provides a description of and documents RRV's options assessment process from the concept alignment development to selection of the preferred alignment, C2, which is the subject of this EES.

3.2 Options development

The need for a bypass of Beaufort has been investigated for ten years, with consideration of a range of strategic alternatives and alignment options. In all the investigations undertaken, RRV and the former VicRoads have sought to develop a bypass alignment that minimises impact on the environmental, social and economic values surrounding the Beaufort township.

Since the release of the scoping requirements, the likely social, strategic, economic and environmental effects of feasible project alternatives have been assessed across the three phases of alignment development as listed below, illustrated in Figure 3.1 and outlined in the RRV Options Assessment Report included in EES Attachment IV: *Options Assessment*:

- **Phase 1** involved identifying a range of alignment alternatives, a rapid assessment to identify a shortlist of feasible alignment corridors and development of an initial alignment within each corridor.
- **Phase 2** involved development of the concept alignment alternatives generated in Phase 1 and public consultation.
- **Phase 3** involved an integrated assessment of alignment alternatives, including an environmental risk assessment, environmental impact assessment and a comparative assessment of the key social, economic and environmental effects of feasible alignment alternatives to inform the selection of a preferred alignment option for detailed assessment in the EES.

Figure 3.1 Options assessment process

As a result of this process, a single feasible alignment option was identified by RRV. Based on a comparative assessment of environmental, social and economic effects, RRV considers that the C2 Alignment would provide the most appropriate solution for a bypass of Beaufort.

3.3 Methodology

An integrated assessment of environmental effects was undertaken, considering the assessment of alternative alignments, to select a preferred bypass alignment of the Beaufort township. Section 3.4 describe the bypass options that were investigated prior to the referral of the project under the *Environment Effects Act 1978.* The method described below and expanded in Section 3.5 outlines the options investigation and assessment process following the publication of the EES scoping requirements. The options assessment method utilised the social, environmental and economic technical aspects that were developed for the EES. The generation, development and assessment of alignment alternatives was undertaken in three phases:

- **Phase 1 Concept alignment development** involved generating a range of alignment alternatives, followed by a rapid assessment to identify a shortlist of feasible alignments for public consultation. The process consisted of:
  - model generation of initial alignment alternatives within the study area (over 200 alignment options)
  - technical workshops involving engineering, planning and environmental specialists
  - developing alignment corridor seed options (the initial foundation corridor alignments which were used as the basis to further develop the alignment options)
  - identifying initial alignment alternatives for public consultation.
- **Phase 2 Option development and assessment** involved modification of the Phase 1 alignment options and feasibility assessment to develop four shortlisted alignments suitable for further impact assessments. This process involved:
  - public consultation and technical assessments
  - feasibility assessments.
- **Phase 3 Identification of preferred alignment** involved detailed assessment of the shortlisted alternatives to inform a comparative options assessment. The three key steps were:
  - environmental risk assessment
  - environmental impact assessment
  - alignment options assessment.

3.3.1 Evaluation criteria

Evaluation criteria were developed for the alignment selection process and are outlined in the RRV Options Assessment Report included in EES Attachment IV: *Options Assessment*. The key considerations in the development of the evaluation criteria for each of the specialists were:

- RRV project objectives described EES Chapter 1: *Introduction*
- the scoping requirements EES evaluation objectives
- relevant legislation, policies or guidelines.

3.3.2 Peer review

A peer review of the Options Assessment Report was provided by EY in August 2020. The purpose of the peer review process was to assess the adequacy and robustness of the framework and process undertaken by RRV. This focused on consideration of the evaluation and scoring framework applied in the comparison of options and the selection of the preferred alignment for the Beaufort Bypass.

The method for the peer review included:

- reviewing benchmark multi-criteria assessments to provide understanding, and key outcomes of best practice approaches when planning the delivery of key infrastructure both Nationally and at a State level
- a parallel or "shadow" rating of RRV's multi criteria assessment to test alternative scoring and adopting weightings. The review further considered the process and procedure adopted in concluding the preferred alignment, alongside objectives identified for the options assessment against project objectives
- conclusions and overall key findings for further consideration.

Limitations of the review process

EY did not undertake any research or review of the validity or robustness of the impact assessments or technical reports provided by RRV, or further research on the Project to inform their peer review report. EY drew upon information provided and leveraged existing knowledge and resources to support their analysis of the options assessment.

3.4 Consideration of relevant alternatives

Prior to the referral of the project under the *Environment Effects Act 1978,* as part of the process to determine feasible duplicated highway alignment options, consideration was given to alternative strategic solutions, including the 'no project' scenario (i.e., the impact of not developing a highway bypass of Beaufort), and consideration of implementing design alternatives to address safety and efficiency requirements. These alternative strategic solutions are detailed throughout Section 3.4. Further details on previous investigations are provided in EES Attachment IV: *Options Assessment*.

3.4.1 The 'no project' scenario

Consideration of the 'no project' scenario is important to evaluate the implications of the project and to provide a comparative basis for evaluating the relative impacts and benefits for each alternative solution.

The rationale for the project is discussed in EES Chapter 2: *Project rationale and benefits*. The key objectives of the project are:

- improve freight movement and efficiency
- improve access to markets and the competitiveness of local industries
- improve road safety within the township and arterial road network
- improve amenity within the township by removing traffic, minimising noise and visual impacts of the new road and minimising impacts on key community facilities during construction and operation of the bypass.

It was concluded that the 'no project' scenario failed to meet any of the above project objectives and that it would permit an existing traffic issue (which was driving the need for the project) to continue. Through traffic, including freight and personal vehicles, would continue to utilise the existing road network in Beaufort as there are no other viable routes. The current route through the centre of Beaufort does not provide sufficient capacity and connectivity and it has the potential to contribute to:

- accidents between vehicles, and pedestrians and vehicles
- inefficient freight movement
- loss of town amenity and town centre function.

3.4.2 Previous investigations

Commencing in 2009, VicRoads investigated a number of concept bypass alignment alternatives both to the north and south of Beaufort. Several studies have looked at identifying and assessing alignment alternatives. This section outlines previous reports that have been considered in the preparation of this chapter. The purpose of these assessments was to select a bypass route that resulted in the least impact on environmental, social and economic values, to progress an option through the planning and environmental approvals process. Further details on previous investigations are provided in EES Attachment IV: *Options Assessment*.

2009 Planning Study

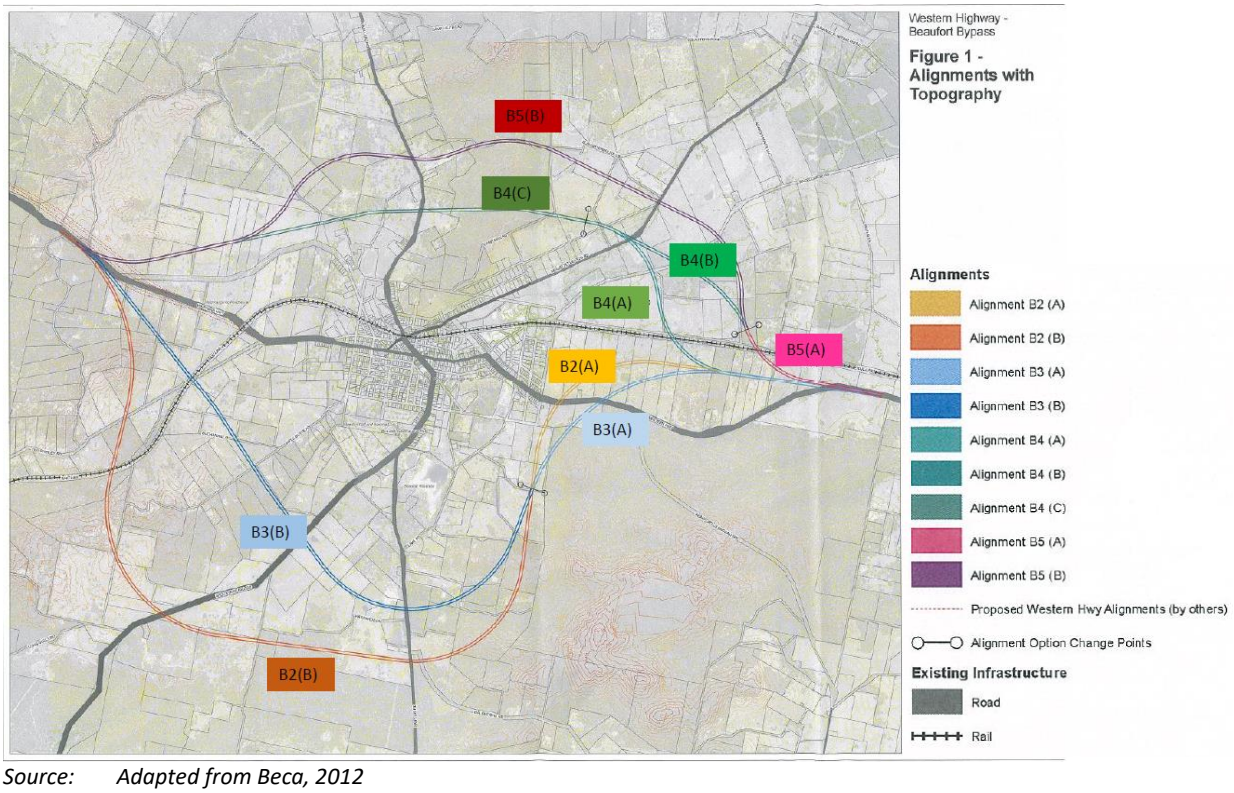
In 2009, Pyrenees Shire Council commissioned a planning study to assist in forming a position on the merits of a bypass around Beaufort. The report was informed by consultation, strategic planning, existing landform, land use, constraints and engineering considerations. In consideration of the various values analysed, the report identified an alignment to the north of Beaufort as the most likely alignment (TTM Consulting 2009).

2012 VicRoads Study

In 2012, VicRoads commissioned an alignment options report for the bypass of Beaufort, which looked at various potential alignments to the north and the south of Beaufort, with tie-ins to the existing Western Highway (Beca 2012, p.1):

- to the east of Beaufort at a location west of Smiths Lane
- to the west of Beaufort at a location east of Grampians View Road.

The report provided analysis of desktop assessments and council reports, and assessed variations on seven alignment alternatives against environment and ecology, community and social, engineering and economics criteria to identify the best performing options. The report did not recommend a preferred alignment. The options assessed by Beca (2012) are displayed in Figure 3.2.



Source: Adapted from Beca, 2012

Figure 3.2 Alignment options previously assessed by Beca (2012)

2015 Option Study

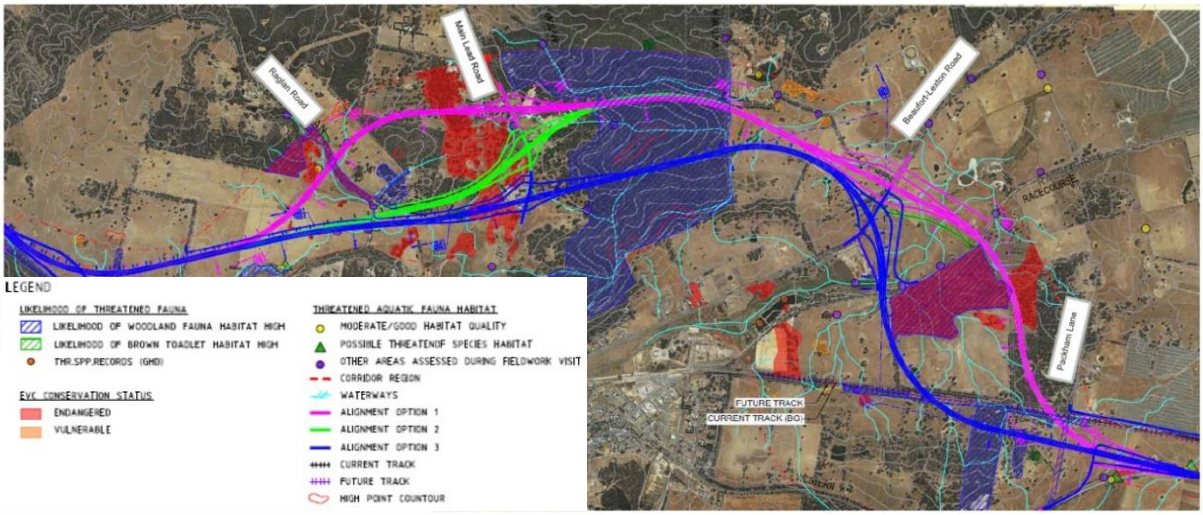
In 2015, VicRoads commissioned an objective-based evaluation of three options that bypassed Beaufort to the north of the town centre. The objective-based evaluation further expanded on the alignment options assessments undertaken in 2012 against three criteria:

- Principal Objectives, such as:
  - improve freight movement and efficiency
  - maintain road network functionality.
- Engineering Objectives, such as:
  - maximise safety and efficiency
  - minimise earthworks.
- Additional Objectives, such as:
  - minimise environmental impacts and cost.

The three alignment alternatives considered in the report are shown in Figure 3.3. These were:

- Option 1 (10.5 km in length)
- Option 2 (10.3 km in length)
- Option 3 (10.2 km in length).

The 2015 report by Aurecon identified that when assessing the three alignment alternatives against the objective based assessment criteria, while all alternatives performed relatively well, Option 2 performed the best overall with a lower ecological impact and the best engineering geometry of the alignments considered.



Source: Development of Concept Road Designs for Bypass Planning Studies for Ararat and Beaufort (Aurecon 2015)

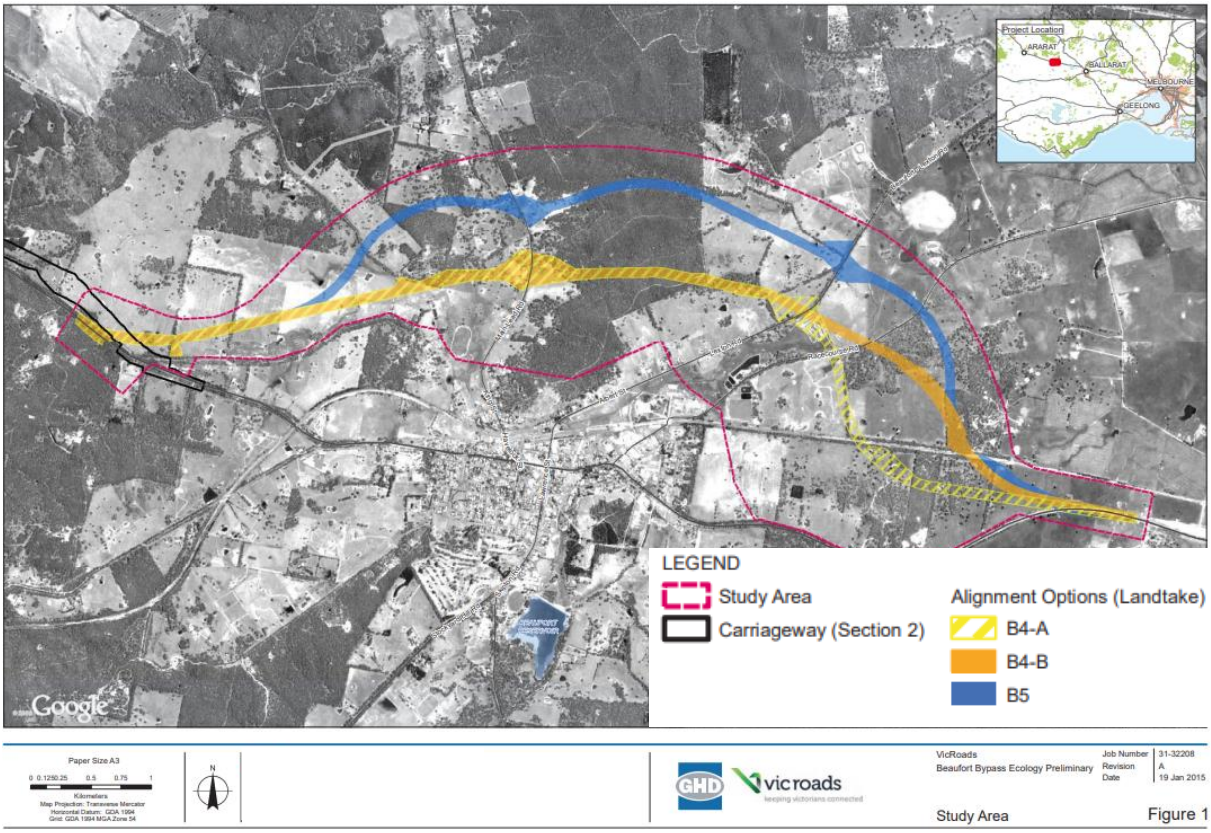
Figure 3.3 Beaufort Bypass alignment alternatives considered in the Aurecon assessment (Pink = Option 1; Green = Option 2; Blue = Option 3)

2015 Environmental Study

GHD (2015) undertook a rapid field-based flora, fauna and aquatic habitat report to identify the main ecological values present within the study area for the proposed Beaufort Bypass. The rapid assessment built on the high-level Aurecon assessment, and informed the development of the following three northern alignment alternatives to reduce native vegetation loss, area of habitat for *Flora and Fauna Guarantee Act 1988* and *Environment Protection and Biodiversity Conservation Act 1999* listed flora and fauna species, and waterway habitat and fragmentation:

- B4-A (9.8 km in length) (yellow hatching)
- B4-B (9.6 km in length) (orange shading)
- B5 (10.5 km in length) (blue shading).

Figure 3.4 shows the options assessed. Assessment criteria were developed to determine the alignment alternatives with the least ecological impact. The report recommended that a risk assessment be undertaken to weigh individual assessment criteria, for comparison and to undertake targeted surveys for a number of threatened species and communities.



Source: *Adapted from 'Western Highway Bypass Project – Beaufort. Stage 1 – Flora, Fauna and Aquatic Assessment' (GHD 2015)*

Figure 3.4 Options assessed by GHD (2015)

While the previous studies did not select one preferred alignment, the recommendations of these studies supported a bypass to the north of Beaufort being more favourable when compared to southern bypass options for the following reasons:

- better alignment with the Pyrenees Planning Scheme:
  - a southern bypass would significantly affect land in the Rural Living Zone south of the township
  - impact on the future short-term growth of the township to the south
  - better land use opportunities for future industry development to the north of the township
- shorter travel distance and travel time
- lower land severance (including land acquisition)
- lower construction cost.

The project was referred under the *Environment Effects Act 1978* in 2015. The resulting study area to investigate bypass options was developed, as outlined in the EES scoping requirements and shown in Figure 3.5.

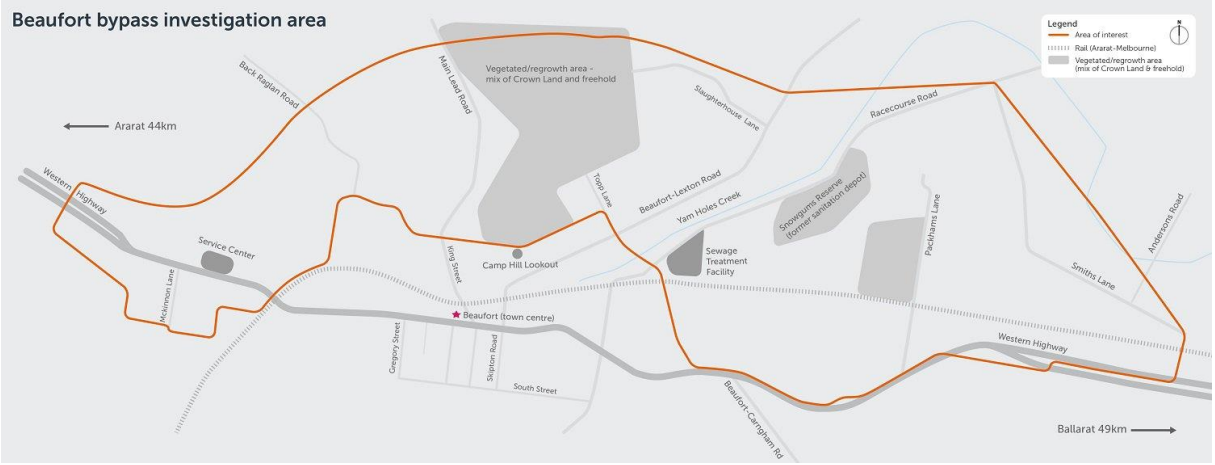


Figure 3.5 Beaufort Bypass study area as defined in the EES scoping requirements (DELWP 2016)

Southern Bypass Options Study

While the scoping requirements guided assessment of bypass options to the north of the Beaufort township, in 2017, while development and assessment of the northern options was occurring, the technical reference group requested further assessment to be undertaken for the southern bypass options. To address this, WSP undertook an additional high-level qualitative review and compilation of existing planning, environment and engineering information for two southern alignment options for the Beaufort Bypass (referred to as D0 and D1). These alignments were developed by refining the two alignments proposed in the Beca 2012 report (alignments B2 and B3). The options were assessed using previous technical investigations that had assessed environmental and planning issues within the southern bypass alignment area. Constraints assessed included land use, conservation areas, land acquisition and residential amenity.

A comparison of the preferred alignment, C2 and the southern options (based on a 250 m impact corridor) is provided in Table 3.1 below, with the identified constraints in the area to the south of Beaufort shown in Figure 3.6. In summary, the assessment identified the following high risks for a southern bypass option:

- the D0 option would provide no time saving compared to the 'do nothing' scenario and the D1 option would achieve only minor travel time reduction, which would be significantly less than northern options
- high amount of property acquisition and proximity to a comparatively high number of dwellings
- inconsistency with strategic planning policy for future low density residential growth (as discussed below)
- high potential impacts on vulnerable and endangered native vegetation
- potential impacts to the higher number of community facilities located on the southern side of Beaufort.

One of the constraints to the further expansion of the Beaufort township is the surrounding topography, with Camp Hill to the north and steep land to the south-east, and low-lying land in the north-east and north-west. Due to these constraints, the land south of the township has been identified for future residential growth, with the majority of the land zoned as Rural Living Zone. This growth strategy is highlighted in the Pyrenees Shire Council Beaufort Framework Plan report, which indicates that the rural character of the Rural Living Zone land in the south of the township should be protected and enhanced due to the capacity for future housing development in this area. As such, a southern bypass conflicts with future land use policy applying to the southern study area. Based on the findings of the Southern Bypass Options Study, the southern options were not progressed and the focus of the EES was directed to the northern alignment options.

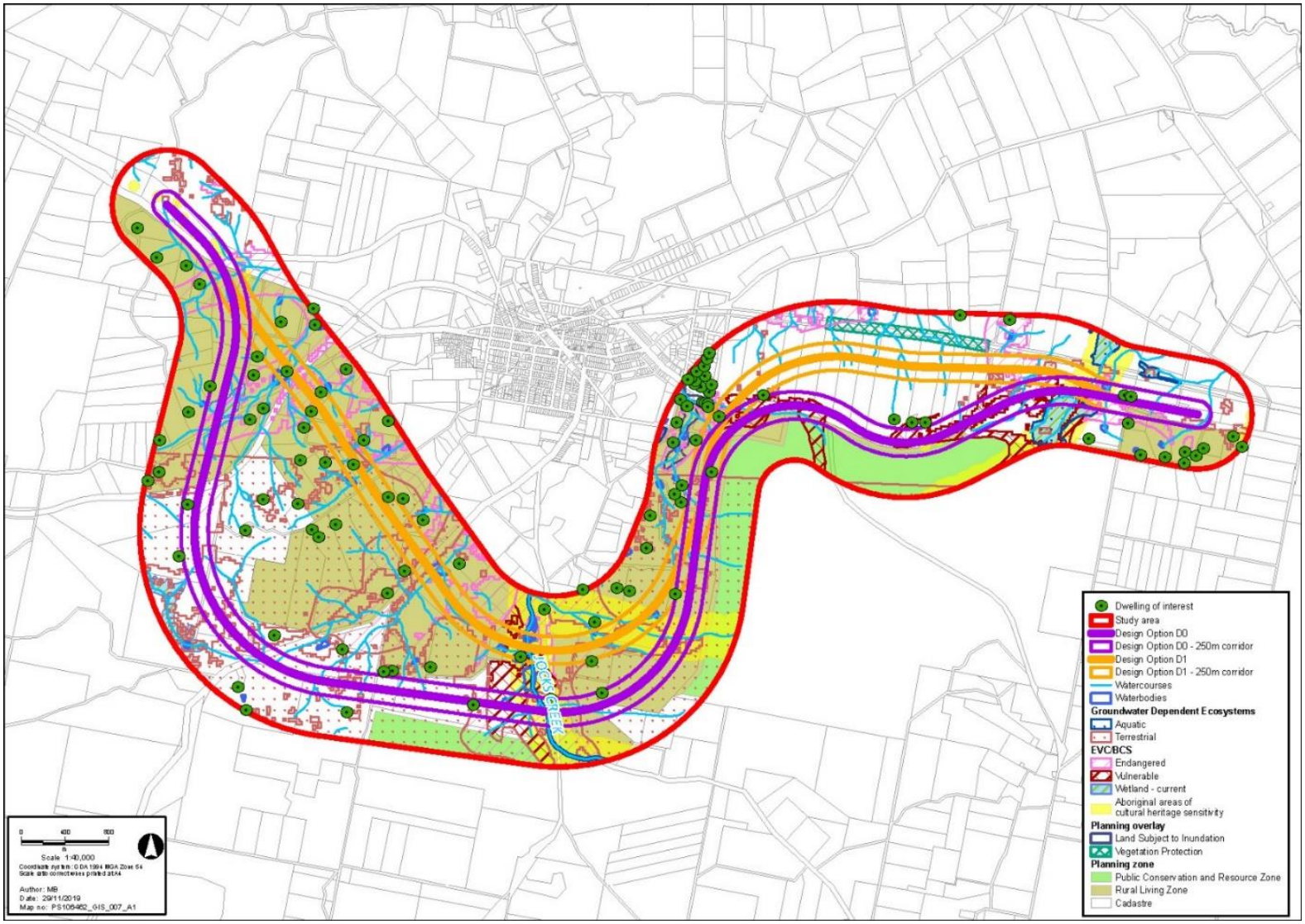


Figure 3.6 Beaufort Bypass southern options assessment: Constraints map

Table 3.1 Comparison of preferred alignment (C2) and southern bypass options (D0 and D1) based on a 250 m corridor

		PREFERRED ALIGNMENT, OPTION C2		OPTION D0		OPTION D1		SUMMARY
Design								
Length (km)		11 km		15.2 km		13 km		The southern alignments are longer in length than the C2 alignment.
Travel time (MM: SS)	Light vehicles (110 km/hr)	06:00 minutes		08:17 minutes		07:05 minutes		Travel time for light vehicles on the southern alignments will be between 01:05-02:17 minutes longer than travel on the C2 alignment.
	Heavy vehicles (100 km/hr)	06:36 minutes		09:07 minutes		07:48 minutes		Travel time for heavy vehicles on the southern alignments will be between 01:12-02:31 minutes longer than travel on the C2 alignment.
Average travel time savings (MM: SS)	Light vehicles (110 km/hr)	02:04 minutes		-00:14 minutes		00:59 minutes		The C2 alignment has a travel time saving for light vehicles of 02:04 minutes. Travel on the D0 alignment for these vehicles will take on average 14 seconds longer than the current Western Highway route.
	Heavy vehicles (100 km/hr)	01:32 minutes		-01:00 minutes		00:20 minutes		The C2 alignment has a travel time savings for heavy vehicles of 01:32 minutes. Travel on the D0 alignment for these vehicles will take on average one minute longer than the current Western Highway route.
Land Use and Planning								
Planning overlays		**Intersects?**	**Area (ha)**	**Intersects?**	**Area (ha)**	**Intersects?**	**Area (ha)**	Southern alignments and corridor do not intersect Vegetation Protection Overlay areas, which are located along the Ballarat-Ararat Railway and avoid the flood prone areas along Yam Holes Creek subject to the Floodway Overlay and Land Subject to Inundation Overlay.
Vegetation Protection Overlay		✓	1.33 ha	×	N/A	×	N/A	
Land Subject to Inundation Overlay		✓	9.07 ha	×	N/A	✓	0.06 ha	
Floodway Overlay		✓	5.81 ha	×	N/A	✓	0.15 ha	

	PREFERRED ALIGNMENT, OPTION C2		OPTION D0		OPTION D1		SUMMARY
Bushfire Management Overlay	✓	117.55 ha	✓	311.12 ha	✓	173.21 ha	Southern alignments intersect a greater area of Bushfire Management Overlay and less areas of Restructure Overlay. Similar areas of Public Acquisition Overlay are intersected for northern and southern alignments.
Restructure Overlay	✓	233.56 ha	✓	72.95 ha	✓	107.71 ha	
Public Acquisition Overlay	✓	20.10 ha	✓	19.27 ha	✓	19.34 ha	
Planning zones	**Intersects?**	**Area (ha)**	**Intersects?**	**Area (ha)**	**Intersects?**	**Area (ha)**	The southern options include a larger area of zones that are more sensitive to the development of a road.
Public Conservation and Resource Zone	✓	4.12 ha	✓	7.60 ha	✗	N/A	
Rural Conservation Zone	✓	2.05 ha	✗	N/A	✗	N/A	
Public Use Zone – transport	✓	1.33 ha	✓	1.95 ha	✓	1.62 ha	
Farming Zone	✓	253.92 ha	✓	187.84 ha	✓	114.09 ha	
Road Zone – Category 1	✓	12.74 ha	✓	34.34 ha	✓	17.49 ha	
Rural Living Zone	✓	3.88 ha	✓	154.07 ha	✓	197.46 ha	
Low Density Residential Zone	✓	0.41 ha	✗	N/A	✗	N/A	
Strategic planning	A relevant strategy of Clause 16.01-1L (Location of residential development in Pyrenees Shire) of the Pyrenees Planning Scheme is: *Discourage the expansion of the low-lying area of Beaufort north of the railway due to drainage issues and the isolation of the area from community facilities.*						Strategic planning policy supports rural-residential to the south of Beaufort within the area that the southern options pass through.

	PREFERRED ALIGNMENT, OPTION C2	OPTION D0	OPTION D1	SUMMARY
Parks / reserves	Direct impact Camp Hill State Forest (4.12 ha)	Park/reserve intersection Andrews State Forest (1.73 ha) Trawalla State Forest (16.04 ha) Adjacent park/reserves 30 m south of Beaufort South Bushland Reserve	Adjacent park/reserves Beaufort South Bushland Reserve (alignment corridor immediately adjacent to the north) 20 m west of Trawalla State Forest	The southern alignments potentially intersect two park/reserve areas and run adjacent to a third park/reserve.
Crown land areas	Intersects 6 areas of Crown land	Intersects four areas of Crown land	Intersects four areas of Crown land	More Crown land areas intersected by C2 alignment than southern options.
Apiary buffer zones	1 x Apiary buffer zones in corridor	Two x Apiary buffer zones in corridor	One x Apiary buffer zone in corridor	Similar impact on apiary buffer zones for C2 and southern alignments
Mineral tenements	No mining licences	No mining licences	No mining licences	The C2 and southern alignments avoid impacting on areas subject to mining licences.

	PREFERRED ALIGNMENT, OPTION C2	OPTION D0	OPTION D1	SUMMARY
Utilities	• Cuts through the middle of irrigation infrastructure for wastewater treatment plant • Seven crossings of Telecommunication (one optical underground cable) • One section of underground water infrastructure • West Tie in (three telecommunications, one optical underground cable) • East tie in (two underground high voltage electrical, three underground low voltage electrical)	Utility assets potentially intersected by alignment include: • NBN (Skipton Road, Dalgleishs Road and Haywards Lane) • Powercor (distribution substations and overhead low voltage cables are also located throughout study area) • Central Highlands Water • Telstra • Optus underground optic fibre cables (located near Martins Lane, north of the existing Western Highway)	Utility assets potentially intersected by alignment include: • NBN (Skipton Road, Dalgleishs Road and Haywards Lane) • Powercor (distribution substations and overhead low voltage cables are also located throughout study area) • Central Highlands Water • Telstra • Optus underground optic fibre cables (located near Martins Lane, north of the existing Western Highway)	There are a higher number of utilities potentially impacted within the southern options than the C2 alignment.
Social				
Number of dwellings within alignment corridor	Four dwellings in corridor (including dwelling at eastern tie-in point)	Seven dwellings in corridor	Twelve dwellings in corridor	There are a higher number of dwellings impacted by southern alignments and corridors than the C2 alignment.
Land acquisition (ha)	262.59 ha	339.6 ha	301.1 ha	Greater land acquisition required for southern alignments.

	PREFERRED ALIGNMENT, OPTION C2	OPTION D0	OPTION D1	SUMMARY
Traffic and Transport				
Transport networks intersected	Five transport networks intersected: • Back Raglan Road • King St/Main Lead Road • Beaufort-Lexton Road • Racecourse Road • Melbourne-Ararat rail line	Four transport networks intersected: • Old Shirley Road • Stockyard Hill Road • Skipton Road • Melbourne-Ararat rail line	Six transport networks intersected: • Old Shirley Road • Rifle Butts Road • Stockyard Hill Road • Skipton Road • Western Highway • Melbourne-Ararat rail line	Similar number of crossings of transport networks between southern and northern alignments.
Geology and Soils				
Acid Sulfate Soils	Bn(p4) zone – low probability of encountering acid sulfate soils	Bn(p4) zone – low probability of encountering acid sulfate soils	Bn(p4) zone – low probability of encountering acid sulfate soils	Acid sulfate soil potential (low probability) consistent across northern and southern study areas
Geology	Pyrenees Formation (-Cap) Beaufort Formation (-Cab) Incised alluvium (Na) Alluvium (Qa1)	Pyrenees Formation (-Cap) Beaufort Formation (-Cab) Incised alluvium (Na)	Pyrenees Formation (-Cap) Beaufort Formation (-Cab) Incised alluvium (Na) White Hills Gravel (-Pxh)	Similar geology across both northern and southern study areas
Hydrology and Groundwater				
Watercourses	0.27 km Yam Holes Creek 22 waterway crossings	1.73 km Jocks Creek 28 waterway crossings	0.56 km Jocks Creek 31 waterway crossings	Southern alignments and corridor cross a greater number of waterways and intersect a greater area of named waterways.
Waterbodies	8.82 ha wetland/swamp	0.68 ha wetland/swamp	3.30 ha wetland/swamp	Southern alignments and corridors intersect fewer areas of wetland/swamp than the C2 alignment.

	PREFERRED ALIGNMENT, OPTION C2	OPTION D0	OPTION D1	SUMMARY
Groundwater dependent ecosystems	Small area of predicted groundwater dependent ecosystems, mainly at crossings of Yam Holes Creek.	Extensive area of predicted groundwater dependent ecosystems, mainly in undulating areas south of Beaufort.	Extensive area of predicted groundwater dependent ecosystems, mainly in undulating areas south of Beaufort.	A greater extent of groundwater dependent ecosystems are intersected by the southern alignments than the C2 alignment.
Flood contour	Flood area crossed between Main Lead Road and Back Raglan Road	No flood or inundation overlays intersected by alignment corridor. Outside flood contour areas.	Corridor intersects Floodway Overlay and Land Subject to Inundation Overlay south of the eastern extent of the existing Western Highway Corridor intersects edge of flood contour south of the eastern extent of the existing Western Highway	Southern alignments avoid the flood prone areas along Yam Holes Creek.
Bores	No registered groundwater bores within alignment and corridor	No registered groundwater bores within alignment and corridor One registered groundwater bore within 20 m of alignment and corridor (domestic and stock use)	No registered groundwater bores within alignment and corridor One registered groundwater bore within 190 m of alignment and corridor (beneficial use not identified)	No registered groundwater bores within the C2 or southern alignments and corridors.
Salinity *(VRO website, DEDJTR)*	Scattered patches of salinity within northern bypass study area	No saline areas identified within the southern bypass study area		Salinity may be more prevalent in the northern study area than the southern study area.

	PREFERRED ALIGNMENT, OPTION C2	OPTION D0	OPTION D1	SUMMARY
Air				
Air quality	Dust and other emissions from a bypass to the south of the Beaufort township would be carried towards Beaufort most of the time. Approximately 47 sensitive receptors in the northern study area that may experience a decrease in air quality.	Dust and other emissions from a bypass to the south of the Beaufort township would be carried away from Beaufort most of the time. Approximately 104 sensitive receptors in the southern study area that may experience a decrease in air quality.		As the dominant wind direction is from the north, it would be anticipated that a bypass to the south of Beaufort would lead to an improvement in air quality in the town.
Ecology				
Ecological Vegetation Classes / Bioregional Conversation Status	78.67 ha endangered	45.18 ha endangered	62.43 ha endangered	The southern alignments and corridors have a greater area of impact on modelled Ecological Vegetation Classes than C2 alignment.
	2.49 ha vulnerable	44.66 ha vulnerable	9.18 ha vulnerable	
	66.07 ha least concern	219.88 ha least concern	140.52 ha least concern	
	147.2 3 ha total	**309.72 ha total**	**212.13 ha total**	
Threatened species	Within a 10 km buffer of the study site, the Protected Matters Search Tool (Department of Agriculture, Water and the Environment) identified: • 36 threatened species • Five EPBC Act listed communities.	Within a 10 km buffer of the study site, the Protected Matters Search Tool identified: • 33 threatened species • Five EPBC Act listed communities.		Potential significant impacts on threatened species have been identified within the southern and northern study areas. Site assessments would need to be undertaken for the southern study area to determine the impact on the 33 threatened species identified by the desktop Protected Matters Search Tool search as potentially present.

	PREFERRED ALIGNMENT, OPTION C2	OPTION D0	OPTION D1	SUMMARY
Cultural Heritage				
Aboriginal areas of cultural heritage sensitivity	43.06 ha	40.21 ha	38.98 ha	The southern alignment areas contain slightly less areas of Aboriginal cultural heritage sensitivity.
Historic cultural heritage	No heritage overlays in planning scheme One site on Victorian Heritage Inventory	No heritage overlays in planning scheme No sites on Victorian Heritage Inventory	No heritage overlays in planning scheme No sites on Victorian Heritage Inventory	No Victorian Heritage Inventory sites intersected by the southern alignments and corridor, while the C2 alignment intersects one Victorian Heritage Inventory site.
Cultural Heritage Management Plan requirements	Mandatory Cultural Heritage Management Plan required	Mandatory Cultural Heritage Management Plan required	Mandatory Cultural Heritage Management Plan required	Mandatory Cultural Heritage Management Plan required for C2 and southern alignments.

3.5 Options selection process

Following notification an EES was required for the project, a three-phase assessment process commenced to determine potential bypass options and assess the potential impacts against each option. The assessment process focussed investigations on the EES study area prescribed in the scoping requirements (see Figure 3.5). The phases described below have been informed by the suite of technical reports prepared by WSP and specialist sub-consultants. Previous investigations, described in Section 3.4.2, provided background information only for the three-phase assessment.

3.5.1 PHASE 1: Concept alignment development

The first phase, concept alignment development, involved the use of Trimble Quantm modelling software in 2017 to generate a large number of initial alignment alternatives within the project study area based on user-selected input data. Input data used for the Beaufort Bypass investigations included:

- the study area
- the proposed tie-in points for the bypass route
- terrain data (digital terrain model)
- native vegetation mapping (2005 modelled Ecological Vegetation Classes with Bioregional Conservation Status)
- Victoria Biodiversity Atlas flora and fauna records, supplemented with field survey records from 2010 and 2015-16
- vegetation mapping from 2015-16 field surveys
- cadastral boundaries
- planning scheme controls
- areas of cultural heritage sensitivity
- parks and reserved land
- geology information (geological units and acid sulfate soils)
- flood mapping
- VicRoads road design criteria, including:
  - design speed
  - grade to maximise truck efficiency
  - horizontal and vertical alignments (in accordance with Austroads Guide to Road Design Part 3 and the corresponding VicRoads Supplement)
  - other typical cross section requirements as per 'Concept Design Reverse Brief'
- participation of technical road design and environmental specialists in two alignment planning workshops.

A number of locations were designated for avoidance as an input to the Quantm model, including:

- Snowgums Bushland Reserve
- Central Highlands Water wastewater treatment plant
- an area of native vegetation to the south-east of Snowgums Bushland Reserve and extending west along the Melbourne-Ararat rail line corridor, representing a large contiguous patch of good quality vegetation.

Technical workshops

Technical workshops were held between VicRoads and its contractors on 10 October and 17 November 2016 to discuss existing values in the study area, re-confirm relevant qualitative data inputs and test the model assumptions and outputs.

The specialists present at the workshops covered the following disciplines:

- ecology
- Aboriginal cultural heritage and historic heritage
- groundwater and hydrology
- contaminated land
- soils and geotechnical
- land use planners
- stakeholder engagement and social planners
- road and tunnel designers
- traffic and transport planners
- noise and vibration specialists.

The workshops provided an opportunity for specialists to discuss constraints in the study area and to confirm that the required inputs had all been captured in the model.

Model outputs

The outputs of the model analysis produced approximately 200 initial design alternatives for consideration as shown in Figure 3.7.

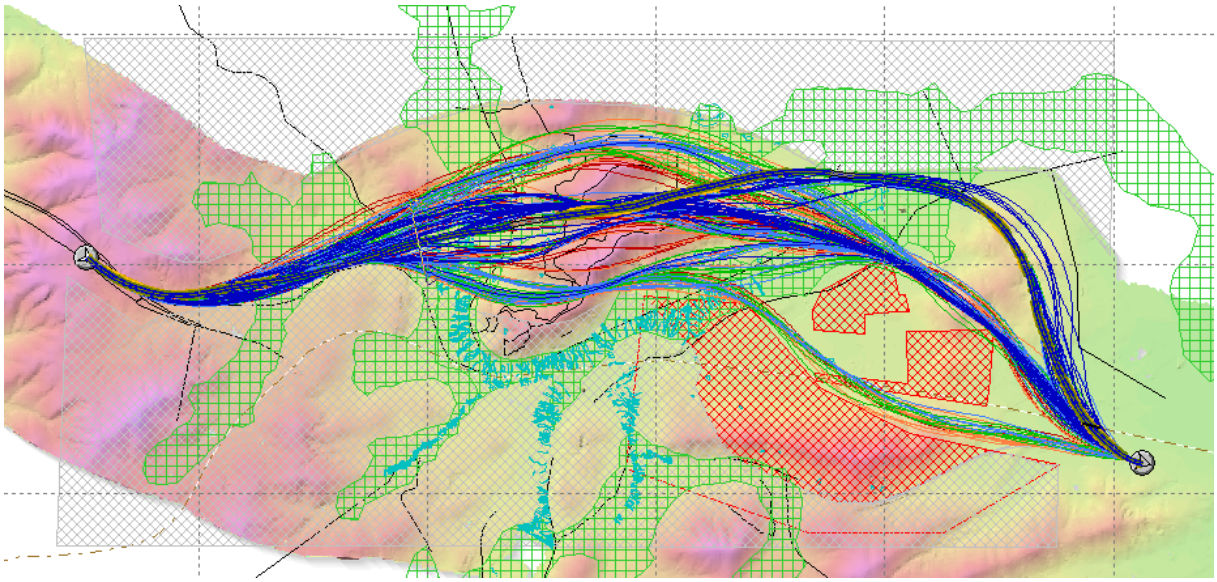


Figure 3.7 Trimble design output

The model outputs represent a desirable road alignment outcome based on the input data catered around truck efficiency and construction cost, however, the data alone does not represent all key issues and solutions which may need to be considered when developing a road alignment and as required by the EES. The model outputs (over 200 design alternatives) were utilised as a good starting point to inform the identification of alternative alignments to be adopted in the EES.

The output of the software planning process was a list of over 200 feasible alignment alternatives for further assessment based on horizontal and vertical optimisation. Model outputs were colour coded according to feasibility of the options, with dark blue lines representing the 'most feasible'.

Bypass corridor seed options

To progress the development of the road alignment alternatives, the model outputs were refined into three distinct corridors (based on the commonality between the outputs) with an approximate width of 250 m for further investigation. These corridors can be categorised into the following:

- an option closest to the Beaufort township (south option)
- an option furthest from Beaufort township (includes two alignment variations – north and north-east options)
- a central option.

The bypass corridor seed options are shown in Figure 3.8.

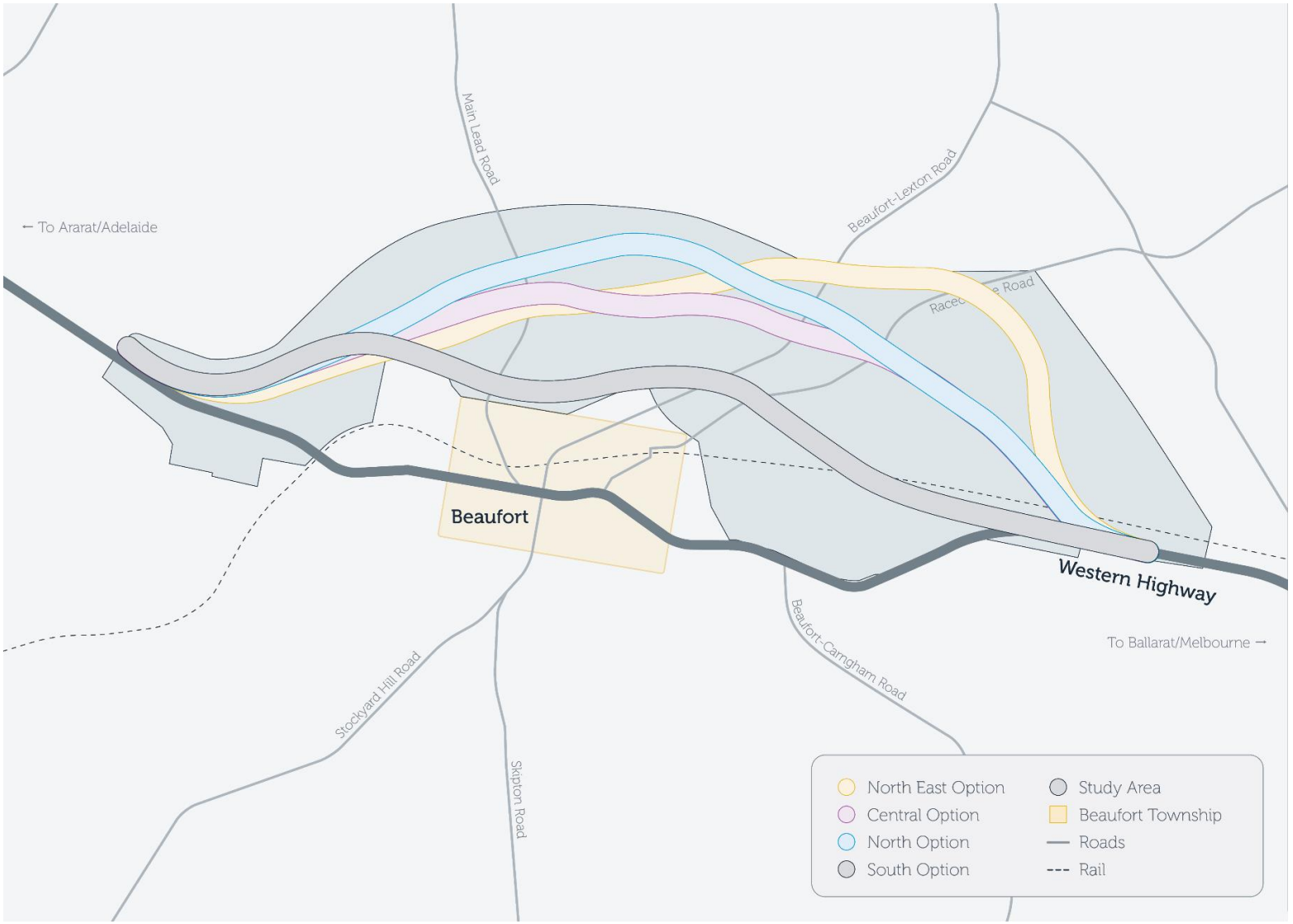


Figure 3.8 **Bypass corridor seed options**

Concept designs within the corridors were developed further by road designers (in association with environmental scientists and planners), with consideration of qualitative project constraint information.

Inputs to this process included:

- a site visit by the road designers, planners and environmental scientists
- analysis of the constraints in the study area through the development of preliminary impact assessments
- ecology survey outputs:
  - biodiversity (Commonwealth and State listed threatened species and communities)
  - large trees
- mining tenements and leases
- significant local infrastructure (e.g. Optus Exchange)
- dwelling locations (avoiding where possible)
- areas of cultural heritage sensitivity
- further concept design workshops between VicRoads and its advisors.

Further adjustments to minimise potential impacts to social and environmental values were made in consideration of identified constraints and risks, including practical improvements to the road design such as following contours in the landscape. Corridors were refined, and concept designs were generated within those corridors to address opportunities and constraints within the corridors.

The results of the 'micro-siting' and subsequent corridor refinements are shown in Figure 3.9.

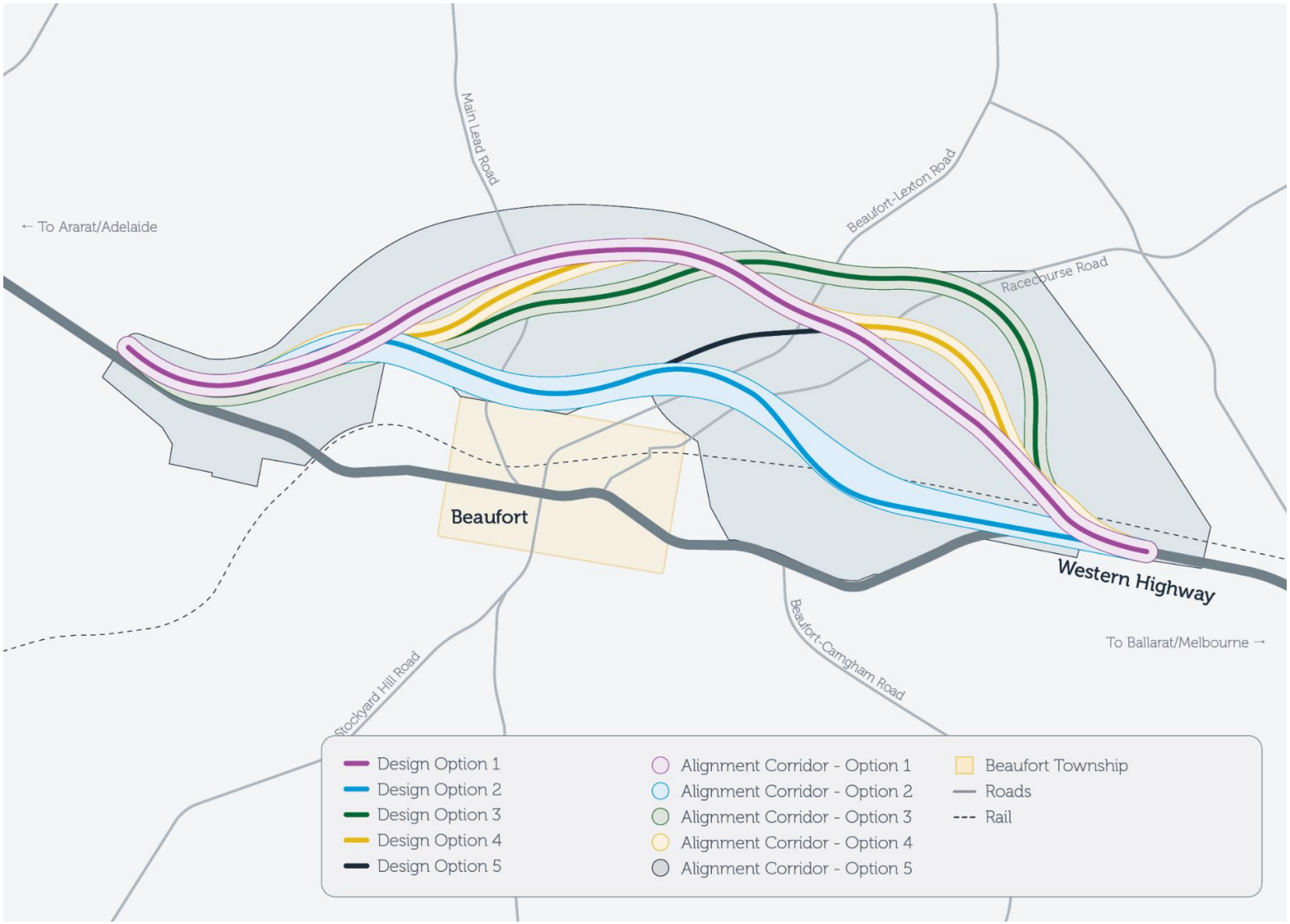


Figure 3.9 **Corridor seed option micro-siting and refinement**

Alignment alternatives for public consultation

After the draft concept design workshop, a shortlist of three alignment alternatives was chosen by VicRoads for further investigation and endorsed by the VicRoads Project Review Committee prior to engaging the community. The three bypass alternatives, shown in Figure 3.10, were chosen to best represent feasible and distinctive options that could meet the project objectives.

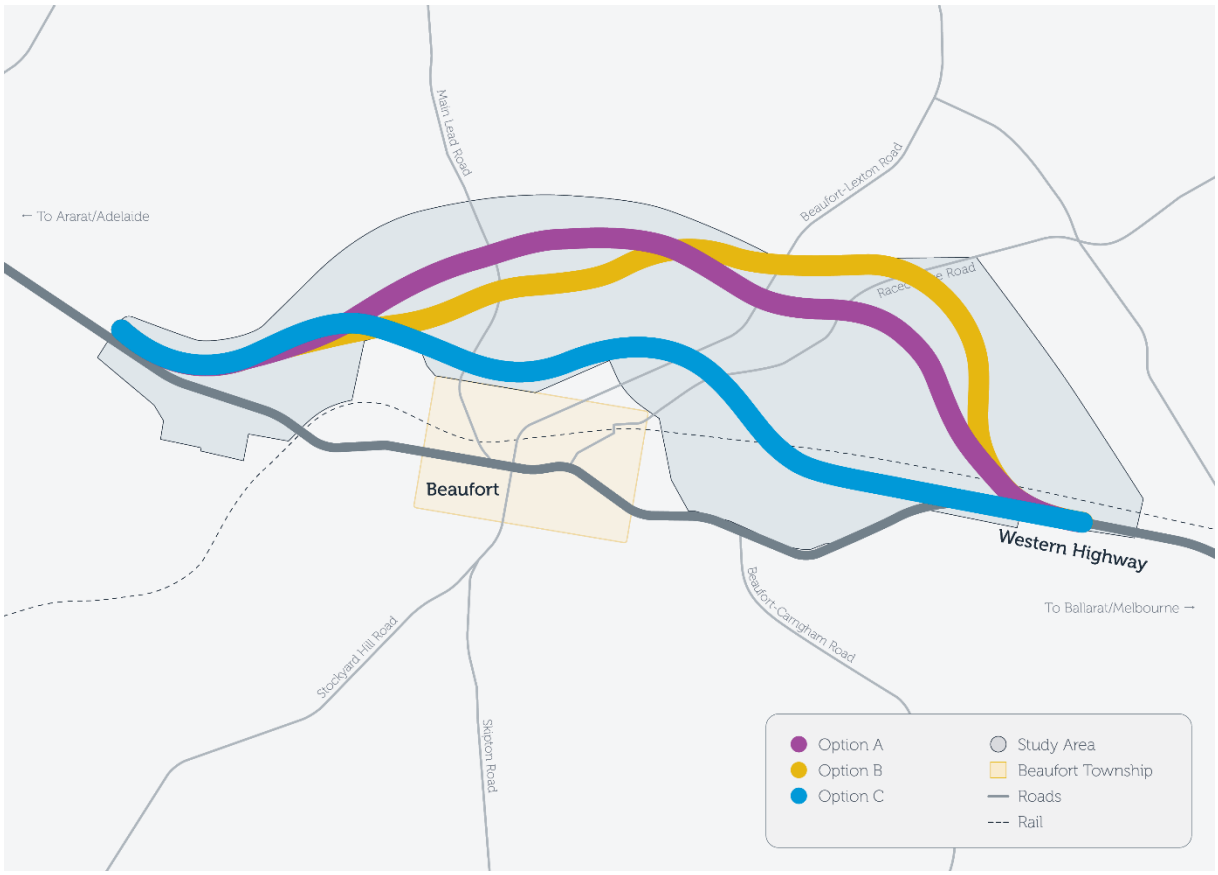


Figure 3.10 Shortlisted Beaufort Bypass alternatives for community consultation (2017)

Further refinement of the three alternatives also occurred at this time, including common start and end coordinates, and ensuring that corridors did not stray outside the study area. The VicRoads' Project Review Committee endorsed three investigation corridors (each 250 m wide) on 20 March 2017. A summary of the three bypass alignment alternatives that formed the basis of concept alignment development and community consultation are detailed in Table 3.2.

Table 3.2 Summary of bypass alignment alternatives presented for community consultation (2017)

Options	Length (approximate)	Summary of key road features (concept)
A	10.9 km	Proposed full diamond interchanges at Main Lead Road and Beaufort-Lexton Road, and half diamond interchanges at Martins Lane and Smiths Lane. Bridges will be required at these interchanges as well as at the Melbourne-Ararat rail crossing, Camp Hill Road, Back Raglan Road, and three crossings of Yam Holes Creek and its tributaries. **A total of 20 structures will be required.**
B	11.3 km	Proposed full diamond interchanges at Main Lead Road and Beaufort-Lexton Road, and half diamond interchanges at Martins Lane and Smiths Lane. Bridges will be required at these interchanges as well as at the Melbourne-Ararat rail crossing, Slaughterhouse Lane, Camp Hill Road, Back Raglan Road, and three crossings of Yam Holes Creek and its tributaries. **A total of 22 structures will be required.**
C	10.2 km	Proposed full diamond interchanges at Main Lead Road and Beaufort-Lexton Road, and half diamond interchanges at Martins Lane and Smiths Lane. Bridges will be required at these interchanges as well as at the Melbourne-Ararat rail crossing, Camp Hill Road, Back Raglan Road and three crossings of Yam Holes Creek and its tributaries. **A total of 18 structures will be required.**

3.5.2 PHASE 2: Option development and assessment

Public consultation

Three shortlisted corridor alternatives were released publicly for feedback in April-May 2017. Public information sessions were held in Beaufort on 28 April and 1 May 2017 to gather community feedback on the three draft bypass alternatives, and the alignment alternatives were made public on the Engage VicRoads interactive map to collect feedback online.

The community was particularly interested in the following issues:

- acquisition of properties
- how the route options would affect local access (maintaining access to the north-south roads for local and regional residents and businesses)
- the amenity impacts of traffic noise and light on the community (a bypass further from town would have a lower impact on amenity, the importance of maintaining Beaufort's rural landscape and character)
- the importance of minimising environmental impacts (protecting wildlife corridors, avoiding the loss of large old trees)
- the negative local economic impacts, such as the loss of passing trade for local businesses (a bypass closer to town may mean vehicles do not have to detour as far to come into Beaufort).

Technical assessments

Detailed technical studies were undertaken for the existing conditions in the study area over May to October 2017. Technical studies included:

- traffic and transport
- Aboriginal cultural heritage
- historic heritage
- surface water
- groundwater
- contaminated soils and geology
- biodiversity
- social
- regional economy
- air quality
- noise and vibration
- land use and planning
- agricultural
- landscape and visual.

The existing conditions assessments identified constraints that, along with public and landholder feedback, were considered in the design of the refined bypass alternative alignments. Including:

- feasible crossing locations for water courses including Yam Holes Creek and natural and man-made water bodies
- low-lying land and areas subject to flooding
- the location of existing utilities and infrastructure including water, sewerage, power, telecommunications, gas and council assets
- flora and fauna habitats including protected species, large trees and revegetation areas
- the Camp Hill Reserve
- current and historic mining licences and tenements
- identified sites of historic and Aboriginal cultural heritage
- geology and soil make up
- planning overlays, council planning, easements, crown land, and dwellings.

Refer to EES Attachment IV: *Options Assessment* for further detail on these assessments.

Concept design and feasibility assessments

Based on landholder, stakeholder and community feedback, and the existing conditions assessments, modifications were made to the draft bypass alternative alignments to avoid and minimise environmental, cultural heritage and social effects where possible.

VicRoads, road design engineers and planners generated new sections of the draft bypass alternatives with the intention of reducing potential impacts on residences on Smiths Lane in the east of the study area (Option B), along Main Lead Road, and at Back Raglan Road, and to avoid impacts on the Central Highland Water wastewater treatment plant assets (Option C).

Following the modifications, eight alignment alternatives (variations on the three shortlisted options) were generated for further assessment. These are described in Table 3.3 and shown in Figure 3.11 below.

Table 3.3 Summary of eight alignment alternatives

Options	Length (approx.)	Summary of key road features (concept)	Shortlisted
A0	11.2 km	From the western tie-in point, approximately 3 km from the Beaufort township, this alignment curves north-north east. The alignment passes over Main Lead Road then climbs through the State Forest north of Camp Hill. From here it descends to Beaufort-Lexton Road, before re-joining the existing Western Highway at its eastern extent, approximately 4.5 km from Beaufort. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat rail line.	✓
A1	11.1 km	Approximately 3 km from the Beaufort township, this alignment deviates north-east from the Western Highway, staying slightly south of option A0 until a point east of Main Lead Road, where it re-joins the A0 alignment. The A1 alignment will re-join the existing Western Highway approximately 4.5 km to the east of the township. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat rail line.	✓
B0	11.4 km	From the western tie-in point, approximately 3 km from the Beaufort township, the B0 alignment option follows the A0 alignment for approximately 1.5 km, where it heads in a more easterly direction and crosses Back Raglan Road. From this point, the alignment curves north-east, crossing Main Lead Road and passing through the State Forest north of Camp Hill. From here it heads east, crossing Beaufort-Lexton Road and Racecourse Road, before turning south and re-joining the existing Western Highway at its eastern extent, approximately 5 km from Beaufort. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat rail line.	×
B1	10.5 km	From the western tie-in point, approximately 3 km from the Beaufort township, the B1 alignment option follows the same path as the B0 alignment until Main Lead Road, where it heads in a more south-easterly direction and passes through the State Forest north of Camp Hill. At Beaufort-Lexton Road, this alignment turns more towards the south, crossing Racecourse Road and the Melbourne-Ararat train before heading east and re-joining the existing Western Highway approximately 4.5 km to the east of the township. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat rail line.	×
B2	11 km	The B2 alignment follows the B0 alignment from the western tie-in point, approximately 3 km from the Beaufort township, passing through the State Forest north of Camp Hill before deviating at a point west of Beaufort-Lexton Road and heading in a more south-easterly direction. At Racecourse Road, this option joins the A0 alignment, which re-joins the existing Western Highway approximately 4.5 km to the east of the township. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat rail line.	×
C0	10.6 km	The C0 option follows the A0 option from the western tie-in point, approximately 3 km from the Beaufort township, before deviating at Back Raglan Road in a more easterly direction almost parallel to the existing Western Highway. This option passes close to the north of Camp Hill, before curving south-east to Beaufort-Lexton Road. The C0 alignment will re-join the existing Western Highway approximately 4.5 km to the east of the township. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat rail line.	✓

Options	Length (approx.)	Summary of key road features (concept)	Shortlisted
C1	10.4 km	The C1 option follows the C0 option from the western tie-in point (approximately 3 km from the Beaufort township) until a point approximately 850 m west of Main Lead Road. From here it heads east, passing close to the north of Camp Hill, before re-joining the C0 alignment after approximately 2.4 km. As per the C0 alignment, this option will re-join the existing Western Highway approximately 4.5 km to the east of the township. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat rail line.	✗
C2	11 km	The C2 alignment follows the C0 option from the western tie-in point (approximately 3 km from the Beaufort township) until Beaufort-Lexton Road, where it continues in an easterly direction and joins the A0 alignment near Racecourse Road. The C2 alignment will re-join the existing Western Highway at the eastern tie-it point, approximately 4.5 km from the township. Again, bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat rail line.	✓

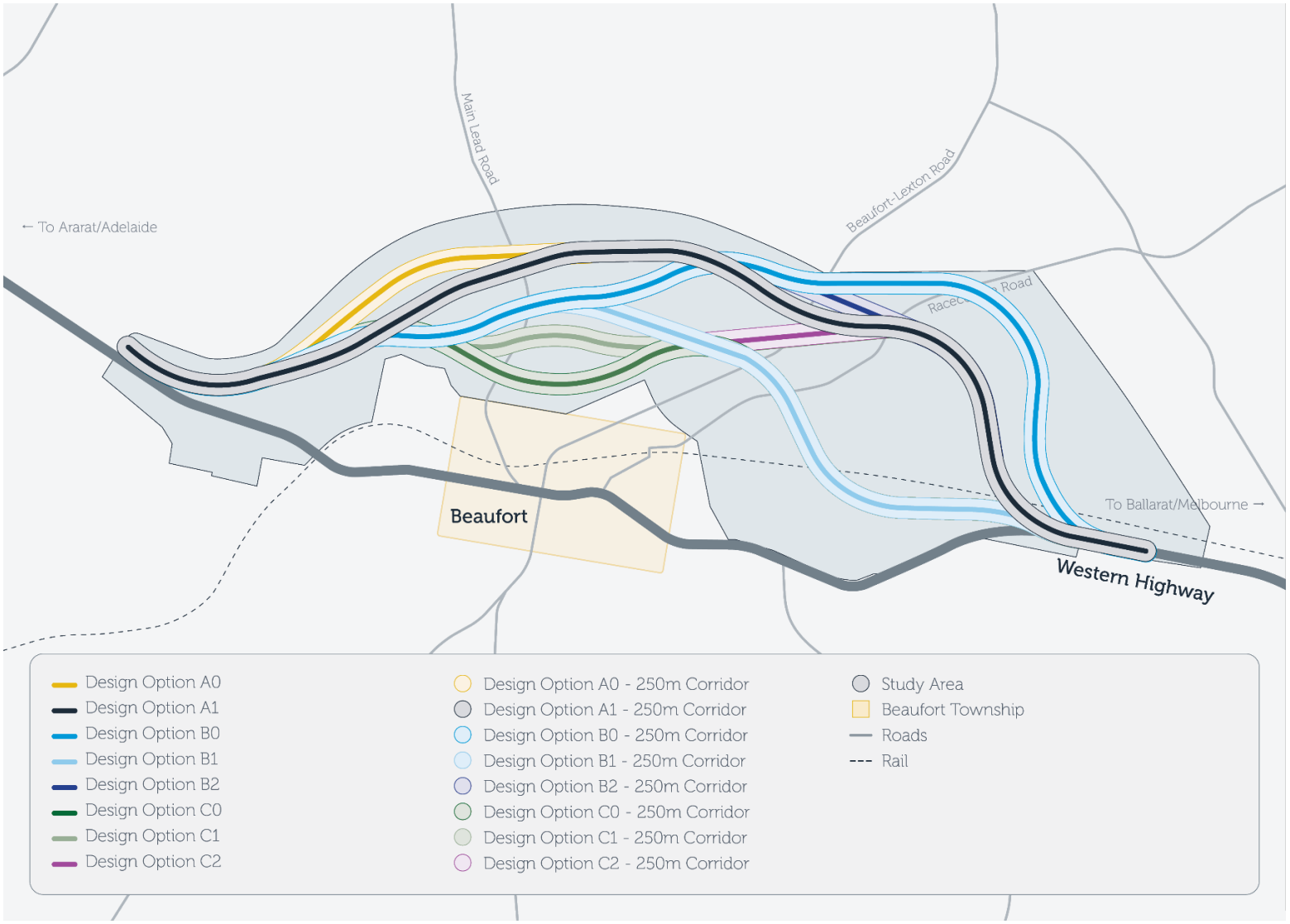


Figure 3.11 **Eight alignment alternatives for feasibility assessment**

A concept design and feasibility workshop was held on 4 October 2017 to assess the feasibility of the eight alignment alternatives. The workshop was attended by VicRoads road engineers, and environmental and stakeholder engagement specialists. During the workshop, each alignment option was assessed in detail using information from the existing conditions assessments, aerial imagery and spatial data, landholder and community feedback, and the project knowledge of those present to identify the key social, cultural heritage, planning and environmental values and engineering considerations for each. The key considerations assessed for each option were the potential impacts on biodiversity, native vegetation and habitat, Aboriginal cultural heritage, historic heritage, soils and geology, dwellings, community and public utility infrastructure, hydrology and flooding, and visual amenity and constructability issues.

The outcomes of the workshop included:

- All three Option B variations (B0, B1 and B2) were de-listed from further investigation due to the requirement for the large removal of earth material through Camp Hill and the resulting significant impacts on biodiversity and native vegetation (in addition to the large removal of earth material, B0 also had negative effects on existing dwellings and land severance along Smiths Lane).
- The Option C1 variant was considered inferior to C0 due to the requirements for greater removal of earth material through Camp Hill and effects on Ben Major Grevillea populations and was not shortlisted for further investigation.
- For options A0 and A1, at the eastern end, A1 was prioritised over A0 because it avoids the dwelling at the eastern tie-in point and has lower impacts on large and scattered tress. However, at the western end, A0 and A1 were considered comparable and were both shortlisted for further investigation.

The workshop resulted in four bypass alignment alternatives being shortlisted for further assessment:

- A0 (western section only)
- A1
- C0 (modified further following the workshop to reduce effects on biodiversity and habitat in the area south of Racecourse Road and avoid the dwelling at Beaufort-Lexton Road)
- C2.

The four bypass alignment alternatives shortlisted for further investigation in the EES are shown in Figure 3.12.

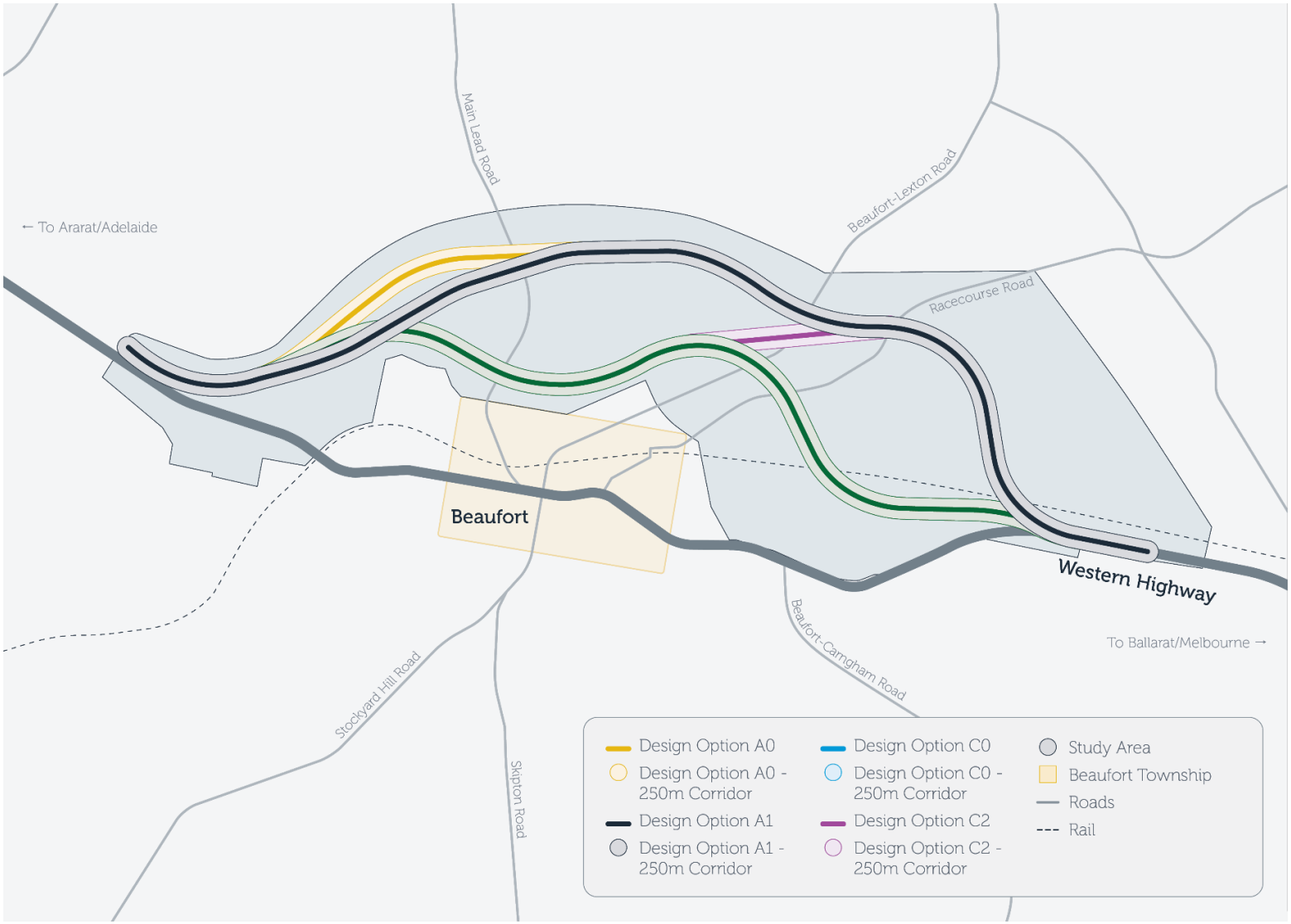


Figure 3.12 Shortlisted bypass alternatives

3.5.3 PHASE 3: Identification of preferred alignment

Comparative assessments of the four shortlisted alignment alternatives were undertaken using an environmental risk and impact assessment of each option and an options assessment methodology to help identify a preferred alignment.

Environmental risk assessment

A detailed environmental risk assessment workshop was held 29 January 2018 to identify potential risks associated with the four shortlisted alignment alternatives identified in Phase 2. The scope of the risk assessment encompassed the associated construction and operation phase risks of each alignment option. This was assessed in relation to potential social, environmental and economic effects on a local and regional scale.

Risks to the following values were assessed:

- road efficiency, capacity and safety
- biodiversity
- catchment values and hydrology
- Aboriginal and historic cultural heritage
- social and community
- amenity (air quality, noise and vibration)
- landscape and visual.

The purpose of the risk assessment was to inform and scope the level of impact assessment required for the social, economic and environmental values for each option for the EES. The risk assessment articulated the probability of an incident with environmental effects occurring and the consequential level impact to the environment.

Once an initial risk assessment was undertaken by specialists for the four proposed alignment alternatives and a preliminary risk register completed by each technical specialist, a risk workshop was held to discuss the key risks. This allowed interrelated risks between disciplines to be discussed and identified the level of impact assessment required for the EES. The risk assessment outcomes are included within EES Attachment II*: Environmental risk register.*

Environmental impact assessment

To assess and evaluate the impacts of the four alignment options, as well as to inform the assessment of the preferred alternative, impact assessment reports were developed in the following key areas in line with the EES scoping requirements for the project:

- traffic and transport
- Aboriginal cultural heritage
- historic heritage
- surface water
- groundwater
- contaminated soils and geology
- biodiversity
- social
- regional economy
- air quality
- noise and vibration
- land use and planning
- landscape and visual.

The findings of the various impact assessments were utilised in the options assessment process. The assessment findings for the preferred alignment (C2) are discussed in EES Part B: Chapters 8-16.

Options assessment

In March 2019, RRV developed the Options Assessment Matrix to consider the RRV primary project objectives and the EES scoping requirements and identify the objectives that were relevant to the selection of a preferred alignment. Table 3.4 and Table 3.5 provide the consideration of each of the objectives and the reasoning for the inclusion or exclusion of each in relation to the preferred alignment key assessment criteria. For specific detail on individual discipline impacts of each alignment, refer to the impact assessments of the four alignment options section of the technical appendices to this EES. Alternatively, EES Attachment IV: *Options Assessment* summarises this information.

Table 3.4 RRV project objectives assessment for preferred alignment key assessment criteria

RRV's primary project objectives	Key issues to consider	Does the objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key assessment criteria
Improve freight movement and efficiency	Freight vehicle travel time improvements compared to "do nothing" alternative. Design maximum freight vehicle count compared to "do nothing" alternative. All vehicles travel time improvements compared to "do nothing" alternative.	No	There will only be a travel time difference of 21 seconds between the four alignment alternatives. While it is acknowledged that overall any of the four alignment alternatives will significantly improve travel time when compared to the current Western Highway alignment through the Beaufort township, the comparative travel time saving is considered minimal. The reduction in heavy vehicles travelling through the Beaufort township will be the same across all four alignments. Further information on traffic and transport impacts from the project is detailed in EES Appendix M: *Traffic and transport impact assessment*.
Improve road safety within the township and arterial road network	Predicted effect on road safety in Beaufort during construction. Predicted effect on road safety in Beaufort during operation.	No	All four alignment alternatives would require a significant amount of imported earthen material and pavement materials to be transported to the construction zone (the exact amount will be determined based on the preferred alignment and as part of the detail design stage). Importation of fill and pavement materials will add a significant number of additional heavy vehicle trucks and trailers onto the road network and through the Beaufort township during the construction phase regardless of which alignment is selected. Therefore, it is considered that the impact of the four alignment alternatives on Beaufort and the road network during construction would be the same. All four alignment alternatives once operational would improve road safety within Beaufort when compared to the current Western Highway alignment through the township. Overall, improved road safety is considered the same across the four alignments. Further information on traffic and transport impacts from the project is detailed in EES Appendix M: *Traffic and transport impact assessment*.

RRV's primary project objectives	Key issues to consider	Does the objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key assessment criteria
Improve access to markets and the competitiveness of local industries	Predicted effect on travel time for businesses located west of Beaufort to Ballarat and Melbourne business centres. Predicted effect on travel time for people visiting towns west of Beaufort from Ballarat and Melbourne (e.g. Stawell). Predicted effect on travel time for metropolitan visitors to tourism destinations west of Beaufort (Grampians National Park, Ararat Hills Regional Park)	No	It is considered that the bypass of the Beaufort township would significantly reduce travel time for businesses west of Beaufort to the key centres of Ballarat and Melbourne and conversely for those visitors travelling to townships west of Beaufort and major tourism destinations such as the Grampians National Park, Ararat Hills Regional Park, Great Western and Pyrenees wine region. As outlined above, there will only be a travel time difference of 21 seconds between the four alignment alternatives, the travel time saving is considered minimal. It is acknowledged, however, that there is one minor difference in the interchange arrangements between the four alignment alternatives. The C0 alignment interchange at Beaufort-Lexton Road is 500 m closer to the Beaufort Township in comparison to the A0, A1 and C2 alignments. As a result, the C0 alignment could be considered slightly better from this perspective. However, any benefit gained would be very marginal and not a major factor in determining a preferred alignment. This factor may be a qualitative factor in the assessment process. Further information on traffic and transport impacts from the project is detailed in EES Appendix M: *Traffic and transport impact assessment*.

RRV's primary project objectives	Key issues to consider	Does the objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key assessment criteria
Improve amenity within the township	Predicted noise and amenity impact of bypass on township. Predicted reduction in traffic volumes within township	Yes – In part	Overall, it is considered that the Beaufort bypass would significantly reduce vehicle noise within the Beaufort township when compared to the current Western Highway alignment through the township. However, it is considered that the reduction in vehicle noise within the Beaufort township will be the same across all four alignments. Overall, the reduction in traffic volumes travelling through the Beaufort township will be the same across all four alignments. While it is predicted that there will be a significant reduction in noise, amenity and traffic volumes on the Beaufort township as result of the bypass, these noise, amenity and traffic volume impacts could potentially be transferred to properties, landowners and other sensitive receptors near the four alignment alternatives, although mitigation measures can be implemented through the installation of noise walls, off-reservation treatment and landscaping. The impact of noise, amenity and visual perspective on properties and sensitive receptors along the route of the proposed four alignments can be used to identify a preferred alignment. Therefore, the noise and visual impact components are included within the social criteria of the preferred alignment assessment matrix. Further information on amenity impacts of the project is detailed in EES Appendix B: *Air quality impact assessment* and EES Appendix H: *Noise and vibration impact assessment*.

Table 3.5 EES Scoping Requirements assessment for preferred alignment key assessment criteria

EES Project objectives	Key issues to consider	Do the Objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key criteria
Road efficiency, capacity and safety To provide for an effective Western Highway bypass of Beaufort, to improve travel efficiency, road safety, and capacity, as well as improve amenity and local transport network in Beaufort.	Impacts from through traffic (including heavy vehicles) in Beaufort. Effective integration of the project with local transport networks including public transport; particularly the existing rail line in Beaufort. Identify and compare expected or modelled transport performance of identified alignment alternatives, in terms of travel times, capacity, traffic volumes, road safety and accessibility.	**No**	The reduction in traffic volumes (including heavy vehicles) travelling through the Beaufort township will be the same across all four alignments. That there will only be a travel time difference of 21 seconds between the four alignment alternatives. While it is acknowledged that overall any of the four alignment alternatives will significantly improve travel time when compared to the current Western Highway alignment through the Beaufort township, the travel time saving is considered minimal. All four alignment alternatives would require a significant amount of imported earthen material and pavement materials to be transported to the construction zone. Importation of fill and pavement materials will add a significant number of additional heavy vehicle trucks and trailers onto the road network and through the Beaufort township during the construction phase regardless of which alignment is selected. It is considered that the impact of the four alignment alternatives on Beaufort and the road network during construction would be the same. All four alignment alternatives once operational would improve road safety within Beaufort when compared to the current Western Highway alignment through the township. Overall, improved road safety is considered the same across the four alignments. Potential delays during the construction phase due to increase in construction vehicle movements on the Beaufort and the road network (including rail movements) will be the same across all four alignments. Further information on traffic and transport impacts of the project is detailed in EES Appendix M: *Traffic and transport impact assessment*.

EES Project objectives	Key issues to consider	Do the Objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key criteria
Biodiversity To avoid and minimise adverse effects on native vegetation, as well as habitat for threatened flora and fauna species and ecological communities, including those listed under the *Flora and Fauna Guarantee Act 1988*, and address offset requirements for predicted losses consistent with relevant policy.	Loss or degradation of native vegetation and habitat for threatened species and communities, including those listed under the *Flora and Fauna Guarantee Act 1988* and DELWP Advisory List. Degradation to local and downstream ecology of aquatic environments. The impact of the road bypass on wildlife movement within continuous vegetation linkages.	**Yes**	Potential impacts on biodiversity are distinct between the four alignment routes, including proposed native vegetation removal, impacts on threatened flora and communities, existing wildlife corridor/connectivity and Ecological Vegetation Class conservation status vegetation, for example. Further information on biodiversity impacts from the project is detailed in EES Appendix C: *Flora and fauna impact assessmen*t.

EES Project objectives	Key issues to consider	Do the Objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key criteria
Catchment values and Hydrology To protect catchment values, surface water and ground water quality, stream flows and floodway capacity, and avoid impacts on protected beneficial uses.	Potential changes to the extent and severity of floodwaters in the area, that could have an effect on Beaufort or other significant locations. Potential adverse effects on the functions and values of existing waterways during construction and operation. Potential for unsuitable soil conditions to support the proposed bypass, including the potential for unearthing acid sulphate and contaminated soils. Potential for effects on surface water quality, stream flows and groundwater, in particular on protected beneficial uses. Potential for increased salinity, and related impacts on vegetation, soil and habitat values.	**Yes – In part**	The impact on groundwater is not considered a key assessment criterion to assist RRV in determining the preferred alignment. This is based on the following assessment: • That impact on groundwater will be the same across all four alignments. The potential impacts on waterways and floodplains is considered a key assessment criterion to assist RRV in determining the preferred alignment. This is based on the following assessment: • Potential impacts on waterways and floodplains are distinct between the four alignment routes, including number and locations of significant waterway crossings, total watercourse crossing length allowing 100 mm or less flood level increase, the extent of ground disturbing works within 50 m of the watercourse and total length of alignment within the 1% Annual Exceedance Probability base case floodplain, for example. Further information on catchment values and hydrology impacts from the project is detailed in EES Appendix D: *Groundwater impact assessment* and EES Appendix L: *Surface water impact assessment.*
Cultural Heritage (Aboriginal and Historic) To avoid and minimise adverse effects on Aboriginal and historic cultural heritage values, and to identify best practice mitigation measures.	The potential for adverse effects on Aboriginal cultural heritage. The potential for adverse effects on significant non-Aboriginal cultural heritage values.	**Yes**	Potential impacts on cultural heritage are distinct between the four alignment routes, including impacts on registered Aboriginal sites, percentage of areas of sensitivity and registered historic heritage sites. Further information on cultural heritage impacts from the project is detailed in EES Appendix A: *Aboriginal cultural heritage impact assessment* and EES Appendix E: *Historic heritage impact assessment.*

EES Project objectives	Key issues to consider	Do the Objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key criteria
Social and Community To minimise and manage adverse effects on the well-being of the local community, including potential impacts on cohesion and severance of community access to services, facilities and infrastructure.	Potential Social impacts from displacement of residences, existing land uses and impacts on businesses. Variable (positive or adverse) effects from relevant alignment alternatives on community access to and within Beaufort, including severance/access to community facilities, services and infrastructure. Impacts of relevant alignment alternatives on opportunities for the future growth and development of Beaufort. Potential for inconsistency with existing strategic land use planning objectives, policies or plans.	**Yes – In parts**	The potential impact on businesses, access to community facilities/services, future growth and development of Beaufort and strategic policies/plans is not considered a key assessment criterion to assist RRV in determining the preferred alignment. This is based on the following assessment: • The impact on businesses within the Beaufort township is considered the same across all four alignments. Existing highway reliant businesses within the township will be impacted regardless as all four alignments will divert traffic that would otherwise travel through the current Western Highway alignment without the bypass. • The impacts on access to community facilities and services are the same across all four alignments. • The four bypass alignments will not impact the future growth and development of Beaufort. The Pyrenees Planning Scheme identifies the areas to the south of the current township for future residential growth. The four alignments are to the north of the current township. • The Pyrenees Planning Scheme currently recognises Beaufort as a highway town and it could be argued that with its bypass it is no longer a highway town and as such does not accord with this policy direction for Beaufort. From this perspective, all four alignments will have the same impact on this policy direction. The potential impacts on property severance, acquisition and landowners is considered a key assessment criterion to assist RRV in determining the preferred alignment. This is based on the following assessment: • It is considered that the potential impacts on properties and landowners along the route of the proposed four alignments can be used to assess which alignment and how many properties/landowners are likely to be impacted from this perspective.

EES Project objectives	Key issues to consider	Do the Objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key criteria
			Therefore, the impacts on acquisition and property components are included within the social criteria of the preferred alignment assessment matrix. Further information on social and community impacts from the project is detailed in EES Appendix J: *Social impact assessment.*
Land use and Planning To minimise and manage adverse effects on local business (including agriculture) and existing or planned land uses.	Potential economic impacts of land severance/changes to existing land uses and local business or planned land uses. Economic performance of project alternatives in terms of relative benefits and costs. Potential impacts on land managers located adjacent to the proposed bypass and township entry point. Economic impacts of relevant alignment alternatives on future growth and development of Beaufort.	**No**	The economic impacts of the four alignments on the Beaufort township is the same. Any bypass of the existing township will have an impact on those existing businesses that are reliant on passing traffic along the existing Western Highway. While there were some suggestions that a bypass alignment closer to the existing township would have a smaller impact in comparison to an alignment further from the township, no economic evidence exists to suggest that this was the case. As indicated above, the future residential growth and development of Beaufort is identified to the south of the existing township and the four bypass alignments will not impact on this. The impact on existing land uses is considered comparable across the four alignments. While some land uses and current operations maybe impacted through potential severance or limited access during construction, this will be temporary. In addition, the bypass alignments will not change the current planning controls within the study corridor (other than applying a Public Acquisition Overlay to land required for the preferred bypass) and as such, is unlikely to change the land use requirements under the current zoning and overlays controls and therefore should not inhibit these existing land uses (for expansion etc.) or any other new/planned land uses to be considered by the relevant planning authority in the future. Further information on land use and planning impacts of the project is detailed in EES Appendix G: *Planning and land use impact assessment.*

EES Project objectives	Key issues to consider	Do the Objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key criteria
Amenity To minimise adverse air quality, noise or vibration effects on the amenity of residents and local communities, as far as practicable during construction and operation.	Increased noise levels from the project's construction and operation could affect amenity in areas in close proximity to the road alignment alternatives.	**Yes**	While it is predicted that there will be a significant reduction in noise, amenity and traffic volumes on the Beaufort township as result of the bypass, these noise, amenity and traffic volume impacts could potentially be transferred to properties, landowners and other sensitive receptors near the four alignment alternatives, although mitigation measures can be implemented through the installation of noise walls, off-reservation treatment and landscaping. The impact of noise, amenity and visual perspective on properties and sensitive receptors along the route of the proposed four alignments can be used to identify a preferred alignment. Further information on amenity impacts of the project is detailed in EES Appendix B: *Air quality impact assessment* and EES Appendix H: *Noise and vibration impact assessment.*
Landscape and Visual To minimise adverse effects on visual and landscape values as far as practicable, during construction and operation.	The potential for adverse effects on landscape and visual values, particularly the sensitive landscape areas of local or regional significance including; Camp Hill State Forest, Snowgums Bushland Reserve, Beaufort trotting track, Beaufort main Lead Common and Beaufort Motorcycle Track, and water crossing including culturally significant watercourses in the landscape. Consider the adverse effects on landscape and visual values associated with potential impacts to treed roadsides and, in general, the impacts associated with loss of trees and other vegetation.	**Yes – In parts**	The potential impact on sensitive landscape areas of local and regional significance is not considered a key assessment criterion to assist RRV in determining the preferred alignment. This is based on the following assessment: • While Option A alignments impact on fewer local areas, they have a greater impact on Camp Hill State Forest than the Option C alignments. The Option C0 alignment currently impacts the Beaufort Motorcycle Track and the Snowgums Bushland Reserve, however this could be minimised or completely avoided by refining the design. RRV considers that this component is very subjective and difficult to define/quantify the impact of one alignment over another. • In relation to the potential impact on landscape and its visual value from vegetation removal, RRV considers that this component will be sufficiently covered through the environment criteria of the preferred alignment assessment matrix.

EES Project objectives	Key issues to consider	Do the Objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key criteria
	Consideration of the interaction of the proposed alignment alternatives with view sheds to the wider landscape and significant landscapes in the area.		The visual impacts on dwellings and property owners along the four alignment routes is considered a key assessment criterion to assist RRV in determining the preferred alignment. This is based on the following assessment: • It is considered that the location of the proposed bypass alignments could potentially have visual impact on properties and landowners that previously were not impacted by the existing Western Highway. • While mitigation measures can be implemented through landscaping and other measures, it is considered that the potential impacts on properties within 500 m of the route of the proposed four alignments can be used to assess which alignment and how many properties it is likely to impact on from a visual perspective. Therefore, the visual impact components are included within the social criteria of the preferred alignment assessment matrix. Further information on landscape and visual impacts of the project is detailed in EES Appendix F: *Landscape and visual impact assessment.*
Environmental Management Framework To provide a transparent framework with clear accountabilities for managing environmental effects and hazards associated with construction and operation phases of the proposed project, in order to achieve acceptable environmental outcomes.	Weak management of environment effects during project construction and operation could result in failure to meet statutory requirements and sustain stakeholder confidence.	**No**	Environmental management framework plan(s) will be developed to meet RRV standards and required legislations for the construction and operational phases of the bypass irrespective of the alignment route selected. The environmental management framework for the project is detailed in EES Chapter 17: *Environmental management framework*.

EES Project objectives	Key issues to consider	Do the Objectives assist RRV to select a preferred alignment (Y/N)	Reasoning for inclusion/exclusion from preferred alignment key criteria
Sustainable Development Overall, to identify an alignment and conceptual design for the Western Highway bypass of Beaufort that would achieve a sustainable balance of environmental, economic and social outcomes and provide a net community benefit.	The choice of the preferred alignment alternative for the project needs to provide an optimal balance of environmental, economic and social outcomes.	**No**	While RRV has not included this objective within the key assessment criteria in determining the preferred alignment, it does, however, acknowledge that the preferred alignment selected needs to demonstrate that on balance it achieves optimal environmental, social and economic outcomes. On this basis, RRV has a developed the preferred alignment assessment matrix based on a triple bottom line approach to clearly demonstrate, in a quantifiable and transparent manner, that the preferred alignment selected achieves a balance outcome from an environmental, social and economic perspective.

The following key assessment criteria were selected:

Social

- impact on number of known or registered cultural or historic heritage sites by proposed alignment
- acquisition and property impacts
- number of residential properties (without mitigation) that would be directly impacted by noise post construction of bypass
- air quality impacts
- visual impact – number of dwellings within 500 m of the proposed alignment.

Economic

- construction cost per alignment.

Environmental

- extent of native vegetation to be cleared (all Ecological Vegetation Classes) per alignment
- threatened vegetation communities within alignment corridor
- wildlife corridor/connectivity impact
- Strategic Biodiversity Value Score per alignment by Ecological Vegetation Class Conservation Status
- condition score of native vegetation to be removed per alignment by Ecological Vegetation Class Conservation Status
- construction within floodplains.

Comparative assessment of alignments

RRV assessed all four alignment alternatives using the key assessment criteria identified for the Options Assessment Matrix. The outcomes of the assessment are shown in Table 3.6, with the scoring scenario results provided for the preferred alignment, C2. Figures presented in Table 3.6 for Alignment C2 (preliminary design) will vary to those used in the detailed assessment of the C2 functional design in EES Chapter 9: *Biodiversity and habitat* due to refined drainage design, affecting the area of impact occurring in the detailed impact assessment stage for the C2 alignment. These variations still outperform the options in Table 3.6.

KEY TERMS REFERRED TO IN TABLE 3.6

Sensitive receptors: defined as residences, schools, camping grounds or other sites of permanent or regular use by persons, as well as vineyards or other horticulture that may be sensitive to elevated dust or increased levels of noise and vibration.

Scattered trees: a native canopy tree that does not form part of a patch.

Large trees: a native canopy tree with a Diameter at Breast Height greater than or equal to the large tree benchmark for the relevant bioregional Ecological Vegetation Class.

Ecological Vegetation Class: an area of vegetation displaying broadly similar botanical characteristics reflecting consistent environmental and structural conditions. Each Ecological Vegetation Class has a conservation status assigned for it for the bioregion in which it occurs. These conservation statuses are categorised by DELWP as endangered, vulnerable, depleted, rare or least concern.

Offset requirement (species units): A species habitat unit is the measure of loss and gain in biodiversity value of native vegetation for a particular rare or threatened species. Species habitat units are used to measure offset amount and gain generated at an offset site

Core areas: large patches of native vegetation and/or fauna habitat which are greater than 50 ha.

Nodes: medium-sized patches of native vegetation, generally 20–50 ha in size.

Stepping stones: smaller-sized patches of native vegetation that are one or more separate patches of habitat in the intervening space between ecological isolates, that provide resources and refuge that assist animals to move through the landscape.

Terrestrial corridors: linear links of native vegetation that are typically a linear strip of vegetation that provides a continuous (or near continuous) pathway between two habitats.

Wetland and riparian corridors: linear links of existing wetlands, watercourse, drainage line with or without native vegetation.

Strategic Biodiversity Value: combines information on important areas for threatened flora and fauna, levels of depletion, connectivity, vegetation types and condition to provide a view of relative biodiversity importance of all parts of the Victorian landscape. The higher the score, the greater the biodiversity value.

1 % Annual Exceedance Probability: refers to the 1 in 100 year flood event

Area of Aboriginal sensitivity: defined by the Aboriginal Heritage Regulations 2018. In the case of the project, this relates to previously registered Aboriginal cultural heritage places and land within 200 m of Yam Holes Creek and two of its tributaries.

Source: RRV Options Assessment Report (July 2019)

Table 3.6 Alignment assessment criteria and quantifiable data

Assessment criteria	Alignment A0	Alignment A1	Alignment C0	Alignment C2
Extent of Native Vegetation to be cleared	62.61 ha	62.55 ha	62.3 ha	50.7 ha
Scattered trees	2.70 ha	2.92 ha	2.23 ha	2.48 ha
Large trees in patches	3.8 ha	3.94 ha	2.67 ha	2.67 ha
Large trees to be removed	396	374	322	317
Endangered Ecological Vegetation Class habitat (impact)	16.89 ha	14.78 ha	9.53 ha	9.03 ha
Offset requirement (Species Units)	143.712	147.134	188.161	80.413
Threatened vegetation communities (corridor)	**41.13 ha**	**38.8 ha**	**44.14 ha**	**31.62 ha**
Seasonal Herbaceous wetlands (Freshwater) of the Temperate lowland plains (Critically endangered under EPBC Act)	0.06 ha	0.06 ha	2.58 ha	0.06 ha
White box - Yellow Box - Blakely's Red Gum Grassy Woodland (Critically Endangered under EPBC Act)	2.64 ha	0.65 ha	3.97 ha	0 ha
Victorian Woodland Bird community (Threatened under FFG Act)	38.43 ha	38.09 ha	37.59 ha	31.56 ha
Wildlife corridor/connectivity impact	**38.852 ha**	**38.739 ha**	**37.683 ha**	**32.520 ha**
Core	24.181 ha	25.389 ha	16.030 ha	10.810 ha
Node	0.169 ha	0.169 ha	0 ha	0.169 ha
Stepping Stones	5.453 ha	5.556 ha	10.788 ha	14.462 ha
Terrestrial Corridors	6.3 ha	6.351 ha	6.044 ha	5.474 ha
Wetlands	2.749 ha	1.274 ha	4.821 ha	1.605 ha

Assessment criteria	Alignment A0	Alignment A1	Alignment C0	Alignment C2
Strategic Biodiversity Value Score per alignment by Ecological Vegetation Class Conservation Status				
Low Score (0.0 - 0.3)				
Endangered	8	8	3	8
Medium Score (0.31 - 0.79)				
Least Concern	22	23	20	23
Depleted	33	44	36	38
Vulnerable	6	6	21	6
Endangered	98	97	64	71
High Score (0.8 +)				
Least Concern	-	-	3	2
Depleted	6	6	11	11
Vulnerable	1	1	2	1
Endangered	6	4	11	5
Condition score of native vegetation to be removed by Ecological Vegetation Class Conservation Status				
Low Score (0.0 - 0.3)				
Least Concern	13	14	11	13
Depleted	3	8	2	3
Vulnerable	4	4	10	4
Endangered	39	39	30	36

Assessment criteria	Alignment A0	Alignment A1	Alignment C0	Alignment C2
Medium Score - between 0.31 - 0.5				
Least Concern	8	8	11	11
Depleted	12	15	25	34
Vulnerable	2	2	9	1
Endangered	65	63	41	46
High Score - above 0.6				
Least Concern	1	1	1	1
Depleted	24	27	20	12
Vulnerable	1	1	4	2
Endangered	7	7	7	2
Construction within floodplains				
Total number of waterway crossings	16	16	14	16
Total number of designated waterway crossings	3	3	3	3
Greatest 1% Annual Exceedance Probability flood depth intersecting bypass alignment option	1.34 m	1.34 m	1.50 m	1.34 m
Max Flooding width at Yam Holes Creek crossing (1% Annual Exceedance Probability base case)	750 m	750 m	300 m	810 m
Total length of alignment within the 1% Annual Exceedance Probability base case floodplain	1,307 m	1,175 m	1550 m	2090 m
Total watercourse crossing length allowing 10 mm or greater (up to 100 mm) flood level increase	990 m	835 m	1380 m	1475 m
Yam Hole Creek crossing length allowing 10 mm or greater (up to 100 mm) flood level increase	610 m	610 m	495 m	570 m
Yam Hole Creek crossing average 1% Annual Exceedance Probability depth allowing 10 mm or greater (up to 100 mm) flood level increase	600 mm	600 mm	400 mm	600 mm
The extent of ground disturbance works within 50 m of watercourse	11.60 ha	12.45 ha	19.50 ha	24.50 ha

Assessment criteria	Alignment A0	Alignment A1	Alignment C0	Alignment C2
Impact on number of known or registered sites by proposed alignment				
Aboriginal	2	2	2	2
% of alignment within an area of Aboriginal sensitivity	14%	14.3%	14.8%	10.5%
Historic	4	3	4	2
Acquisition and property impacts				
Total areas to be acquired	278.47 ha	278.88 ha	256.12 ha	262.59 ha
Number of lots directly impacted by alignment corridor	65	62	72	73
Number of landowners directly impacted by alignment corridor	26	23	23	25
Number of dwellings directly impacted by alignment corridor	2	3	5	4
Number of residential properties (without mitigation) that would be directly impacted by noise post construction of bypass	23	23	27	27
Air quality impacts				
Sensitive receptors within 100 m of alignment	4	2	2	2
Sensitive receptors within 200 m of alignment	5	5	6	4
Sensitive receptors within 500 m of alignment	12	10	12	9
Visual impacts				
Visual Impact - Number of dwellings within 500 m of proposed alignment	40	37	61	66
Construction costs				
Construction cost per alignment	Estimate: $406 million	Estimate: $391 million	Estimate: $425 million	Estimate: $483 million

3.6 Preferred option assessment process

3.6.1 Scoring methodology

Using the data in Table 3.7, RRV evaluated the four bypass alignment alternatives against various scoring methods. Multiple scoring scenarios were used to ensure that no one scenario was the primary determining factor in selecting a preferred alignment. The scoring scenarios used in the evaluation were:

- Scenario 1: Apply a score of 1 to 4 from least to highest impact.
- Scenario 2: Alignment with highest number of least impact scores.
- Scenario 3: Apply a score of 1 to the highest impact and then subtract the percentage difference between alignments.
- Scenario 4: Apply a score of 1 to least impact and then add the percentage difference between remaining alignments.
- Scenario 5: As per Scenario 3, but minus criteria that can be mitigated.
- Scenario 6: As per Scenario 4, but minus criteria that can be mitigated.

Three scoring sensitivity scenarios were also used in the evaluation:

- Scoring sensitivity scenario 1:
  - options with the lowest impact and other options within 5% of the lowest impact are apportioned a score of one point and a green light
  - options within 5-20% of the lowest impact option are apportioned a score of zero points and an amber light
  - options with an impact of 20% or greater than the lowest impact option are apportioned a score of minus one and a red light.
- Scoring sensitivity scenario 2:
  - options with the lowest impact and other options within 5% of the lowest impact are apportioned a score of one point and a green light
  - options within 5-25% of the lowest impact option are apportioned a score of zero points and an amber light
  - options with an impact of 25% or greater than the lowest impact option are apportioned a score of minus one and a red light.
- Scoring sensitivity scenario 3:
  - options with the lowest impact and other options within 5% of the lowest impact are apportioned a score of one point and a green light
  - options within 5-15% of the lowest impact option are apportioned a score of zero points and an amber light
  - options with an impact of 15% or greater than the lowest impact option are apportioned a score of minus one and a red light.

These three sensitivity scenarios were evaluated against all criteria rather than the reduced criteria reflected in scoring scenarios 5 and 6. The alignment option with the highest positive total score across all criteria was considered to have the lowest impact.

Further details on the scoring methodology are provided in Attachment IV: *Options Assessment*.

Table 3.7 Alignment C2 scoring scenario

Assessment criteria	Alignment C2 Scoring								
	Scoring scenario 1	Scoring scenario 2	Scoring scenario 3	Scoring scenario 4	Scoring scenario 5	Scoring scenario 6	Sensitivity Scenario 1	Sensitivity Scenario 2	Sensitivity Scenario 3
Extent of Native Vegetation to be cleared	1	1	0.810	1.000	0.810	1.000	1	1	1
Scattered trees	2	2	0.849	1.112	0.849	1.112	0	0	0
Large trees in patches	1	1	0.678	1.000	0.678	1.000	1	1	1
Large trees to be removed	1	1	0.801	1.000	0.801	1.000	1	1	1
Endangered Ecological Vegetation Class habitat (impact)	1	1	0.535	1.000	0.535	1.000	1	1	1
Offset requirement (Species Units)	1	1	0.427	1.000	0.427	1.000	1	1	1
Threatened vegetation communities (corridor)	1	1	0.716	1.000	0.716	1.000	1	1	1
Seasonal Herbaceous wetlands (Freshwater) of the Temperate lowland plains (Critically endangered under EPBC Act)	1	1	0.023	1.000	0.023	1.000	1	1	1
White box - Yellow Box - Blakely's Red Gum Grassy Woodland (Critically Endangered under EPBC Act)	1	1	0.000	0.000	0.000	0.000	1	1	1
Victorian Woodland Bird community (Threatened under FFG Act)	1	1	0.821	1.000	0.821	1.000	1	1	1
Wildlife corridor/ connectivity impact	1	1	0.837	1.000	0.837	1.000	1	1	1
Core	1	1	0.426	1.000	0.426	1.000	1	1	1
Node	2	2	1.000	0.169	–	–	-1	-1	-1
Stepping Stones	4	4	1.000	2.652	–	–	-1	-1	-1
Terrestrial Corridors	1	1	0.862	1.000	–	–	1	1	1
Wetlands	2	2	0.333	1.250	–	–	-1	-1	-1

Assessment criteria	Alignment C2 Scoring								
	Scoring scenario 1	Scoring scenario 2	Scoring scenario 3	Scoring scenario 4	Scoring scenario 5	Scoring scenario 6	Sensitivity Scenario 1	Sensitivity Scenario 2	Sensitivity Scenario 3
Strategic Biodiversity Value Score per alignment by Ecological Vegetation Class Conservation Status									
Low Score (0.0 - 0.3)									
Endangered	2	2	1.000	2.700	1.000	2.700	-1	-1	-1
Medium Score (0.31 - 0.79)									
Least Concern	3	3	1.000	1.150	–	–	0	0	0
Depleted	3	3	0.864	1.150	–	–	0	0	0
Vulnerable	1	1	0.286	1.000	0.286	1.000	1	1	1
Endangered	2	2	0.724	1.110	0.724	1.110	0	0	0
High Score (0.8 +)									
Least Concern	2	2	0.667	1.000	–	–	-1	-1	-1
Depleted	2	2	1.000	1.830	–	–	-1	-1	-1
Vulnerable	1	1	0.500	1.000	0.500	1.000	1	1	1
Endangered	2	2	0.455	1.250	0.455	1.250	-1	0	-1
Condition score of native vegetation to be removed by Ecological Vegetation Class Conservation Status									
Low Score - Less than 0.3									
Least Concern	2	2	0.929	1.180	–	–	0	0	-1
Depleted	2	2	0.375	1.500	–	–	-1	-1	-1
Vulnerable	1	1	0.400	1.000	0.400	1.000	1	1	1
Endangered	2	2	0.923	1.200	0.923	1.200	0	0	-1
Medium Score - between 0.31 - 0.5									
Least Concern	2	2	1.000	1.370	–	–	-1	-1	-1
Depleted	4	4	1.000	2.830	–	–	-1	-1	-1
Vulnerable	1	1	0.111	1.000	0.111	1.000	1	1	1
Endangered	2	2	0.708	1.120	0.708	1.120	0	0	0
High Score - above 0.6									
Least Concern	1	1	1.000	1.000	–	–	1	1	1
Depleted	1	1	0.444	1.000	–	–	1	1	1
Vulnerable	2	2	0.500	2.000	0.500	2.000	-1	-1	-1
Endangered	1	1	0.286	1.000	0.286	1.000	1	1	1

Assessment criteria	Alignment C2 Scoring								
	Scoring scenario 1	Scoring scenario 2	Scoring scenario 3	Scoring scenario 4	Scoring scenario 5	Scoring scenario 6	Sensitivity Scenario 1	Sensitivity Scenario 2	Sensitivity Scenario 3
Construction within floodplains									
Total number of waterway crossings	2	2	1.000	1.140	–	–	0	0	0
Total number of designated waterway crossings	1	1	1.000	1.000	–	–	1	1	1
Greatest 1% Annual Exceedance Probability flood depth intersecting bypass alignment option	1	1	0.893	1.000	–	–	1	1	1
Max Flooding width at Yam Holes Creek crossing (1% Annual Exceedance Probability base case)	3	3	1.000	2.700	–	–	-1	-1	-1
Total length of alignment within the 1% Annual Exceedance Probability base case floodplain	4	4	1.000	1.780	–	–	-1	-1	-1
Total watercourse crossing length allowing 10 mm or greater (up to 100 mm) flood level increase	4	4	1.000	1.770	–	–	-1	-1	-1
Yam Hole Creek crossing length allowing 10 mm or greater (up to 100 mm) flood level increase	2	2	0.934	1.150	–	–	0	0	0
Yam Hole Creek crossing average 1% Annual Exceedance Probability depth allowing 10 mm or greater (up to 100 mm) flood level increase	2	2	1.000	1.500	–	–	-1	-1	-1
The extent of ground disturbance works within 50 m of watercourse	4	4	1.000	2.110	–	–	-1	-1	-1

Assessment criteria	Alignment C2 Scoring								
	Scoring scenario 1	Scoring scenario 2	Scoring scenario 3	Scoring scenario 4	Scoring scenario 5	Scoring scenario 6	Sensitivity Scenario 1	Sensitivity Scenario 2	Sensitivity Scenario 3
Impact on number of known or registered sites by proposed alignment									
Aboriginal	1	1	1.000	1.000	–	–	1	1	1
% of alignment within an area of Aboriginal sensitivity	1	1	0.709	1.000	–	–	1	1	1
Historic	1	1	0.500	1.000	–	–	1	1	1
Acquisition and property impacts									
Total areas to be acquired	2	2	0.942	1.025	0.942	1.025	1	1	1
Number of lots directly impacted by alignment corridor	4	4	1.000	1.170	1.000	1.170	0	0	-1
Number of landowners directly impacted by alignment corridor	2	2	0.962	1.080	0.962	1.080	0	0	0
Number of dwellings directly impacted by alignment corridor	3	3	0.800	2.000	0.800	2.000	-1	-1	-1
Number of residential properties (without mitigation) that would be directly impacted by noise post construction of bypass	2	2	1.000	1.170	–	–	0	0	-1
Air quality impacts									
Sensitive receptors within 100 m of alignment	1	1	0.500	1.000	0.500	1.000	1	1	1
Sensitive receptors within 200 m of alignment	1	1	0.667	1.000	0.667	1.000	1	1	1
Sensitive receptors within 500 m of alignment	1	1	0.750	1.000	0.750	1.000	1	1	1
Visual Impact - Number of dwellings within 500 m of proposed alignment	4	4	1.000	1.720	1.000	1.720	-1	-1	-1
Construction cost per alignment	4	4	1.000	1.230	–	–	-1	0	-1
Alignment C2 score totals	**111**	**27**	**43.95**	**74.12**	**19.44**	**35.49**	**9**	**11**	**5**

3.6.2 Outcomes

The evaluation of the four alignment alternatives resulted in the alignment scoring outlined in Table 3.8. As well as the score for each alignment under each scenario, a colour coding has been applied to rank the options performance under each scenario as follows:

- best performing Alignment Option: Green
- second performing Alignment Option: Yellow
- third performing Alignment Option: Orange
- worst performing Alignment Option: Red.

Table 3.8 Combined alignment option scenario scoring

Scenario	Alignment A0	Alignment A1	Alignment C0	Alignment C2
Scenario 1	128	123	126	111
Scenario 2	18	22	20	27
Scenario 3	45.85	44.89	50.01	43.95
Scenario 4	81.03	77.59	93.98	74.12
Scenario 5	24.16	22.70	27.03	19.44
Scenario 6	47.74	42.69	56.16	35.49
Sensitivity Scenario 1	-6	-3	-5	9
Sensitivity Scenario 2	-3	2	-4	11
Sensitivity Scenario 3	-11	-6	-9	5

Key:

1st overall	2nd overall	3rd overall	4th overall

The alignment scoring scenarios outlined in Table 3.8 show that the best performing option is the C2 Alignment, while the worst performing alternatives are the A0 and C0 Alignments. The primary drivers for this outcome were due to the C2 alignment having:

- the lowest amount of total native vegetation clearance
- the least impact on threatened vegetation communities identified under the EPBC Act and FFG Act
- the least impact on wildlife corridors, particularly the core habitat areas
- the lowest amount of native vegetation with high conditions to be removed by Ecological Vegetation Class Conservation Status
- the lowest potential impacts on known or registered sites of Aboriginal and historic heritage significance
- the smallest number of dwellings within 100, 200 and 300 m of the alignment corridor from an air quality impact perspective.

3.6.3 Findings from the EY peer review

Following the completion of the Options Assessment Report, peer review by EY was undertaken to assess the robustness of the Options Assessment Report and multi-criteria assessment process. The peer review concluded:

- the overall approach using the multi criteria assessment was considered reasonable in the context of the project objectives and EES scoping requirements
- EY's shadow multi-criteria assessment, revealed an unweighted score produced similar results to RRV's assessment, with C2 as the preferred alignment
- the RRV Options Assessment Report demonstrated a defensible position in supporting the preferred alignment.

3.7 Preferred alignment design refinement

Following the selection of the preferred alignment, additional investigations were undertaken to further inform environmental, social and economic impact assessments. Key refinements were made to al assessments in this phase to refine the impacts of the functional design.

Of particular note were the updates to the:

- EES Appendix L: *Surface water impact assessment*, which included hydrological, hydraulic and water quality modelling to determine the bridge, culvert and creek realignments required to manage the impacts of the cross and road drainage for the project.
- EES Attachment V: *Draft Planning scheme amendment*, which included a draft Public Acquisition Overlay that refined the number of properties and dwellings assessed as impacted through the options assessment
- EES Appendix C: *Flora and fauna impact assessment* updates to account for the revised surface water design and incorporation of a Camp Hill State Forest fire track redesign
- EES Appendix H: *Noise and vibration impact assessment* updates to include assessment of sleep disturbance
- EES Appendix I: *Regional economy impact assessment* updates to include review of bypass case studies and the impacts to similar sized bypassed towns.

The selection of culvert and bridge locations that were incorporated into EES Appendix L: *Surface water impact assessment* was completed in consultation with project ecologists. The aim of this exercise was to ensure bridge and culvert locations aligned with the priority fauna passage locations, whilst also meeting cross and road drainage criteria to maintain existing water flows. The iterative process resulted in additions to the C2 construction footprint and project area to include these drainage requirements. These additions were considered across all relevant impact assessments.

The construction footprint, project area and location of surface water design features are detailed further within EES Chapter 4: *Project description*.

3.8 Conclusion

A three-phase process was used for identifying initial alignment alternatives, shortlisting feasible alternatives and assessing feasible alignment alternatives, which used input from technical specialists in the project team and feedback received from community information sessions. This process resulted in the identification of four feasible alignment alternatives, which were shortlisted for further investigation during the EES: A0, A1, C0 and C2.

A comparative integrated options assessment was conducted of the four shortlisted feasible alignment alternatives using a project-specific impact evaluation and scoring framework that included key social, economic and environmental criteria. The overall performance of each alignment alternative was evaluated using multiple scoring scenarios, resulting in the identification of the C2 alignment as the preferred alignment option, which was supported by the EY peer review. Of the four alignments, the C2 alignment does intersect the most area of floodplain, illustrated in Table 3.6. However, across the range of options assessment criteria, the C2 alignment scored best due to its lower impacts on native vegetation, ecology, heritage and amenity (air quality). The C2 alignment is the focus of this EES. Following its selection, detailed impact assessments have occurred and are reported throughout the technical EES Chapters 8 to 16.