1. Introduction

1.1 Background and Purpose

In early 2001, work commenced on the development of the Coffs Harbour Highway Planning Strategy (CHHPS). The Strategy, which addresses the need to upgrade the highway between Sapphire and Woolgoolga, while planning for future traffic needs within the Coffs Harbour urban area, covers a study area from Sawtell in the south to Arrawarra in the north.

Preliminary objectives for the Strategy are listed in Table 1.1 as they relate to the principal objectives of the Pacific Highway Upgrading Program.

Table 1.1 Project Objectives

Pacific Highway Program Objectives	Coffs Harbour Highway Planning Strategy Objectives
Significantly reduced road accidents and Injuries	• A dual carriageway road with potential to reduce crash rates to 15 crashes per 100MVK over the project length.
Reduced travel times	• A design which would allow sign posting at a minimum of 100km/h in rural areas and 80km/h in urban areas. • Provide flood immunity on at least one carriageway for a 1: 100 year flood event
Reduced freight transport costs	• A design that minimises vehicle operating costs. • A design that meets or exceeds B-Double requirements, including at intersections where required.
A community satisfied with physical development of the route	• Integrate input from local communities into development of the Project through the implementation of a comprehensive program of community consultation and participation • A solution at all potential conflict points with local traffic that meets community expectations and maintains local connectivity.
A route that supports economic development.	• Provide transport developments that are complementary with land use • Consider delay management strategies to minimise disruption to local and through traffic and maintain access to affected properties and land during construction
Upgrading of the route managed In accordance with Ecologically Sustainable Development principles.	• Cumulative impacts assessed and addressed • Best environmental practical incorporated. • RTA Guidelines for managing environmental issues (biodiversity, noise impacts, water quality, acid sulphate soils, etc) are met.
Maximum effectiveness of expenditure objectives	• Maximise the use of the existing road asset where consistent with the Project • Ensure the project outcomes achieve value for money

The Strategy was publicly launched in September 2001 and, in March 2002, an information sheet containing the following key announcements was released:

- identification of four initial corridor options for the northern section of the strategy area from Sapphire to Woolgoolga
- a decision that the Inner Corridor in the southern section of the strategy area between Sawtell and Sapphire / Moonee was the only potentially feasible bypass option suitable for further consideration
- commencement of a detailed comparison of upgrading the existing highway in the southern section of the strategy area as an alternative to an inner corridor bypass.

Following a decision by CHCC to conduct a peer review of the work completed up to March 2002, work in the southern section of the study area between Sawtell and Sapphire was deferred, while work proceeded in the northern section between Sapphire and Woolgoolga. Following Council's receipt of the peer review in October 2002, investigations have recommenced in the southern section. The peer review made a number of recommendations and broadly endorsed the findings from the undertaken work previously.

A community update released in December 2002 described five route options for the Sapphire to Woolgoolga Upgrade Project (refer Connell Wagner, 2002) and a decision on a preferred route was expected to be announced in mid 2003. This was delayed until CHCC concluded a series of public forums that further examined the options.

As part of the investigations in the Southern Coffs Harbour section, indicative route options have been developed in the Inner Bypass Corridor and a range of studies have been undertaken to determine the performance of the Inner Bypass and the Existing Highway Upgrade. This is reported separately in the Strategy Report (Connell Wagner 2004b).

In parallel with these activities, a review of a community generated proposal for a western bypass of Coffs Harbour, known as the Coastal Ridge Way (CRW), was undertaken. A plan of the CRW is presented in Figure 2.1. As originally defined, the CRW extends for a length of 38 km from Englands Road in the south to Arrawarra. The northern section is the same alignment as Option A, which has been investigated as one of five route options in the Sapphire to Woolgoolga study area. Regardless of the findings as to which is the most feasible corridor in the southern section, each option is compatible with all of the route options currently being examined in the northern part of the strategy area (ie. from Moonee to Woolgoolga). As a consequence, this review is confined to the southern section of the CRW proposal.

This Review is being carried out to examine the key physical features, cost, traffic and economic performance of the CRW and to assess its impacts across a range of social and environmental planning issues.

1.2 Study Methodology

The following activities were adopted for the review of the CRW:

- Refinement of design in terms of horizontal and vertical alignment to ensure that the CRW would meet relevant design guidelines and RTA requirements for safety and traffic performance. Issues that have been considered include horizontal radii of curves, gradients, earthworks, interchange locations and the need for ancillary features such as arrester beds and safety ramps.
- Analysis of traffic and transport performance of CRW including consideration of traffic volumes, travel speeds, attraction for heavy vehicles and vehicle operating costs.
- Preparation of strategic cost estimate and broad economic analysis to determine road user costs and benefits of the proposal.
- Assessment of a range of social issues associated with the CRW proposal and its likely benefits and adverse impacts in terms of amenity, land use, property, heritage, visual, road traffic noise and accessibility issues.
- Assessment of the proposal in terms of biophysical issues including ecological and geotechnical attributes.

COFFS HARBOUR HIGHWAY PLANNING
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REVIEW OF COASTAL RIDGE WAY

FIGURE 2.1
COASTAL RIDGE WAY ALIGNMENT

2. Description of Coastal Ridge Way

2.1 Development of Coastal Ridge Way Proposal

The CRW and other options for a wide western bypass proposal have had their genesis in two proposals that were developed by members of the community. The first of these, in the northern section of the study area, was for a western bypass of the existing highway between Moonee and Arrawarra. Following review and refinement by the study team, this option became Option A in the northern (Sapphire to Woolgoolga) section of the study area. This option has been investigated as part of the route selection process for the Sapphire to Woolgoolga section of the Pacific Highway Upgrade.

The second community based alignment proposal, which was developed for the southern section of the study area, was originally known as the 'Peoples Choice' option. The 'Peoples Choice' option is functionally similar to the central corridor option developed for the southern section of the study area. The 'Peoples Choice' corridor departed the existing highway at Englands Road and headed west through the North Boambee Valley. The option then headed north to traverse the Roberts Hill ridge near Red Hill and continuing generally north towards Lower Bucca. The 'Peoples Choice' option was originally developed so that it could join Option A in the northern section of the study area.

In May 2002, following consideration of the 'Peoples Choice' option, it was decided that the route did not merit further investigation. This decision was made because the option was not considered feasible from the viewpoint of engineering practicality and the very high cost and relatively low road user benefits of the option. This decision was subsequently acknowledged by the Community Focus Group (southern section) in May 2002.

Following the abandonment of the 'Peoples Choice' option, the CRW proposal was put forward for consideration by community interests. The modified route in the southern section was further developed by community members who also advocated that it be combined with Option A in the northern section and be known as the Coastal Ridge Way.

The CRW proposal was presented to Council at its meeting in October 2002. Following that meeting, Council requested that a review of the CRW proposal be undertaken. This request was agreed to, and this report documents the findings of the review.

Following the request for a formal review of the CRW proposal, the RTA subsequently agreed to further refinement and fine-tuning of the alignment in close consultation with the original proponent of the route. A fully interactive session using the MXRoad software package was held in Coffs Harbour in March 2003 and from that it was agreed to 'lock-in' the horizontal and vertical alignments for the purposes of the review, including preparation of a cost estimate.

2.2 Description of the Coastal Ridge Way Proposal

The CRW option (refer Figure 2.1) is approximately 22km in length and generally traverses to the west of Coffs Harbour, passing through very rugged terrain between the Coffs Harbour basin and the Orara Valley. There is flexibility at the northern end of the Coastal Ridge Way alignment in that it could connect to Option A of the Sapphire to Woolgoolga section or rejoin the existing highway at Moonee (and hence connect with Options B, C and D). This report is primarily concerned with the Coffs Harbour section of the Highway Planning Strategy and the route description focuses on the alignment that would rejoin the Pacific Highway at Moonee.

The route would bypass approximately 18km of the existing highway between Englands Road, North Boambee and Bucca Road near Moonee. The CRW option is a four lane / dual carriageway formation with grade separation (bridges) at all intersecting local and access roads. Interchanges would be provided at Englands Road, Coramba Road (if practical) and at Bucca Road.

The indicative alignment for the CRW veers west from the existing Pacific Highway at Englands Road and passes through the North Boambee Valley, crossing the southern Coffs Harbour ridgeline at Red Hill. From there it would traverse generally north through the Orara East State Forest, crossing numerous ridges and passing immediately to the west of the Ulidarra National Park. Heading in a north-easterly direction, it then passes through the upper reaches of Bucca Creek and a major ridge line known locally as Polyosma. From that point, it trends north and north-east through the Lower Bucca Valley toward Settles Road, passing over the main escarpment near the western end of Maccues Road. Once down on the lower level terrain around West Moonee it would then rejoin the existing Pacific Highway near its intersection with Bucca Road.

Due to the rugged nature of the terrain traversed by the CRW, some cuttings would be more than 60m deep and some fill embankments would be more than 40m high. The use of conventional road construction practices is unlikely to be practical for cuttings and fill embankments of this size. As such, major structures would be necessary for practical construction purposes, to limit earthworks volumes and reduce the impact on the natural environment. Specifically, the route has been developed on the basis that up to 2.4 km of tunnels through approximately five major ridges would be required along with elevated viaducts (or high bridge structures) across three deep valleys and over the North Coast Railway tunnel through Red Hill. The rationale for the development of these structures and details of their location is provided in the following sections.

2.3 Preliminary Concept Design

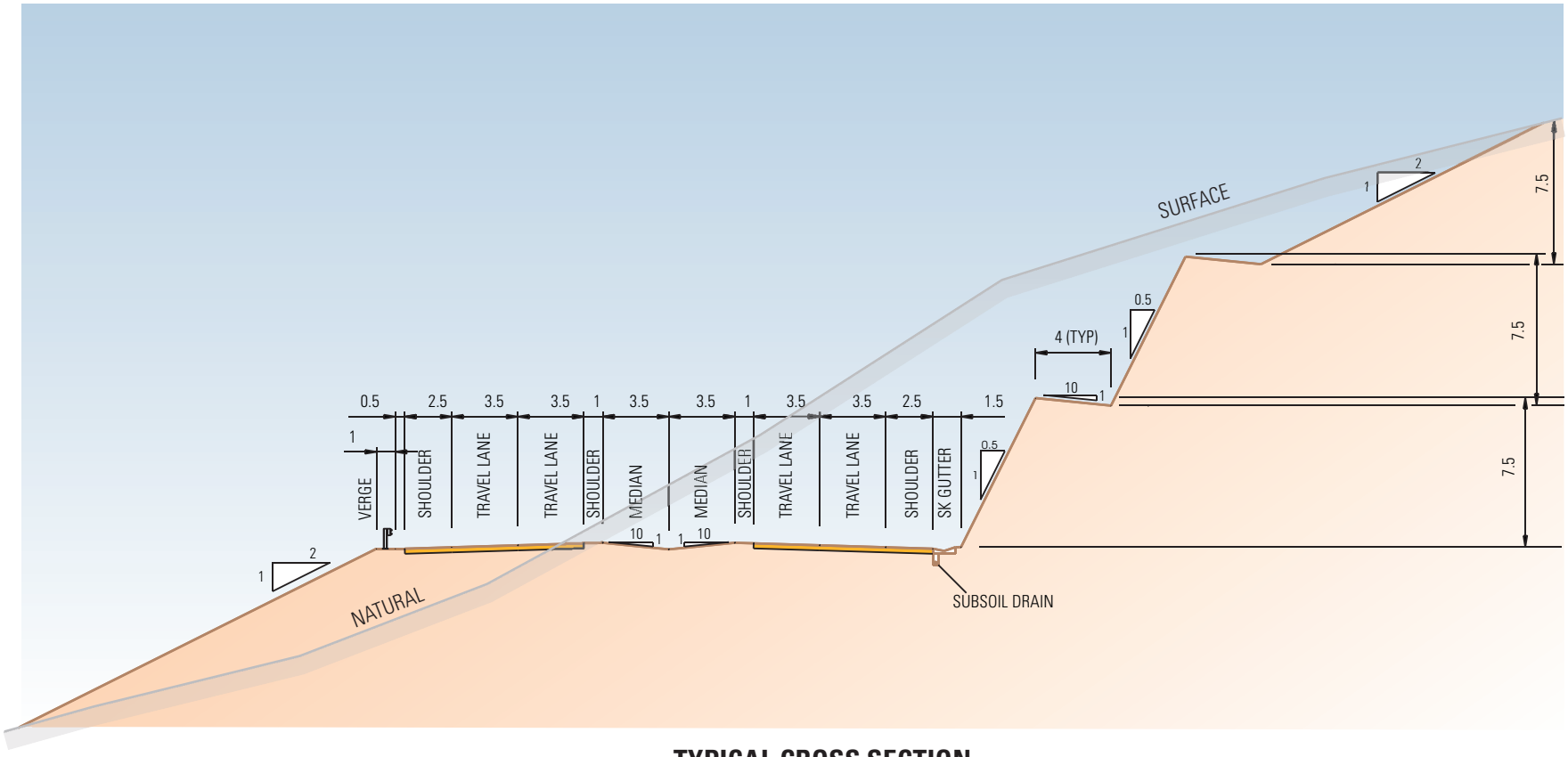
For the purposes of this review of the CRW proposal, a preliminary concept design utilising the horizontal alignment developed in consultation with the community representatives has been prepared. The preliminary design has been prepared at a strategic level to allow key features of the proposal including vertical alignment, earthworks quantities, cross sections and structures to be identified. The strategic cost estimate reported in Section 4 of this report was based on the preliminary concept design with the following design parameters.

- Dual carriageway construction for design speed of 110km/hr
- Horizontal alignment is curvilinear with desirable minimum curve radius of 1000 metres
- Maximum vertical grade of 6%
- Crest vertical curves to provide minimum stopping sight distance for 110km/hr
- Sag vertical curves to provide headlight stopping sight distance for 110km/hr
- Limited access conditions would apply.

2.3.1 Typical Cross Section

Application of a typical dual carriageway cross section in conjunction with the vertical alignment provides a 'footprint' for the CRW route in relation to the existing surface profile and allows the calculation of earthworks volumes along the route. The concept designs generated by Quantm and refined by the MX model are based on the following cross-sectional parameters:

- Dual carriageways, each 10.5 metre wide
- 9 metre wide, depressed central median (including 1.0 metre wide inner shoulders)
- 2 x 3.5 metre wide through lanes in either direction
- 2.5 metre wide outer shoulders through cuttings and shallow embankments
- 3.0 metre wide outer shoulders adjacent guard fence
- SK kerbs on both sides of cuttings with 0.3 metre concrete infill behind SK kerbing
- Fill batters generally 2H:1V, with berms provided on higher embankments as shown on typical cross section
- Cut batter slopes vary with depth and benching as discussed below.



TYPICAL CROSS SECTION

COFFS HARBOUR HIGHWAY PLANNING
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FIGURE 2.2
TYPICAL CROSS SECTION

Further details of the typical cross sections used for the preliminary concept design are provided in Figure 2.2 and Appendix A. Additional information regarding cut batter slopes and fill batter designs and treatments are discussed in the following sections.

2.3.2 Cut Batter Design

The design of cutting slopes for earthworks purposes has evolved considerably in the last thirty-five years. Given that the CRW alignment passes through very rugged terrain it is pertinent to consider the proposed batter treatments in relation to earlier RTA designs and construction in similar circumstances. A profile of the cutting treatments on four major roadworks projects is provided in Appendix A. These profiles are on the following projects.

- F3 Freeway south of the Hawkesbury River
- F3 Freeway at Kangy Angy near Wyong
- Pacific Highway at Bulahdelah
- Pacific Highway south of Chinderah

These projects are respectively 35, 20, 5 and 1 years old and the cut batter profiles represent a history of the design process, albeit that these projects are in differing geological regimes. They show an evolution from steep rock faces to sloping and terraced batter designs. The general modern day rule is that deep cuttings are now sloped at either 0.5:1 or 2:1 (H:V), depending on rock quality and integrity and the slopes are terraced at 7 – 10 metre intervals to provide drainage, allow for maintenance and to protect the adjacent carriageway from rock falls.

A comparison of the deepest cuttings from the four projects above shows that the deep cuttings on the CRW would far exceed the deepest cuttings ever constructed by the RTA. The maximum cut depth along the CRW is 81 metres, there would be four cuttings over 50 metres and another four between 40 and 50 metres deep. By comparison, the maximum cut depth along the F3 Freeway between the Hawkesbury Bridge and Berowra interchange is 45 metres and the isolated Kangy Angy cutting, which is believed to be the deepest in Australia, is 60 metres deep. The 134m long tunnel on the Yelgun to Chinderah Project was provided instead of a 45m deep cutting. The deepest cutting on the Yelgun to Chinderah Project is approximately 40m.

To demonstrate the impact of these major cuttings, the potentially deep cross section at Red Hill is overlaid on the four cross sections in Appendix A. In addition, a longitudinal profile of the route is provided in Appendix B to show the frequency and depths of cuttings required on the CRW. For comparative purposes, the profile of the Bulahdelah to Coolongolook project is also included, as is the profile for the potential inner bypass corridor for Coffs Harbour.

It is clear from a constructability / basic engineering feasibility viewpoint that numerous cuttings of between 50 and 81 metres are not viable. The undesirability of these major open excavations would be further compounded by the potential risks associated with their construction, onerous future maintenance commitments and the impact on the natural environment associated with the significant width of land clearing (up to 300m wide).

2.3.3 Fill Batter Design

In a similar vein to the cut batter slopes, the treatment of fill embankments is a key design consideration. In steep and rugged terrain featuring sharp cross slopes, overall embankment stability is critical and it could, in some areas, be impractical to construct even shallow fill embankments. At this point the earthworks quantities have been calculated using 2:1 (H:V) fill batters and this has the potential to create very wide embankment widths (at the base) in some valleys with natural environment sensitivities.

As such, it was considered prudent to provide bridge structures where very deep valleys are traversed and these are outlined in Section 2.3.5.

2.3.4 Earthworks

As previously outlined, the earthworks requirements for the CRW would be a major undertaking. Assuming a base case scenario of routine cut to fill earthworks for the alignment, the theoretical total volume of excavated material would significantly exceed that required for the Inner Bypass corridor and the previously rejected Central Bypass corridor. Table 2.1 shows that the earthworks for the CRW would be more than double the Central Corridor even though it is 3km shorter.

Table 2.1 Key Earthworks Parameters – Full Earthworks Scenario

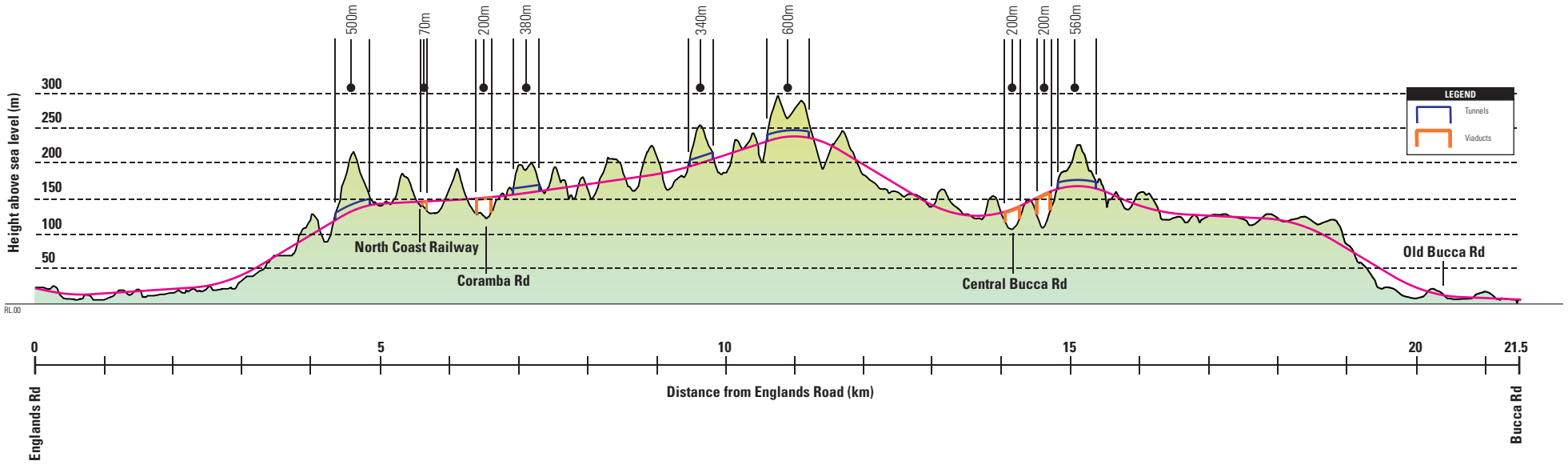
	Inner Corridor	Central Corridor	Coastal Ridge Way
Length	11 km	25 km	22 km
Earthworks Cut Volume	2.1 – 3.7 million cubic m	5 – 6 million cubic m	12 – 13 million cubic m
Deepest Cutting (without tunnels)	60 metres	60 metres	81 metres
Highest Embankment	23 metres	38 metres	48 metres

In the light of this major earthworks quantity differential and the previously described geotechnical risks associated with deep cuttings and high embankments, a series of tunnels through ridges and bridge structures, or viaducts, across valleys have been incorporated as an essential component of the design of the CRW (refer Figure 2.3). The locations and lengths of these structures are described below. Implementation of these major structures would obviously have a fundamental impact on the cost of the work and this is outlined in Section 4.

The provision of the tunnel and viaduct structures would reduce the overall cut to fill earthworks quantities from 12-13 million cubic metres to approximately 7 million cubic metres, still in excess of the base volumes for the shorter but comparable Central Bypass corridor. Importantly, the construction of numerous tunnels could seriously interrupt materials management and haulage operations during the earthworks phase of any construction. As such, it may be necessary for the majority of earthworks to be delayed until after some of the tunnels and viaducts were complete. This would be particularly the case in the more isolated sections of the route.

2.3.5 Tunnels and Viaducts

As a general design rule, for locations with cutting depth greater than 45 - 50 metres, a tunnel section has been introduced and for areas of fill embankment height greater than 30 - 35 metres, viaduct structures have been nominated and costed as part of the CRW. Table 2.2 summarises the locations and lengths of the tunnel and viaduct sections.



COASTAL RIDGE WAY

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FIGURE 2.3
LONGITUDINAL SECTION

Table 2.2 Proposed Tunnel and Viaduct Locations

Structure Type	Chainage	Length
Bored Tunnel through Ridge	Ch. 4350 to 4850	500 m
	Ch. 6920 to 7300	380 m
	Ch. 9480 to 9820	340 m
	Ch. 10600 to 11200	600 m
	Ch. 14800 to 15360	560 m
Viaduct Structure across Valley	Ch. 5600 to 5670	70 m
	Ch. 6400 to 6600	200 m
	Ch. 14050 to 14250	200 m
	Ch. 14500 to 14700	200 m

A length of the tunnel greater than 200 metres would typically be expected to require some form of mechanical ventilation and as such, this has been assumed as being necessary on all of the nominated tunnels.

The risks associated with the use of tunnels by vehicles carrying dangerous or hazardous goods has been assessed separately.

2.3.6 Interchanges

Interchanges for the CRW proposal would be provided at the Englands Road departure from the Pacific Highway, Coramba Road (if practical) and in the vicinity of Bucca Road. These are shown in Figure 2.4. The qualified comment in relation to a potential Coramba Road interchange is that the vertical alignment would be approximately 30 metres above Coramba Road and substantial earthworks would be necessary north of the intersecting point to provide ramp connections. As a result, the cost of this interchange would be very high and may not be justified in terms of the associate road user benefits.

All interchanges would have four way access and egress, providing for all movements on and off the CRW.

No other access or egress points to the CRW proposal would be provided. Access along other roads and access tracks traversed by the proposal would be provided by means of overpasses or underpasses.

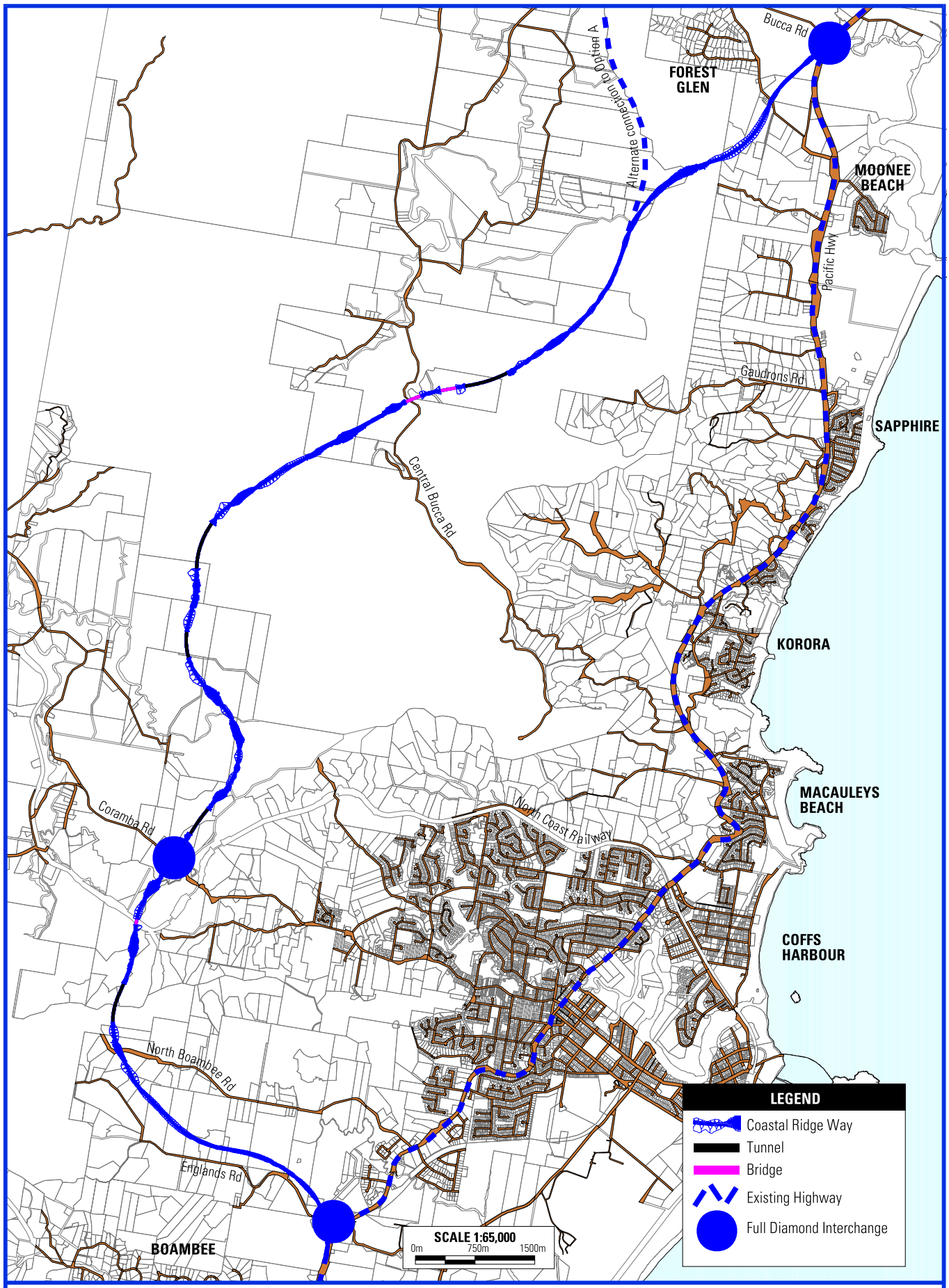

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FIGURE 2.4
ACCESS PLAN