

**DRAFT**

**Roads and Maritime Services**

**Princess Highway Upgrade Berry Bypass**

**Bridge Design Workshops Process Report**

24 November 2011

## Table of Contents

<b>1</b>	<b>EXECUTIVE SUMMARY</b>	<b>1</b>
<b>2</b>	<b>PROJECT OUTLINE</b>	<b>2</b>
2.1	Introduction	2
2.2	Berry Bypass community review group	2
2.3	Workshop Series Structure	3
<b>3</b>	<b>WORKSHOP ONE</b>	<b>5</b>
3.1	Attendees	5
3.2	Objectives	5
3.3	Review of options	6
3.4	Design considerations	7
3.5	Outcomes	12
<b>4</b>	<b>POST WORKSHOP DESIGN DEVELOPMENT</b>	<b>13</b>
<b>5</b>	<b>WORKSHOP TWO</b>	<b>15</b>
5.1	Attendees	15
5.2	Objectives	15
5.3	Review of revised options	15
5.4	Considerations	16
5.5	Outcomes	19

## List of Appendices

<b>APPENDIX 1</b>	<b>BERRY BYPASS PREFERRED CONCEPT DESIGN</b>
<b>APPENDIX 2</b>	<b>BERRY BYPASS COMMUNITY REVIEW GROUP UPDATE</b>
<b>APPENDIX 3</b>	<b>RMS WORKSHOP DISCUSSION PAPER</b>
<b>APPENDIX 4</b>	<b>INDEPENDENT EXPERTS BIOS</b>
<b>APPENDIX 5</b>	<b>WORKSHOP #1 AND #2 AGENDAS</b>
<b>APPENDIX 6</b>	<b>WORKSOP #1 BRIEFING PRESENTATION</b>
<b>APPENDIX 7</b>	<b>BR2 OPTION - GENERAL ARRANGEMENT</b>
<b>APPENDIX 8</b>	<b>WORKSOP #2 OPTIONS PRESENTATION</b>
<b>APPENDIX 9</b>	<b>BR3-D OPTION - SKETCH</b>
<b>APPENDIX 10</b>	<b>WORKSOP #2 BRIDGE PRESENTATION</b>
<b>APPENDIX 11</b>	<b>WORKSHOP #1 AND #2 MEETING STATEMENTS</b>

## List of Figures

Figure 1 Process Flow Chart



# 1 EXECUTIVE SUMMARY

The proposed Foxground and Berry Bypass provides a four lane highway with median separation for approximately 11.6 kilometres on the Princes Highway between Toolijooa Road and Schofields Lane. It includes a bypass of Berry with access ramps at the north and south of the town.

In August 2011 residents from Berry locality commenced a formal process to re-examine the concept design for Berry bypass, with the Roads and Maritime Services (RMS, formerly Roads and Traffic Authority). RMS agreed to work through options in more detail with a community review group, with a focus on improving the aesthetics and form of the Berry bridge and aiming to keep the alignment as low as possible to minimise environmental and community impacts.

This report documents two workshops held in October and November 2011 to consider design alternatives for Berry bridge and the highway alignment at the Berry north interchange. An independent panel of experts, community members and RMS staff participated together in the workshops.

The first workshop held on 27 October 2011 reviewed the latest design options, and worked together to generate new design ideas. A list of 12 refinements/considerations were developed for future design development.

The priority considerations for the review were (i) an optimised bridge format, (ii) improved bridge aesthetics, and (iii) optimised cut/fill balance.

Significant design review work was completed following the workshop, taking into account the key considerations identified in workshop #1 to optimise the horizontal and vertical alignment of the BR2 option and develop an improved BR3 option.

The second workshop held on 7 November 2011 examined the revised BR3 option (variants A, B and C), and focused on reaching agreement among the attendees on bridge and interchange alignment, bridge structural form and aesthetic treatments. From these criteria several design objectives were generated.

The group agreed to adopt the BR3 option as the baseline road geometry for ongoing design development.

The workshop series was successful in reviewing the revised design options and identifying areas of the design needing further work or revision. The key outcome from the workshops was to lower the height of the Berry bridge by approximately seven metres and correspondingly lower the northern interchange layout to suit.

The group generated a number of preferences and agreed a set of objectives to guide the work by RMS and community in finalising the design for the Berry bridge and interchange.

## **2 PROJECT OUTLINE**

### **2.1 Introduction**

The proposed Foxground and Berry bypass provides a four lane highway with median separation for approximately 11.6 kilometres on the Princes Highway between Toolijooa Road and Schofields Lane. It includes a bypass of Berry with access ramps at the north and south of the town.

The preferred route for the Berry bypass to the north of town was announced in 2009. During 2011 a group of Berry residents developed a number of design iterations and with RMS assistance generated a preferred alignment within the study area (Appendix 1). RMS then proceeded to work up the detail behind that preferred alignment.

Local MP Gareth Ward announced in August 2011 a review of the Berry Bypass project in the area immediately north of Berry township. RMS committed to a process to re-examine the concept design in this area with the community and invited interested members of the community to be part of a community review group. RMS agreed to work through options in more detail with the community, with a focus on improving aesthetics and form of the Berry bridge and aiming to keep the alignment as low as possible to minimise environmental and community impacts.

RMS engaged an independent panel of experts to work with community participants in two one-day workshops to consider design alternatives for Berry Bridge and the highway alignment at the Berry north interchange. RMS is to report back to the community review group in late November with the outputs from the workshops.

The scope of the workshops was confined to the Berry bridge and north interchange only with further discussions relating to the north Berry precinct to be held separately.

This report documents the process and outcome of the two workshops.

### **2.2 Berry Bypass community review group**

The Berry Bypass community review group includes local residents, representatives from interested community groups: Berry Alliance and Better Options for Berry. At a community review group meeting held on 26 October 2011, the group endorsed the workshops and requested community members report back to the wider group on the progress made in the two workshops. Members of the community group Better Options for Berry (BOB) prepared a number of engineered alternate alignment options.

Participants of the review group confirmed they would work with RMS and focus on alignment options along and in the vicinity of the preferred route and participate in their development.

In community review group meetings on 13 and 26 October 2011 the group committed to continuing two main discussions relating to the proposed alignment including:

- a focus on the bridge should improve its aesthetics and design, noting the aim to lower the bridge and reduce its impacts had not yet been achieved; and
- a focus on reducing the impact of the highway on the north Berry precinct and should examine appropriate landscape and urban designs for this newly created space.

It was agreed that these discussions would continue with two one-day workshops, and that meeting statements would be issued at the conclusion of each workshop to continue with the transparency provisions adopted by the review group.

The community review group identified key community 'concerns' for resolution (outlined in the *Berry Bypass Community Review Group Update 13 October 2011*) including:

- the amenity of North Street;
- flooding and flood management along the alignment north of North Street;
- the visual impact and amenity of the highway at Woodhill Mountain Road;
- the current design and aesthetics of the Berry Bridge; and
- noise management and residential impacts, possible shadowing impacts from the noise walls and how to manage noise from bridge deck joints.

These issues are described in the *Berry Bypass Community Review Group Update* included in Appendix 2.

### **2.3 Workshop Series Structure**

A *Discussion Paper* issued by RMS on 21 October 2011 (Appendix 3) proposed a structured and collaborative approach to developing design options for the Berry bridge and northern interchange workshops.

The Berry Bypass community review group agreed with local community participants including representatives of BOBS and the Berry Alliance to attend this workshop.

The proposed workshops included the following key components:

- Hold workshops with members of the community and independent road design and construction experts;
- The independent experts to be briefed ahead of the workshops to gain a better understanding of the issues and to visit the site;
- The workshops to be facilitated by Peter Stewart, an engineering professional and independent facilitator;
- The workshop will review the current issues and design options, and identify and agree new options; and
- The process and outputs of the workshop to be documented by Evans & Peck (independent infrastructure advisory company) and prepared for publishing.

The proposed workshops would consider the two main design options as a baseline for the discussions. These design options included:

- (a) RMS early 2011 concept design; and
- (b) Bruce Ramsey option #2 (BR2 option).

To establish the context for the workshops and inform the independent experts, these design options were reviewed through pre-workshop activities:

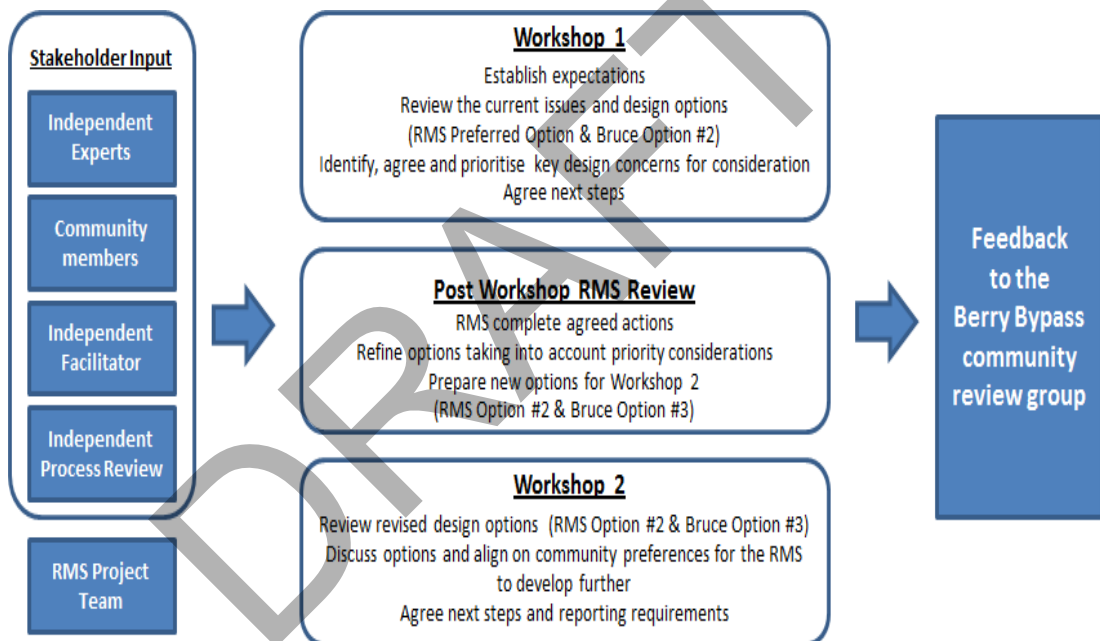
- **Pre workshop briefing**

The independent experts attended a briefing at the RMS Pymont Office on 24 October 2011. RMS provided an overview of the project history, consultation process to date and presented a summary of the RMS concept design and BR2 option.

- **Site visit**

RMS hosted a site visit for the independent experts and interested community participants, Bruce Ramsey and Bob Fitzell.

Three locations were visited including Woodhill Mountain Rd (Ch16000), Sculpture Park on Princes Hwy (Ch15700), and a private access off Princes Hwy (Ch15150). Attendees were able to physically visualise and review the location of the proposed bypass as documented in the RMS early 2011 concept design and the BR2 option.



**Figure Process Flow Chart**

The following sections of this report describe the process and outcomes of the two workshops.

## **3 WORKSHOP ONE**

### **3.1 Attendees**

The first workshop was held on 27 October 2011 at the Berry Village Boutique Motel.

The workshop was attended by:

#### **Independent facilitator**

- Peter Stewart - Director, Peter Stewart Consulting

#### **Independent experts**

- Vladimir Sofrevski - Divisional Director, Mott MacDonald Hughes Trueman
- Darrel Conybeare – Director, Conybeare Morrison International Pty Ltd
- Ken O’Neill – Associate - Transport Services, Aurecon
- Barry Murphy – Project Director, Baulderstone
- Michael Moore – Principal, Evans & Peck

#### **Community participants**

- Stuart Coughlan (representing local MP Gareth Ward as process auditor)
- Philip Thorniley (local resident)
- Bruce Ramsey (BOB member with background in construction)
- Bob Fitzell (BOB member with background in acoustics and building)
- Will Armitage (Chair of BOB with background in building infrastructure)
- John Cullity (local resident)

#### **Independent process review (Evans & Peck)**

- Michael Moore – Principal, Evans & Peck
- Gillian Goldsmith – Associate, Evans & Peck

#### **RMS project team**

- Steve Zhivanovich – RMS Project Director
- Carla Brookes – RMS Project Communications Manager
- Adam Berry – RMS Project Development Manager, Berry Bypass (PM only)

At the workshop the experts provided an introduction (summarised in the bios in Appendix 4) and the community participants provided a summary of their previous involvement in the route selection and design process.

### **3.2 Objectives**

The agenda for workshop 1 reflected the agreed proposal outlined in the RMS Discussion Paper, and included:

- (i) Introduction and establish expectations for the workshop series;
- (ii) Presentation by RMS to 'set the scene' and recap current design options;
- (iii) Review design options and generate new design ideas;
- (iv) Identify a list of refinements/considerations for future design options;
- (v) Agree structure for next workshop and actions; and

(vi) Generate meeting statement.

The workshop participants outlined their expectations for the two workshops. The expectations identified at the commencement of the first workshop were that:

- scope be confined to the Berry bridge and the Berry northern interchange and exploring two current options (RMS early 2011 concept design and Bruce option #2);
- process/outcomes be documented in a way that clearly explains the design process and alternatives discussed, for the benefit of the community;
- understanding of the consequences of our the findings on other project areas be developed;
- alternatives for the Berry bridge in relation to environmental impacts, particularly in relation to Woodhill Mountain Road (focusing on the lowest possible height bridge) be fully explored;
- vertical and horizontal alignments for the bypass are agreed to help determine the strategic cost estimate and community agreement;
- aesthetics, urban design, noise and property severance and cost impacts are understood and mitigated; and
- opportunities to control flood mitigation, encouraging a whole of government approach and identified.

The group acknowledged previous challenges in the RMS consultation process, recognised the frustration felt by the community participants that the community had to take the initiative to develop alternate design solutions, and agreed to work collaboratively to achieve a better result for the bypass and interchange.

Community participants acknowledged that a number of recent community review group meetings had assisted to enhance the community's technical understanding of the design process. They requested that the process and outputs of the workshop be clearly documented and made available for public distribution.

### **3.3 Review of options**

#### **Current alignment options**

The current alignment options that formed the baseline for discussion in workshop #1 were:

- (a) RMS early 2011 concept design; and
- (b) Bruce Ramsey option #2 (BR2 option).

The RMS early 2011 concept design followed the preferred route and featured a high level bridge and a shallow cutting at the northern interchange, with the northbound on-ramp crossing under the mainline bridge.

The BR2 option was aligned further to the north over Woodhill Mountain Road and featured a low level bridge across the floodplain with a deep cutting at the northern interchange. The northbound on-ramp crossed under the mainline bridge.

A general arrangement of the BR2 option superimposed on the RMS early 2011 concept design is included in Appendix 7.



Steve Zhivanovich (RMS) presented slides from the previous community review group meetings to provide a context of the previous process/options that had been explored relating to:

- Woodhill Mountain Road
- Design and aesthetics of Berry Bridge
- Flood models
- Original RMS proposal overview with the northbound on-ramp under the highway compared to Bruce Ramsey #1 option (BR1) with the northbound on-ramp on bridge over the highway
- Comparison of the consequences of adopting the BR1 or RMS options
- Design options relating to bridge construction, noise and design features
- Fly-over animations of RMS concept design and BR1 options
- Map showing previous options and including sensitive receivers, RMS owned land, and impacted properties
- Project assessment criteria guiding the options development to date

This presentation is included in Appendix 6. Hard copy drawings showing a longitudinal section and plan view of the RMS early 2011 concept design and BR2 option were distributed for review and use throughout the workshop.

#### **Previous alignment options**

The group recapped on previous design options running at ground level across the floodplain with Woodhill Mountain Road bridging over the new highway. RMS confirmed that this option had been set aside with the consensus of the community review group because the highway needed to be on structure above the 1 in 100 year flood event (equivalent to a minimum of 4 metres depth above the floodplain in the vicinity of the bridge), and provide for the required vehicle clearance over Woodhill Mountain Road.

The group also confirmed and agreed that the Bruce Ramsey #1 option (BR1) was no longer under consideration and had been superseded by the BR2 option which had support from the community.

### **3.4 Design considerations**

The workshop attendees agreed that the purpose of the workshop was to go beyond simply comparing the RMS concept design and BR2 option, and to explore all potential design solutions. All acknowledged the importance of establishing agreed design criteria to ensure the best outcome. Following review of the two design options the facilitator initiated an open forum to identify key issues of concern to the stakeholders. The group discussed the key issues summarised below.

#### **Bridge aesthetics**

The group discussed the impact of design elements on overall aesthetics of the bridge. Various elements were discussed including different span lengths, modification of barrier edging to create shadow lines, freeboard, vertical alignment and parapet depth.

The group discussed RMS bridge requirements for the overall deck width and height of bridge parapets (barriers). The group explored the benefits of different structural options including a short span plank bridge (BR2 option) or longer span super-T structure (RMS

early 2011 concept design). Pier headstock options and their aesthetic impact were also discussed.

The independent experts commented on improving the aesthetics of the bridge by exploring alternate span lengths. The BR2 option with 15m spans on 600mm bridge planks would require a 1,800mm deep parapet (concrete edge barrier) and could appear visually "busy" against comparatively closely spaced bridge supports. Increasing the bridge span with a super-T structure would create more transparency between the piers, but would increase the parapet depth to 2,600mm. To achieve a visually thinner profile the edge of the parapet could be detailed to create a shadow line and soften the edge with a rounder appearance.

Land uses under the bridge (when not in flood) was also raised as a consideration to optimise potential benefits to the community.

The height of the bridge above the floodplain was primarily an issue towards the western end where it became visible from the town. The importance of considering the longitudinal sloping bridge and its effect on aesthetics was highlighted (i.e. the vertical alignment being on an increasing grade heading east, rather than horizontal east-west bridge). There is work required to clearly define and assess the visual impact of the structure.

Bruce Ramsey suggested a cost difference between plank and super-T bridge options of approximately \$25million, with the plank option considered lowest cost. The group agreed there was a need to find a balance between aesthetics and cost and queried the budget allocated to achieve this balance of aesthetics. RMS confirmed that a design and construct contract structured to ensure specific design details and aesthetics are achieved for nominated structures.

It was agreed that the core structure should be determined and then options considered to improve the overall aesthetics of the bridge.

### **Twin bridges**

The group considered potential opportunities to transition the current two-by-three lane design into twin two-lane bridges separated by a physical clear zone between carriageways. The experts acknowledged that twin bridges would be more costly to design and construct due to increased foundations, additional median treatment, additional parapet barriers and a wider footprint. Consideration was also given to the potential of reducing the width of the median to minimise the overall bridge footprint. An option to introduce an urban style narrow median with a central rigid barrier on a single two-by-three lane bridge was also discussed.

Questions were raised relating to the necessity of the third lane on each carriageway and RMS confirmed its strategy was to future-proof the Princes Highway design with the provision for operating a third lane as increases in traffic demand dictate RMS agreed to locate the information it uses to determine future traffic volumes for predicting demand for the additional third lane.

### **Noise impact**

Noise was identified as a major concern for the community and discussion focussed on how noise could be mitigated through bridge and alignment design.

It was identified that as the height of bridge increases the efficiency of noise barriers on the bridge also increases, reducing noise transmitted to sensitive receivers. However, as

the bridge height increases the noise radiated from the bridge soffit (the area immediately under the bridge deck) also increases.

The pros and cons of different noise walls were discussed including solid concrete barriers, transparent barriers and earth mounds. It was noted that barriers with a density over 20kg/m<sup>3</sup> tend to reflect noise, and that transparent barriers whilst reducing overall bulk do not completely screen vehicles from view, and can often reflect light.

The key source of noise was understood by the group to be compression braking, truck exhaust and traffic movements over bridge deck joints. This was noted as primarily caused by steep grades, as in the case of the existing highway entry north of Berry with a 3.9% grade. Modelling of loud noise events such as truck exhaust and compression braking was noted as unreliable. However, maintaining low bridge height was expected to reduce impact from these loud noise events. Both highway design options offer a reduced grade and trucks were considered less likely to brake where there is a good high speed alignment.

In addition with regard to noise mitigation in the cutting to the east of the bridge, the use of acoustic precast concrete panel linings or landscaping were identified as options that could be considered if needed.

### **Visual impacts**

The group identified the importance of maintaining sight lines to the escarpment and discussed design solutions to minimise the impact on this view. The group acknowledged that the bridge will be viewed primarily from the town at the eastern end, but agreed that the key community concern was to lower the bridge as much as possible to retain the view of trees and escarpment when looking north from the town. With a lower alignment, it was evident the BR2 option was more likely to satisfy this criteria.

Darrel Conybeare introduced the idea of a sloping landscaped mounding (or "ha ha" wall) between the alignment and North Street to conceal the highway and reduce visual impact on views from the town.

### **Flooding**

The independent experts confirmed that designing infrastructure for a 1 in 100 year flood event is standard industry practice. The map used to inform the design was tabled, outlining the 1 in 100 year flood levels over the study area. The map was taken from a Cardno report prepared for the local Shoalhaven City Council and based on the RMS proposed alignment.

Freeboard above the flood level to the underside of the bridge was discussed and the Council preferred minimum of 600mm was suggested as appropriate.

A number of options to alleviate the flooding throughout the study area were discussed, with potential to allow the bridge to be lowered. The options included moving the bridge abutment north, introducing culverts and training walls through Memorial Park, formalising the creeks to assist flow (subject to environmental approvals), and adding an additional span to the bridge on Woodhill Mountain Road. Some community participants suggested that the investment into raising the bridge could instead be redirected to addressing flood issues throughout the study area. The group agreed that the relevant flood studies should be considered and discussions with Council progressed in relation to recommended flood mitigation strategies to alleviate flooding.

## **Road geometry**

Road geometry (i.e. vertical and horizontal alignment) was considered through the cutting and interchange area. RMS requirements for a minimum horizontal curve of 600m radius were discussed, with preference for 750m radius especially with the reverse ("S" shaped) curve on the bridge and the 110kph design speed. The BR2 option complied with the 600m minimum but had a lower vertical alignment through the cutting than the RMS concept design.

## **Volume of excavated rock and soil**

Alternate alignment options were explored aimed at reducing the volume of excess material excavated to form the cutting east of the bridge and the consequential truck movements and disposal sites required including:

- Commencing the on/off ramps further east prior to the cutting and following the topography separate from the new highway alignment (to reduce width of cut);
- Raising the vertical alignment between the northern interchange and the eastern bridge abutment (if not visible from town beyond Woodhill Mountain Road) and steepening the descent to the valley;
- Steepening the cutting slopes and treating them with soil nails and anchor bolts drilled into the soil and rock faces;
- Spraying a stabilising special mix concrete onto the exposed rock faces (known as shotcrete); and
- Stepping the cutting slopes to stabilise the rock faces (known as benching).

Another option for a cut and cover tunnel was raised citing the Leura Bypass tunnel as an example of limiting excavation and reducing excess cut earthworks. It was agreed that the additional width of on/off ramp lanes would cause the tunnel to be excessively wide and that the aesthetics of a tunnel were not in keeping with the Berry rural environment.

## **Geotechnical**

RMS outlined the available information in relation to the geotechnical condition of the study area. The rock around Berry was noted as mostly sandstone (Berry Siltstone) in contrast to the basalt and volcanic rock in the Kiama district. The rock within the existing cutting (reclining at a 1-to-1 or 45 degree slope) was noted as over 30 years old. As the vertical alignment of the upgrade is lowered, better quality rock could be expected. RMS anticipated some unsuitable material would be encountered where the alignment is lower adjacent to North Street (and which was not included in the cut/fill quantities). Re-use of unsuitable material was discussed briefly including potential for use in noise mounds or for processing to improve product quality.

## **Cost**

The community participants sought clarification from RMS of the importance of cost in determining the optimal solution. RMS confirmed that the project solution needs to be economically viable and that the main elements impacting cost are property acquisition and the balance of cut and fill required for the different options. RMS advised that details from further geotechnical investigations will be an important driver of cost outcomes.

RMS detailed modelling of the BR2 option indicated approximately 250,000 m<sup>3</sup> of excess fill compared with BR's own (hand calculated) estimate of 100,000 m<sup>3</sup>. The difference was subsequently accounted for as a result of the wider study area RMS had adopted in

its calculations. RMS revised its calculations to 195,000 m<sup>3</sup> during the afternoon workshop session to ensure a like for like comparison. Costs of the BR2 option were partially offset through adopting the short span plank bridge structure.

In contrast the RMS concept design produced just 2,000 m<sup>3</sup> of excess material from the cutting. The group agreed that all options need to be considered to identify ways to reduce excess cutting material, ideally to less than 100,000m<sup>3</sup>, and reduce the need for costly haulage and disposal/re-use.

Options to reuse excess cut material were identified by the group including utilising as fill in potential earth mounding along North Street in lieu of or combined with noise walls. RMS advised that they were aware of several methods available for reuse of cut material and would seek to identify suitable options for utilising the excess in the most economical manner.

Reducing cut by steepening batter slopes and where necessary using innovative screening panels over a shotcrete treated slope (spraying a stabilising special mix concrete onto the rock faces) was also discussed. The group identified the potential to steepen cut batters beyond 1-in-1 (45 degree slope angle) particularly as the vertical alignment is adjusted lower and deeper into better quality rock. It was considered and acknowledged by RMS that the RMS concept design was conservative with its shallower cut slopes, based on the information known at present. RMS advised that the potential to steepen the cut slopes was available as an option once further geotechnical data is obtained by drilling boreholes into the rock layers, nearer the time of construction.

#### **Criteria weighting for comparing the options**

At the commencement of the afternoon session the workshop facilitator proposed a comparison of the RMS and BR2 options against weighted criteria. RMS suggested the following criteria for consideration; noise, amenity/visuals, flooding, aesthetics, cut surplus, cost, and property impacts.

The community participants preferred not to compare options, considering it more effective use of the workshop time to continue the design review, and specifically refining the BR2 option. They acknowledged cost would be of most importance and preferred to focus on developing the best option within the RMS budget.

RMS stated a preference for retaining the RMS concept design as a baseline.

### 3.5 Outcomes

Following on from the discussion of design issues described above, a list of key considerations was identified by the group. It was agreed that both options (RMS concept design and BR2 option) would be further reviewed taking into account the key considerations to identify potential solutions which achieve better cut and fill balance and a lower bridge alignment. Optimising the alignment for BR2 option was agreed to be the primary focus.

The considerations were listed and prioritised by the group at the end of the workshop, as detailed below. It was agreed that the design options would be reviewed against the priority considerations prior to Workshop#2, with the other considerations to be actioned at a later date.

It was agreed that Workshop #2 would be held on the 7 November 2011.

Prior to closing, the group drafted a statement to the community for the RMS project website, which briefly described the progress achieved and acknowledged this unique opportunity for collaborative consultation (Appendix 11).

#### Priority considerations

1. Consider optimum bridge format including potential to:
  - Reduce width to two lanes in lieu of three lanes;
  - Introduce parallel twin bridges in lieu of one (consider a continuous headstock for future widening);
  - Reduce median of bridge (currently 5m in width) and allow for future widening; and
  - Maximise spacing of bridge expansion joints.
2. Improve bridge aesthetics through consideration of:
  - Proportionality, light, shadowing treatment;
  - Structural design - soften parapet, profile, shadow line options; and
  - Treatment of noise barriers.
3. Explore options to optimise cut/fill balance:
  - Investigate ramp alignments to reduce excess cut by considering;
    - Use of lower vehicle design speeds;
    - Following the natural topography outside the cutting;
    - Commencing on/off ramps earlier to exclude them from the cutting zone; and
  - Consider the longitudinal profile by raising the vertical alignment from the southbound off-load ramp to achieve an improved earthworks balance, noting that 110kph design speed compliance criteria need to be critically reviewed in order to satisfy the road safety audit.

### **Other considerations**

4. Confirm typical grades that assist in reducing vehicle braking, acknowledging that lower grades may reduce noise from heavy vehicle compression braking
5. Consider options to maintain visuals of the escarpment/amenity
6. Develop alternate methods to steepen batters and reduce cut material
7. Consider extending earthworks and reducing bridge length at western bridge abutment and providing flood training walls for Bundewallah Creek (approvals and environmental issues to be addressed)
8. Investigate lengthening of Woodhill Mountain Road bridge at Connolly's Creek to increase water flow capacity
9. Consider options to lower Woodhill Mountain Road in the vicinity of Berry bridge
10. Berry bridge freeboard height above flood level (1 in 100 year) to be checked with Shoalhaven City Council
11. Identify disposal options for excess fill including quantifying noise mound requirements along North Street and researching potential tip sites
12. Better understand the floodplain management and flood mitigation policy of Shoalhaven Council (and their design consultants Cardno) to inform the solution and consider potential to re-use surplus excavated materials for infill or to form high ground for livestock refuges.

## **4 POST WORKSHOP DESIGN DEVELOPMENT**

Activities following Workshop #1 described below helped to inform Workshop #2:

- In response to priority considerations above, Bruce Ramsey sketched a BR3 Option on behalf of the community groups as a further development of the BR2 option. The BR3 sketch moved the ridge road alignment further north and followed the RMS alignment more closely, commencing the descent from the same point as RMS to improve the balance between cut and fill. Bruce Ramsey requested that RMS redraw the BR3 option.
- The BR3 option was assessed by the RMS design team, and road geometry input provided by members of the independent experts, to inform the development of options for consideration in Workshop #2. Three revised options based on BR3 were developed and documented by RMS prior to workshop #2 and called BR3-A, BR3-B and BR3-C.
- RMS generated the revised design options by considering the following requirements:
  - Incorporate a maximum longitudinal grade of 3% as indicated in BR Mk 3 sketch;
  - Investigate starting the southbound off-ramp further east by 150-250m;
  - Retain the northbound on-ramp alignment below the main alignment;
  - Use retaining structures where necessary to reduce extent of fill spill on side embankments;
  - Investigate lowering Woodhill Mountain Road by approximately 0.5m whilst ensuring the road surface and substructure drain to the adjacent land surface;

- Investigate moving the eastern bridge abutment as far west as possible to maximise use of surplus fill bounded by the on and off-ramps;
- Bridge height clearance to be determined by minimum vehicular clearance of 4.6m (local road) above Woodhill Mountain Road; and
- Assume super-T bridge superstructure.
- The RMS project team carried out the following additional actions:
  - Reviewed pavement structure options to facilitate lowering Woodhill Mountain Road;
  - Investigated how to steepen batter slopes – further discussions required with RMS Southern Region geotechnical team;
  - Investigated the feasibility of installing road culverts under Woodhill Mountain Road to aid faster drainage of recreation ground during a flood event;
  - Investigated engineering / urban design aesthetic / cost relationships between super-tee and plank bridge structures;
  - Confirmed availability of Shoalhaven Council's flood modelling expert to attend during workshop #2 and brief the group on Council's flood management and mitigation policy for the Berry catchment area;
  - Updated cost estimates to include the BR3 option; and
  - Coordinated the independent experts to prepare presentations in bridge design and aesthetics for workshop #2.

DRAFT



## **5 WORKSHOP TWO**

### **5.1 Attendees**

The second workshop was held on 7 November 2011 at the Berry Village Boutique Motel.

The workshop was attended by the same community participants, independent experts and RMS as per workshop #1, with the exception of Barry Murphy who was unable to attend.

Shoalhaven City Council's Natural Resources and Floodplain Manager, Isabelle Ghetti, attended the workshop for one hour to present the Council's flood management and mitigation policy for the Berry catchment area.

### **5.2 Objectives**

The expectations established by the group in Workshop #1 were revisited and guided the outcomes of the second workshop. It was expected that the focus of the workshop be on outcomes and feedback to the community review group, and that the workshop should produce real outputs. The outcome is to be promoted in the future as the preferred RMS design option. RMS agreed the RMS early 2011 concept design would no longer be under consideration.

The agenda for the second workshop (Appendix 5) included:

- (a) Revisit expectations and objectives;
- (b) Recap actions arising from last meeting;
- (c) Present design options BR3-A, BR3-B and BR3-C and provide feedback on opportunities to optimise cut and fill balance (Priority 3);
- (d) Presentations from Shoalhaven City Council regarding flood management;
- (e) Present bridge structural options and aesthetic impacts (Priority 1 & 2);
- (f) Align on preferences and agree next steps;
- (g) Generate meeting statement; and
- (h) Review value and benefit of the workshop process.

### **5.3 Review of revised options**

Three revised options (BR3-A, BR3-B and BR3-C) were developed by RMS based on the BR3 option prepared by Bruce Ramsey after workshop #1. The features of each of the BR3 options are outlined in the presentation included in Appendix 8.

All options shared the same 3% vertical grade for the mainline carriageways and for comparison purposes, quantities were measured over a common distance of 650m between Ch15150 and Ch15800. The three design options differed in terms of cut/fill balance, off load ramp grades and safety considerations primarily around the interchange, as follows:

- BR3-A option included the use of reinforced earth retaining walls on both off-load and on-load ramps at Berry north interchange and resulted in 104,000m<sup>3</sup> excess material from the cutting;
- BR3-B option had fill batters (embankments) on both ramps in lieu of reinforced earth walls and resulted in excess material from the cutting of 79,000m<sup>3</sup>. An

additional “Mohawk” feature (a wedge shaped unexcavated rock pillar left between two diverging roads) on the southbound off-ramp was included as an option to further reduce excess cut; and

- BR3-C option followed the existing topography for the southbound off ramp, as suggested at the previous workshop, and was deemed not feasible due to excessive grades exceeding 10%.

The options taken forward for further discussion were BR3-A and BR3-B.

At this second workshop the independent experts presented and informed the workshop discussions on each of the options:

- Assessment of BR3 option to derive the BR3-A, BR3-B and BR3-C design options (Vladimir Sofrevski – Appendix 8);
- Urban design modelling of Berry bridge to assess aesthetic impacts on the study area (Darrel Conybeare – Appendix 10); and
- Displaying visuals of other multi-span bridge projects to inform the optimal design solution (Ken O’Neill – Appendix 10).

## **5.4 Considerations**

### **Alignment**

Each of the options included a maximum vertical longitudinal grade of 3%, a minimum horizontal radius of 750m, and a minimum vertical curve through the cutting. The independent experts explained that a reduction in the maximum grade would result in additional cut or increase the height of bridge over the floodplain. However a flatter grade could assist in mitigating noise impacts. Alternatively increasing the grade would impose a steeper ascent/descent into the floodplain, which would likely increase truck noise and reduce travel efficiency for road users.

The independent experts advised that a 3% grade at 110kph design speed was considered suitable over a length of 350m (east of Woodhill Mountain Road), being short enough to prevent heavy vehicles slowing down on the mainline and avoid noise impacts from truck exhausts (heading northbound towards Kiama) and truck braking (heading southbound towards Nowra). The group agreed that BR3-X (i.e. all sub-options A, B and C) should be adopted as the base model for mainline road geometry.

### **Height of Berry bridge**

The height of the Berry bridge across the floodplain was revisited, as the revised design of the bridge over Woodhill Mountain Road was 1.3m higher than the previous BR2 option.

The independent experts explained that the bridge height is dictated by the vertical curve east of the bridge through the cutting (as discussed above), and by a minimum 4.6 metre vehicle clearance required to the underside of the bridge at Woodhill Mountain Road. The pavement level on Woodhill Mountain Road could be adjusted lower provided pavement subgrade (foundation material) drainage could be maintained a minimum 100mm (ideally) above the swale drain.

Assuming the vertical alignment and 3% grade east of the bridge were maintained as designed for BR3, it was agreed that to lower the bridge across the floodplain would require a change to the type of structure or to the pavement level of Woodhill Mountain Road. Adopting 4.6m vehicle clearance, structural depth of 800mm, and crossfall (camber of the road surface) of 500mm on the bridge deck, it was estimated that the target level

of the control line over Woodhill Mountain Road should be RL13.625 (RL= Reduced Level from a common reference height datum point measured in metres) to achieve the minimum height.

It was agreed that any gradient savings that could be achieved would be a positive and it would be preferred that Woodhill Mountain Road should not be a constraint in achieving the optimal solution. RMS agreed to investigate options to lower Woodhill Mountain Road including the option to realign part of the road eastward to improve clearance under the Berry bridge.

### **Drainage**

The group discussed the importance of maintaining adequate deck drainage and the impact on longitudinal grade. The independent experts advised the bridge must have a minimum 0.5% grade for drainage and cannot be permitted to be horizontal, otherwise vehicle safety would be at risk due to aquaplaning in wet conditions. The latest design standards call for new bridges to have piped drainage systems to deal with road surface water. For bridge drainage pipework to perform correctly the bridge gradient must fall at least two metres over a distance of 400m back to the western abutment, where the pipework must drain into a sedimentation basin. This drainage pipework is also required to manage potential fuel spills on the bridge and prevent environmental damage.

Alternate solutions suggested by the group included:

- running the pipework down each pier and then underground back to the abutment (although the pipe and pit depth at the abutment would be excessive); or
- moving the low point (sag) of the bridge further east across Bundewallah Creek.

These suggestions were to allow the bridge to be further lowered across the floodplain. RMS stated that further work was required to understand drainage pipework requirements and develop an improved drainage solution.

### **Constructability**

Bruce Ramsey tabled an alternative to the BR3 design which was labelled BR3-D option (Appendix 9). This option aimed to further enhance the cut/fill balance, improve constructability through staging, and preserve adjoining properties.

The design moved the main highway alignment and on-ramp (for the northern interchange) further to the north and aligned the southbound off-ramp along the existing highway alignment into Berry. The potential for a retaining wall between the off-ramp and mainline was noted where levels differ due to ramp vertical alignment. The design also sought to preserve the natural barrier (cutting) to optimise acoustic outcomes. RMS agreed to further investigate the feasibility of this option.

### **Flooding**

Shoalhaven City Council's Natural Resources and Floodplain Manager, Isabelle Ghetti, attended the workshop to present on flood management within the study area. Isabelle Ghetti confirmed that a flood study had been completed in 2009 (available on Council's website) and in 2010 Council commenced work on preparing a flood risk management plan. The flood risk management plan will explore options to mitigate flood risk in catchment and the community have been engaged in the development of initial options including:

- Improvements to flow paths;
- Enlargement of Council water system;
- Planning controls (raising ground levels in low lying areas);
- Flood warning systems; and
- Structural solutions.

Community consultations will be held before Christmas to present these options and identify key priorities. The Council is targeting a draft plan to be released for comment in the first quarter of 2012. Isabelle Ghetti explained that funding for flood programs are highly competitive and the Council is unable to commit to an implementation timeframe as funding is uncertain.

In relation to the Berry bypass, Council has been working with RMS to ensure collaboration across the project in regard to managing flood risk. The Council has started modelling the bypass and is now awaiting final concept design to understand the full impact on flood behaviour. There are opportunities to work together to develop optimal flood management and engineering solutions. Council is also liaising with the Southern Catchment Management Authority as part of this process.

As number of design questions were raised in relation to the Berry bypass project. Isabelle Ghetti confirmed that vegetated mounds/noise walls would change the direction of water flow but could have benefits for flood management and would need to be considered by Council. Measures, such as refuge mounds, could be used for flood control if suitable. Isabelle Ghetti confirmed that the Council's design flood level for local roads was determined by a number of factors and could range between 1 in 5 years through to 1 in 100 year flood event. It was also confirmed that whilst 500mm freeboard was commonly applied across the floodplain, it was locally dependent and would be considered on a case by case basis.

### **Noise**

Noise impacts were reconsidered and the independent experts confirmed that noise levels generated by either a plank bridge or super-T structure would be almost identical, and that most noise would be transmitted over the top of the bridge structure. The independent experts described longitudinal grooving of concrete pavements (as commonly used in the USA) as a means of reducing noise from vehicle tyres. Bridge deck joints, also a significant generator of noise, could be spaced 250-300m apart to minimise the number of joints traversed (i.e. three joints only for the Berry Bridge). It was also noted that by moving the horizontal alignment further north from Berry under the BR3 option, the noise impact of the bypass on the township could be further reduced.

### **Aesthetics**

Independent expert member Darrel Conybeare presented a series of 3D models of bridge structural types, which included:

- 2 pier bridge options, for 15m span plank bridge and 30m span super-T bridge;
- 4 pier bridge option, for twin 15m span plank bridges; and
- 3 and 4 pier bridge options, for a single bridge.

The presentation allowed the group to visualise and compare different bridge options, and gain an understanding of the aesthetics of each and the impact on amenity and views of each bridge structure from the public domain. Following, Ken O'Neill and RMS presented

images of various bridge projects to demonstrate the aesthetics of different bridge types (Appendix 10).

The presentations confirmed to the group that the span length could have a significant impact on the bridge aesthetics. A solution with a larger span and minimal piers could provide improved aesthetics as well as maintaining maximum views of the escarpment. It was suggested that the super-T structure could cost more but could also deliver better aesthetic outcomes. Ken O'Neill commented that whilst the shallow rock across the floodplain (estimated depth 6m below natural surface) would support either a plank or super-T structure, a shallow plank bridge would be a cost effective solution.

The aesthetic impact of noise walls was discussed. The group agreed that noise walls have the ability to change the bulk of the bridge structure significantly and that noise walls should be lightweight and relate to the treatment of the headstock and parapet. A series of material options that might provide visually suitable options include glass (high maintenance), glass fibre reinforced concrete, and composite wood panels (emerging in Europe, USA, and China). The group discussed options to landscape the noise walls such as external planter boxes on the bridge or tapered "ha ha" walls on embankment. RMS confirmed that current modelling of the bridge shows no requirement for noise walls on the bridge, with a noise wall to be introduced near the cutting. Nonetheless it was agreed that the requirement for noise walls would not be confirmed until the environmental impact assessment phase, and so should be considered in next steps bridge design development.

In considering the aesthetics of the bridge, the independent experts advised that treatment of the surrounding land should also be a consideration. Ideally the bridge design would introduce a function or merit for the floodplain (such as wetland or runoff treatment area) that could provide a community benefit.

## **5.5 Outcomes**

The workshop successfully reviewed the BR3 design options and identified areas of the design that required further work or revision. The key outcome from the workshop was to lower the height of the Berry bridge by approximately seven metres, and correspondingly lower the northern interchange layout to suit.

The group generated a number of preferences and objectives that RMS is to consider in finalising the design for the Berry bridge and northern interchange. It was agreed that RMS would provide a full justification to the community review group if an objective is unable to be met.

The group agreed to a number of objectives relating to the alignment of the bypass and interchange including:

- Using BR3 to be the base model for road geometry;
- BR3-D option tabled at workshop would be explored by RMS to determine feasibility to preserve the natural barrier (cutting);
- Mainline gradient to be at or below 3% to mitigate noise impacts;
- Target RL 13.625 for the vertical alignment control line over Woodhill Mountain Road;
- Woodhill Mountain Road to be lowered as far as possible to allow Berry bridge to be lowered.

Design objectives were agreed by the group to address the visual and noise impacts of the upgrade, to be considered by RMS in finalising the design options. The objectives included:

- Eliminate visually intrusive noise barriers;
- Limit expansion joints on bridge to maximum of three joints (300m separation) to minimise noise;
- Ensure bridge design is sufficiently robust not to generate inferior alternatives along the way – ensure cost effective design developed now to minimise need for change;
- Conceal bridge pilecaps (foundations) below ground;
- Headstocks (transverse beams) to be supported on two piers at the ends of each span;
- Retain the option of investigating the use of twin bridges in the event that there are yet to be identified benefits;
- Maintain 3 metre shoulder width for 110kph design speed and sight distance; and
- Investigate at least two bridge type concepts (Plank and Super-T) and develop architectural models for each without noise walls.

The expectations established at the commencement of workshop #1 were revisited to test the progress of the group's discussions. It was agreed that the following expectations were fully achieved:

- scope be confined to the Berry bridge and the Berry northern interchange and exploring two current options (RMS early 2011 concept design and Bruce option #2);
- alternatives for the Berry bridge in relation to environmental impacts, particularly in relation to Woodhill Mountain Road (focusing on the lowest possible height bridge) be fully explored;
- vertical and horizontal alignments for the bypass are agreed to help determine the strategic cost estimate and community agreement;

The group agreed that whilst significant progress had been made, further design development and technical detail was required to fulfil the following expectations:

- understanding of the consequences of our the findings on other project areas be developed;
- aesthetics, urban design, noise and property severance and cost impacts are understood and mitigated; and
- opportunities to control flood mitigation, encouraging a whole of government approach and identified.

The community participants reiterated their expectation that the following should be achieved:

- process/outcomes be documented in a way that clearly explains the design process and alternatives discussed, for the benefit of the community;

Overall the feedback on the workshop process was positive. The community participants stated that the process had endorsed the Bruce Ramsey proposed designs and allowed the independent experts to inform into the design development. Whilst substantial progress had been made to reach alignment on various issues, the group agreed that further work would be required to finalise the design particularly around visual and noise

impacts. RMS representatives felt that the workshop process had been effective in helping the group to work towards a common goal.

At the conclusion of the workshop a meeting statement was developed outlining the process and reflecting the ideas above (Appendix 11).

The group agreed that the independent report documenting the two workshops should be completed by 21 November 2011 for presentation to the community review group.

DRAFT