

The information in this register is subject to ongoing change and improvement as a result of the work being done by the southern route technical investigation group. This revision (29 May 2012) contains important updates. Updates to this information are highlighted in blue text.

The register provides a plain English description of items that are being put to RMS to consider as part of the cost exercise for the southern suggestion. These are suggestions that the authors feel could affect the outcome of the costing exercise. It's best we work on these as we go, rather than at the end. Everyone wants this process to be robust. And we want to be transparent about receiving them. If you have further cost suggestions, please email foxgroundandberrybypass@rms.nsw.gov.au What we do is then consider whether they could affect costs in a large way, or only in a minor way. Large cost impacts are flagged priority issues. Colour coding correlates with the abbreviated version of the issues, Actions and Outcomes Register

Critical technical questions being raised

Update 29/05/2012

Key:

■ Property Acquisition
 ■ Deviating route south of sewage works
 ■ Earthworks
 ■ Kangaroo Valley Road pedestrian access
 ■ Structures and flood access
 ■ Application of allowances for climate change (sea-levels and rain intensity)

	Issue	Community view/suggestion put to RMS	Information and actions	Outcome
1.	Northern route: issue of pedestrian connectivity	<p>Access across the highway is currently limited to a single point at Kangaroo Valley Road interchange.</p> <p>Is this sufficient from a socio impact viewpoint?</p> <p>Argued that it is not and costings should include additional pedestrian connection points.</p>	<p>Information</p> <p>The Kangaroo Valley Road working group is examining this issue and there are likely to be significant improvements made to the interchange which will improve pedestrian connectivity.</p> <p>The North Street precinct working group was also given a commitment that RMS will explore pedestrian bridge concepts in relation to North Street.</p> <p>There is potential for an underpass connecting the Huntingdale Park Estate with Mark Radium Park and Victoria Street.</p>	<p>RMS to explore pedestrian bridge concepts in relation to North Street. Completed</p> <p>The likely cost of a pedestrian bridge, \$4.5 or \$5.5M has been considered against the benefits it would provide, in light of an improved pedestrian/cycle friendly KVR interchange. Having done so, RMS does not consider an additional pedestrian bridge over North Street provides value for money and is therefore currently not part of RMS's proposal.</p> <p>RMS has explored the feasibility of a pedestrian underpass between Huntingdale Park Estate and Mark Radium Park and Victoria Street. The underpass is not feasible as the extension of Queen St/onload ramp is too low to provide adequate height for an underpass and raising the road would result in large batters impacting Mark Radium Park or a large retaining wall adjacent to the duck pond.</p> <p>Completed</p> <p>RMS will continue to examine possible improvements to pedestrian connectivity through environmental assessment process and the subsequent detailed design process.</p> <p>Completed</p> <p>RMS will provide a cross-section of the Kangaroo Valley Road bridge to showing pedestrian connectivity in the environmental assessment.</p> <p>Completed</p>
2.	Northern route: drainage structures – main viaduct <i>Priority issue</i>	<p>The length of the main northern viaduct at 600m is too short to avoid flooding impact. Advice from the flood modellers is needed.</p> <p>Felt that the flood flow velocities at the northern route are likely to be significant as they occur opposite the confluence of Bundewallah and Connollys Creek.</p>	<p>Information</p> <p>Under the northern preferred route there would be a localised increase in flood levels upstream of the western embankment. Flood behaviour in this area has been documented in the Environmental Assessment report, which shows that flood levels would be increased by up to 0.3m in the 1 in 100 year ARI flood.</p> <p>A consequence of lowering the viaduct height at Woodhill Mountain Road is the western approach is close to ground level over its length up to Bundewallah Creek, approximately 50m to 75m. The height</p>	<p>The area below the bridge will no longer have public access as Shoalhaven Council no longer requires access under the bridge to a small section of Council land.</p> <p>Resolution of the clearance at the western abutment for maintenance access (1.8 metres required) is a matter for detailed design.</p> <p>Possible solutions for maintenance access are:</p> <ol style="list-style-type: none"> 1. Leave as is. 2. Raise the alignment of the western bridge approach to provide

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			<p>clearance from ground level to the underside of the bridge is approximately 1.5m in this area. The design of the embankment / road / bridge must be reviewed in this location to provide adequate height clearance and flood flow capacity at the same taking account of the environmental impact on the Bundewallah Creek riparian zone.</p> <p>Maps of the flood modelling undertaken for the northern alignment have been generated and are available in the RMS presentation of Monday 19 March 2012. Further mapping of the flood consequences of the southern suggestion has been completed.</p>	<p>clearance.</p> <ol style="list-style-type: none"> 3. Excavate under bridge to increase clearance. 4. Shorten bridge but add additional culverts. 5. Adjust the type and dimensions of the bridge at its western end. To be assessed in detail design 6. Combinations of 2 to 5 above <p>In addition under the current design, there is a minimum of 0.15m freeboard between the 100 year ARI flood level and the underside of the bridge structure. The vertical alignment of the bridge and flood level gradient is such that this minimum freeboard occurs over a relatively short section. The preferred minimum freeboard is 0.5m.</p> <p>Possible solutions for flood impacts are:</p> <ol style="list-style-type: none"> 7. Adjust the vertical alignment to achieve the minimum freeboard 8. Undertake further flood modelling to assess the implications of blockage to the area of the bridge where freeboard is less than 0.5m. <p>The flood modelling under item 8 will be carried out as part of the environmental assessment. If the modelling shows an adjustment of the vertical alignment is required, this will be carried out as part of the detailed design process.</p> <p>Completed</p>
3.	<p>Northern route: costing drainage structures required on a like for like basis.</p> <p><u>and</u></p> <p>The issue of a Berry flood evacuation route.</p> <p><i>Priority issue</i></p>	<p>Are several short bridge structures required between Schofields Lane and Croziers Road to avoid flooding?</p> <p><u>and</u></p> <p>A flood immune route would be provided as a consequence of the preferred option. The northern preferred route with ramps provide northbound out and southbound in flood free access through the Kangaroo Valley Road interchange.</p> <p>Whose responsibility to provide this – RMS or Council?</p> <p>The southern suggestion leaves Berry in its current form with no changes to the existing flood evacuation routes, currently provided by Queen Street through to Kangaroo Valley Road.</p> <p>If the southern route were to also have flood immune access, this would require an upgrade of the highway from town to the southern interchange with the highway?</p> <p>What would this cost and should it be included in the costings?</p>		<p>The Northern route provides access to Berry in a 1 in 100 flood event. To make a valid like for like comparison the Southern route must also provide the same level of service.</p> <p>Under existing conditions there are five waterway crossings between Victoria Street and Croziers Road, consisting of pipe or box culverts. Under both the northern and southern route options these existing culverts will be replaced with larger culverts or bridges to provide 1 in 100 year ARI flood immunity to the upgraded highway whilst minimising adverse flood impacts on adjacent development. The choice between a bridge or culvert crossing is based on the size and environmental significance of the waterway. The design approach adopted is consistent for both the northern and southern route options.</p> <p>The Technical Investigation Group has produced a preliminary design that identifies the road adjustments required to provide 1 in 100 year flood immune access to Berry with the southern option. Some culvert upgrades may be required, and the alignment may need to be raised slightly in limited sections.</p> <p>The designs have been adjusted accordingly, with the details shown in the cost estimate section of the report being produced.</p> <p>Completed</p>
3(a)	<p>Northern route drainage structures</p> <p><i>Priority issue</i></p>	<p>In designing the capacity of the culverts, allowance should be made for a lack of maintenance and reduced capacity due to silting up.</p>		<p>The design of the culverts is being undertaken in accordance with standard practice and guidelines, which takes into consideration measures to minimise or manage blockage and siltation.</p> <p>Completed</p>
4.	Southern route	Vertical alignment is nearing completion.	Information	Results from further flood modelling have been finalised and

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<p>option: the establishment of the design RL</p> <p><i>Priority issue</i></p>	<p>RL of existing structures proposed at 7.5.</p>	<p>The vertical alignment (elevation) along the southern route is being determined by the results becoming available through the technical investigations.</p> <p>Surveyed levels from along the route were compared to photogrammetric results at known points along the route. This comparison found that the photogrammetric measurements in the area are sufficiently accurate.</p> <p>The vertical alignment is being developed to provide appropriate clearance between the 1 in 100 year ARI flood level and the underside of bridge structures in accordance with the RTA Bridge Water Manual.</p> <p>The minimum elevation of the bridge deck with respect to flooding is determined by the 1 in 100 year flood level, plus an appropriate clearance (technically referred to as freeboard which is generally 0.3m to 0.5m), plus the thickness of the bridge and pavement.</p> <p>Flood behaviour south of Berry is influenced by a combination of flooding from the Shoalhaven River, as well as local flooding of Broughton Creek and its tributaries. There is detailed flood information available on flooding from these two separate mechanisms. The TIG is working through this information to determine how the combined influence of flooding from Shoalhaven River and Broughton Creek would affect the proposed road alignment in order to come up with the most appropriate flood level(s) applicable to the road alignment.</p> <p>Note the 100 year ARI flood level is not constant along the alignment. This level changes as a function of how far upstream the point of interest is. As such it is not appropriate to adopt a single value.</p> <p>Further flood modelling has been undertaken on the flooding behaviour to the south of Berry.</p> <p>This has involved adaptation of SMEC's flood model to tie into the boundary conditions of the Cardno flood model used in the Berry area. The flood model is based on a finite element analysis with a grid sample size of 3 x 3 metres equating to several million data points over the study area. High powered computers are required to process the data for many hours and both AECOM has organised computer run time over-night and weekends to undertake the modelling.</p> <p>Results and constraints will be documented in detail and water engineering consultants, Lyall & Associates (the independent flood and drainage reviewer) will review the results of the modelling.</p> <p>This additional flood modelling has provided more refined information about the flood levels and will be used to adjust the design.</p> <p>The preliminary results indicate the following revised alignments at two critical points:</p> <ol style="list-style-type: none"> 1. Hitchcocks Lane Creek (Ch16800): Prior information indicated a 100 year flood level of 5.1m, further modelling indicates a level of 5.0m 2. Southern abutment of bridge (Ch18600): Prior information indicated a 100 year flood level of 5.5m, further modelling indicates a level of 5.3m 	<p>incorporated into design.</p> <p>Completed</p> <p>An annotated long section has been produced to describe constraints and incorporated in the report.</p> <p>Completed</p>

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4(a)	<p>Vertical alignment for the southern suggestion. <i>Priority issue</i></p>	<p>Proposed revisions of the current design provided by a community member. It is believed the revisions will provide the most economical balance between cut & fill and reduce costs.</p> <p>Note: A minimum height for bridge structures at 7.5m AHD to allow flood clearance to the soffit of the Super T's. (assume 1.5m clearance) is currently proposed. The minimum height of the embankments should be on average 6.5m AHD on an equivalent basis, which provides for 0.5m freeboard.</p>	<p>Information</p> <p>The vertical alignment has been developed to achieve a design that addresses the following constraints / requirements:</p> <ul style="list-style-type: none"> - Crest curve heights driven by required clearances over the railway / road, structure thicknesses and allowance for road cross fall - Sag curve heights driven by required flood immunity, structure thicknesses and allowance for road cross fall - Requirement to comply with geometric standards required for a 100km/hr vertical alignment - Minimising poor coordination of horizontal and vertical alignment characteristics where possible (for safety, drainage and aesthetics) <p>Optimisation of the cut fill balance has been a consideration throughout and work is ongoing to optimise this. The study area for the mass haul analysis was extended to include Toolijooa to achieve the most cost effective design given the constraints above.</p> <p>A number of options for optimising the cut/fill earthworks balance have been identified and the impacts of these have been quantified. The group is currently assessing which of these options are to be incorporated into the design with consideration to their impacts on the environment, urban design and property acquisitions. In addition, the cost of the options is being assessed.</p>	<p>The design has been revised, and an adjustment item has been provided in the cost estimate which indicates the cost changes that would be required to balance the earthworks.</p> <p>Completed</p>
5.	<p>Climate change assumptions for the project, and the effect of the railway on flooding. <i>Priority issue</i></p>	<p>Have there been different assumptions between Berry and Gerringong projects?</p>	<p>Information</p> <p>The assessment of climate change impacts at Omega Flats on the Gerringong upgrade was carried out in accordance with the DECC Technical Guideline – Practical Considerations of Climate Change (2007). This approach is consistent with current floodplain management practice in NSW. Consequently, this approach is also being adopted for the north and south Berry options. In this way, a standardised approach is being adopted to assess the sensitivity of the different route alignments to potential variations in sea level rise and rainfall intensities as prescribed in the DECC guideline.</p> <p>The assumptions made for the Gerringong upgrade and the Foxground and Berry bypass are the same regarding rainfall and climate change. The level of documentation is different. This is because the level of documentation in a Review of Environmental Factors (prepared for the Gerringong upgrade) is different to that required for an Environmental Impact Study (being prepared for the Foxground and Berry bypass).</p> <p>For each project we have allowed for a 6% increase in rainfall intensity in accordance with the RMS design parameters specification document.</p> <p>The other consideration is the expected sea level rise. The influence of sea level rise on flooding depends on the location being considered. See response to 5(a) for more detail on this in relation to the Gerringong upgrade and Omega Flats.</p>	<p>Further documentation of the application of climate change allowances has been prepared and will be included in the report following review by the independent reviewer.</p> <p>Completed</p>

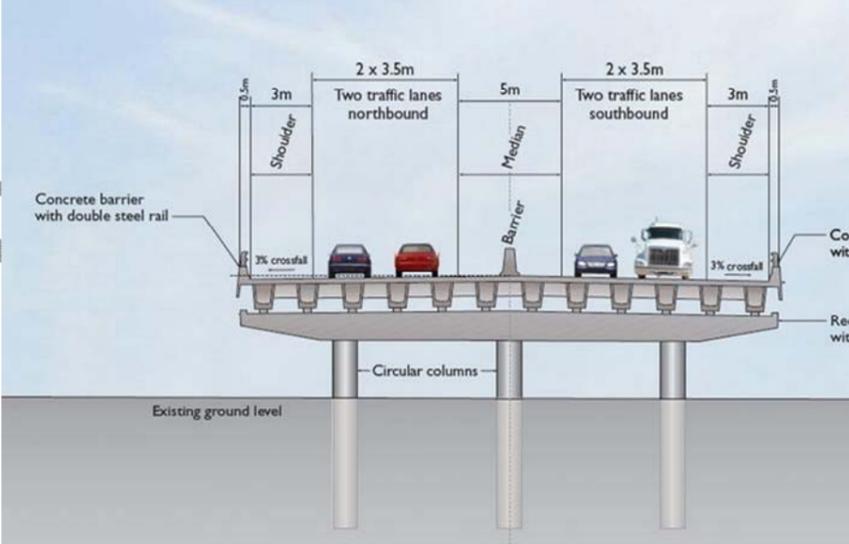
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		<p>What are the assumptions for the southern suggestion? Resident discussions with Shoalhaven City Council noted the assumed 100 year flooding level should be 5.05m</p> <p>The proposal of a centreline of 6m to cover super elevation is suggested, with a maximum road gradient of 2.5%.</p>	<p>Information</p> <p>Flood behaviour south of Berry is influenced by a combination of flooding from the Shoalhaven River, as well as local flooding of Broughton Creek and its tributaries. There is detailed flood information available on flooding from these two separate mechanisms. The TIG is working through this information to determine how the combined influence of flooding from Shoalhaven River and Broughton Creek would affect the proposed road alignment in order to come up with the most appropriate flood level(s) applicable to the road alignment.</p> <p>As part of this assessment, consideration is also being made to the potential impacts due to climate change in accordance with DECC Floodplain Risk Management Guideline – Practical Considerations of Climate Change (2007).</p>	<p>Compliance with prescriptive policy documents and specifications will be detailed in the report following review by independent reviewers.</p> <p>Completed</p>
		<p>The Cardno Flood Study has indicated that the rail embankment across Broughton Mill Creek overtops due to 3 creek openings through the embankment being under designed for the volumes & velocities of water passing through.</p> <p>The embankment acts as a weir resulting in backing-up of flood waters on the northern side until overtopping occurs. The top of the embankment at this point is at approx. R.L.6m, whereas the downstream side of the adjoining floodplain is about 3-4m. Suggested that easements under the railway be considered to improve floods topping the railway.</p> <p>The southern suggestion is south of the railway line. The height setting for the embankments on the southern alignment are not affected by this overtopping affect.</p>		<p>The project is related to the highway upgrade. Improvement works to the railway line to better manage flooding is not within the scope of the highway upgrade works. Shoalhaven Council is currently undertaking a floodplain management study for the Berry township and the issue of flooding of the railway line should be addressed through this process.</p> <p>It should be noted that consideration of flood impacts on the railway line is an important factor in the road design, to ensure that the current situation at the railway line is not made worse.</p> <p>It is RailCorp's responsibility to make necessary changes to the railway embankment to reduce the impacts of flooding.</p> <p>Completed</p>
5(a)	<p>Climate change assumptions for the project, and the effect of the railway on flooding.</p> <p><i>Priority issue</i></p>	<p>A community member disputes the RMS stated increase in tailwater of only 0.1m at the existing highway at the Omega Flats and believes that the Northern Route will be impacted by the Shoalhaven River tailwater rise.</p> <p>It is proposed that the consensus by the Local Councils of NSW (with the only exception being Pittwater Council) is that the possible increase in rainfall is not a proven scientific fact, with the likelihood that there will be a reduction in average rainfall by 2100, although there may be a greater intensity of the rain in such rain events.</p> <p>As such they do not model for increased rainfall in their flood predictions for climate change and this should be considered by the design.</p>		<p>At Omega Flats on the Gerringong upgrade the railway line is located east of the road alignment and forms a physical barrier to the flow of floodwaters. This causes an afflux between the flood level upstream (west) and downstream (east) of the railway line, with flood levels on the western side appreciably higher. This arrangement and its influence on flood behaviour means that variations in ocean levels are drowned out by the flood gradient that occurs across the railway line.</p> <p>The assessment of climate change impacts at Omega Flats was carried out in accordance with the Floodplain Risk Management Guideline – Practical Considerations of Climate Change (DECC 2007). This approach is consistent with current floodplain management practice in NSW. The Guideline recommends a sensitivity analysis of potential sea level rises of between 0.18m to 0.91m.</p> <p>RMS utilised a factor for increased rainfall intensity of up to 6% in the design of culverts and other structures for both alignments in accordance with risks identified in:</p> <p>"NSW Climate Impact Profile, Department of Environment, Climate Change and Water NSW, June 2010".</p> <p>Completed</p>

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6.	Town Creek diversion <i>Priority issue</i>	What exactly is the management proposal for Town Creek and its costs? Is RMS able to proceed with the diversion?		The current design of the Town Creek diversion comprises an asymmetrical open channel. The affected property owners prefer a 'box culvert' solution. RMS has met with affected property owners regarding potential design locations and issues for the diversion of Town Creek, A strategic estimate to construct an asymmetrical open channel diversion of Town Creek with a five cell, 2.1m by 2.4m box culvert giving vehicular access across the channel is \$1.4 million. RMS is able to proceed with the inclusion of the diversion in the environmental assessment if the project continues with a northern bypass of Berry. Completed
7.	Can we deviate to the south of the sewerage treatment works in order to create more clearance to the Miller Dairy on Wharf Road?		Information Initial examination of the specific change to route the alignment south of the sewerage treatment plant shows it will lengthen the route by approximately 200 metres which is unlikely to net any cost efficiencies. In addition, preliminary results from geotechnical fieldwork indicate that this deviation involves more construction in areas of deep soft soils than the base case design. The foundation requirements for such construction would be likely to increase the cost of construction significantly.	This proposed deviation has been assessed by the technical investigation group and has been included as a provisional item in the cost estimate. Completed
8.	Earthworks cost estimation <i>Priority issue</i>	Clarity required regarding the parameters for earthworks redesign and costing. Current process involves optimisation of cut and full across both northern and southern routes for earthworks costs to be considered. Suggested that the imported fill can be brought from the Toolijooa cut and cost of disposal of Toolijooa excess fill (\$35 per m3) could be avoided by using on Southern Option embankment. 400,000m3 noted. This would need early placement for settling. Otherwise costs for exporting soil need to be added into the equation.	Information The Toolijooa cut is included in the current optimisation process, to utilise excess fill to minimise the cost of the southern suggestion.	See Item 4a. The volume of material to be won/removed from the Toolijooa cut does not create an excess available for haulage to the south of Berry. The mass haul analysis indicates that all the material won/removed from the Toolijooa cut is required in the adjacent fills/embankments. The Northern alignment has balanced earthworks over the entire 11.5 kilometre project length and thus generates no surplus. There is therefore no cost associated with exporting excavated material from the Northern alignment. Completed
9.	Northern route and southern route tree removal	Both would result in tree removal Northern: Over 120 mature age (150 yr) eucalypt trees will need to be removed during road construction Southern: tree removal would be required.	Information Tree preservation is an important part of the environmental considerations for the project. This investigation is focused on preparing cost estimates for the two routes. At this stage, the technical investigations have been conducted into project aspects that have the most significant impacts on cost. This has not involved detailed consideration of environmental factors. For whichever route is progressed, environmental considerations including tree preservation will be considered in detail as design development proceeds to achieve the best project outcome.	RMS has included estimates for the cost of removal of mature trees for both routes in the cost estimate. These estimated have assumed that 120 mature trees will be removed for the northern option and 30 mature trees for the southern option. Completed
9(a)	Tree removal and realignment to the north.	Apart from the tree issue, the Arbour Village & the Bupa Village would both gain environmentally the increased distance created by realigning the route from Kangaroo Valley Road/Victoria Street, to the north away from	Information As discussed in Item 9, detailed consideration of environmental impacts occurs at a later stage of design development. This investigation has focused on project aspects with significant cost impacts.	Design refinements such as this one would be considered as the design is developed. The current concept design for the northern route shows widening on the northern side (i.e. adjacent to the existing northbound lane). Completed

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		the Arbour Village forest and further along the BUPA forest, this can be done by switching the widening to the northern side of the existing highway at these locations.		
10.	Property acquisitions <i>Priority issue</i>	Full cost information on required acquisition. Can costs for the southern suggestion be credited with the resale value of properties acquired (or to be acquired) on the northern preferred route - the difference could be \$20m?	Information and outcome A southern suggestion horizontal alignment has been designed and boundaries have been set for the southern suggestion. This has allowed RMS to quantify the required property acquisitions.	The estimate for the southern suggestion includes a credit for the resale of properties already purchased for the northern preferred route. The estimate for each route includes all property acquisition costs incurred to date. The property equation includes total costs on both alignments - acquisitions and disposals. The contingency applied to property acquisition costs has been determined in consultation with the independent cost estimating reviewer. The details of the methodology for determining property costs are included in the TIG report. Completed
11.	Access roads and local road adjustments	Design details required for northern and southern bypass route options	Information Access roads and local road adjustments are included in the concept design for the Northern route and will be developed in the design of the southern route. Access provisions will also include stock underpasses.	Drawings of access provisions and local road adjustments have been completed for both bypass routes. Costs have been included in the estimates and stakeholders will be able to examine these access provisions in the report. Completed
12.	Southern suggestion viaduct could be shortened by up to 500m by replacing a middle section with an island embankment (as done on the northern preferred route). <i>Priority issue</i>	A 500m embankment island is suggested, to half the length of the viaduct structure (cost savings could be about \$33m). Erosion controls would need to be costed. Can this be done with minimal impact on flooding? Noted that similar occurs with the northern preferred route design with the 200m extension to the viaduct's western abutment. An island embankment could be armoured, if necessary with Reno Mattresses or equivalent, plus a flood relief culvert located at about mid point along the embankment. Understand the flood flow velocities at the northern route are likely to be significant as they occur opposite the confluence of Bundewallah and Connollys Creek and near Broughton Mill Creek. (To be checked).	Information The proposed island embankment has been investigated in detail. This has included performing further modelling on the impacts of the island embankment on flood flow paths, impacting on upstream water levels (need to check distance) and the duration of flooding. The creeks affected are Broughton Mill and Broughton Creek. This further flood modelling has provided information about these impacts and this has been used to develop a feasible design incorporating this embankment. However, this embankment will be treated as a provisional item as the technical investigation group has assessed that a route with an island embankment is not the best engineering solution. The impact of this proposed island embankment is not the same as that of the northern route island embankments. The embankments are in different areas and subject to different flood behaviour. This island structure located in the riparian area of Broughton Creek may not be accepted in an environmental process, unless mitigation measures were employed. In terms of constructability, cost savings from the cheaper embankment may be reduced significantly with this suggestion, by a loss in efficiency in constructing multiple structures (i.e. two separated viaducts and an embankment instead of 1 continuous viaduct). There are two recent examples at Windsor and Kempsey, where the construction teams removed an island design to save time, offset the cost of additional bridge structure and reduce the	An island embankment has been assessed as a provisional item for the southern suggestion. Completed

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			<p>overall project cost.</p> <p>Preliminary results from the geotechnical fieldwork indicate that this embankment would be located in an area of relatively deep soft soils which would cause problems for settlement and stability. Addressing these problems would further increase the cost of this embankment, as well as increasing the risk profile.</p> <p>Documentation to be prepared for report on</p> <ul style="list-style-type: none"> - Risks - Impact of discontinuous construction - Precedents of inclusion or exclusion of equivalent embankments in other projects 	
12(a)	<p>Island embankment <i>Priority Issue</i></p>	<p>It has been suggested that an island embankment will result in a major cost benefit of approx. \$20m to \$25m (net). It is believed that the Technical Investigation Group is overstating the impacts of flooding to the island embankment.</p> <p>It is considered that the embankment could be compared to a typical flood levee embankment built running parallel to the flow of a river. The embankment has minimum impact on the Broughton Mill Creek / Broughton Creek Floodplain due to its small percentage cross-sectional profile across the combined floodplain of approximately 3.0%.</p> <p>The Island embankment location is well outside the riparian area, as such the environmental process should not be affected. Also, the existing rail embankment already impacts on the riparian area of Town Creek, Broughton Mill Creek & Broughton Creek.</p> <p>If it is considered that the Northern Option embankment is OK then the same logic must be used for the Southern Route Island Embankment in order to provide a "like for like" cost assessment as the conditions are nearly the same. Costing alternatives should be prepared for both having and not having an Island Embankment. Obviously the cheapest solution either way should be considered.</p>	<p>Information</p> <p>The Technical Investigation Group has considered the incorporation of an island embankment on the southern suggestion in detail. This assessment and actions are detailed in (12.)</p>	<p>See Item 12. Completed</p>
13.	Pier design	<p>Information on pier design requested:</p> <p>– can round piers be considered given most efficient hydraulic profile in respect of flood flow?</p>	<p>Information</p> <p>Yes they can be considered.</p> <p>The Berry bridge and northern interchange working group was given a commitment that RMS would further develop the design for the bridge, including pier design, which needs to be considered as part of an integrated bridge design – abutments, piers, headstocks, recessing etc.</p> <p>Advice from Aurecon (assisting on the bridge design) is that the design for the northern bridge would be broadly suitable for the</p>	<p>Completed</p> <p>Round piers have been included in the design for the large bridge for the northern alignment and the viaduct on the southern alignment.</p>

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			southern alignment main bridge, subject to geotechnical investigations which may require design changes.	
14.	Construction program and cost <i>High priority</i>	<p>If the soil is brought in straight from the Toolijooa excess fill, the construction time for the southern suggestion could be reduced compared to a stand alone project.</p> <p>Can the team assume for the southern suggestion preloading outside the construction contract period (as soon as soil from Toolijooa cut becomes available). This could reduce cost, due to only one operation of loading and unloading, without the need for double handling and a temporary dump/storage site with all its associated environmental costs.</p>	<p>Information</p> <p>There is no excess from the Toolijooa cut. The volume of material to be won/removed from the Toolijooa Cut is required in the adjacent fills/embankments.</p> <p>If this material won/removed from the cut was instead used for preloading the Southern alignment, then material would need to be imported for use in the fills/embankments in the northern section of the project adjacent to the Toolijooa cut.</p> <p>This also means there is no need for double handling and temporary storage.</p> <p>Work has been completed to optimise the earthworks balance to achieve the best cost outcome.</p> <p>Areas considered were:</p> <ol style="list-style-type: none"> 1. Reduction of embankment fill material by steepening batter slopes 2. Increase of material production by making cutting slopes shallower 3. Examining localised adjustments to the vertical alignment to generate fill 	See Item 4a. Completed
14(a)	Construction program and cost. <i>High priority</i>	<p>A community member has requested a Budget Estimate from a Picton based Earthmoving Company, who advise the following:-</p> <p>Based on 250,000m³ (guesstimate) of select fill (soil or rock), to be loaded at Toolijooa Cut, transported approx. 12.0 kms, to the Southern alignment, unloaded and return trip.</p> <p>The works to be completed within a 6 months duration.</p> <p>They allow 1.0 hour per return trip.</p> <p>They advise a total 14,500 truck movements (av. 150/day).</p> <p>Dump Truck + Dog Trailer:- 13 to 15 m³ or 33.00 tonnes/load</p> <p>Cost Estimate:-</p> <p>Loading 250,000m³ at Toolijooa Cut at \$1.00/m³ = \$ 250,000</p> <p>Heavy Haulage 250,000m³ Toolijooa Cut to Southern alignment at \$9.00/m³ = <u>\$2,250,000</u></p> <p>TOTAL = \$ 2,500,000 or \$10.00/m³.</p>	<p>Information</p> <p>The Technical Investigation Group has considered this feedback. Item 14 indicates there is no surplus fill.</p> <p>Work has been completed to optimise the earthworks balance to achieve the best cost outcome.</p> <p>Areas considered were:</p> <ol style="list-style-type: none"> 1. Reduction of embankment fill material by steepening batter slopes 2. Increase of material production by making cutting slopes shallower 3. Examining localised adjustments to the vertical alignment to generate fill 	See Item 4a. Completed
15.	Construction assumptions and the width of the bridge and roadway	<p>For the embankments – 4 traffic lanes with space in centre for 2 more lanes should be costed.</p> <p>For bridges – 4 lanes with piles, pile caps, piers and headstocks designed for a possible future</p>		<p>RMS road design requirements have been applied to the bridge and roadway for both the northern alignment and the southern suggestion.</p> <p>The typical cross section for a straight bridge is included in the project design assumptions: 1m inner shoulder, 2 x 3.5m lanes and 2</p>

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	<p><i>Priority issue</i></p>	<p>expansion to 6 lanes but not now (may not be needed for many years). This should be costed.</p>		<p>- 3m outer shoulder.</p> <p>The shoulder width needs to match the approaches. As most bridge approaches are on an embankment requiring 3m clearance to the concrete safety barrier this width has been carried over to the bridges.</p>  <p>Bridges on curves require additional widening to the median shoulder (up to a maximum of 2.5m) to provide stopping sight distance at 100kph of 175m.</p> <p>The design approach for the major bridge on both the northern alignment and the southern suggestion is the extra width would allow for the provision at some point in the future of an additional lane in each direction.</p> <p>Completed</p>
15(a)	<p>Construction assumptions and the width of the bridge and roadway</p> <p><i>Priority issue</i></p>	<p>Feedback from a community member suggests that at this stage 4 lanes only are required, and as such would envisage 2 separated carriageways of 2 lanes each would be built spanning off a common headstock.</p> <p>This feedback suggested that major cost savings could be made to both the Northern & Southern structures if the future 2 lanes were omitted (Super T's + insitu deck) at this stage but allowance made for future widening through the centre median.</p> <p>Such savings would not be limited to the direct construction savings only, but would be reflected in the capital investment saving (including interest, asphalt replacement & maintenance etc.) over the projected life of 100 years or up until such time that the future widening occurs.</p>		<p>The current designs have been developed according to RMS requirements for road design.</p> <p>RMS road design requirements for the project are for two lanes in each direction as well as minimum sight distance adjacent to the median barrier and cyclists.</p> <p>These design requirements have been applied to both route options resulting in the same road and bridge widths for both options.</p> <p>These design requirements may in future allow for the addition of an extra lane by providing an alternate route for cyclists and reducing shoulder widths.</p> <p>Completed</p>

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		<p>A community member suggested a number of bridge structure design amendments</p> <ul style="list-style-type: none"> - By utilising a post tensioned headstock, it may be possible to reduce the number of caissons & piers to 2 rather than 3 - For aesthetic and possible hydraulic reasons it may also be advantageous to utilise haunched Super T's bearing on a flush soffit headstock - For economic reasons consideration could be given to making the Super T's continuous over their supports. This would also be reflected for the insitu deck design of providing movement joints at say 200m centres to mitigate road noise. - Consideration could be given to casting the haunched Super T's on site and post tensioning them rather than setting up a pretensioning bed. - Continuity post tensioning could be introduced to make the Super T's continuous. The onsite casting may result in major savings in respect of transportation & handling 	<p>Information</p> <p>With regard to the technical suggestions relating to the bridge structure types and construction methods, design refinements would normally be assessed during the detailed design phase of a major project such as this one. For the purposes of consistency and as noted above, the same bridge type and construction methods has been applied to both bridges.</p> <p>Casting of precast beams on site has been investigated by the TIG due to the large number of precast beam elements on the project, particularly for the Southern Route suggestion.</p> <p>Haunched or "Step-Jointed" Super-Ts were investigated during the review of the Northern Viaduct. This gives the effect that the headstock support beams are buried within the bridge deck depth. Due to the large spans between piers, the benefits of providing an embedded headstock were found to be negligible in regards to the hydraulic performance. Based on discussions with the Urban Design Consultant CM+ and the Berry Bridge Working Group, it was agreed that a bridge deck placed onto the headstock beam was the preferred solution. It was also found that this pier solution is more cost effective when compared with a step-joint arrangement.</p> <p>The Super-T girders will be simply supported between piers, however the deck slab will be continuous between expansion joints. The expansion joints will be 200-300 m apart which would be finalised during the detailed design.</p> <p>Making the Super-Ts continuous over the supports to reduce the structural depth is something that can be looked at during a detailed design stage. It is noted however that on current Pacific Highway Upgrade projects for RMS, making Super-T bridges continuous is prohibited for skews greater than 1 degree or where girders in an adjacent span are not straight. The curved geometry of the Northern and Southern Viaducts would preclude the use of continuous Super-T bridges.</p>	<p>The TIG has included casting of precast beams on site in the estimates.</p> <p>Completed</p> <p>Post-tensioning Super-Ts in lieu of prestressing the girders is not recommended. Setting up a prestressing bed on site as part of the casting yard is a one-off cost and would be far less than the additional post-tensioning activities and quality control that would be required to post-tension the Super-Ts. If a post-tensioned concrete bridge structure was to be adopted at a detailed design stage, a match-cast segmental construction would be most likely, similar to the bridge RMS built for the Windsor Flood Evacuation Route in Sydney. The TIG believes that the current prestressed Super-T bridge option is one of the most cost competitive bridge types for the Berry Bypass.</p> <p>Completed</p>
16.	How are we costing noise/urban design considerations – especially on the southern suggestion?		<p>Information</p> <p>Noise and urban design considerations are recognised as an issue of major importance to the community.</p> <p>The northern option is at an advanced stage of design development and noise/urban design issues are being looked at in detail with community working groups formed to address these issues.</p> <p>The southern suggestion is currently being investigated for the purposes of cost estimate preparation. The investigation is focusing on the aspects with the largest impacts on cost.</p> <p>Should the southern suggestion be considered further following this investigation, detailed design refinements would be developed in consultation with the community. This is the stage at which noise and urban design considerations would be addressed in detail.</p>	<p>Requirements for noise barriers and property treatments have been assessed for the southern suggestion and included in the cost estimate.</p> <p>Completed</p>
17.	Urban Design	The Southern Route is not within an urban design area - therefore the same urban design principles as for the Northern Route should not be applied.		An integrated engineering and urban design approach is applied to all RMS projects in accordance with corporate policy applicable to projects in all settings and contexts. This approach is taken to achieve an appropriate, attractive and cost effective outcome which

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				fits sensitively within its built, natural and community environment. Urban design principles appropriate for the particular issues and opportunities of the southern route option would be developed to guide design development. Completed
18.	Rail infrastructure requirements <i>Priority issue</i>	The RailCorp representative states that the rail electrification cannot be incorporated in overhead structures. This statement is incorrect. The cost to the Southern Route could be further reduced if the RMS / RailCorp agreed that the duplication/electrification was not a design requirement for the future.		RailCorp determines design and construction constraints regarding their assets. They have stated that: <ul style="list-style-type: none"> • Overhead wiring cannot be incorporated within the bridge structure. • Provision must be made for duplication and electrification • Provision must be made for maintenance access Completed
19.	Provision for future lanes <i>Priority issue</i>	Further cost reductions can be made to both the Southern & Northern Routes by designing the superstructures of the Viaducts & Bridge Structures as dual 2 lane carriageways with the provision for 2 more future lanes, should they ever be required? The substructures would be designed to accept 6 lanes at this stage.		RMS road design requirements have been applied to both routes. These design requirements are for two lanes in each direction with 3 metre shoulders including provision for sight distance adjacent to the median barrier and cyclists. These design requirements have been applied to both route options resulting in the same road and bridge widths for both options. These design requirements may in future allow for the addition of an extra lane by providing an alternate route for cyclists and reducing shoulder widths. Completed
20.	Impact on aquifers in the Toolijooa ridge excavation		Information There is a potential to increase the impact on aquifers and the water table if the Toolijooa cutting is further excavated. This could have significant environmental impact and is of concern to the local community. Groundwater levels have been monitored a part of the geotechnical investigations at the Toolijooa cut by RMS. Monitored groundwater levels vary between 0.15m to 9m below ground level, with an average of 4m to 6m below ground level. Groundwater flows are expected into the cuts from depths of 1m to 3m during wet weather. Surface drainage measures will be required to dispose of this water. In addition, a drainage blanket will be provided at the base of the cut to ensure the proper long term performance of the pavement. These measures will locally reduce groundwater levels in the vicinity of the cut. A deeper cut can locally reduce groundwater levels further where groundwater flows through vertical joints or fissures in the rock.	The impacts on aquifers and the water table if the Toolijooa cutting is further excavated to provide additional fill material have been investigated and the results included in the TIG report. Completed
21.	Southern Route proposal, balanced earthworks to Croziers Rd	At the 30 April Q&A meeting RMS and the Independent Reviewers received a copy of a submission from a community member containing a new design proposal for the south route with costing information.	Information The Independent Reviewer advised the first exercise the TIG must undertake is an evaluation of whether the submission conforms to the RMS project design parameters and relevant design standards. Further consideration of the suggestion would be warranted if the design was compliant.	A written submission with a revised southern bypass route proposal was handed to the technical investigation group (TIG) and the independent reviewer by Mr. Bruce Ramsay on 30 April 2012. An initial reading of the submission was discussed at the TIG meeting held on 2 May 2012. The independent reviewer advised the first exercise the TIG must undertake is an evaluation of whether the submission conforms to the RMS project design parameters and relevant design standards. The results of this technical

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				<p>conformance and design strategy evaluation are listed below in no particular order. Where applicable, commentary is provided (<i>italics</i>) on the impact of the proposed design change to assist subsequent decisions.</p> <ol style="list-style-type: none"> 1. It was observed that the revised alignment is approximately 180m longer than the current southern option. 2. The curve at the northeast approach (approximate CH15000 to CH16000) appears to be a compound curve. <i>This type of curve is to be avoided as it introduces safety issues relating to driver perception in the change in curvature at speed. Traversing a compound curve changes side friction demand between tyres and the road surface with associated safety issues. This curve could be replaced with a single best fit curve of 750m radius and was used in attempting to digitally model this alignment.</i> 3. It appears that a short curve length (less than 300m) of 1500m radius is proposed between approximate chainages 18700 to 19000. <i>On high speed divided carriageways curve lengths less than 300m are to be avoided relating to driver perception in changing from straight to curve to straight at speed with associated safety issues.</i> 4. The proposed alignment enters the sewage treatment plant facility. 5. The proposed alignment runs along Broughton Mill Creek for approximately 200m. <i>The skew angle of the bridge creek crossing would likely require bridge supports within the creek's riparian area.</i> 6. The proposed alignment runs along Broughton Creek for approximately 150m. <i>It is likely, the embankment or embankment retaining structure would encroach the creek's riparian area.</i> 7. The proposed longitudinal vertical profile does not comply with design standards. An exercise to make the longitudinal vertical profile comply would fundamentally change the characteristics of the proposal, i.e. turning it into an inherently different alignment vertically with consequential impacts to the horizontal geometry and earthworks balance. The scale of such an exercise is beyond the scope of this evaluation. 8. There is a 4.3m clearance provided over the railway crossing No.1 (near Tannery Rd). <i>The minimum clearance required at this crossing is 6.5 m in accordance with RailCorp's requirements for the project. Clearances to railway crossings and local roads should be in accordance with the vertical height clearance requirements.</i> 9. The carriageway width appears to provide for two lanes in each direction in embankments and cuttings. <i>Provision is required for the future upgrade to three</i>

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				<p><i>lanes in each direction in line with the design parameters set out for the upgrade of the Princes Highway.</i></p> <p>The submission from Mr. Ramsay was provided to the TIG to assist in the development of the design for the southern bypass route. Based on this review the TIG considers the revised alignment not suitable for further consideration at this time and will continue working on the current design for the southern bypass route. Should the southern bypass route be selected as an option to be further developed in the future, some of the concepts proposed in this revision may be considered in the design development process.</p> <p>Completed</p>

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