Table 5-1 Implementation Plan

ID	Required Actions	Estimated Cost	Responsibility
Property Modification Measures			
P1	Adopt new Development Control Plan (DCP). Ongoing reviews of the DCP may be required to keep the controls up to date, particularly as climate change predictions change.	Low	Council
P2	Develop formal document providing guidance on appropriate limits for levees used to protect arable land in the lower Richmond River catchment - engage with Richmond River County Council (RRCC).	Low	Council / OEH / RRCC
P3	Investigate feasibility of raising the properties identified in the Ballina Floodplain Risk Management Study and draft Wardell Floodplain Risk Management Plan for consideration in a voluntary house raising scheme, i.e. how many are slab on ground and would therefore be cost prohibitive to raise. Consult with property owners to determine support for house raising proposal. Following the above two tasks, develop a list of properties to be included in the scheme and consult with OEH regarding the likelihood of gaining funding for works. Subject to funding approval, undertake voluntary house raising.	Low $40k per house $560,000 in total for Wardell	Council / OEH / Property Owners
P4	Integrate outcome of Ballina Major Retail Centre Strategy with Floodplain Risk Management Plan and Development control Plan as appropriate	Low	Council
Response Modification Measures			
R1	Engage DoCS to appraise the proposed evacuation centres and compose a list of adopted evacuation centres. Document the list of selected evacuation centres and capacities in the Local Flood Plan.	Low	DoCS / Council / SES
R2	Develop revised Local Flood Plan taking into account the following: • Evacuation procedures proposed in the draft Cabbage Tree Island and Wardell Floodplain Risk Management Plans (Worley Parsons 2009a and 2009b). • Evacuation routes and zones presented in the BFRMS. • Evacuation centres adopted through measure 'R1'. • Prioritising of flood warning to parts of Zone A which have the furthest to travel (see Figure D-10 in Appendix D of the BFRMS). Note that this recommendation would become redundant should road raising in Zone A, discussed in item 'R9', be undertaken. Develop and implement street signage strategy	Low	SES / Council

R3	Develop community engagement strategy to improve community awareness and preparedness.	$10k Ongoing	SES /Council
	Implement community engagement strategy.		
R4	Identify locations for additional gauges in the catchment. Install additional gauges in the catchment.	Low $150k	SES /Council
R5	Undertake further modelling to facilitate flood intelligence card development. Prepare flood intelligence cards.	$20k $20k	Council /SES
R6	Investigate and implement alternatives to door knocking for disseminating evacuation orders.	Low	SES
R7	Undertake feasibility study on potential flood warning and prediction systems. Engage BoM to discuss the possibility of extending their flood forecasting down to Ballina. Implement flood warning and/or predictive tool strategy.	$20k Unknown	Council / SES / BoM
R8	Investigate the potential to improve evacuation route capacity through raising low points on Moon Street, Kerr Street and River Drive (see Figures D-1 and D-6 in Appendix D in the BFRMS). Also consider other routes, such as sections of Tamarind Drive and River Street.	Depends on scope	Council
Flood Modification Measures			
F1	Undertake a preliminary design and detailed feasibility of the Gallans Road Cycleway/Footway. Consider potential environmental impacts in the feasibility assessment. Undertake detailed design and seek funding for the works. Subject to funding approval, community support and environmental assessment, construct proposed floodway.	$400,000	Council
F2	Council has considered a report and determined its preference is to lower the surface of Deadmans Creek Road to a level of 0.9mAHD. The level represents the preferred optimum balance between providing a level of flood immunity for the road and achieving a reduction in the impact of flooding for upstream property owners. Undertake detailed assessment and determine a solution for provision of satisfactory access service levels for Tamarind Drive, immediately north of Deadmans Creek Road. Lowering of Deadmans Creek Road not to proceed until implementation of solution for Tamarind Drive. Subject to funding approval, community support and environmental assessment, undertake the works.	$500,000	Council

F3	Consult with property owners and the Jali Aboriginal community to gauge support for construction of the proposed low level levee on Cabbage Tree Island. Undertake a detailed assessment of the costs, impacton flooding and potential environmental impacts associated with construction of the proposed levee. Also consider feasibility of the levee in terms of structural resilience to high flows. Prepare detail design drawings and seek funding for the works. Subject to funding approval, community support and environmental assessment, construct the deflector levee.	$500,000	Council
F4	Design and construct West Ballina flood relief culverts		Council/ Developers
F5	Design and construct waste transfer floodway		Council
F6	Design and construct development specific flood mitigation measures.		Council / Developers
F7	Consider recommendations from the Newrybar Swamp Flood and Drainage Assessment (ref: R.B17689.001.00.docx).		Council / RRCC
F8	Investigate the feasibility of alternative system of flood structural resources that may include a combination of levee, pump and floodgates to provide protection for the Ballina Island precinct.	$100,000	Council
General Flood RiskManagement			
G1	Maintain Flood Model.		Council
G2	ReviewFloodplain Risk Management Plan.		Council / OEH

BMT WBM

Our Ref: P.B21395.002_Ballina_Island

16 August 2016

Ballina Shire Council
PO Box 450
BALLINA
NSW 2478

BMT WBM Pty Ltd
Level 8, 200 Creek Street
Brisbane 4000
Queensland Australia
PO Box 203 Spring Hill 4004

Tel: +61 7 3831 6744
Fax: + 61 7 3832 3627

ABN 54 010 830 421

www.bmtwbm.com.au

Attention: Paul Busmanis

Dear Paul

RE: PRELIMINARY OPTIONS INVESTIGATION OF FLOOD MITIGATION ALTERNATIVES FOR BALLINA ISLAND AND WEST BALLINA

Further to our recent discussion and your subsequent email dated 1 August 2016, we have reviewed the documentation and have developed a scope of works for the preliminary options investigation of flood mitigation alternatives for Ballina Island and West Ballina.

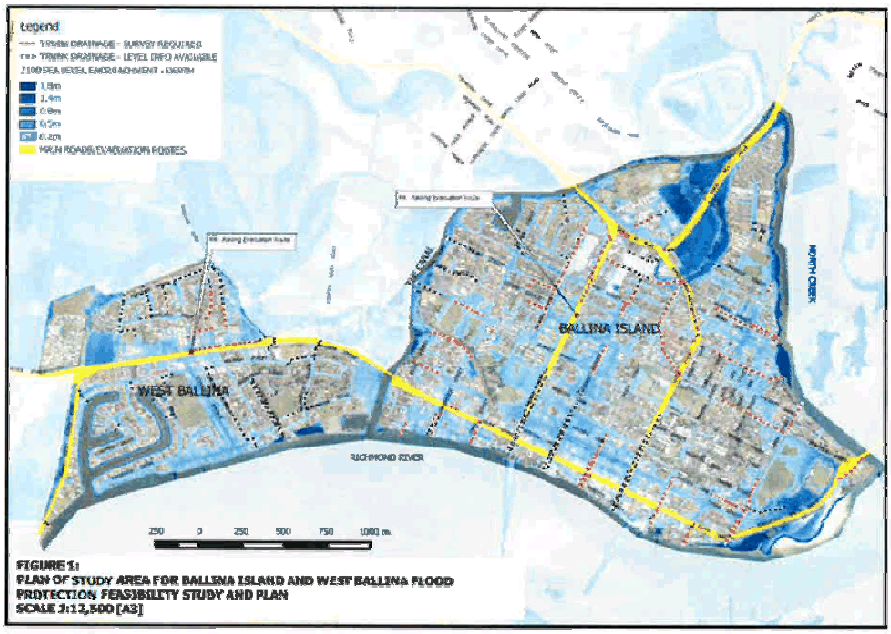

Figure 1 Study area

Background

Through the work that BMT WBM has undertaken for Ballina Shire Council and various other government and private sector stakeholders over the past 20 years, we have assessed a wide range of flood mitigation and management options. These have included:

- Flood modification (structural) measures, including:
  - Floodways, culverts and channel widening; and
  - River and creek dredging.
- Response modification measures, including:
  - Evacuation planning; and
  - Flood warning systems.
- Property modification, including:
  - House raising; and
  - Site filling.

Flood modification

The location of Ballina at the mouth of the Richmond River provides few opportunities for structural flood mitigation. The magnitude of flood discharges result in most structural approaches not being economically or environmentally viable. There are a few exceptions where there are localised benefits from such structural approaches, such as the West Ballina Flood Relief, and the constructed culverts beneath the Pacific Highway at West Ballina. To date, most flood modification measures have been associated with relieving flooding in urban and rural areas surrounding Ballina Island. The only approach to have been investigated to date which benefits Ballina Island is the potential dredging of the Richmond River mouth and North Creek.

Response modification

The Ballina Flood Risk Management Plan (BMT WBM, 2016) identifies a range of response modification measures, which have either been implemented, or will be further considered by Council during its ongoing commitment to building a flood resilient community.

Property modification

Following publication of the Ballina Flood Risk Management Plan (BMT WBM, 2015), Council updated its Development Control Plan to incorporate the latest flood modelling and consequent changes to Council's minimum fill policy. The updated policy has been designed to ensure Ballina continues to develop as a regional centre, whilst addressing the increasing risk of climate change.

We understand that Council are interested in further assessment of alternatives to site filling, with a particular focus on Ballina Island and West Ballina. Alternatives to filling include, but are not limited to levees, pumps and backflow prevention devices on stormwater mains. In early 2016, Council submitted an application to OEH for financial support for a detailed investigation into the alternatives.

In the interim period before funding is announced, Council have expressed an interest to commence work on the study. In response to your email request, we are pleased to submit this proposal of services for the preliminary options investigation of flood mitigation alternatives for Ballina Island and West Ballina.

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Scope of Works

We propose the following tasks to complete this study.

1. Collate available topographic data for Ballina Island and West Ballina and assess the best source of data for re-running flood models. Available data sources include:
    a. 2004 photogrammetry (vertical accuracy +-200mm)
    b. 2010 LiDAR from the NSW Department of Lands (vertical accuracy +-500mm)
    c. Ballina Shire Council ground survey

    We have included an optional item for collection of high accuracy topographic survey across Ballina Island using an unmanned aerial vehicle (UAV). The vertical accuracy from the UAV will be +-150mm, thus providing the most recent and accurate topographic dataset.
2. Re-simulate design events (for all three dominant sources of flooding) and climate change scenario events to develop detailed mapping of flood risk over Ballina Island and West Ballina. Produce 'heat maps' to show the frequency of flooding across the areas of interest. The refined 10m grid model shall be used for the modelling, rather than the 40m version developed for the Ballina Flood Study Update..
3. Collect (from Council) and map anecdotal evidence of overland flooding, including identification of trunk drainage where pipe leakage and failing flood gates are located. Confirm the reasons for overland flooding at each of the identified flooding 'hotspots'.
4. Develop a list of flood mitigation options to be investigated. Structural and non-structural methods shall be investigated including, but not limited to:
    a. Improved urban drainage
    b. Floodgates
    c. Levees and pumps
    d. Raising of evacuation routes

    Each option shall be qualitatively evaluated in the context of benefits, costs, ongoing operation and maintenance, disadvantages, feasibility for implementation, and social and environmental factors. Case studies where similar approaches have been used on other east coast towns shall also be included. Note, this does not include modelling each option.
5. Develop and present two preliminary mitigation strategies for discussion. Qualitatively consider the advantages and disadvantages in the context of the alternative of site filling.
6. Assess the preliminary 'worst case' flood impacts that could be expected for areas outside of Ballina Island and West Ballina. This is to inform future modelling and impact assessment. This exercise will demonstrate the absolute maximum impacts that would be generated should a flood mitigation scheme be implemented that eliminates all flooding from Ballina Island and West Ballina.
7. Present findings to Council and the community during an afternoon / evening information session.

Cost and Program

We propose to undertake this scope of works for a lump sum of **$24,225 excluding GST**. Should Council wish to include the option for high resolution topographic survey, then this will be an additional $10,000 excluding GST. The optional survey will cover the 6.4km^2 area shown in Figure 1.

Table 1 Cost Breakdown

	Task	Cost (ex GST)
1	Collate data and check accuracy	$2,660
2	Simulation of design events & CC	$3,710
3	Collect and map anecdotal evidence	$3,710
4	Assess mitigation options	$6,450
5	Develop 2 mitigation options	$3,225
6	Impacts	$2,660
7	Presentation	$1,810
	Total	**$24,225**
	Optional topographic survey	$10,000

We are able to complete the works within 4 weeks from commissioning.

Should you require any additional information or wish to discuss the contents of this letter, please do not hesitate to contact the undersigned on 07 3831 6744.

Yours faithfully

BMT WBM Pty Ltd

Ben Caddis

Senior Flood Engineer