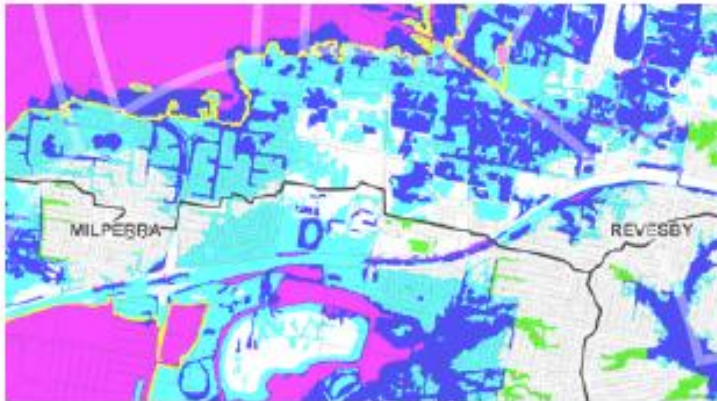


"Where will our knowledge take you?"



Floodplain Risk Management Study and Plan for Sub-Catchments of the Mid Georges River Draft Report

April 2016

Executive Summary

Reasons for the Study and Plan

Stormwater flood studies have been carried out for the seven sub catchments within the Mid Georges River study area. The primary objective of each of the stormwater flood studies has been to define the overland flood behaviour within the respective catchment through the establishment of appropriate numerical models. These models provide detailed information on the extent and depth of inundation for a range of design floods. The most recent stormwater flood studies for each of the seven sub-catchments were completed between 2009 and 2015.

In July 2012, BMT WBM was commissioned by Bankstown City Council to assist its Floodplain Management Committee in preparing a floodplain management study and plan for the seven sub catchments within the Mid Georges River study area. Assistance was provided during the course of the study by Grech Planners on planning and development control issues.

The floodplain management study further identifies the flood problem and investigates options to reduce these flooding problems. A plan of recommended actions works and initiatives for managing the overland flooding is also presented for Council to implement.

Responsibilities

The prime responsibility for planning and management of flood prone lands in NSW rests with local government. The NSW Government provides assistance on state wide policy issues and technical support. Financial assistance is also provided to undertake flood and floodplain risk management studies and for the implementation of works identified in any subsequent floodplain risk management plan.

Bankstown Council's Floodplain Management Committee oversaw the Study. This committee includes Councillors and staff from Bankstown City Council, staff from neighbouring Councils including Fairfield City Council, Hurstville City Council and Liverpool City Council, staff from the Office of Environment and Heritage, Sydney Water Corporation and the State Emergency Service. A number of community representatives are also members of the committee.

The Study Area

The Mid Georges River study area is comprised of seven sub catchments, namely, Milperra, Kelso Swamp, East Hills, Lucas Road, Picnic Point, Morris Gully and Little Salt Pan Creek. The sub-catchments are based on natural topographical divides and are bounded by the Georges River along the east and south of the study area. Encompassing a total area of approximately 30km², the study area represents a significant proportion of the 77km² Bankstown Local Government Area (LGA).

The study area incorporates the entire suburbs of Bankstown Airport, Milperra, Panania, East Hills, Picnic Point, Revesby Heights and parts of Georges Hall, Bass Hill, Yagoona, Condell Park, Revesby, Padstow and Padstow Heights.

A map of the study area is shown on Figure 1-1.

Executive Summary

Consultation

Community consultation has aimed to inform the community about the development of the floodplain risk management study and its likely outcome as a precursor to subsequent floodplain risk management activities. Consultation activities have included:

- Regular meetings with the Floodplain Management Committee;
- Establishment of project website (<http://midgeorgesfrmsp.bmtwbm.com.au>);
- Distribution of a community questionnaire and newsletter to 7600 properties in October 2013;
- Distribution of information leaflet and survey to 25 key stakeholders in August 2013;
- Eight community information sessions that were held during the course of the study; and
- The intended public exhibition of the draft FRMS&P.

Modelling of Flood Behaviour

The stormwater flood studies involved the development of numerical computer models to simulate overland flood behaviour through the sub-catchments of the study area. Bankstown City Council has adopted a consistent flood modelling approach across all sub-catchments in the Bankstown LGA. This approach uses combined two-dimensional (2D) and one dimensional (1D) hydraulic models developed using TUFLOW modelling software. These models are capable of modelling urban overland flow paths and the pipe drainage network, channels and creeks.

Overland flows are typical in urban environments where it is not feasible to design stormwater drainage to capture very large and infrequent flood events. Often the overland flow paths are aligned with roads, however, in some instances, houses and other property may be located on or to adjacent major overland flow routes. Flooding associated with overland flow exhibits different behaviour than mainstream flooding associated with the Georges River.

Flood Risk Management and Development Control

Floodplain management is focused on managing the risk of flooding across the floodplain. In doing so, it should be recognised that different parts of the floodplain are subject to different degrees of flood risk. The following flood risk precincts have been adopted for the study area:

- High Flood Risk. Land below the 100 year ARI flood level that is either located within floodway area, subject to a high hydraulic hazard (as defined in Figure L2 of the Floodplain Development Manual (DIPNR, 2005) or where there are significant evacuation difficulties.
- Medium Flood Risk. Land below the 100 year ARI flood level that is not subject to high hydraulic hazard and where there are no significant evacuation difficulties.
- Low Flood Risk. All land within the floodplain (i.e. within the PMF extent) but not identified as either in a high or medium flood risk precinct.
- Overland Flow Risk. Areas of shallow overland flow, typically less than 0.25m in depth in a 100 year ARI flood event and distant from a recognised watercourse or major drainage system.

The Flood Problem

A flood damages database has been prepared for the study area to quantify the flood problem and to assist in evaluating the merit of a range of flood mitigation measures.

The database includes details on 3,233 properties throughout the study area that could potentially be affected by flooding (in a 100 year flood). Flood damages for the seven sub-catchments of the Mid Georges River study area are presented in Table ES1.

Table ES1 Predicted flood damages for existing flood conditions

Sub-catchment	Damage in Flood Event (\$M)					Average Annual Damage (\$M)	Net Present Value of Damage (\$M)
	5 Year	20 Year	50 Year	100 Year	PMF		
Milperra	55.4	71.1	95.0	105.0	402.5	20.2	5.2
Kelso Swamp	7.9	10.1	11.3	13.3	41.6	2.7	0.7
East Hills	0.7	0.7	0.8	0.9	2.6	0.2	0.1
Lucas Road	3.9	5.9	9.1	10.4	16.5	1.5	0.4
Picnic Point	2.2	3.0	3.2	3.6	5.1	0.7	0.2
Morris Gully	3.7	5.4	6.0	6.7	11.3	1.3	0.3
Little Salt Pan Creek	9.2	14.8	16.5	19.0	42.9	3.5	0.9
Mid Georges TOTAL	82.9	111.0	142.1	158.8	522.4	30.2	7.8

Flood Mitigation Options Investigated

Areas with flooding problems have been identified throughout the study area on the basis of:

- The extent of inundation experienced throughout the study area, particularly those areas that experience a high flood risk as shown in ;
- The location of buildings potentially affected by above floor flooding, based on the flood damages database as shown in ;
- Feedback from the community through the community consultation exercises (as shown in) and subsequent community information sessions; and
- Information from Council and the Committee members.

Specific flood mitigation options for the study area are discussed in Chapter 7.

It will not be feasible to find solutions to all of the flooding problems within the study area, given the magnitude of the problem and the number of properties and buildings potentially affected by flooding. Where localised solutions are not feasible, other study area-wide measures will provide some benefit, such as planning and development controls, public awareness initiatives and emergency management operations. Further discussion on these types of measures is in Chapter 7.

Executive Summary

Recommended Floodplain Management Plan

The draft Floodplain Risk Management Plan for the sub-catchment of the Mid Georges River is summarised in Table ES2.

It is important to note that not all flooding problems in the study area have been alleviated. A complete solution to the flooding problem is not cost effective from a floodplain management perspective. However, problems can be reduced gradually over time as sensible redevelopment occurs in accordance with Council's planning controls.

Table ES2 Recommended Floodplain Management Plan

Summary of Proposed Actions, Works and Initiatives	Responsibility	Estimated Cost	Potential Funding Source	Priority
Ensure that flooding is duly considered by current planning policy and future reviews				
Prepare a Planning Proposal to amend LEP 2015 for Carinya Road area <ul style="list-style-type: none"> - Adopt an E4 Environmental Living zone for the Carinya Road area subject to development permitted with consent being extended to include environmental protection works, flood mitigation work, recreation area and roads. Note, the foreshore area including reserve, road and boatshed should remain separately zoned RE1 Public Recreation - Applying a minimum lot size of 1,000m² consistently across all existing housing lots. 	BCC	Staff Time	BCC	High
Replace Schedule 5 of the DCP in line with the Salt Pan Creek Catchment: <ul style="list-style-type: none"> - Adoption of overland flow flood risk precincts (FRP) - Separation of overland flow areas from the Medium FRP - The freeboard for development, where applied in the Overland Flow FRP has been reduced from 500mm to 300mm 	BCC	Staff Time	BCC	High
Amend DCP for Carinya Road Area <ul style="list-style-type: none"> - Amend the DCP to delete the provisions referring specifically to the Carinya Road area including in Clause 4.3.1, 4.3.2 and 4.3.3 of Part E and Schedules 4A, 4B and 4C. The general provisions relating to the Georges River would thereafter apply. 	BCC	Staff Time	BCC	High
Review Bankstown City Council Section 94A Development Contributions Plan 2009 <ul style="list-style-type: none"> - Consider whether any structural mitigation works identified by this FRMS (or others) should be funded (or partly funded) with S94A funds. 	BCC	Staff Time	BCC	High

Executive Summary

Summary of Proposed Actions, Works and Initiatives	Responsibility	Estimated Cost	Potential Funding Source	Priority
Ensure that the overland flow paths are maintained as part of any master plan prepared for the Panania and East Hills Centres	BCC	Staff Time	BCC	High
Ensure existing overland flow path from Eldridge Road through commercial units off Edgar Street is maintained or enhanced as redevelopment occurs.	BCC	Staff Time	BCC	High
Waterways and Water Quality Improvement Plan				
Implement Waterways and Water Quality Improvement Plan for sub catchments of the Mid Georges River	BCC	Refer to Georges River CZMP	BCC	High
- Georges River CZMP actions specific to study area	BCC	Staff Time	BCC	High
- Planning and policy	BCC	\$4,750,000	BCC	Medium
On-ground works	BCC		BCC	
Flood Proofing				
Investigate flood proofing through prioritisation of eligible properties and establishment of a funding model	BCC	Staff Time	BCC/OEH	Low
Voluntary Fence Modification				
Assess feasibility of establishing a voluntary fence modification scheme	BCC	Staff Time	BCC/OEH	Medium
Flood Forecasting and Warning				
Expand flood warning system on Milperra Drain at Ashford Avenue to Milperra Industrial Area	BCC	\$50,000	BCC/OEH	High
Develop a Riverine flood warning system for Carinya Road utilising existing gauge at Kelso	BCC	\$50,000	BCC/OEH	Medium
Investigate opportunities to develop a flood forecasting and warning system for overland flooding	BCC	\$10,000	BCC/OEH	Low
Improve Public Awareness				
Consolidation of the recent flood risk mapping, flood data and flood damages database into Council's GIS system.	BCC	Staff Time	BCC	High
Review flood affectation notations and provide flood certificates to residents	BCC, OEH	Staff Time	BCC, OEH	High
Expand on the flood information page on Council website	BCC, SES, OEH	Staff Time	BCC, OEH	High
Undertake ongoing community education programs	BCC, SES, OEH	\$30,000	BCC, OEH	High
Provide targeted awareness to residents living in high flood hazard areas	BCC, SES	\$10,000	BCC, OEH	High
Notify NSW Department of Education and Communities of schools located in flood prone areas	BCC	Staff Time	BCC	High
Install and maintain flood depth markers on roads affected by higher flood depths	BCC	\$20,000	BCC, OEH	High

Executive Summary

Summary of Proposed Actions, Works and Initiatives	Responsibility	Estimated Cost	Potential Funding Source	Priority
Emergency Response and Management				
Update and implement as required the Bankstown City Flood Emergency Sub Plan to include overland flood risks	SES	\$20,000	BCC, OEH	High
Provide advice to residents on preparing Personal Flood Plans	SES/BCC	\$10,000	BCC, OEH	High
Stormwater Drainage Network				
Review, update and implement stormwater drainage maintenance program	BCC	Staff Time	BCC	High
Implement a program for monitoring performance of OSD's	BCC	Staff Time	BCC	High
Localised Flood Mitigation Options				
Increase the size of existing detention at Surrey Reserve, Georges Hall <ul style="list-style-type: none"> - Undertake feasibility and design - Implement as part of any future upgrades to the park at Surrey Reserve 	BCC	\$25,000	BCC, OEH	Medium
Improve overland flow path between Endeavour Road and Rabaul Road <ul style="list-style-type: none"> - Liaise with residents regarding issues - Provide advice to residents on enhancing overland flow path via a voluntary fence modification scheme 	BCC	Staff Time	BCC, OEH	High
Undertake channel improvement works at 116-120 Milperra Road, Milperra <ul style="list-style-type: none"> - Consult with RMS regarding proposed solution - Pursue opportunities to improve channel conveyance as part of any future road upgrades to Milperra Road. 	BCC - consultation RMS – design / Construction	\$925,000	BCC, OEH, RMS	Low
Increase the size of existing detention basins at Bankstown Airport <ul style="list-style-type: none"> - Consult with BAL regarding proposed solution - Undertake further analysis on the feasibility of detention basins in Bankstown Airport in consultation with BAL 	BCC - consultation BAL – feasibility / design / construction	\$1,900,000	BAL	Low
Construct a detention basin within Deverall Park, Bankstown Airport <ul style="list-style-type: none"> - Consult with BAL regarding proposed solution - Undertake a detailed feasibility into developing a flood detention basin in Deverall Park in consultation with BAL 	BCC - liaison BAL – feasibility / design / construction	\$2,600,000	BCC/OEH	Medium
Undertake channel improvement works through Bankstown Golf Club, Milperra <ul style="list-style-type: none"> - Develop detailed designs - Implement works 	BCC	\$1,400,000	BCC/OEH	High

Executive Summary

Summary of Proposed Actions, Works and Initiatives	Responsibility	Estimated Cost	Potential Funding Source	Priority
Improve conveyance through the M5 noise wall at Tracey Street Reserve, Revesby <ul style="list-style-type: none"> - Consult with RMS regarding proposed solution - Implement works 	BCC – consultation RMS – design / construction	\$20,000	RMS	High
Increase the size of the culverts on Lucas Road Drain at Henry Lawson Drive, East Hills <ul style="list-style-type: none"> - Consult with RMS regarding proposed solution - Pursue opportunities to replace culverts on Henry Lawson Drive as part of future road upgrades 	BCC – consultation RMS – design / construction	\$600,000	RMS	Low
Construct a flood wall at Thomas Street, Picnic Point <ul style="list-style-type: none"> - Liaise with residents - Implement works 	BCC	\$110,000	BCC/OEH	High

Timing and Funding

The total cost for implementing the Floodplain Management Plan is estimated at \$13.45 million and represents relatively large financial implications for Council and other responsible authorities. This is largely as a result some large capital works being recommended.

The timing of the implementation of recommended measures will depend on overall budgetary commitments of Council and the availability of funds from other sources. Many of the Plan components can be implemented progressively with few barriers, particularly those elements requiring Council staff time only which may be undertaken within normal Council operations and budget. It is envisaged that the remainder of the Plan, particularly the structural options investigations, would be implemented progressively over say, a 15 year time frame.

Draft Floodplain Risk Management Plan

1 Draft Floodplain Risk Management Plan

1.1 Overview

The majority of overland flooding problems within the study area are as a result of past planning practices for development, and these problems have been compounded by lack of information on past flooding. In these instances, much of the older development has been undertaken without due consideration of natural drainage lines and appropriate provision for overland flow paths. Accordingly, many properties have been constructed across natural gully lines/overland flow paths, and in the instance where stormwater drainage system capacity is exceeded, excess flows are conveyed through property which in many areas results in property inundation.

The floodplain risk management study has considered a range of measures and options to minimise the adverse impact of flooding on existing property and future development. In addition to over-arching policy and study area wide floodplain risk management options, a number of flood modification options have also been considered for managing localised overland flooding issues in “hot-spot” areas.

This draft Plan forms the basis for further discussion with Council, the Floodplain Management Committee and the community, to consider further the recommended options in establishing a formal floodplain risk management plan for the Mid Georges River study area.

1.2 The Draft Plan

The draft Mid Georges River Floodplain Risk Management Plan has been developed to direct and co-ordinate the future management of areas affected by overland flooding in the Mid Georges River study area. The draft FRMP sets out a strategy of actions and initiatives that are to be pursued by agencies and the community in order to adequately address the risks posed by flooding. Development of the draft FRMP has been guided by the NSW Government’s Floodplain Development Manual (DIPNR, 2005).

Completion of the study and ultimately adoption of the recommended FRMP represents a major step in ongoing floodplain risk management in the study area with a number of positive outcomes including:

- That a number of options have been identified and recommended that would alleviate some of the impacts of overland flooding on the community;
- Once adopted, the FRMP can provide access to funding for council and property owners to implement a number of recommended actions;
- The recommended actions will inform Council's capital works program; and
- The FRMP recommends further investigations that will require active community involvement and engagement.

Draft Floodplain Risk Management Plan

1.3 Recommended Floodplain Management Options

The recommended floodplain risk management options are summarised in Table 1-1 together with details on what action need to be undertaken, responsibilities and a priority schedule. Figure 1-1 provides a layout of the proposed flood risk mitigation options.

Table 1-1 Summary of recommended flood risk management options

Summary of Proposed Actions, Works and Initiatives	Responsibility	Estimated Cost	Potential Funding Source	Priority
Ensure that flooding is duly considered by current planning policy and future reviews				
Prepare a Planning Proposal to amend LEP 2015 for Carinya Road area <ul style="list-style-type: none"> - <i>Adopt an E4 Environmental Living zone for the Carinya Road area subject to development permitted with consent being extended to include environmental protection works, flood mitigation work, recreation area and roads. Note, the foreshore area including reserve, road and boatshed should remain separately zoned RE1 Public Recreation</i> - <i>Applying a minimum lot size of 1,000m² consistently across all existing housing lots.</i> 	BCC	Staff Time	BCC	High
Replace Schedule 5 of the DCP in line with the Salt Pan Creek Catchment: <ul style="list-style-type: none"> - <i>Adoption of overland flow flood risk precincts (FRP)</i> - <i>Separation of overland flow areas from the Medium FRP</i> - <i>The freeboard for development, where applied in the Overland Flow FRP has been reduced from 500mm to 300mm</i> 	BCC	Staff Time	BCC	High
Amend DCP for Carinya Road Area <ul style="list-style-type: none"> - <i>Amend the DCP to delete the provisions referring specifically to the Carinya Road area including in Clause 4.3.1, 4.3.2 and 4.3.3 of Part E and Schedules 4A, 4B and 4C. The general provisions relating to the Georges River would thereafter apply.</i> 	BCC	Staff Time	BCC	High
Review Bankstown City Council Section 94A Development Contributions Plan 2009 <ul style="list-style-type: none"> - <i>Consider whether any structural mitigation works identified by this FRMS (or others) should be funded (or partly funded) with S94A funds.</i> 	BCC	Staff Time	BCC	High
Ensure that the overland flow paths are maintained as part of any master plan prepared for the Panania and East Hills Centres	BCC	Staff Time	BCC	High
Ensure existing overland flow path from Eldridge Road through commercial units off Edgar Street is maintained or enhanced as redevelopment occurs.	BCC	Staff Time	BCC	High

Draft Floodplain Risk Management Plan

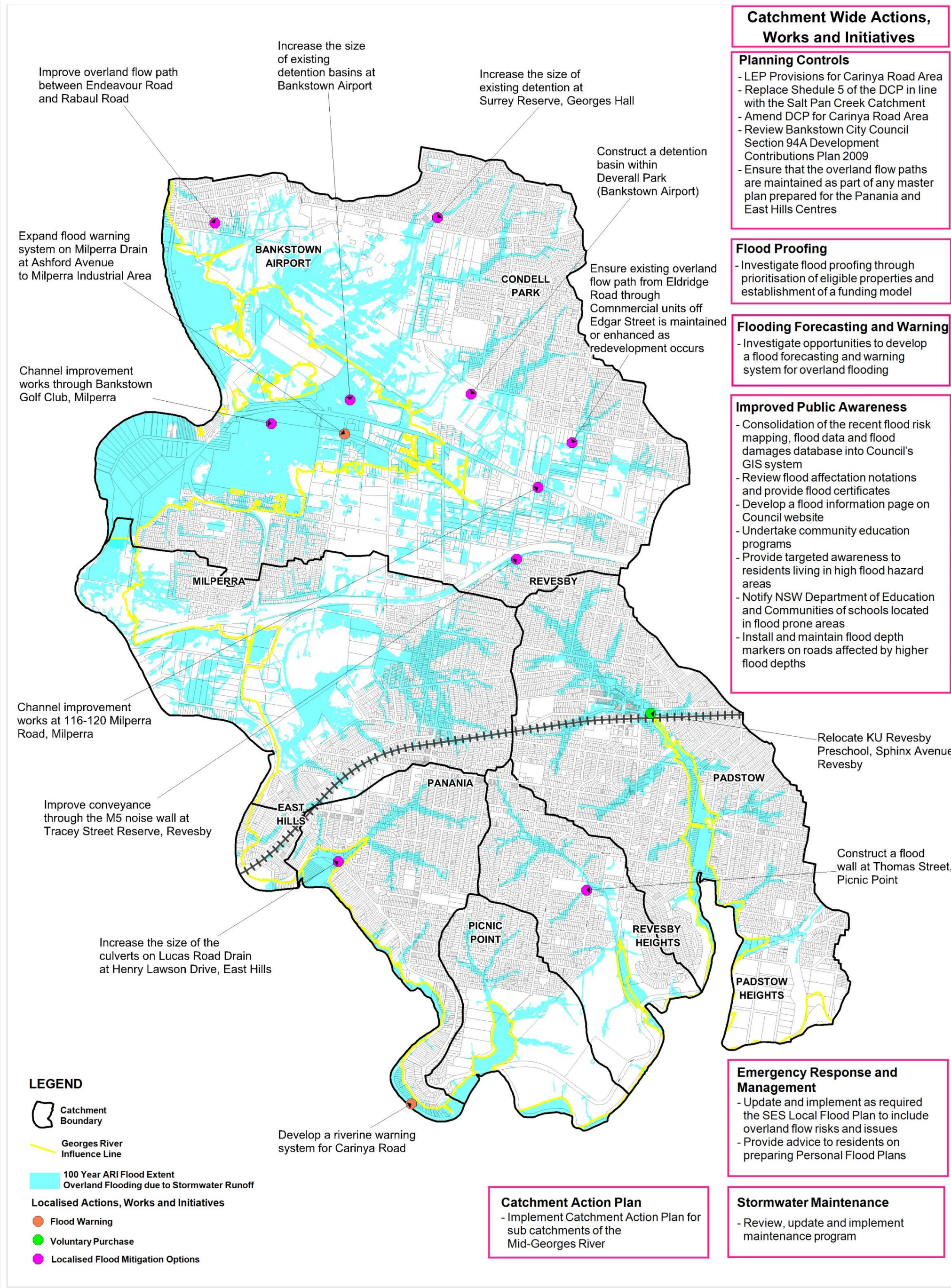
Summary of Proposed Actions, Works and Initiatives	Responsibility	Estimated Cost	Potential Funding Source	Priority
Waterways and Water Quality Improvement Plan				
Implement Waterways and Water Quality Improvement Plan for sub catchments of the Mid Georges River	BCC	Refer to Georges River CZMP	BCC	High
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On-ground works	BCC		BCC	
Flood Proofing				
Investigate flood proofing through prioritisation of eligible properties and establishment of a funding model	BCC	Staff Time	BCC/OEH	Low
Voluntary Fence Modification				
Assess feasibility of establishing a voluntary fence modification scheme	BCC	Staff Time	BCC/OEH	Medium
Flood Forecasting and Warning				
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Improve Public Awareness				
Consolidation of the recent flood risk mapping, flood data and flood damages database into Council's GIS system.	BCC	Staff Time	BCC	High
Review flood affectation notations and provide flood certificates to residents	BCC, OEH	Staff Time	BCC, OEH	High
Expand on the flood information page on Council website	BCC, SES, OEH	Staff Time	BCC, OEH	High
Undertake ongoing community education programs	BCC, SES, OEH	\$30,000	BCC, OEH	High
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Stormwater Drainage Network				
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Draft Floodplain Risk Management Plan

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Construct a flood wall at Thomas Street, Picnic Point <ul style="list-style-type: none"> - Liaise with residents - Implement works 	BCC	\$110,000	BCC/OEH	High



1.3.1 Planning Controls

Land use planning and development controls are key mechanisms by which Council can manage flood affected areas with the Mid Georges River study area. These controls could maximise the compatibility of new developments with flood risk and allow for existing flooding issues to be gradually reduced over time as re-development takes place.

A summary the suggested recommendations relating to planning controls are as follows:

- Any master plan prepared for the Panania and East Hills Centres should ensure that the overland flow paths are maintained;
- Bankstown City Council Section 94A Development Contributions Plan 2009 should be reviewed to consider whether any structural mitigation works identified by this FRMP (or others) should be funded (or partly funded) with S94A funds.
- Climate change flood risk associated with overland flow flooding does not warrant the introduction of specific planning controls at this stage. The decision to apply planning controls to address climate change flood risks should be based on broader policy considerations undertaken on an LGA wide basis.
- The FRMP should endorse the recommendations of previous FRMPs (Georges River FRMP and Salt Pan Creek FRMP) regarding the format and content of the Bankstown LEP 2015. The LEP 2015 generally reflects these recommendations and is supported other than as stated below:
- Prepare a Planning Proposal to amend LEP 2015 to:
 - Adopt an E4 Environmental Living zone for the Carinya Road area subject to development permitted with consent being extended to include environmental protection works, flood mitigation work, recreation area and roads. Note, the foreshore area including reserve, road and boatshed would be separately zoned RE1 Public Recreation.
 - Applying a minimum lot size of 1,000m² consistently across all existing housing lots.
- Adopt the DCP changes for overland flow flooding that have been recommended as part of the Salt Pan Creek FRMP.
- Delete the provisions of the DCP referring specifically to the Carinya Road area including in Clause 4.3.1, 4.3.2 and 4.3.3 of Part E and Schedules 4A, 4B and 4C. The general provisions relating to the Georges River would thereafter apply to this area.

1.3.2 Waterways and Water Quality Improvement Plan

The Mid Georges River WWQIP identifies opportunities for improving stormwater movement and managing stormwater pollutants through a series of recommended actions (refer to Chapter 9 for further information). The FRMP recommends that actions, works and initiatives identified in the WWQIP are implemented.

The Mid Georges River WWQIP identified that the Georges River CZMP actions were relevant for incorporation into the WWQIP. Further information on the estimated costs for implementing the

CZMP actions is in the Georges River CZMP (BMT WBM, 2012). A number of additional actions were also identified to assist to achieve the aims and objectives of the CZMP and the Mid Georges River WWQIP. These additional actions have been integrated into the existing aims and best management options adopted from the CZMP and include policy recommendations and on-ground works. The estimated costs of implementing these additional actions are \$4.75 million.

1.3.3 Relocation

KU Revesby has been identified as being at significant risk of flooding based on a true hazard assessment. KU Revesby Preschool is a Council owned property and it recommended that Council cease leasing the premises to the preschool with the aim to have the preschool relocate to an alternate location.

It is recommended that Council consider rezoning the land for flood compatible use. A change in land use provides opportunities to improve the conveyance along the over land flow path through the removal of obstructions at the railway culvert inlets.

The total estimated cost of this option is \$0.8 million and has been assigned a high priority for implementation given the risk to life posed at this location. The option is considered to have some minor social impacts with the relocation of school children to alternative accommodation. The option provides opportunities for environmental enhancement by returning developed land to park land.

As an interim step to completing the relocation, Council, under its duty of care, has advised the preschool of the flood hazards to allow for the preparation of a flood plan for the school.

1.3.4 Flood Proofing

Given the generally shallow depth of overland flooding and potentially low economic feasibility of major stormwater drainage system upgrades, flood proofing is seen as an effective measure for much of the existing property constructed across natural overland flow paths.

It is recommended that the majority of costs for this option are borne by the home owners as part of building renovation works. It is recommended that Council given consideration to establishing a funding model to provide some financial support to eligible properties in undertaking flood proofing. Information in the damage database could be used to identify eligible properties.

The option is considered to have negligible social and environmental impacts and has been assigned a low priority.

1.3.5 Flood Forecasting and Warning

It is recommended that Council expand the existing flood warning system on Milperra Drain to provide flood warnings to commercial businesses with the Milperra Industrial Area. Flood warnings would be issued based on appropriate trigger levels and rate of rise of flood levels in Milperra Drain. The flood warnings would be issued to businesses within an appropriate zone of influence from the gauge. Appropriate flood warning trigger levels and approaches for dissemination warnings would need to be investigated as part of any detailed design. The estimated cost of this

Draft Floodplain Risk Management Plan

option is \$0.05 million and is considered a high priority given the extent and frequency of flooding and the availability of existing flood warning telemetry.

It is recommended that Council pursue opportunities to improve flood warnings for Georges River flooding at Carinya Road. The existing gauge telemetry at Kelso Levee could be utilised to provide more accurate flood warnings to Carinya Road. Appropriate flood warning trigger levels and approaches for dissemination warnings would need to be investigated as part of any detailed design. The estimated cost of this option is \$0.05 million and is considered a medium priority given the adequacy of the existing warning services provided for this area.

As data collection methodologies, forecast rainfall products and 2D flood models advance, there will be opportunities to use 2D flood models for operational flood forecasting and flood warning for overland flooding. It is recommended that Council explore opportunities for developing an overland flood forecasting and warning system as technologies advance.

These options are considered to have positive social impacts through improved awareness of flooding in the community. The option is not considered to have any environmental impacts.

1.3.6 Improved Public Awareness

There are numerous mechanisms to inform the community and the following actions are recommended:

- Consolidation of the flood mapping, flood data and flood damages database prepared during this FRMS into Council's computer based GIS system.
- Provide information on the flood risk and the flood levels that apply to a particular property on a special flood certificate. These certificates could be;
 - Appended to the Section 149(5) certificates.
 - Provided whenever flood information is requested for a property.
 - Provided on a regular basis to all residents in the study area.
- Expand on the existing flood information page on Council's website by providing material on flood awareness and preparedness.
- Undertake ongoing community education programs to remind the community of the flood risks and measures to reduce the flood risk.
- Notify NSW Department of Education and Communities of schools located in flood prone areas. The NSW Department of Education and Communities requested this information so a Flood Plan can be prepared for the schools in question.
- Install and maintain flood depth markers on roads affected by higher depth overland flows. These markers would provide flood hazard information based on the depth of flooding. The markers would be located along Milperra Road, Henry Lawson Drive (Monash Reserve, Lambeth Reserve and Yeramba Lagoon), The River Road at Sphinx Avenue and Uranus Road at the Little Salt Pan Creek crossing.

- Provide targeted consultations for people living/working in high risk areas. This would involve one on one meeting between Council/SES and residents to provide site specific information on the flood risks and advice on actions during a flood event.

The total estimated costs to implement all of the actions, works and initiatives identified for an improved public awareness campaign is \$0.06 million. These actions have been assigned a high priority as they provide an effective tool in highlighting the flood risks to the community at a relatively low cost. These options are considered to have positive social impacts through improved awareness of flooding in the community. The option is not considered to have any environmental impacts.

1.3.7 Emergency Response and Management

Information generated as part of this FRMS, including flood mapping and the flood damages database provides a valuable dataset on which to update the Bankstown City Flood Emergency Sub Plan for overland flooding issues within the study area. Whilst this is normally the responsibility of the SES, assistance could be offered through the Floodplain Management Committee to assist in the development and review of the Bankstown City Flood Emergency Sub Plan.

In recognition of the potential for limited external support and requirement for self-help associated in an overland flood event, it is recommended that households prepare Personal Flood Plans. These plans are undertaken to determine steps to prepare for a flood event, respond when a flood event occurs and recover after the flood event.

The total estimated cost to implement emergency response actions, works and initiatives is \$0.03 million. These actions have been assigned a high priority as they provide an effective tool in managing the flood risk to the community. These options are considered to have positive social impacts through both improved awareness and management of flooding. The option is not considered to have any environmental impacts.

1.3.8 Stormwater Maintenance

One of the more dominant issues raised by the community as part of the community consultation related to the perceived lack of maintenance by Council to keep the stormwater system clear of leaves and other rubbish. A review of Councils maintenance program for the study area is recommended. It is also recommended undertaking regular street sweeping to help reduce blockage problems.

The option is considered to have a high priority. The option will have a positive social impact by providing the community with a visual reminder of Councils commitment to maintaining the stormwater system. The option is not considered to have any environmental impacts.

1.3.9 Voluntary Fence Modification

Modification of fences to allow for the free flow of floodwaters is considered to be a potentially cost-effective option particularly in areas such as Endeavour Road, Georges Hall, where other structural flood mitigation options are not cost-effective. It is recommended that Council commence investigating the feasibility of establishing a voluntary fence modification scheme, in consultation with OEH.

The initial assessment of the feasibility of the scheme will require staff time. The possible costs of the scheme and its social and environmental impacts can be assessed if and when the scheme is determined to be feasible.

1.3.10 Localised Flood Mitigation Options

1.3.10.1 *Increase the Size of Existing Detention at Surrey Reserve, Georges Hall*

This option would involve increasing the existing detention storage in the park by raising the footpath along the southern boundary of the park. This option would be combined with improvements to the covered pit located within the park to convert it to an outlet flow control structure.

The cost of the works is estimated to be \$0.025 million. No environmental issues were identified and the option would reduce flood risk to 3 properties providing positive social benefits. The option has been assigned a medium priority and it is recommended that Council pursue it as part of any future upgrades to the park at Surrey Reserve.

1.3.10.2 *Improve Overland Flow Path between Endeavour Road and Rabaul Road*

Flooding occurs through a number of properties on Endeavour Road. Flooding accumulating at a sag point on Endeavour Road activates an overland flow path through properties on Endeavour Road. With no dedicated overland flow path, properties are affected as the overland flow continues along the natural gully line southwards to Rabaul Road and into Bankstown Airport land. Flooding is exacerbated by boundary fences and building located along the overland flow path. Overland flow depths for the 100 year ARI event are generally less than 0.25m.

Given the relatively shallow flow depths, the property database indicates no flood damages to properties at this location for the 100 year ARI event. It is noted that although brick walls and fences could significantly affect local overland flood flow paths through these properties, these have not been explicitly incorporated into the flood model, and were instead considered in the setting of appropriate land use roughness values. Recent flood events indicate that these local features affect the flood depth and property flooding at this location.

The ponding effect in the sag point and activation of the overland flow path can only be removed if sufficient drainage system capacity is provided. Increasing the capacity of the drainage network in this location is however not cost-effective due to the lengths of pipe required, downstream channel constraints and that flood modelling indicates very little reduction in flood levels from the drainage upgrade. There is also the residual risk of flooding as a result of larger events exceeding the design capacity and through potential blockages of the system.

The option of increasing the capacity of the culvert underneath Rabaul Road just to the west of the intersection with Tower Road / Link Road, and establishing an open channel connection to the existing open channel on BAL land, was investigated. Modelling revealed only minor reductions in flood levels which were constrained to the immediate vicinity of Rabaul Road.

Given these constraints, it is recommended that Council explore the option of voluntary fence modification with local property owners in order to improve overland flow path. Given the frequency of flooding, this has been assigned a high priority. The option is not considered to have any

environmental impacts and would provide some social benefits through reduced risks and inconveniences associated with flooding.

1.3.10.3 Channel Improvement Works at 116-120 Milperra Road, Milperra

Flooding within the Milperra Industrial Area affects a large number of commercial properties. An assessment of the feasibility of reducing flood risk from a tributary of Milperra Drain at Condell Business Park was undertaken. This option would involve the removal of vegetation, the widening of a channel and the replacement of existing structures with new larger capacity structures. A low flood embankment would also be constructed along the left bank of the channel.

The estimated costs of these works are relatively high at \$0.93 million. The assessment of economic benefits for this option indicates a Benefit Cost Ratio (BCR) of 2.6. The majority of the costs are driven by the need to replace the culverts under Milperra Road. As the option is relatively ineffective without improvements to the size of the culverts under Milperra Road, it is recommended that this option is pursued of as part of future upgrades to Milperra Road. This option has been assigned a medium priority. It is assumed that construction costs for the culvert replacements on Milperra Road would be borne by RMS with the remaining works potentially funded by Council/OEH.

There are potential environmental impacts with this option associated with the engineering works to widen and deepen the existing channel. These environmental impacts would need to be assessed as part of the detailed design. The option would reduce flood risk to commercial properties providing social benefits through reduced risks and inconveniences associated with flooding.

1.3.10.4 Increase the Size of Existing Detention Basins at Bankstown Airport

This option would involve increasing the size of the existing detention basins north of McDonald's, Milperra Road and south of the roundabout on Nancy Ellis Leebold Drive to mitigate the impacts of development at Bankstown Airport on flood levels at Milperra Road.

The estimated costs of this option are relatively high at \$1.9 million and would be borne by BAL. The option reduces flood risk to Milperra Road however, it does not eliminate the flooding issues on Milperra Road and does not reduce flood risk at any properties. It is recommended that further analysis is undertaken on the feasibility of this option given the benefits provided. The option is considered a low priority.

No environmental issues were identified with this option. The option would reduce flood risk to Milperra Road providing social benefits through improved transport access during times of flood.

1.3.10.5 Construct a Detention Basin within Deverall Park, Bankstown Airport

This option would involve the development of a detention basin at Deverall Park, Bankstown Airport, through the construction of a dam embankment, outlet control structure and a spillway structure. The detention basin would reduce flood risk to commercial buildings within the Milperra Industrial Area.

The estimated costs of this option are relatively high at \$2.6 million and would potentially be funded through OEH and Council. The assessment of economic benefits for this option indicates a BCR of 0.95. This option has been assigned a medium priority.

There are potential environmental issues with this option associated with bushland adjacent to Deverall Park. It is zoned an “Environmental Protection Zone” and is protected from clearing. The option would reduce flood risk to commercial properties providing social benefits through reducing risk and inconveniences associated with flooding.

It is recommended that Council progress with a detailed feasibility into the viability of this option in consultation with BAL.

1.3.10.6 Channel Improvement Works through Bankstown Golf Club, Milperra

Council has recently tendered (December 2015) for the investigation and Design of Milperra Drain Widening Scheme. The option would help reduce the flood risk along Milperra Drain and provide benefits to the commercial areas within the Milperra Industrial Area. It is recommended that Council pursue this option through to construction and it has been assigned a high priority.

The estimated costs of this option are high at \$1.4 million and would potentially be funded through OEH and Council. The assessment of economic benefits for this option indicates a BCR of 2.2.

There are potential environmental impacts with this option associated with the extensive engineering works to widen and deepen the channel. These environmental impacts would need to be assessed as part of the detailed design. The option would reduce flood risk to Milperra Industrial Area providing social benefits through reducing inconveniences associated with flooding.

1.3.10.7 Improve Conveyance through the M5 Noise Wall at Tracey Street Reserve, Revesby

This option would involve the provision of improved conveyance through the M5 noise wall at the north-eastern corner of Tracey Reserve to reduce flood risk to properties on Alliance Avenue. The flooding is exacerbated by the M5 noise wall which impounds water within the park.

The estimated costs of this option are low at \$0.02 million. The assessment of economic benefits for this option indicates a BCR of 6.7. It is assumed that construction costs for the works would be borne by RMS. The option has been assigned a high priority given the limited works required to achieve a reduction in flood risk

No environmental issues were identified with this option. The option is considered to provide social benefits through reducing risk and inconveniences associated with flooding.

1.3.10.8 Increase the Size of the Culverts on Lucas Road Drain at Henry Lawson Drive, East Hills

Out of bank flooding from Lucas Road Drain results in flood risk to a number of properties immediately upstream of Henry Lawson Drive. Construction of new larger capacity culverts under Henry Lawson Drive improves the conveyance along Lucas Road Drain and reduces the flood risk to properties.

The estimated costs of these works are relatively high at \$0.6 million which is driven by the expenses of undertaking works on Henry Lawson Drive. The assessment of economic benefits for this option indicates a BCR of 0.75. It is recommended that this option is pursued as part of any planned works to upgrades to Henry Lawson Drive and has therefore been assigned a medium priority. It is assumed that construction costs for the works would be borne by RMS.

No environmental issues were identified with this option. The option is considered to provide social benefits through reducing risk and inconveniences associated with flooding.

1.3.10.9 Construct a Flood Wall at Thomas Street, Picnic Point

A flood wall to the rear of properties off Thomas Street will prevent overland flooding to a total of 5 residential properties.

The estimated costs of these works are relatively low at \$0.1 million. The assessment of economic benefits for this option indicates a BCR of 10 indicating significant economic benefits.

It is recommended that Council pursue the development of this option in consultation with the local residents as a high priority.

No environmental issues were identified with this option. The option is considered to provide social benefits through reduced inconveniences associated with flooding.

1.3.10.10 Ensure Existing Overland Flow Path from Eldridge Road through Commercial Units off Edgar Street is Maintained or Enhanced

As part of any future developments with the commercial area off Edgar Street, Council need ensure that the existing overland flow path is maintained or enhanced. This is considered a high priority.

1.4 Plan Funding and Implementation

The next steps in progressing the floodplain risk management process from this point includes:

- Public exhibition of the draft Floodplain Risk Management Study and Plan;
- Review of comments/submissions received and amendments as considered appropriate;
- Adoption by Council following recommendation from the Floodplain Management Committee;
- Determination of program of works for responsible authorities based on overall priority, available funds and other constraints;
- Implementation of the Plan proceeds as funds become available in line with established priorities.

The total cost for implementing the Floodplain Management Plan is estimated at \$13.45 million and represents relatively large financial implications for Council and other responsible authorities. This is largely as a result some large capital works being recommended.

The timing of the implementation of recommended measures will depend on overall budgetary commitments of Council and the availability of funds from other sources. Many of the Plan components can be implemented progressively over the next 12 months with few barriers, particularly those elements requiring Council staff time only which may be undertaken within

normal Council operations and budget. It is envisaged that the remainder of the Plan, particularly the structural options investigations, would be implemented progressively over a 1 to 5 year time frame.

There are a variety of sources of potential funding that could be considered to implement the FRMP. These include:

1. Council funds;
2. Section 94 contributions;
3. State funding for floodplain risk management measures through the Office of Environment and Heritage;
4. State Emergency Service, either through volunteered time or funding assistance for emergency management measures;

State funds are available to implement measures that contribute to reducing existing flood problems. Funding assistance is likely to be available on a 2:1 (State Council) basis. Although much of the FRMP may be eligible for Government assistance, funding cannot be guaranteed. Government funds are allocated on an annual basis to competing projects throughout the State. Measures that receive Government funding must be of significant benefit to the community. Funding is usually available for the investigation, design and construction of flood mitigation works included in the FRMP.

1.5 Review of Plan

The plan should be regarded as a dynamic instrument requiring review and modification over time. The catalyst for change can include new flood events and experiences, legislative change, alterations in the availability of funding, or changes to local planning strategies.

Ongoing monitoring and review of plan progress & success should be undertaken regularly. In broad terms the review should identify:

- the strategies that have been implemented;
- a measure of the relative performance of implemented measures
- review of the appropriateness of the strategy; and,
- if necessary, required modifications in the FRMP to define a more desirable/achievable outcome.

The strategies that are outstanding, reasons for delay in implementation if relevant, revision of the FRM to reflect alternate timeframe for implementation.



BMT WBM Bangalow	6/20 Byron Street Bangalow 2479 Tel +61 2 6687 0466 Fax +61 2 66870422 Email bmtwbm@bmtwbm.com.au Web www.bmtwml.com.au
BMT WBM Brisbane	Level 8, 200 Creek Street Brisbane 4000 PO Box 203 Spring Hill QLD 4004 Tel +61 7 3831 6744 Fax +61 7 3832 3627 Email bmtwbm@bmtwbm.com.au Web www.bmtwml.com.au
BMT WBM Denver	8200 S. Akron Street, #B120 Centennial Denver Colorado 80112 USA Tel +1 303 792 9814 Fax +1 303 792 9742 Email denver@bmtwbm.com Web www.bmtwbm.com
BMT WBM London	1 st Floor, International House St Katherine's Way London E1W1TW Email london@bmtwbm.co.uk Web www.bmtwbm.com.au
BMT WBM Mackay	Suite 1, 138 Wood Street Mackay 4740 PO Box 4447 Mackay QLD 4740 Tel +61 7 4953 5144 Fax +61 7 4953 5132 Email mackay@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Melbourne	Level 5, 99 King Street Melbourne 3000 PO Box 604 Collins Street West VIC 8007 Tel +61 3 8620 6100 Fax +61 3 8620 6105 Email melbourne@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Newcastle	126 Belford Street Broadmeadow 2292 PO Box 266 Broadmeadow NSW 2292 Tel +61 2 4940 8882 Fax +61 2 4940 8887 Email newcastle@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Perth	Suite 6, 29 Hood Street Subiaco 6008 Tel +61 8 9328 2029 Fax +61 8 9486 7588 Email perth@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Sydney	Level 1, 256-258 Norton Street Leichhardt 2040 PO Box 194 Leichhardt NSW 2040 Tel +61 2 8987 2900 Fax +61 2 8987 2999 Email sydney@bmtwbm.com.au Web www.bmtwbm.com.au
BMT WBM Vancouver	Suite 401, 611 Alexander Street Vancouver British Columbia V6E 3W1 Canada Tel +1 604 683 5777 Fax +1 604 608 3232 Email vancouver@bmtwbm.com.au Web www.bmtwbm.com