

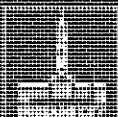
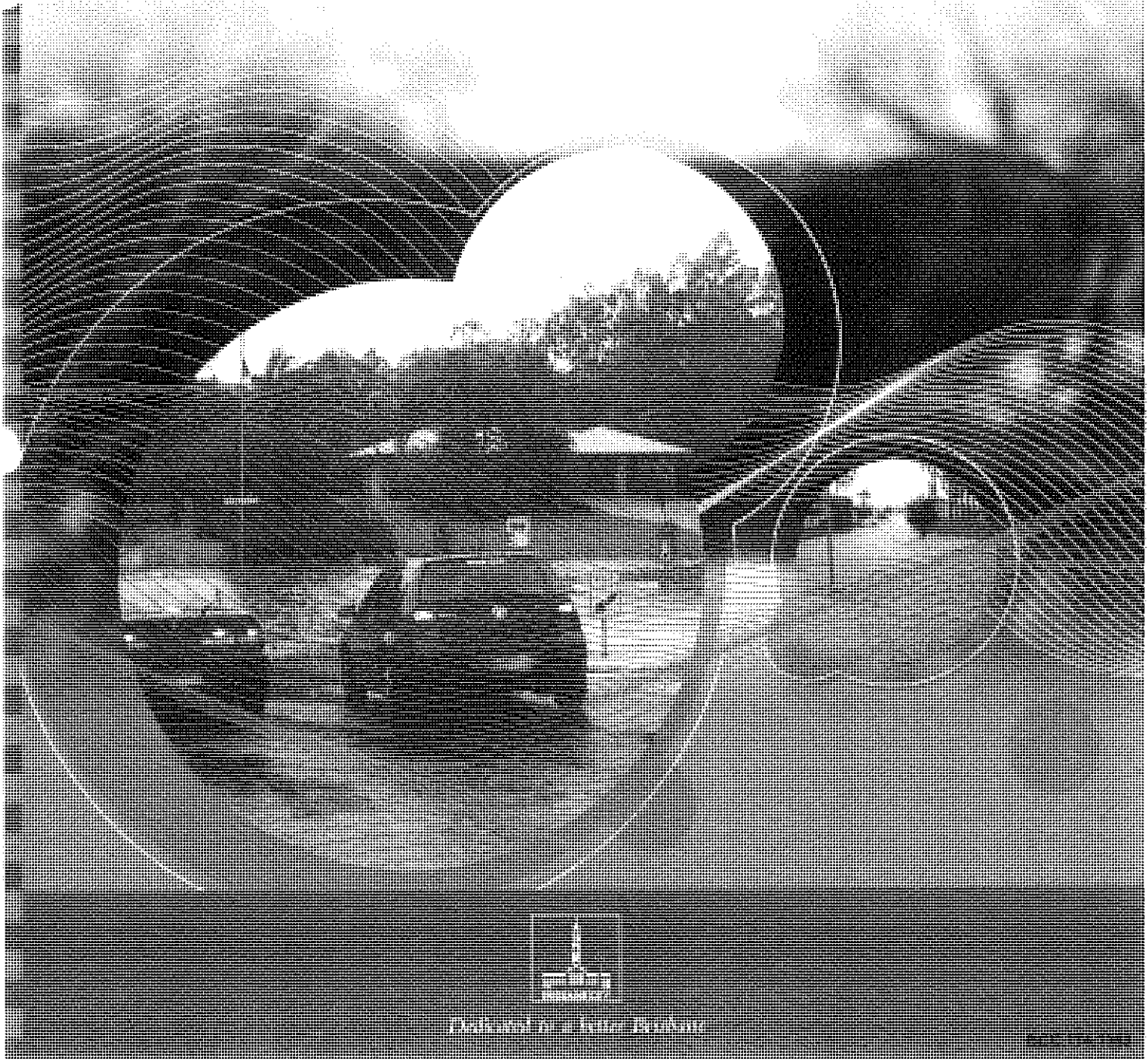
Lord Mayor's Taskforce



on suburban flooding

Strategies to reduce the effect of significant rain events on areas of Brisbane prone to flooding.

PREPARED FOR BRISBANE CITY COUNCIL AUGUST 2005



Dedicated to a better Brisbane

Foreword

Dear Lord Mayor

This Report from your Taskforce on Suburban Flooding is a distillation of very extensive discussion and debate that required twelve meetings and extended over a period of seven months.

The Taskforce has noted with concern that, in some parts of Brisbane, people are living in houses that are potentially subject to or at risk of frequent flooding above habitable floor level, from creek flooding or from overland flow. Many problems exist in areas that were developed before the current knowledge of flooding likelihood had been developed and when current development standards did not apply. The Taskforce recognises that voluntary residential property buy-back will be one of the long term solutions to these problems and it has recommended criteria and priorities to guide this process.

Worsening of flooding must be prevented. The Taskforce has proposed that land use planning controls and development and building controls in City Plan be reviewed and strengthened where necessary, to ensure that development and redevelopment cause no adverse impact from flooding and that environmental and ecological functions and values in flood prone land are preserved.

The role of the community in all aspects of flood risk management is of central importance. The Taskforce has proposed a range of Actions to achieve effective consultation with the community and education about flooding, including the provision of flood information and the provision of effective flood forecasting and flood warning services.

The members of the Taskforce constituted a group of people with very diverse backgrounds and representing a wide variety of interests and concerns. All members of the Taskforce are in complete agreement that worsening of flooding must be prevented and that the impacts of suburban flooding should be reduced to the extent that is possible.

Many issues considered by the Taskforce provoked strenuous debate but, at all times, the members were respectful of the different opinions and concerns of individuals. Despite such differences, the Taskforce was able to achieve consensus on the majority of Actions and Sub-actions that it proposed. The few cases in which consensus was not achieved are identified in this Report and the majority and minority views are detailed where appropriate.

Each member of the Taskforce has given explicit approval to this Report.

The Taskforce could not have completed its work without the continued, extensive assistance provided by a number of Council officers from Water Resources Branch of the City Policy & Strategy Division. My task as Chairman was made much easier and more pleasant by their unflinching enthusiastic support and helpfulness.

Professor Colin Apelt (Chair)

Executive Summary

➤ General

Lord Mayor Campbell Newman and Civic Cabinet established the Lord Mayor's Taskforce on Suburban Flooding in February 2005. The Terms of Reference (TOR) are provided in Appendix A. The role of the Taskforce is to examine all possible strategies to reduce the effects of significant rain events on areas of the city liable to frequent flooding.

The Taskforce was guided in its discussion by the information in A Framework for Risk Management by Brisbane City Council (Draft). Much of the material in this Report by the Taskforce is based on that document and the two documents should be seen as complementary.

Why manage flood risk?

1. Brisbane has a substantial flood risk problem. It is estimated that up to 11,000 residential buildings may be prone to flooding by a 100 year ARI flood from creek and river flooding. Of these, 6,900 can be attributed to creek flooding. Many more properties would be prone to flooding by the 'Probable Maximum Flood' (PMF - the largest flood that could conceivably occur) and to flooding from overland flow. The average annual cost of flood damage in Brisbane has not been reliably estimated, but is expected to be very significant. The cost of damage caused by the 1974 Brisbane River Flood, which inundated some 15,000 properties above ground level (including properties in Ipswich), was around \$200M (1974 values).
2. Community expectations. The people of Brisbane expect to be able to live and work with no untoward flood risk to their life and limb or health, and no unacceptable flood risk to their goods and possessions or to public infrastructure.
3. Legal obligations. Council has an obligation to manage flood risk under recent State and Federal legislation and initiatives concerning the management of 'natural disasters' (which include floods). In addition, Council has an obligation under 'Duty of Care' and Common Law considerations to manage flood risk across Brisbane.

➤ Taskforce's Objectives

The Taskforce was asked to produce a report providing opinions, recommendations and advice on the strategies and options available to reduce the effects of significant rain events on areas of the city prone to flooding.

The Taskforce's objectives and outcomes as stated in the TOR are:

Objectives:

1. Consider the existing, future and residual flood risks and examine actions to reduce the impact of flood events on residents in flood-prone areas.
2. Determine longer term strategies to reduce the impact of flooding on the city.
3. Evaluate the feasibility and likely costs of the strategies and actions.
4. Provide specific recommendations and create a prioritised list of work to be undertaken.

➤ Taskforce's Strategy For Suburban Flooding

Brisbane is a sub-tropical city subject to the vigour and extremes of a sub-tropical climate. At times, flooding occurs along the Brisbane River and Brisbane creeks and in local and low-lying coastal areas. The Taskforce's strategy is to reduce the impact of creek and overland flow flooding on the individual owners and occupiers of flood-prone land and to reduce private losses caused by flooding. This will be done through a process of flood Management Measures.

This strategy recognises that:

1. Flooding in Brisbane can be caused by a number of mechanisms:
 - heavy or sustained rainfalls over the catchments of Brisbane's creeks
 - overloaded stormwater systems as surface runoff makes its way into creeks (overland flow)
 - heavy or sustained rainfalls over the catchments of the Brisbane River
 - storm surge in Moreton Bay
 - failure of one of the three dams in the City's environs, Gold Creek Dam, Lake Manchester and Enoggera Dam or the SEQ Water controlled Wivenhoe Dam
 - a tsunami in the Pacific Ocean.
2. Creek and local flooding occur regularly in Brisbane and causes considerable disruption to the community. Accordingly, the Taskforce has addressed creek and overland flow flooding issues across Brisbane in this report.
 - With regards to river flooding, the Taskforce notes that a Independent Expert Panel has recently reviewed flooding associated with the Brisbane River (BCC 2003, Review of Brisbane River Flood Study) and that development and redevelopment in areas below the Defined Flood Event (DFE) flood level have strict flood immunity requirements under the Brisbane City Plan. Such requirements are supported.
 - There is no realistic remedy for storm surge other than proper education of the community and effective land use planning and warning systems.
 - The Taskforce recognises the very low risk of dam failure flooding. It is noted that this risk is managed principally through dam safety audits that are a State Government responsibility.
 - It is thought that the risk of significant flooding by tsunami is remote, but this needs to be confirmed. Further, the Bay islands would provide some protection for Brisbane against tsunami flooding.
3. Flooding in Brisbane can be worsened by a number of processes:
 - Loss/ alteration of overland floodwater flowpaths and their natural detention/ retention basins.
 - Loss/ alteration/ infilling of waterway corridor, flood plains, wetlands and their natural detention/ retention basins.
 - Loss of infiltration processes and increases in impervious surfaces.
4. While Council is the primary public agency responsible for the delivery of local flood management services, a number of Federal and State government agencies have specific roles to play in the management of flooding risk. Council should liaise with these agencies to facilitate coordinated and effective management initiatives across Brisbane at the three levels of government.
5. Flood-prone areas across Brisbane can serve a variety of urban and ecological purposes and are a source of natural resources. When making development decisions for flood-prone land, Council should adopt an approach that takes into account social, economic and ecological factors, as well as flood risk and environmental considerations.

6. Flood risk can be managed by a variety of measures that modify property at risk (eg. land use controls), the response of individuals or communities at risk (eg. flood warning), or flood behaviour itself (eg. the use of levees/ pipes to reduce overland flow). Council should reduce flood risk by determining an effective and integrated mix of Management Measures appropriate to each flooding situation.
7. All flooding events have an associated flood risk. Council should manage flooding risk for events up to the 'probable maximum flood' (PMF).
8. Individuals and communities in flood-prone areas have roles to play in the management of flood risk. Through education programs, Council should inform the public of their exposure to flood risk (flood awareness) and how they can actively contribute to the management of this risk to reduce the impact of flooding on themselves and their possessions (flood readiness, flood response and flood recovery).
9. A host of 'flood information' should be retrieved, collected, stored and presented to assist various stakeholders to better manage flood risk.
10. Emergency management and recovery programs are essential components of flood risk management and need to be integrated with other Management Measures.
11. Climate change is occurring and its impact on sea levels and storm events are yet to be fully determined.

❖ Strategy Management Measures And Components

Based on the review of creek and local flooding issues in Brisbane, the Taskforce identified 22 major findings that will improve Council's policy and practices regarding management of creek and overland flow flooding. These findings have been translated into a framework that the Taskforce believes will provide solutions to Brisbane flooding issues.

The members of the Taskforce constituted a group of people with very diverse backgrounds and representing a wide variety of interests and concerns; nevertheless, the Taskforce was able to reach consensus on the great majority of Actions and Sub-actions that are proposed in its report. All members of the Taskforce were in complete agreement that worsening of flooding must be prevented and that the impacts of suburban flooding should be reduced to the extent that is possible. However, there is a small number of decisions on which consensus was not achieved. These are detailed in the body of the Report.

The following four Management Measures and their Components form the framework that supports the Taskforce's Strategy for Suburban Flooding:

1. **Non Structural Measures** – are aimed at reducing or avoiding the susceptibility of new and existing development to flooding, i.e. 'keeping people and vulnerable activities away from floodwaters':
 - 1.1 Land Use Controls: Include Land Use Planning Considerations and Land Use Controls in the Flood Risk Management Planning Process.
 - 1.2 Environmental Management: Include Environmentally Sustainable Guidelines and Best Practice Planning Processes.
 - 1.3 Voluntary Residential House Buy-Back: Consider Voluntary Buy-Back of Houses that are Subject to Frequent Creek or Overland Flow Flooding.
2. **Structural Measures** – are aimed at physically modifying the natural behaviour of flooding and reducing the frequency and impact of flooding, i.e. 'keeping floodwaters away from people and managing the impact floodwaters have on structures':

- 2.1 Structural Controls: Ensure Adequate Design, Construction and Maintenance of Structural Flood Controls.
- 2.2 Development and Building Controls: Define Appropriate Development and Building Controls for Areas Prone to Flooding.
3. **Flood Preparedness Measures** – are aimed at ‘getting people ready for floods before they come’:
 - 3.1 Flood Risk Management Planning: Develop and Implement a Flood Risk Management Planning Process.
 - 3.2 Flood Studies: Review Flood Study Procedures and Results.
 - 3.3 Information Management: Develop and Implement an Appropriate Flood Information Management System.
 - 3.4 Education and Communication: Improve Stakeholder Understanding of Flood Risk Management Principles and Stakeholder Communications.
 - 3.5 Flood Forecasting and Warning: Ensure that Flood Forecasting and Warning Services are Timely, Accurate and Effective.
 - 3.6 Flood Insurance: Liaise with the Insurance Industry to Facilitate the Provision of Flood Insurance to the General Public.
 - 3.7 Legal and Administrative: Define and Meet Legal and Administrative Responsibilities and Obligations.
4. **Flood Emergency Measures** – are aimed at ‘helping affected people to cope and recover from the effects of flooding’:
 - 4.1 Emergency Management: Develop Flood Emergency Plans for Brisbane’s Floodplains.

Each of these Components contains Actions and Sub-actions to guide Council in the implementation of the Management Measures.

➤ Key Actions Summary

Three levels of priority for the implementation of the strategy are defined in Section 4. These are:

- **Priority 1** - indicates the Actions and Sub-actions that should be started as soon as resources and commitments allow, and be substantially completed over the period September 2005 – September 2006 (Immediate Actions).
- **Priority 2** - indicates the Actions and Sub-actions that can be delayed but ideally should be undertaken over the period July 2006 – December 2009 (Intermediate Actions).
- **Priority 3** - indicates the Actions and Sub-actions that can be further delayed but ideally should be undertaken over the period July 2007 – December 2016 (Long Term/ Ongoing Actions).

From the Management Measure Components, the Taskforce selected ten Key Actions for immediate attention and recommends that these be started as soon as resources and commitments allow and be substantially completed over the period September 2005 to September 2006. These are listed in the following Key Actions Summary. Priority 2 and Priority 3 Actions/ Sub-actions are detailed in Section 4 of the Report

➔ **Table 1: Lord Mayor's Taskforce on Suburban Flooding – Priority 1 Key Actions and Sub-actions Summary**

Action no.	Priority 1 Key Actions and Sub-Actions Summary	Comments
1	<p>Provide for the voluntary buy-back of low flood immunity residences:</p> <p>Management Measure No. 1 – Non Structural Measures – Component 1.3</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 3)</p> <p><i>Based on preliminary findings for properties that may be subject to 2 year ARI creek flooding, i. e. on average 1 in 2 year flood immunity, the Taskforce recognises voluntary residential property buy-back will be one of the long term solutions to creek flooding and to overland flow flooding and that State and Federal Government financial support will be required to ensure this important initiative is adequately funded.</i></p> <p>This can be achieved by:</p> <p>1.1 Establish how many properties and houses are subject to frequent creek and overland flow flooding, and to what extent.</p> <p>1.2 Using the Voluntary Residential House Buy-Back criteria outlined in Appendix D, review arrangements in other states and territories concerning Local Government purchasing houses where the flood immunity is unacceptably high, including funding arrangements and responsibilities. On completion of review, finalise policy for voluntary residential property buy-back.</p> <p>1.3 As part of the review, consider arrangements in other states and territories concerning Local Government purchasing land for use as detention areas, i.e. after completion of modelling and assessment of multiple benefits such as environmental and recreational. On completion of review, if practical, develop policy for voluntary land buy-back for the creation of flood water detention areas, particularly if the land is flooded regularly and there is little opportunity to economically develop further.</p>	<p>Approx 400 properties may have floor levels affected by ARI 2 flooding @ current market value = \$120M.</p> <p>Assume 50% of property owners will want to stay and of the remaining 50%, some may not be affected by flooding to floor levels – assume 20% = \$60M.</p> <p>If cost is spread over 20 years = \$3.0M/ year and allows for purchase of ~ 10 houses per year.</p> <p>Annual ancillary costs, eg. expenses, removal etc. are estimated to be \$0.5M per year.</p> <p>Total estimated cost is \$3.5M/ year (in 2005 dollars).</p>
2	<p>Review and strengthen, where necessary, land use planning controls in City Plan to ensure no adverse impact from flooding:</p> <p>Management Measure No. 1 – Non Structural Measures – Component 1.1</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 1)</p> <p><i>Council should undertake a comprehensive review of land use planning controls as specified in City Plan to ensure that development (greenfield) and redevelopment (infill) take into account their cumulative impact, and that there are no adverse impacts on properties from flooding and that ecological functions are retained.</i></p> <p>This can be achieved by:</p> <p>2.1 Option A (Supported by 6 votes out of 10 possible votes) - Create 'Flooding Code' as a Primary Code in City Plan specific to both greenfield and infill developments. All Sub-actions relevant to this new Flooding Code are to be considered for inclusion in it.</p>	<p>Estimated cost is \$150K.</p>

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	<p>Option B (Supported by 2 votes out of 10 possible votes) - The City Plan should consider flooding and climate change as significant.</p> <p>Option A is to be adopted.</p> <p>2.2 Control filling within overland flow paths, waterway corridors and floodplains especially with regards to 'cumulative impact'.</p> <p>2.3 Reassess the allowance in City Plan of 1.0m of fill to be placed without approval in Waterway Corridor, overland flow paths and flood risk areas.</p> <p>2.4 Option A (Supported by 6 votes out of 10 possible votes) - Prohibit development and filling inside City Plan Waterway Corridors. The objective is to protect and enhance the water flow, water quality, ecology, and open space, and recreational and amenity values of the City's waterways, subject to ground truthing of the Waterway Corridor.</p> <p>Option B (Supported by 4 votes out of 10 possible votes) - City Plan review to incorporate performance criteria that specifically address flooding and require no adverse impact to downstream, upstream and adjacent properties or ecological processes, taking into full account the cumulative effect.</p> <p>Option A is to be adopted.</p> <p>2.5 Restrict further filling and development within the area of 100 year ARI or Defined Flood Event flood to satisfy the new 'Flooding Code' in Sub-action 2.1. (6 votes for, 2 against out of 8 possible votes).</p> <p>2.6 Develop guidelines/ practice documents for specific catchments, specifically for the issues of the catchment or potential new development areas.</p> <p>2.7 Investigate if the planning process can reduce the magnitudes of peak flows.</p> <p>2.8 Make provision in Council Policy, City Plan and Codes to not allow the practice of cut and fill in Waterway Corridors where there will be an adverse effect on the incremental flood storage. (7 votes for, 1 against out of 8 possible votes).</p>	
3	<p>Review and strengthen, where necessary, development and building controls in City Plan to ensure no adverse impact from flooding:</p> <p>Management Measure No. 2 – Structural Measures – Component 2.2 (Priority No. 1 Action with Taskforce Ranking No. 4)</p> <p><i>In conjunction with Key Action 2, City Plan and building legislation need to be enhanced to ensure controls are adequate to ensure that developments and buildings do not adversely impact on flooding or drainage of properties that are upstream, downstream, and adjacent. State Government has a key role to play in this Action by enhancing relevant legislation and controls.</i></p>	<p>Estimated cost is \$100K.</p>

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	<p>This can be achieved by:</p> <p>3.1 As a matter of priority and subject to a successful trial, Council identifies and places drainage and overland flow easements on BiMAP and flags in City Plan 2000. Seek amendment to IPA to require easement owners to sign/ approve an application for development on a property. It needs to be a requirement for applications that owners of rights over land, eg. easement owners, approve of applications (currently only the owner and the developer need to sign applications).</p> <p>3.2 Amend the City Plan House Code to require that 'lots on land that is subject to flooding' are to be code assessable against the requirements of the 'Flooding Code' recommended in Action 2 Sub-action 2.1.</p> <p>3.3 Review arrangements in other states and territories concerning Local, State and Federal Government responsibility and funding for 'house-raising' as a means of reducing flood damage and, if a local Government responsibility, determine policy on house raising. House raising will not be considered where offer of Voluntary Buy-Back has been declined (refer Appendix D).</p> <p>3.4 Update current building regulations/ controls/ advice and guidelines that relate to the 'flood proofing' of properties in flood-prone areas. Standards will apply to both new construction and redevelopment works.</p> <p>3.5 Consider relaxing 8.5m roof height where relaxation is required to achieve non-flood habitable areas where houses are identified as being in one of the flooding categories.</p> <p>3.6 Subject to a cost benefit assessment, where infill development is proposed and the condition status of existing drainage infrastructure is not known, the carrying capacity is to be established prior to development approval.</p> <p>3.7 Review City Plan Waterway Code Performance Criteria to determine if developer contribution is sufficient to maintain biodiversity and stormwater management in waterway Corridors and land that is subject to flooding.</p> <p>3.8 Amend and strengthen codes/ policies based on appropriate quality modelling. Develop a best practice document to support codes and policies.</p> <p>3.9 Review building standards for infill development to promote suspended floors to avoid need for cut and fill.</p> <p>3.10 Accept alternate solutions on remnant blocks in built up areas where a better outcome for water quality and sustainability would result from development.</p> <p>3.11 Recognising that industrial developments have large roof and hard surface areas, Council should encourage integrated water management measures in these developments.</p>	

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	<p>3.12 Identify appropriate water cycle outcomes including development footprints for industrial lots where there are areas of valuable eco-hydrological functions including flood storage and waterway functions.</p> <p>3.13 Maintenance plans for existing structural flood controls, eg. mitigation schemes, detention basins, the three water supply reservoirs, should be in place to ensure their flood readiness and effectiveness.</p>	
4	<p>Determine and establish an appropriate forum to consult with and provide feedback in respect of Council's flood risk management planning process and the implementation of Taskforce's recommendations:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.1</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 6)</p> <p><i>Council should include stakeholders in the planning process by creating a Reference Group. The Reference Group will be a consultative body rather than one that directly determines Council Policy.</i></p> <p>This can be achieved by:</p> <ul style="list-style-type: none"> 4.1 Ensure consistency in Council's policies and practices. 4.2 Ensure planning controls on new development on existing sites achieve no adverse impact on flooding. 4.3 Council to work with EPA on SEQ Coastal Management Plan to ensure that flood mitigation is included as a consideration along side environmental protection. 4.4 Council to liaise with State Government to ensure that planning legislation is amended, if necessary, in order that proposed developments take full account of cumulative effects on flooding so that developments do not adversely impact on flooding or drainage of properties that are upstream, downstream, and adjacent to the subject site. 4.5 Lobby State Government for the removal of injurious affection provisions of IPA - (3 votes for, 2 against out of 7 possible votes). 4.6 Strategic permits from State Government should be negotiated to facilitate flood mitigation design, construction and maintenance works. 4.7 Provide copies of the Taskforce Report to those responsible for the preparation of the state flood risk management policy and the SEQ disaster communication strategy. 4.8 Ensure flood information provided is supported by accredited independent professional experts, for quality assurance and verification. 	<p>Estimated cost is \$200K – includes additional position to implement Taskforce's recommendations.</p>

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	<p>4.9 Solutions should be multi purpose, eg. include socio-economic, ecological, amenity, natural resource and cultural aspects of land use across flood-prone areas, as well as the associated flood risk and hazard.</p> <p>4.10 Solutions should address whole of catchment issues.</p> <p>4.11 Flood management budget to be guided by clear criteria transparent to the community.</p> <p>4.12 Review maintenance funding and, if necessary, increase budget allocation.</p> <p>4.13 Identify opportunities and determine the appropriate nature and means for community consultation in Council's flood risk management planning process. External stakeholders and representatives of flood-prone communities should be represented at this forum. Special attention should be paid to improving consultation and awareness with flood-prone communities.</p> <p>4.14 Clarify within Council that Water Resources is the lead agent in Council for Waterway Corridors, to eliminate inter-agency conflicting agendas/ interpretations.</p> <p>4.15 Clarify flood risk management roles and responsibilities within Council's business units and amend if necessary.</p> <p>4.16 Provide feedback on the reviews of City Plan and Local Laws to ensure the recommended mix of Management Measures from this report are incorporated into the appropriate statutory instruments, eg. land use plans, codes of building and development conditions, local emergency plans, etc.</p> <p>4.17 Review consultative arrangements, particularly with regards to the provision of financial support, with Federal and State agencies and other SEQ Council's and amend if necessary.</p> <p>4.18 Provide feedback on what is acceptable risk of flooding in houses in older areas.</p>	
5	<p>Establish Flood Information Data Base:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.3</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 2)</p> <p><i>Council has extensive flood information and should identify, review and document the flood information needs of all stakeholders, including the community, business, Council and State Government. Council should consider providing flood information on individual properties free of charge (currently residents pay \$16 for this report).</i></p>	<p>Initially review/ evaluate upgrade to existing systems.</p> <p>Estimated cost is \$150K.</p> <p>Note that the provision of free flood information will result in loss of approx \$300K of annual revenue.</p>

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Action no.	Priority 1 Key Actions and Sub-Actions Summary	Comments
	<p>This can be achieved by:</p> <p>5.1 Develop a Business Case for Council having a specific flood data management system to assist with the management and use of flood and flood management data and information. Base on existing purpose designed Flood Information Management Systems (FIMS) and Decision Support Systems (DSS). Consider whether current Council databases could form the basis of such a system.</p> <p>5.2 Liaise with State Government (NRM) concerning likely data and information requirements under the proposed Queensland flood policy, and ensure that data and information collection, storage and retrieval procedures conform with the proposed requirements.</p> <p>5.3 Review the extent to which Council's current flood and flood management data and information are geo-referenced and determine whether geo-referencing of further data is required.</p> <p>5.4 Create a record/ register of the history of flooding in Brisbane and a process to keep the records current, including historical information about filling and potential flooding. Make available to the public.</p> <p>5.5 Make accurate flood lines available to public.</p> <p>5.6 Make flood studies held in archives available to public.</p> <p>5.7 Produce special building overlays and maps showing major and minor overland paths.</p> <p>5.8 Make all information on flooding available to the community free of charge.</p> <p>5.9 Develop electronic database to record 'as-constructed' information, connections to pipe systems, etc.</p> <p>5.10 Council to devise and institute appropriate cost codes to track time and expenses spent on flood risk management across Council's various business units.</p> <p>5.11 Ensure the Flood information Data Base is available to Flood Emergency Managers.</p>	
6	<p>Investigate the establishment of local flood advice, forecasting and warning systems:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.5</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 8)</p> <p><i>Ensure that flood information is timely and adequate for the purposes of flood management decision-making (eg. flood warning, flood defence, evacuation and routine flood information). Given that State and Federal Government agencies have responsibilities for forecasting and emergency services, this Action needs to be undertaken in partnership with these agencies.</i></p>	<p>Total estimated cost is \$1.65M.</p> <p>\$150K for initial review/ evaluation of upgrade to existing systems.</p>

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	<p>This can be achieved by:</p> <p>6.1 Determine whether significant flood plain changes have affected the relevance of current forecasting and upgrade if necessary.</p> <p>6.2 Network at the local level to achieve better gathering of information.</p> <p>6.3 Ensure that flood forecasting and warning activities are well coordinated and consistent.</p> <p>6.4 Provide feedback to the community on the impact of major storm events (post storm advice/ learnings).</p> <p>6.5 Make Council's FloodWise system SMS and web enabled.</p> <p>6.6 Provide flashing light warning systems on all roads at creek crossings.</p> <p>6.7 Provide flash flooding warning to residents prone to creek flooding.</p> <p>6.8 Review Council's flood advice activities with the view to defining scripting and standard operating procedures etc., to ensure that advice is reliable and effectively delivered under varying caller circumstances. Assess the need to provide training in these procedures and deliver any necessary training.</p> <p>6.9 Develop and test programs to improve the flood awareness and flood readiness of flood-prone communities and individuals.</p> <p>6.10 Determine 'standard' warning advices and formats that are suitable for dissemination to the community.</p> <p>6.11 Council/ SES to provide specific information from 'on ground' staff, eg. use GPS technology as part of flood advice/ information systems.</p> <p>6.12 Develop internet solutions and use of radio and TV for communication of flood forecasts - needs to be specific.</p> <p>6.13 As part of the flood risk management process, ascertain what flood affected residents need most for preparation for flooding.</p> <p>6.14 Set up a Council/ community flood warning network, eg. a pyramid based structure – designated Council officer/ catchment community contact/ community web or network.</p>	<p>\$150K for Council wide scripting and standard operating procedures etc.</p> <p>\$100K for flashing lights at crossings (5 x \$20K sites).</p> <p>\$200K for systems development – 'FloodWise' on web.</p> <p>\$900K for telemetry stations (30 x \$30K sites).</p> <p>\$150K for communications technology.</p>
7	<p>Develop external education programs to improve the Community's understanding of flooding:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.4</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 9)</p> <p><i>Develop external education and communication programs for residents and businesses to improve their understanding of flooding issues and to enable them to respond to possible flooding of their property.</i></p> <p>This can be achieved by:</p> <p>7.1 Clearly explain the requirements of City Plan to the community, developers and private certifiers.</p>	<p>Estimated cost is \$500K</p>

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Action no.	Priority 1 Key Actions and Sub-Actions Summary	Comments
	<p>7.2 Make the community aware of the impact on downstream infrastructure from installation of pipes and hard surfaces, eg. increased runoff.</p> <p>7.3 Inform the community of the facts about creek flooding. For example, clearing instream and riparian vegetation can worsen flooding.</p> <p>7.4 Undertake targeted information campaigns rather than broad scale campaigns.</p> <p>7.5 Inform community about effects of debris in creeks.</p> <p>7.6 Advise community of the need to obtain information about flooding before purchase of property.</p> <p>7.7 Determine how to ensure the community accepts, as being accurate, Flooding Reports/ Investigations and general information provided by Council (a key part of the education process).</p> <p>7.8 Increase community awareness of the multi-benefits of waterway catchments and floodways, and the need to balance their functions, eg. ecological and flood capacity.</p> <p>7.9 Inform community on how to behave during flood, preparedness, crisis and post event, eg. through safe driving and children's play safety (creeks/ drains/ bike paths) etc.</p> <p>7.10 Each year, conduct a summer campaign to prepare community for flooding eg. via internet, TV etc.</p> <p>7.11 Assist flash flood affected communities with education material regarding flash floods.</p>	
8	<p>Ensure a 'whole of catchment' process is undertaken when selecting Capital Works projects:</p> <p>Management Measure No. 2 – Structural Measures – Component 2.1 (Priority No. 1 Action with Taskforce Ranking No. 5) <i>Council's process for the selection of capital works projects should be reviewed and priority given to the approval of projects that take into account a suite of possible solutions to reduce flooding impacts on residential areas. Programming should be orderly and selection should be undertaken on a 'whole of catchment' basis, i.e. no job should be considered in isolation, except where overland flow issues need to be dealt with.</i></p> <p>This can be achieved by:</p> <p>8.1 Priorities for works/ actions designed to reduce flooding impacts are</p> <ul style="list-style-type: none"> • residential habitable living areas • residential utility areas • commercial floor areas • yards. 	<p>Existing Council process.</p> <p>Estimated cost is \$20K to review process</p>

➤ Table 1: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions Summary

Action no.	Priority 1 Key Actions and Sub-Actions Summary	Comments
	<p>8.2 When developing priorities of works, the benefits of the project are to be quantified and specifically state what ARI flood event these works are focussed on, or what risk is being minimised including cost versus benefit and frequency of benefit.</p> <p>8.3 Give priority to work in low lying areas particularly downstream of development.</p> <p>8.4 Maximise capacities of waterways, floodplains, etc. subject always to no worsening downstream.</p> <p>8.5 Consider flood mitigation schemes as an option in all cases.</p> <p>8.6 Provide relief drains for bottlenecks.</p> <p>8.7 Include opportunities for social benefits eg. recreational parks from flood mitigation works, in assessing cost benefits.</p> <p>8.8 Include use of detention basins, infiltration systems and other storage schemes, as options in all cases.</p>	
9	<p>Review the creek and local flooding data needs of all stakeholders, including the community, and if necessary, upgrade current flood study procedures and modelling methodology:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.2</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 7)</p> <p><i>Review the creek and local flooding data needs of all stakeholders, including the community, to ensure that appropriate data in appropriate formats are generated and delivered by flood studies.</i></p> <p>This can be achieved by:</p> <p>9.1 Audit existing processes.</p> <p>9.2 Use 'plain English' wording for simplified reports/ recommendations.</p> <p>9.3 Implement a Quality Assurance (QA) system to engender confidence in the process.</p> <p>9.4 Develop a strategic approach to modelling across city.</p> <p>9.5 Select and adopt, wherever appropriate, a suite of 'standard' analytical methods best suited for flood studies in Brisbane.</p> <p>9.6 Assess how the cumulative impact from new development is determined.</p> <p>9.7 Develop a simple and effective standard procedure for undertaking flood damage assessment studies during flood studies.</p> <p>9.8 Involve the community and get their feedback during the process of doing flood reports/ investigation.</p> <p>9.9 Include historic information in flood study reports</p> <p>9.10 Develop improved flood models for larger catchments eg. Oxley.</p> <p>9.11 Audit catchment by catchment to determine if developments have had adverse effects on downstream catchments.</p>	<p>While this is a Priority 1 this work will take 2-3 years to complete.</p> <p>Estimated cost is \$500K/ year.</p>

➤ Table 1: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions Summary

Action no.	Priority 1 Key Actions and Sub-Actions Summary	Comments
	<p>9.12 Catchment audits should consider urban infill projections.</p> <p>9.13 Monitor works that have been established to ensure benefits have been realised.</p> <p>9.14 Seek solutions that have multiple benefits, eg. environmental, social and economic (such as reduced maintenance or repair).</p> <p>9.15 Determine the nature, names and means of defining the 'hydraulic categories' used as a basis for prescribing land use controls in flood-prone areas.</p> <p>9.16 Adopt a procedure for assigning 'hazard categories' as a basis for prescribing land use controls in flood-prone areas.</p> <p>9.17 Collect flood behaviour data needed for a 'flood hazard analysis', develop a 'standard' procedure for assessing hazard in flood studies, and ensure that the necessary data are generated by flood studies.</p> <p>9.18 Establish the size and significance of overland flow and creek tributary flooding problems in Brisbane and assess the feasibility and accuracy of developing a 'rapid means' of addressing these problems.</p> <p>9.19 Use local catchments, for which comprehensive flood study results are available, as case studies to develop procedures for analysing overland flow and creek tributary flooding.</p> <p>9.20 Review past Stormwater Management Plans to set up infrastructure plans for areas to be redeveloped.</p> <p>9.21 Before any new filling is approved within a floodplain, modelling should be undertaken to determine whole of catchment impacts, including cumulative impacts.</p> <p>9.22 Ascertain whether or not development across the city is increasing impervious areas. Determine what the real impact is on creek and overland flow flooding.</p>	
10	<p>Review Council's legal liabilities:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.7</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 10)</p> <p><i>Council's objective should be to clearly define and meet its legal and administrative responsibilities and obligations under existing and proposed state and federal legislation and initiatives and under common law. Previous investigation has been conducted on Council's legal position regarding flooding. This work is contained in the document 'Risk Based Approach to Flood Management - Benchmarking Component'. As a section of this report has direct relevance to the implementation of various Components of this strategy, it has been included as Appendix E.</i></p>	<p>Estimated cost is \$50K for specialist legal advice.</p>

→ Table 1: Lord Mayor's Taskforce on Suburban Flooding – Priority 1 Key Actions and Sub-actions Summary

Action no.	Priority 1 Key Actions and Sub-Actions Summary	Comments
	<p>This can be achieved by:</p> <ul style="list-style-type: none"> 10.1 Clearly define Council's flood risk management obligations under federal and state legislation and arrangements and under common law duty of care requirements. 10.2 Review Council's administrative obligations under the Local Government Finance Standard. 10.3 Determine Council's legal liability if the public is provided with incorrect flood advice. 10.4 Determine what liabilities Council incurs from providing flood risk data to the insurance industry for premium setting purposes. 10.5 Investigate requirements for compensation/ purchase of properties that may be used as retention/ detention basins due to future development. These are likely to be small acreage properties. 10.6 Determine Council's responsibility to provide flood forecast and flood warning advice to the public. 	

➤ Recommendations

The Taskforce recommends that:

- 1 The ten Key Actions that have been allocated to Priority 1 be started as soon as resources and commitments allow and that they be substantially completed over the period September 2005 to September 2006.
- 2 The Actions allocated to Priority 2 be started no later than July 2006 and that they be substantially completed by December 2009.
- 3 The Actions allocated to Priority 3 be started no later than July 2007 and that they be substantially completed by December 2016.
- 4 Council create a temporary position within Water Resources Branch for a period of up to twelve months. The primary role of the position will be to ensure that the Taskforce's Priority 1 recommendations are actioned and a framework is established for implementation of the intermediate and long term recommendations.
- 5 The Reference Group reviews the progress of implementation of Recommendation 1 in July 2006.
- 6 The Reference Group reviews the progress of implementation of Recommendations 1, 2 and 3 in July 2008.

➤ Lord Mayor's Taskforce On Suburban Flooding

The following people constitute the Lord Mayor's Taskforce on Suburban Flooding. Full details are provided in the TOR in Appendix A.

Professor Colin Apelt (Chair)

Cr Helen Abrahams

Cr Carol Cashman

Trevor Bray/Peter Redshaw

Wayne Cameron

Tracy Comans

Upali Jayasinghe

Leo Jensen/Andrew Hall

Andrew McPhail

Brian Stewart

Andrea Young

Note:-

Peter Borrows and Daniel Musson were initially appointed to the Taskforce but were able to participate only during the early stages of its activities and withdrew due to ongoing work commitments.

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List Of Abbreviations

AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
BCC	Brisbane City Council
BoM	Bureau of Meteorology
CoM	Council of Mayors (SEQ)
DES	Department of Emergency Services (Queensland)
DFE	Defined Flood Event
DLG&P	Department of Local Government and Planning
NR&M	Department of Natural Resources & Mines (Queensland)
DRS	Development and Regulatory Services
DSS	Decision Support System
EPA	Environmental Protection Agency
ESD	Environmentally Sustainable Development
FIMS	Flood Information Management System
FY	Financial Year
GPS	Global Positioning System
ICA	Insurance Council of Australia
IPA	Integrated Planning Act
NALL	Natural Assets Local Law
NRM	Natural Resource Management
OUM	Office of Urban Management
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
QA	Quality Assurance
RG	Reference Group
RPEQ	Registered Professional Engineer of Queensland
SEQ	South East Queensland
TOR	Terms of Reference
WSUD	Water Sensitive Urban Design

Glossary Of Flooding Terminology

These definitions are those used in CSIRO 2000, Floodplain Management in Australia: Best Practice Principles and Guidelines.

Annual Exceedance Probability (Aep)

The likelihood of occurrence of a flood of a given size or larger in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m³/s has an AEP of 5%, it means that there is a 5% risk (i.e. a probability of 0.05 or a likelihood of 1 in 20) of a peak flood discharge of 500 m³/s or larger occurring in any one year (see also Average Recurrence Interval).

Adverse Flooding (From Current City Plan)

Flooding that adversely affects the value, safety or use of land, whether public or privately owned. Adverse flooding may result from a change in:

- peak discharge
- runoff volume
- impervious area
- rate of runoff, i.e. the travel time of stormwater runoff through the catchment.

Average Recurrence Interval (Ari)

A statistical estimate of the average period in years between the occurrence of a flood of a given size or larger (eg. floods with a discharge as big as or larger than the 100 year ARI flood event will occur on average once every 100 years). The ARI of a flood event gives no indication of when a flood of that size will occur next.

Catchment

The area of land draining to a particular site. It always relates to a specific location and includes the catchment of tributary streams as well as the main stream.

Defined Flood Event (Dfe)

The flood event selected for the management of flood hazard, as determined in flood management studies and incorporated in flood management plans. Selection of DFEs should be based on an understanding of flood behaviour and the associated risk and consequences of flooding. The DFE should also take into account the social, economic and environmental consequences associated with floods of different severities. Different DFEs may be appropriate for structural measure (eg. levees), different categories of land use and for emergency service planning. The concept of a range of DFEs supersedes sole focus on the 1% AEP flood event, as in earlier practice. DFEs do not define the extent of flood-prone land, which is defined by the PMF (see also Probable Maximum Flood).

Defined Flood Fringe

The remaining area of land inundated by the DFE after defined floodway areas have been defined (see also Defined Floodway).

Defined Flood Level

The flood level associated with a DFE.

Defined Floodway

The area where significant discharge or storage of water occurs during a DFE. Floodways are areas which, if filled or even partially blocked, would cause a significant redistribution of flood flow, or significant increase in flood levels. Floodways are often aligned with naturally defined channels and are often, but not necessarily, areas of deeper flow or areas where higher velocities occur, and also include areas where significant storage of floodwaters occur. Each DFE has a defined floodway and the extent and behaviour of floodways may change with flood severity. Areas that are benign for small floods may experience much greater and more hazardous flows during larger floods (see also Defined Flood Fringe).

Detention Basin

A generally small self-draining storage constructed on a creek or drain that mitigates downstream flood discharge and flood levels by providing temporary storage for floodwaters.

Development

The erection of a building or the carrying out of work, including the placement of fill; or the use of land or a building or work; or the subdivision of land.

Types of development include:

- Infill – the development, within an existing subdivision, of vacant blocks of land that are generally surrounded by development properties; conditions may be imposed on infill development (eg minimum floor levels).
- New – development of a completely different nature from the one associated with the former land use (eg. urban subdivision of an area previously used for rural purposes), involves rezoning and typically requires significant extensions of existing urban services (eg. roads, water supply, sewerage, electric power).
- Redevelopment – rebuilding an area under the current or a similar land use zoning. As urban areas age, it may become necessary to demolish and reconstruct buildings.

Discharge

The rate of flow of water, as measured in terms of volume per unit time [eg. cubic metres per second (m³/s)].

Effective Warning Time

The time available for the evacuation of people and their goods and possessions before the onset of flooding. the effective warning time available to a flood-prone community is equal to the time between the delivery of an official warning to prepare for imminent flooding and the loss of evacuation routes due to flooding. Improved flood forecasting systems and warning delivery systems increase the available warning time.

Flash Flooding

Sudden and unexpected flooding caused by local heavy rainfall or rainfall in another area. Often defined as flooding which occurs within six hours of the rain which caused flooding. BoM: Flood of short duration with a relatively high peak discharge.

Flood

Relatively high water levels caused by excessive rainfall, storm surge, dambreak or a tsunami that overtop the natural or artificial banks of a stream, creek, river, estuary, lake or dam.

Flood Awareness

The ability of flood-affected landholders to defend themselves, their property and their community from flood threats and to effectively evacuate themselves and their possessions when necessary (i.e. an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures). In communities with a high degree of flood awareness, the response to flood warnings is prompt and effective. In communities with a low degree of flood awareness, flood warnings are liable to be ignored or misunderstood, and residents are often confused about what they should do, when to evacuate, what to take with them and where it should be taken. The principal factor determining the degree of flood awareness of a community is usually the frequency of moderate to large floods in the recent history of the area.

Flood Damage

The tangible (direct and indirect) and intangible cost (financial, opportunity cost, clean up) of flooding. Tangible costs are quantified in monetary terms (eg. damage to goods and possession, loss of income or services in the flood aftermath). Intangible damages are difficult to quantify in monetary terms and include the increased levels of physical, emotional and psychological health problems suffered by flood-affected people and attributed to a flooding episode.

Flood Emergency

A condition or situation caused by flooding that require urgent action or assistance.

Flood Emergency Plan

An agreed set of roles, responsibilities, functions, actions and management arrangements to deal with flood events of all sizes. Such plans describe flood warning, defence, evacuation, clean up and recovery arrangements. A local flood emergency plan forms an essential component of a flood management plan.

Flood Fringe

See Defined Flood Fringe

Flood Hazard

Potential loss of life, injury and economic loss caused by future flood events. The degree of hazard varies with the severity of flooding and is affected by flood behaviour (extent, depth, velocity, duration and rate of rise of floodwaters), topography, population at risk and emergency management.

Floodplain

Area of land adjacent to a creek, river estuary, lake, dam or artificial channel, which is subject to inundation by the PMF (i.e. flood-prone land).

Flood-prone Land

Land subject to inundation by the PMF. Flood management plans should encompass all flood-prone land, rather than being restricted to land subject to DFEs.

Flood Management Plan

The recommended means of assessing and managing the flood risk. It represents the considered opinion of the local community, local agency and state agencies on how best to manage flood-prone land and provide a long term path for the future development of the community. Usually includes both written and diagrammatic information. It fosters flood warning, response, evacuation, clean-up and recovery in the onset and aftermath of a flood, and suggestions on organisational structure for integrated risk management for existing, future and residual flood risks. A flood management plan should be developed in accordance with the principles and guidelines of this document. Plans need to be reviewed regularly to assess progress and to consider the consequences of any changed circumstances that have arisen since the last review.

Flood Study

A comprehensive technical investigation of flood behaviour. It defines the nature and extent of flood hazard by providing information on the extent, level and velocity of floodwaters and on the distribution of flood flows. The flood study forms the basis for subsequent management studies and will need to address the above issues for a full range of flood events up to and including the PMF.

Freeboard

The height above a defined flood levee, typically used to provide a factor of safety in, for example, the setting of floor levels and levee crest levels (i.e. design flood event). Freeboard compensates for effects such as wave action, localised hydraulic behaviour and settlement of levees, which increase flood levels or reduce the level of protection from provided by levees. Freeboard also provides protection from floods that are marginally above the defined flood level. However, freeboard should not be relied upon to provide protection for flood events larger than the DFE.

Frequency

The measure of likelihood expressed as the number of occurrences of a specified event in a given time. For example, the frequency of occurrence of a five year ARI flood event is once every five years on average.

Habitable Room/ Floor Level

Any living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom, or any area in an industrial or commercial establishment used for offices or used to store valuable possessions susceptible to flood damage.

Hazard

See Flood Hazard.

Minor, Moderate And Major Flooding

The State Emergency Services Organisation of the various States and Territories and the Bureau of Meteorology use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood:

- Major – extensive rural areas are flooded with properties, villages and towns isolated and/ or appreciable urban areas are flooded.
- Moderate – low-lying areas are inundated requiring removal of stock and/ or evacuation of some houses, main traffic bridges may be covered.
- Minor – causes inconvenience such as closing of minor roads and the submergence of low level bridges.

Probable Maximum Flood (Pmf)

The largest flood that could conceivably occur at a particular location, resulting from the PMP. The PMF defines the extent of flood-prone land. Generally, it is not physically or financially possible to provide general protection against this event. It is difficult to define a meaningful annual exceedance probability for the PMF event. It is commonly assumed to be of the order of 10^{-7} (i.e. a flood risk of 1 in 10,000 to 1 in 10,000,000; 0).

Probable Maximum Precipitation (Pmp)

The greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of year, with no allowance made for long-term climatic trends (World Meteorological Organisation). It is primary input to the estimation of the PMF (see also Probable Maximum Flood).

Residual Flood Risk

The remaining level of flood risk that a community is exposed to after flood management measures to reduce risk have been implemented (i.e. 'untreated' flood risk). Residual risk varies with flood severity and may be substantial for flood events that are larger than the DFEs adopted for planning purposes or for the design of structural works.

Risk Management

The systematic application of management policies, procedures and practices to the tasks identifying, analysing, assessing, treating and monitoring flood risk.

Runoff

The amount of rainfall that drains into the surface drainage network to become stream flow, also known as rainfall excess.

Storm Surge

The increase in coastal water levels caused by the inverted barometer effect and wind setup. Some analyses of 'storm surge' also include wave setup.

Tsunami

Low crested waves generated in the oceans by underwater volcanic or landslide activity or by underwater earthquakes. As tsunamis move into shallower coastal waters, their height can increase causing inundation and extreme hazard.

Vulnerability

The degree of susceptibility and resilience of a community and the environment to flood hazards. Vulnerability is assessed in terms of the ability of the community and environment to anticipate, cope with and recover from flood events. Flood awareness is an important indicator of vulnerability.

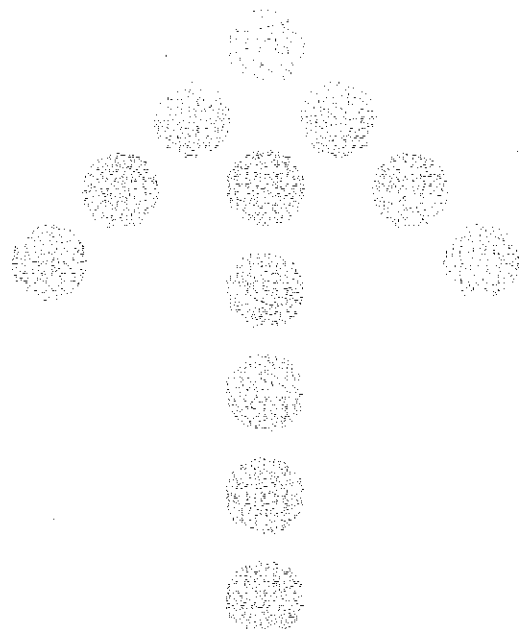
Waterway Corridor

The corridors along a waterway indicated on the Planning Scheme Maps. These corridors are defined by:

- a flood regulation line (FRL)
- a Local Plan, Environmental Corridor or Waterway Corridor
- a Waterway Corridor defined in a Stormwater Management Plan (SMP)
- a Waterway Corridor defined in a Waterway Management Plan (WMP)

If more than one of these measurements is available for a particular waterway, the largest applies. If there is no FRL, Local Plan, SMP or WMP, a 30m distance measured on each side from the centre line of a waterway defines the Waterway Corridor.

The Waterway Corridor is the riparian corridor along a waterway (being a river, creek or tributary of a creek) which protects and enhances the water flow, water quality and biodiversity. Consequently the corridor is an area where development is controlled.



1. Introduction

➤ Purpose

Lord Mayor Campbell Newman and Civic Cabinet established the Lord Mayor's Taskforce on Suburban Flooding in February 2005. The Terms of Reference (TOR) are provided in **Appendix A**. The role of the Taskforce is to examine all possible strategies to reduce the effects of significant rain events on areas of the city liable to frequent flooding.

The Taskforce was guided in its discussion by the information in *A Framework for Risk Management by Brisbane City Council (Draft)*. Much of the material in this Report by the Taskforce is based on that document and the two documents should be seen as complementary.

Why manage flood risk?

1. Brisbane has a substantial flood risk problem. It is estimated that up to 11,000 residential buildings may be prone to flooding by a 100 year ARI flood from creek and river flooding. Of these, 6,900 can be attributed to creek flooding. Many more properties would be prone to flooding by the 'Probable Maximum Flood' (PMF - the largest flood that could conceivably occur) and to flooding from overland flow. The average annual cost of flood damage in Brisbane has not been reliably estimated, but is expected to be significant - perhaps \$4M per year or greater. The cost of damage caused by the 1974 Brisbane River Flood, which inundated some 15,000 properties above ground level (including properties in Ipswich), was around \$200M (1974 values).
2. Community expectations. The people of Brisbane expect to be able to live and work with no untoward flood risk to their life and limb or health, and no unacceptable flood risk to their goods and possessions or to public infrastructure.
3. Legal obligations. Council has an obligation to manage flood risk under recent State and Federal legislation and initiatives concerning the management of 'natural disasters' (which include floods). In addition, Council has an obligation under 'Duty of Care' and Common Law considerations to manage flood risk across Brisbane.

This report by the Lord Mayor's Taskforce on Suburban Flooding describes a framework that will allow Brisbane City Council (BCC) to implement flood Management Measures based on best practice principles. The Taskforce comprises community and business representatives as well as hydraulic experts. Taskforce membership details can be found in the Terms of Reference (TOR) shown in **Appendix A**.

The Taskforce briefly reviewed the current issues for suburban flooding i.e. creek/ waterway/ floodplain (creek) and overland flow (local). In this report, a number of major findings from this review are described, a basis for the strategy is presented, Management Measures and Components are identified, and the Actions and Sub-actions necessary to implement the Components are detailed.

Various Actions and Sub-actions to guide Council through the strategy implementation process are described. It should be noted that a number of the implementation Actions are quite general in nature, and that additional Sub-actions are recommended and will be generated as Council addresses the listed Actions.

A broad action timetable is provided in **Section 4**. The timetable is aimed at implementing the key elements of the Taskforce's recommendations over the period September 2005 – September 2006. These are the Priority 1 - Immediate Actions.

The framework of Management Measures that support the strategy is not an end in itself but a means to an end – better management of creek and local flooding across Brisbane - with consequent reductions in the economic and social impacts of flooding.

➤ Background

The *Floodplain Management in Australia: Best Practice Principles and Guidelines* (CSIRO 2000) identifies three distinct types of flood risk problems. These are:

- **Existing Flood Risk** – The risk to existing buildings and developments on flood-prone land.
- **Future Flood Risk** – The risk to those buildings and developments that will be built in the future on flood-prone land. Future flood risk does not materialise until these buildings and developments are built. Future developments need to be considered in terms of their cumulative effect on flood behaviour and not in terms of the individual impact, development by development. Flooding is managed through a combination of non-structural (for example, flood education and awareness) and structural means (eg. setting minimum flood immunity levels for new developments, pipes to convey stormwater).
- **Residual (or Continuing) Flood Risk** – Refers to risk of floods generally and in particular to those floods that exceed or overwhelm structural flood management measures already in place. Unless structural measures are designed to withstand the Probable Maximum Flood (PMF) (and this is generally not cost-effective or socially acceptable) they will be overwhelmed by a sufficiently large flood at some time in the future.

Substantial areas in Brisbane are prone to flooding (refer to **Appendix B** for creek flooding 'hot spots'), regardless of the origin of the flooding. All are places where Brisbane's residents live, work and play (socio-economic use and amenity), a habitat for plants and animals, are the location of land, mineral, vegetation and water resources, and possible sites of cultural significance. In the new areas of the city the subdivision design ensures that the flows in excess of the pipe capacity are carried in areas other than private properties eg roadways. This reduces the potential for flooding of residences. In the older areas of the city that were subdivided and piped in an era of different standards, excess discharge may flow through the properties. This leads to the potential for flooding of dwellings; however it is not feasible to resubdivide the city when standards change. Likewise, there are areas of the city adjacent to creeks/ waterways where the modern knowledge of flooding likelihood was unknown and current development standards did not apply. If these areas were to be subdivided or developed today then it would be to a higher level or no development would occur.

The sustainable management of flooding within Brisbane needs to recognise and carefully weigh up the impact of existing, future and residual flood risk on the multiple uses of these areas, i.e. risk to life and limb, damage to private and public property, and social impacts caused by future floods.

Brisbane has a history of flood inundation. Each of these events caused, or had the potential to cause, significant impacts ranging from property damage to, in the extreme, loss of life. A table summarising Brisbane flooding since 1893 is provided in **Appendix C**. The most severe of these events was the 1974 flood, which resulted in 14 deaths, over 15,000 affected properties (including Ipswich) and a damage bill of approximately \$200M (1974 values).

A number of flood mitigation works (eg widening and deepening of creeks) were constructed in the late 70's and through the 80's to improve the flood immunity of properties following the devastating floods of January 1974. The major schemes were Kedron Brook, Norman Creek, Breakfast Creek, Sandy Creek (Enoggera), Stable Swamp Creek and Oxley Creek. Since the flood mitigation schemes were completed minimal maintenance has been undertaken.

The Enoggera Dam wall (Enoggera Creek) was raised 6m in 1976 and construction of Wivenhoe Dam (Brisbane River) was completed in 1985. The purpose of these works was to provide the community with better downstream flood immunity in major events.

Over \$100M of local relief drainage (eg major and minor pipes) has been constructed by Council over the past decade to reduce the impact of flooding on properties and roads. Priorities have focused on safety issues (eg water ponding in sags on busy roads) and reducing the number of homes where flooding affects living areas.

Following the 1974 flood, Council introduced a buy back scheme for the properties worst affected by floodwaters. Funding was on the 40:40:20 basis, that is, 40% each Federal and State funding and 20% Council funding. Council purchased approximately 50 properties in the period following the 1974 flood. Of these, the worst affected properties - those between Northey Street and Breakfast Creek at Windsor - were subject to compulsory resumption. The remaining properties were resumed on a voluntary basis. This scheme finished many years ago.

➤ Methodology

The taskforce met twelve times over seven months to review current flooding issues and develop a strategy to reduce the effects of flooding in flood prone areas of Brisbane. Following their review, the Taskforce identified 22 major findings on which to base the strategy. From these findings, four Management Measures were developed. These measures consist of varying numbers of Components (13 in total). Actions (24 in total) and Sub-actions are contained within each Component. The 24 Actions were then given a priority listing of 1, 2 or 3, with those at Priority 1 being Key Actions to be implemented as soon as resources and commitments allow.

➤ Scope And Limits Of Report

The Taskforce's brief was to consider all flooding issues, but in particular to focus on suburban flooding, i.e. creek and local flooding.

This report presents a framework for the development and implementation of a strategy to address and mitigate the impacts of existing, future and residual creek and localised flooding on individuals and communities living and working across the City.

➤ A Guide To This Report:

This Report consists of a further six Sections and five Appendices. The details of these are as follows:

- **Section 2** presents the results of the review of creek and local flooding issues in Brisbane, including the identification of broad areas where new risk management activities need to be included and where existing activities need strengthening.
- **Section 3** presents a vision for the Taskforce's proposed Council flood risk management strategy and describes the outcomes that will follow if the strategy is adopted. Background information for the four Management Measures and their Components are identified and described.
- **Section 4** describes the Actions and activities necessary to develop and implement the twelve Components of the Strategy.
- **Section 5** focuses on the 10 Priority 1 Actions recommended for immediate start.
- **Section 6** details flood mitigation funding.
- **Section 7** presents conclusions and recommendations.
- **Appendix A** is the Taskforce Terms of Reference, including membership details.
- **Appendix B** shows Creek Flooding 'Hotspots'.
- **Appendix C** details Brisbane's flood history.
- **Appendix D** details criteria recommended for Voluntary Residential House Buy-Back.
- **Appendix E** is an excerpt from the document Risk Based Approach to Flood Management – Benchmarking Component.

2. Review Of Creek And Local Flooding

➤ General

The Taskforce met on twelve occasions over the period February 2005 to August 2005. The main business of each meeting was as detailed below:

- Meeting No.1 (8 Feb 05) - Identify Issues and information needs
- Meeting No.2 (21 Feb 05) - Focus Areas and Issues
- Meeting No.3 (16 Mar 05) - Local Flooding and Focus Areas
- Meeting No.4 (7 April 05) - Flooding Problem Statements and Solutions
- Meeting No.5 (28 April 05) - Solutions and Final Report Format
- Meeting No.6 (11 May 05) - Draft Recommended Actions and Estimated Costs
- Meeting No.7 (1 June 05) - Draft Report
- Meeting No. 8 (22 June 05) - Draft Report and Inundation Survey
- Meeting No. 9 (6 July 05) - Draft Report and Inundation Survey
- Meeting No. 10 (26 July 05) - Draft Report and Voluntary Buy-Back Criteria
- Meeting No. 11 (8 August 05) - Draft Report and Voluntary Buy-Back Criteria
- Meeting No. 12 (24 August 05) – Final Report Sign Off

➤ Major Findings

The Taskforce briefly reviewed creek and local flooding issues in Brisbane. The major findings of the review (unranked) are as follows:

- 1 Council should refine its flood risk management planning processes so that it addresses the concerns of all stakeholders, including the community.
- 2 There is a need to increase the level of understanding of 'best practice' flood risk management principles by all stakeholders, including the community.
- 3 There is a need to strengthen communication between the community, Council and Federal and State agencies associated with flood risk management.
- 4 Council's City Plan should address the effects that cumulative filling of waterways and floodplains have on flooding to downstream, upstream and adjacent communities.
- 5 Some houses subject to creek and floodplain flooding may be either the wrong 'design' for the environment they are in or were approved under older development conditions.
- 6 When blocked, overland flow paths contribute to local flooding.
- 7 City Plan and existing Local Laws for the mitigation of creek and local flooding, eg. by preventing unauthorised or unlawful filling of sites, may not be effective or adequately enforced.
- 8 State Government Legislation and Permit conditions may be impeding the implementation of effective flood mitigation measures.
- 9 Residents want effective flood forecasting for creek, waterway and floodplain events and flood warning systems.
- 10 Community understanding of the extent of flooding that occurs throughout Brisbane may be limited.
- 11 Information/ results from flooding reports/ investigation undertaken by Council may not be accepted as being accurate by the community.

- 12 Council should review how creek and local flooding events, and construction and maintenance works are recorded.
- 13 Consideration should be given to changing the budget funding and mix to mitigate creek and local flooding.
- 14 Drainage Works Programs selection priorities should be reviewed to ensure they reflect current community expectations/ needs.
- 15 Maintenance Work Programs are to keep Council's existing infrastructure operating to its optimum efficiency.
- 16 Capacities of existing open waterways and floodplains should be reviewed to ensure they operate to full capacity whilst taking into account environmental considerations.
- 17 Design standards should ensure Council infrastructure and drainage systems operate efficiently and effectively during flood events.
- 18 Land use planning may not be effectively keeping people away from, or managing, development within waterway corridors and floodplain areas.
- 19 Development across the city is increasing impervious areas, causing the volume of runoff to increase and reach creeks faster than in undeveloped catchments.
- 20 Council should ensure that compliance with legislation and policies is adequately regulated.
- 21 A flood affected property data set is required for:
 - historical flooding
 - potential (below BCC design standards) flood prone property.
- 22 Council should adopt a community development approach, building on catchment coordination committees engaging the community to address the following solutions:
 - flood awareness raising
 - local warning systems
 - local flood level monitoring
 - consultation on remediation priorities
 - community support/ assistance to flood affected residents/ businesses.

Based on these findings, the Taskforce developed strategies to reduce the effects of significant rain events on areas of Brisbane prone to flooding, as detailed in the following sections.

3. Taskforce Strategy For Creek And Local Flooding Development

In the formation of a strategy for Brisbane creek and local flooding, it is important to realise that a number of obligations, needs, constraints, opportunities and achievements to date affect the nature and details of the strategy. These include:

- The need for Council to work towards community expectations and Duty of Care obligations with respect to flood risk management.
- There are few 'greenfield' sites left for development across the City. Future development will consist largely of 'infill' development and the redevelopment of existing developed areas. This provides both constraints and opportunities for creek and local flood management.
- Flood studies have been undertaken for the Brisbane River and for most Brisbane creeks. Therefore, in formulating a creek and local flood strategy, Council is starting from a strong position with respect to essential background information.
- Brisbane has well developed land use planning and development assessment systems, essential for a creek and overland flow flood risk management planning system.

The Taskforce understands that the Council has been undertaking various components of flood risk management planning since the mid-1970s. Today it is not so much a case of starting from scratch, but of identifying and incorporating missing elements, strengthening existing elements where necessary, and integrating the various components into a comprehensive and effective planning process.

Brisbane is a sub-tropical city subject to the vigour and extremes of a sub-tropical climate. At times, flooding occurs along the Brisbane River and Brisbane creeks and in local and low-lying coastal areas. The objective of this strategy is to reduce the impact of creek and overland flow flooding on the individual owners and occupiers of flood-prone land and to reduce private and public losses caused by floods. This will be done through a process of flood Management Measures.

This strategy recognises that:

1. Flooding in Brisbane can be caused by a number of mechanisms:
 - heavy or sustained rainfalls over the catchments of Brisbane's creeks
 - overloaded stormwater systems as surface runoff makes its way into creeks (overland flow)
 - heavy or sustained rainfalls over the catchments of the Brisbane River
 - storm surge in Moreton Bay
 - failure of one of the three dams in the City's environs, Gold Creek Dam, Lake Manchester and Enoggera Dam or the SEQ Water controlled Wivenhoe Dam
 - a tsunami in the Pacific Ocean.
2. Creek and local flooding occur regularly in Brisbane and causes considerable disruption to the community. Accordingly, the Taskforce has addressed creek and overland flow flooding issues across Brisbane in this report.
 - With regards to river flooding, the Taskforce notes that a Independent Expert Panel has recently reviewed flooding associated with the Brisbane River (BCC 2003, *Review of Brisbane River Flood Study*) and that development and redevelopment in areas below the Defined Flood Event (DFE) flood level have strict flood immunity requirements under the Brisbane City Plan. Such requirements are supported.

- There is no realistic remedy for storm surge other than proper education of the community and effective land use planning and warning systems.
 - The Taskforce recognises the very low risk of dam failure flooding. It is noted that this risk is managed principally through dam safety audits that are a State Government responsibility.
 - It is thought that the risk of significant flooding by tsunami is remote, but this needs to be confirmed. Further, the Bay islands would provide some protection for Brisbane against tsunami flooding.
3. Flooding in Brisbane can be worsened by a number of processes:
 - Loss/ alteration of overland floodwater flowpaths and their natural detention/ retention basins.
 - Loss/ alteration/ infilling of waterway corridor, flood plains, wetlands and their natural detention/ retention basins.
 - Loss of infiltration processes and increases in impervious surfaces.
 4. While Council is the primary public agency responsible for the delivery of local flood management services, a number of Federal and State government agencies have specific roles to play in the management of flooding risk. Council should liaise with these agencies to facilitate coordinated and effective management initiatives across Brisbane at the three levels of government.
 5. Flood-prone areas across Brisbane can serve a variety of urban and ecological purposes and are a source of natural resources. When making development decisions for flood-prone land, Council should adopt an approach that takes into account social, economic and ecological factors, as well as flood risk and environmental considerations.
 6. Flood risk can be managed by a variety of measures that modify property at risk (eg. land use controls), the response of individuals or communities at risk (eg. flood warning), or flood behaviour itself (eg. the use of levees/ pipes to reduce overland flow). Council should reduce flood risk by determining an effective and integrated mix of Management Measures appropriate to each flooding situation.
 7. All flooding events have an associated flood risk. Council should manage flooding risk for events up to the 'probable maximum flood' (PMF).
 8. Individuals and communities in flood-prone areas have roles to play in the management of flood risk. Through education programs, Council should inform the public of their exposure to flood risk (flood awareness) and how they can actively contribute to the management of this risk to reduce the impact of flooding on themselves and their possessions (flood readiness, flood response and flood recovery).
 9. A host of 'flood information' should be retrieved, collected, stored and presented to assist various stakeholders to better manage flood risk.
 10. Emergency management and recovery programs are essential components of flood risk management and need to be integrated with other management measures.
 11. Climate change is occurring and its impact on sea levels and storm events are yet to be fully determined.

This creek and local flooding strategy for Brisbane consists of defining and implementing an effective management planning process that fosters the sustainable use of the urban land of the City for social, economic and ecological purposes. It pays due regard to the risk and damage likely to be caused by future flooding, the environmental impact of future developments and risk management measures, and the general environmental health and well-being of Brisbane waterways and floodplains.

➤ Strategy Management Measures

To formulate a flood risk management strategy, the Taskforce categorised potential management Actions arising from their key findings into four broad categories (Management Measures). These four Management Measures and their Components form the framework that supports this strategy. Each Management Measure, its Components and background information is provided below. Section 4 of the Report expands on each of these measures, giving details of the recommended Actions and Sub-actions that form the flood risk management strategy for Brisbane.

1. Non Structural Measures

Non structural measures ensure that the vulnerability of a particular land use activity is consistent with the flood risk of the area of land, i.e. the objective is to keep people and vulnerable activities away from flood waters. Non structural measures include land use controls, the acquisition of land and relocation.

Land use within Brisbane has a variety of purposes. The sustainable management of land requires that the impact of flood risk on the multiple uses of the land needs to be carefully weighed up. Land use controls are the most cost-effective means of controlling development in areas that may be subject to flooding.

When reviewing or developing land use plans for flood-prone areas of Brisbane, Council should ensure that flood risk is identified, assessed and appropriately addressed in the adopted land use zones and associated development controls. This means that, as new areas are developed or older areas are redeveloped, better land use design standards are incorporated.

At times, other land use considerations will outweigh flood risk factors. In these circumstances, it is essential to adopt compensating flood risk management measures to reduce hazards to acceptable levels. Hence, the need for planning that considers and weighs the socio-economic, amenity, natural resource and cultural aspects of land use across flood-prone areas, as well as the associated flood risk, and develops an appropriate and integrated mix of Management Measures to address risk.

The affected community should be involved in the process of revising or formulating land use plans to include flood risk considerations.

Where residential houses have habitable floor areas subject to frequent flooding eg. 2 year ARI events, and no other cost-benefit solutions are available, Council should give consideration to the acquisition of the land and using it for more appropriate purposes. The Taskforce understands Council has previously participated in a jointly funded compulsory and voluntary 'house purchasing' scheme with State and Federal Governments following the 1974 flood.

In the event land is purchased as a result of frequent flooding of habitable floor levels, all structures on the land should be removed and the land zoned accordingly. Criteria for a Residential House Voluntary Buy-Back scheme are proposed in **Appendix D**.

Environmentally Sustainable Development (ESD) and Natural Resource Management (NRM) principles should be included as part of all land use and flood management considerations.

Non structural Components of the flood risk management strategy are:

- 1.1 **Land Use Planning Controls: Include Land Use Planning Considerations** – Council should ensure that floodways are retained for floodway purposes, and only allow development that is consistent with this waterway function. In doing so Council should ensure that its current land use planning process is appropriate for managing flood risk and developing flood risk management plans, including a review, and possibly, rationalisation of land use zones. For example, development should be constructed above the defined flood level (eg. 100 year ARI).
- 1.2 **Environmental Management: Include Environmentally Sustainable Guidelines and Best Practice Planning Processes** – Council's planning processes should recognise and address the ecological, environmental and cultural features of waterways and floodplains and incorporate the principles of ecologically sustainable development, natural resources management and integrated catchment management.
- 1.3 **Voluntary Residential House Buy-Back** - Where residential houses are subject to frequent creek or overland flow flooding eg. for 2 year ARI events and there is no local cost-beneficial infrastructure solution alternative, Council should consider the acquisition of the land as part of a voluntary buy-back scheme.

2. Structural Measures

Structural measures include piped drainage, constructed open drains, flood mitigation schemes, detention basins and catchment diversions, etc. Building controls can be seen as a particular kind of structural measure aimed at reducing flooding of, and flood damage to, buildings. Typical building controls can include minimum floor levels and the use of selected construction materials and designs that minimise damage and enable rapid and effective clean up after flooding has occurred.

Current structural flood control works in Brisbane include piped drainage, constructed open drains, flood mitigation schemes, detention basins and the three water supply reservoirs on the upstream reaches of Brisbane creeks. Maintenance plans for these existing public assets should be in place to ensure their flood readiness and effectiveness.

Structural controls only manage/ mitigate flood risk up to that of the design flood event. Additional consideration needs to be given to the management of risk associated with flood events bigger than the design that overwhelm the structural measures.

Development and building controls, by themselves, are not an effective and appropriate flood risk management measure. At best, they are an adjunct to other management measures, especially land use planning controls, flood emergency management measures and structural works, which together provide a 'regional' basis for flood risk management in the area to be developed. Building controls are aimed at managing 'local' (site-specific) aspects of flood risk.

Minimum floor levels for existing houses may be achieved through raising the structure. 'House raising' schemes are understood to have been undertaken in other states and territories and funding is indicated to be from various levels of government and the property owner. There are restrictions to the title of the property to prevent building underneath once the property is raised and each case is investigated and approved on a site by site basis. The Taskforce discussed relaxation of City Plan roof height requirements but, given the State Government is the likely lead agent for house raising, did not discuss the development of a 'house raising' scheme in detail.

The approval process for flood-prone buildings should consider the local impact of the building on flood behaviour and flood risk. Adequate access for evacuation purposes during flooding is an essential consideration. The appropriate orientation of the buildings and associated roads and fences, etc. (and the nature of fences – solid or open) can reduce local impacts on flood behaviour and risk, and ensure that adequate local flood access is maintained. Council should educate developers and building certifiers to seek advice on these aspects at the conceptual design stage of the development.

The approval process needs to consider the impact of site 'cut and fill' operations on creek and local (overland flow) flood behaviour and risk when assessing proposed building on land prone to flooding. For example, the location and extent of proposed site 'filling' must have due regard to the 'cumulative impact' of the proposed development. The works must not adversely impact on flooding or drainage of properties that are upstream, downstream or adjacent to the subject site.

Further, consideration should be given to the question of whether it is appropriate to 'balance' local cut and fill volumes (i.e. no loss of floodplain storage). The impact of cut and fill operations on both regional and local 'hydraulic conveyance' (i.e. the ability of the floodplain to convey floodwaters) may need to be quantitatively assessed via flood models.

Council should review the treatment of 'cumulative impacts' when assessing development applications. Currently, Council assesses (correctly) the impact of future development on a cumulative basis when undertaking flood studies. It is essential that changes to the development application process under Integrated Planning Act (IPA) 1997 do not allow developers to propose developments on flood-prone land that were not originally intended and that impacts are treated on a cumulative basis in accordance with the tenets of best practice flood risk management. Flood-based land use zoning and controls are fundamental flood risk Management Measures and the statutory land use planning process needs to incorporate them in an effective and transparent manner. It is noted that the adoption of appropriately named and conditioned hydraulic 'zones' (categories) for flood-prone land will assist in managing the cumulative impact problem.

Structural Components of the flood risk management strategy are:

2.1 Structural Controls: Ensure Adequate Design, Construction and Maintenance of Structural

Flood Controls – Council should review the appropriateness of current structural control measures for managing flood risk, and ensure that appropriate maintenance and asset management plans are in place for current structural controls.

2.2 Development and Building Controls: Define Appropriate Development and Building Controls

for Areas Prone to Flooding – Council should ensure that its current development and building controls are appropriate to managing flood risk.

3. Flood Preparedness Measures

Flood preparedness recognises that regardless of how effective the structural and non structural Management Measures are, an overwhelming flood (larger than Defined Flood Event - DFE) can always occur. Flood preparedness aims at having people ready for flooding before it occurs and, in cases, may be the only type of management that is feasible or economically justified. Flood preparedness measures embody flood forecasting, flood warning, and raising of general flood awareness.

Reference Group

Council should identify and include representatives of all stakeholders in Brisbane who, through their activities, affect flood behaviour or flood response or who are affected by flooding, in the flood risk management planning process. It is noted that there are Federal, State, Regional, Council and Community stakeholders:

Federal	BoM (flood forecasting and warning)
State	NR&M (proposed State flood risk management policy); DES (Queensland Disaster Management Act 2003); DLG&P (SPP1/03 – Natural Hazard Management Areas) and OUM (Regional Planning to 2026)
Regional	Council of Mayors (SEQ) regional emergency planning – prevention, preparation, response and recovery
Council	internal 'business units' associated with flood risk management
Community	community at large and special interest groups (eg. developers)

Council should devise an appropriate structure for a Reference Group (RG) or other forum and include the various stakeholders in the flood risk management process by encouraging them to appoint representatives. The RG should include external stakeholders and representatives of flood-prone communities.

Practice in other Australian states and territories shows that forming a RG can strengthen communication between stakeholders. Other than the Taskforce, Council does not have a flood management forum that brings together flood risk management stakeholders. Council should create such a forum. The RG will be a consultative body rather than one that directly determines Council policy.

Flood Studies

An integrated and effective mix of Management Measures to address the existing, future and continuing flood risk problems can only be realised by investigating the full range of flood events. This requires the investigation of flood behaviour for creek and overland flow flooding over a full range of minor, moderate and major flood events, including the PMF.

Flood studies must generate the full range of flood data required by all stakeholders in the flood risk management planning process. Such data should include flood producing rainfalls, flood discharges, flood levels, flood hazard indicators (depth, velocity, rate of rise, effective warning time, ease of evacuation, flood depths over roads, etc.), building floor levels, capacity of existing infrastructure (pipes, gullies etc.) etc.

When assessing the impact of future development on flood behaviour and risk, it is essential to assess the impact on a 'cumulative basis', i.e. on the assumption that all development allowed under the proposed land use scheme has taken place. Assessment on a case-by-case basis can underestimate the ultimate impact on flood behaviour.

A suite of 'standard' analytical methods best suited for flood studies in Brisbane (eg. the most appropriate hydrological and hydraulic models to predict flood discharges and water levels across Brisbane's catchments) should be selected and adopted. The use of 'standard' analyses and models will tend to eliminate analysis-specific issues when comparing results from one flood study to another. Council should investigate ways to facilitate the efficient generation, storage and retrieval of 'standard format' input and output flood study data.

Flood studies should undergo Quality Assurance (QA) to ensure technical soundness with respect to methods of analysis and the handling of input and output data (given that these data form the foundation of other flood risk management studies). This will foster community confidence in the outcomes recommended as a result of flood studies.

It is understood that Council has undertaken flood studies for approximately 30 years. An audit of Council flood studies should be conducted to determine the stage Council has reached with studies that have been undertaken, and prior studies should be consolidated where possible.

To date, comprehensive flood studies have been undertaken for the Brisbane River and for the main stem of most of Brisbane's creeks. The Taskforce identified the following areas as needing further work:

- flooding along tributaries of Brisbane creeks (this has only been partially assessed)
- flooding caused by overland flow (because of its widespread nature, this is potentially a significant problem)
- flood hazard considerations in general.

Risk Management and Damage Assessment

Current changes in the nature and responsibility for flood risk management in Queensland legislation require that Council's flood studies address these and other issues described below.

Council should assess the extent of flooding across Brisbane caused by the PMF event, as this information is required for flood emergency planning purposes. Many studies have not included this assessment.

In zoning flood-prone land, Council should consider changing the names of hydraulic categories to better reflect hydraulic behaviour. Currently, Council adopts two (inferred) hydraulic categories for flood-prone land, the 'waterway' zone, and the area outside this zone - 'limit of fill'. These areas form the basis for defining land use controls along creeks and floodplains. The terms 'floodway' and 'flood fringe' better reflect the hydraulic purpose and importance of these areas. In addition, Council should consider introducing the category of 'flood storage', to provide a more comprehensive hydraulic basis for land use controls. Council should also review how such zones are defined.

Council should determine how it will prioritise, assess and manage flooding caused by overland flow and local runoff along tributaries to Brisbane's creeks. In general, these two flooding types generate more flood risk than the Brisbane River and Brisbane creeks breaking their banks. This should be taken into account when allocating resources to these problems.

Currently, most overland flow flooding is a civil matter, i.e. a matter between affected property owners. Overland flow flooding results from surcharging (overloaded) stormwater drainage systems; it is a common occurrence during major storm events (the piped stormwater drainage system is generally designed to handle flood events of 2 year to 5 year ARI). The problem is exacerbated by the connection of new upstream developments to the existing downstream stormwater system. Generally, overland flow is relatively shallow, but can be of high velocity and locally hazardous.

The management of overland flow flooding could be time-consuming and costly. Council should ensure that the means and costs of management are appropriate to the risk caused by overland flow flooding. It is suggested that a local drainage catchment with existing overland flow problems be selected and treated as a case study, to enable the methodology of analysis and cost-effective means of management to be tested.

Flood levels and other flood behaviour along creek tributaries have not been assessed during past flood studies because of the absence of local discharge estimates or tributary cross-sections. The assessment of flood behaviour along tributaries could also be time consuming and costly. Council should:

- Determine the size and significance of the creek tributary flood problem in Brisbane.
- Select a single catchment and use it as a case study for the purposes of developing and testing a rapid means of assessment.

Council should undertake flood damage assessment studies when undertaking flood studies. These provide a basis for assessing the economic costs and benefits of various flood risk Management Measures.

Flood Information and Community Education

It is apparent that there is a significant amount of flood data and information available for the purposes of efficient flood management in Brisbane City. A database system is the only effective way to handle this volume of data. A number of purpose-designed Flood Information Management Systems (FIMS) and Decision Support Systems (DSS) have been developed by different agencies to facilitate better flood management. Council should consider the value of such a system.

An asset register for structural control works should also be in place. A register (database) of the levels of protection provided by the various structural works on a catchment-by-catchment basis should be kept, to provide a 'ready reckoner' for flood management purposes during floods.

Council should endeavour to improve the general levels of flood awareness of Brisbane residents to enable them to better understand flooding issues in general (eg. flood reporting) and how to prepare and respond to significant rain events (eg. through safe driving and children's play safety (creeks/ drains) etc.).

Council should also endeavour to improve general levels of flood awareness and readiness of 'providers' to the community (eg. solicitors and real estate agencies etc.) to better manage their flood risk, i.e. Council should attempt to influence their professional behaviour. Developing strong lines of communication and providing appropriate training is the most effective way to achieve this.

A large number of Council's business units (internal stakeholders) participate in the current flood management process and will continue to participate in the proposed flood Management Measures. It is essential that these stakeholders are aware of basic best practice principles of modern flood risk management, and that good communication and an understanding of their roles and responsibilities, is maintained between internal stakeholders.

The proposed management process requires input by external stakeholders from a number of regional, state and federal agencies. These external stakeholders should be aware of modern flood risk management principles. It is important that Council maintain good communications with these external stakeholders to facilitate the exchange of information.

Flood Warning

In Australia, the Federal Government has charged the Commonwealth Bureau of Meteorology (BoM) with responsibility for providing flood forecasts for flood-prone areas along the major rivers of Australia. To this end, BoM has established a substantial flood forecasting capability in all Australian states and territories. BoM issues warnings for 'flash flooding' (less than 6 hours between rainfall and flooding) and 'non-flash flooding' (greater than 6 hours). Typically, local councils, including BCC, augment BoM's forecasting and warning service by providing ancillary flood reporting and forecasting capabilities.

The BoM communicates flood warnings to Brisbane residents via their website, recorded telephone messages, 'weather-by-fax', radio and television. Residents access the Council's information through its Contact Centre.

By its very nature, flash flooding occurs quickly. Flash flood affected communities are often caught off guard with no time to try to mitigate the damage that is caused. There is currently no reliable technology to provide timely forecasts for flash flooding; however, Council has a project under development that has the potential to empower local flash flood affected communities to lower their flash flood damage.

This project is known as "FloodWise", it is currently only available internally on the Council's intranet. At some future stage, it may be feasible to make this available on the internet. FloodWise site data is updated every 5 minutes with rainfall and water level at all operational gauges in and around Brisbane. There are approximately 100 rainfall gauges and 40 water level gauges. There is the potential for a 'Trigger Point' to be set on the actual and/ or processed data, causing the system to generate SMS and email messages automatically whenever the trigger is reached.

Council's Legal Responsibilities

Flood risk management involves Council determining creek and local flooding risks across the City and implementing measures to reduce risk to 'acceptable' levels. Council has various legal and administrative obligations in undertaking this process. It is recommended that Council make flood risk and flood warning data available to the public. These activities may incur legal liabilities for Council. It behoves Council to know its legal and administrative obligations.

Recent changes to the Local Government Finance Standard require Councils in Queensland to identify, track and report on the costs of 'disaster management'. Council will be required to report on both internal costs and external costs it incurs for flood risk management in Brisbane.

Council should investigate any legal and administrative obligations or impediments it has in implementing a flood risk management process for the City, and those that may arise from this process.

Flood Insurance

Council does not have an explicit responsibility to assist the insurance industry in the provision of flood insurance to the general public; however, if it did so, Council would be performing a valuable public service. The Council of Australian Governments 2002 recognised the importance of disaster insurance as a significant risk management measure, advocating that the insurance industry make available such insurance to areas prone to natural disasters and assist disaster management agencies with research into better management of disasters.

Council can assist the insurance industry by making available, or ensuring that it has available for possible future use, flood risk data in an appropriate format to be used in the setting of insurance premiums. Council should liaise with the ICA and other insurance industry agencies to determine the most appropriate nature, format and access to transfer of flood risk information. Data will need to be geo-referenced and quality assurance checking will be required before data are used to set 'real-world' premiums.

Flood Preparedness Summary

Flood preparedness Components of the flood risk management strategy are:

3.1 Flood Risk Management Plans: Develop and Implement a Creek and Local Flood Risk

Management Planning Process – Council should develop and apply, when considering existing and future land use, an overarching flood risk management planning process that addresses the multiple uses and users of flood-prone land and its associated flood risk, and culminates in flood risk management planning.

3.2 Flood Studies: Review Flood Study Procedures and Results for Creek and Local Flooding

– Council should review the current state of its flood studies for Brisbane’s creeks and overland flow flooding to ensure that the flood studies are being undertaken to consistent and appropriate technical standards and that all relevant data are being generated and used in the flood risk management planning process.

3.3 Information Management: Develop and Implement an Appropriate Flood Information

Management System – Council should review the nature of flood data required by the various stakeholders, including the community and the State Government, to ensure that the data and means of collection, storage and presentation, are appropriate to users’ needs.

3.4 Education and Communication: Improve Stakeholder Understanding of Flood Risk

Management Principles and Stakeholder Communications – Council should undertake training/ education programs to inform all stakeholders of the principles of creek and overland flow flood risk management planning and their roles and responsibilities in this process, and to develop and deliver communication programs to all Brisbane residents, in particular flood-prone individuals and communities, to foster flood education, flood awareness, flood readiness and flood response.

3.5 Flood Forecasting and Warning: Ensure that Flood Forecasting and Warning Services are

Timely, Accurate and Effective – Council should ensure that its current flood forecasting and warning arrangements and activities, including coordination with the Commonwealth Bureau of Meteorology and State agencies, are appropriate and that Council flood advices are appropriate, easy to understand and effective.

3.6 Flood Insurance: Liaise with the Insurance Industry to Facilitate the Provision of Flood

Insurance to the General Public – Council should liaise with the Insurance Council of Australia (ICA) to keep abreast of developments and data needs for the possible provision of flood insurance.

3.7 Legal and Administrative: Define and Meet Legal and Administrative Responsibilities and

Obligations – Council should review its legal obligations with respect to creek and overland flow flooding risk management under the various pieces of State legislation and under Duty of Care requirements, and review its administrative arrangements with respect to management of flooding risks. Refer to Appendix E.

4. Flood Emergency Measures

Flood emergency measures deal with the occurrence and aftermath of a flooding event by helping affected people cope. Flood emergency management is a process that typically encompasses preparation, response and recovery. In addition to flood preparedness, flood emergency measures include evacuation planning and training, flood clean up planning and the restitution of essential services, and social and financial recovery measures.

The Taskforce understands Council has a local disaster management plan that demonstrates the capability to respond to a range of disaster events including flood.

Coordination between all emergency management stakeholders is essential in preparing flood disaster management plans, as is the effective integration of their efforts. Stakeholders include flood forecasting and warning agencies, flood defence agencies, flood evacuation agencies and relief and recovery agencies. Good communication and a clear definition of roles and responsibilities between all stakeholders are essential.

The flood emergency plan is an essential component of a flood risk management strategy. They are complementary, and there are significant benefits in developing them jointly, especially with respect to land use planning and controls and evacuation considerations. Emergency management agencies should be encouraged to liaise with Council and contribute to the flood risk management planning process, especially in interpreting the hazard and evacuation aspects of flood studies.

Flood emergency Components of the flood risk management strategy are:

- 4.1 **Emergency Management: Develop a Flood Emergency Plan for Brisbane** – Given the recent changes to emergency management responsibilities in Queensland, Council should review emergency management arrangements for flood prevention, preparation, response and recovery, including coordination with other agencies responsible for emergency management activities, and ensure that emergency management considerations are appropriately addressed in the formulation of flood risk management plans.

4. Details Of The Strategy

This section provides details of all Actions and Sub-actions and their corresponding Management Measures, Components and priorities, providing the framework for Brisbane City Council to implement a flood risk management process.

Members of the Taskforce made their individual choice of their highest 10 Action priorities. The Taskforce then allocated timeframes for completion to those Actions that received the most votes, identifying Priorities 1, 2 and 3 as defined below. Within Priority 1, the Actions were ranked by the number of votes received. In the following table the Actions are listed in an agreed logical order not in the order of their ranking.

Three levels of priority have been defined for strategy implementation:

- **Priority 1** - indicates the Actions and Sub-actions that should be started as soon as resources and commitments allow, and substantially completed over the period September 2005 – September 2006 (Immediate Actions). The Taskforce has ranked Priority 1 Actions.
- **Priority 2** - indicates the Actions and Sub-actions that can be delayed but ideally should be undertaken over the period July 2006 – December 2009 (Intermediate Actions). The Taskforce has not ranked Priority 2 Actions. The Taskforce has not ranked Priority 2 Actions.
- **Priority 3** - indicates the Actions and Sub-actions that can be further delayed but ideally should be undertaken over the period July 2007 – December 2016 (Long Term/ Ongoing Actions). The Taskforce has not ranked Priority 3 Actions. The Taskforce has not ranked Priority 2 Actions.

To assist Council implement the Strategy, the:

- specific **Actions** are listed by priority order. In effect, the Action list is a 'check-list' of implementation activities.
- **Sub-actions** that formulate the Action are listed. These are essentially dynamic in nature and additional Sub-actions will be generated as Council addresses the listed Actions.

The Taskforce has allocated **Priority 1 to 10 Key Actions** for immediate action and recommends that Council address these Actions as soon as resources and commitments allow. Further information and the rationale behind these Actions is provided in **Section 5**.

The entire strategy framework, including additional comments that relate to the various Actions, is presented in Table 2.

The members of the Taskforce constituted a group of people with very diverse backgrounds and representing a wide variety of interests and concerns; nevertheless, the Taskforce was able to reach consensus on the great majority of Actions and Sub-actions that are proposed in its report. All members of the Taskforce were in complete agreement that worsening of flooding must be prevented and that the impacts of suburban flooding should be reduced to the extent that is possible. There is a small number of decisions on which consensus was not achieved. These are Sub-actions 2.1, 2.4, 2.5, 2.8 and 4.5.

In the case of Sub-actions 2.1 and 2.4, the Sub-actions are shown with two different versions, identified as Option A and Option B. Option A is the version that has majority support and Option B represents the dissenting minority view. The numbers supporting each Option is stated with it. In the case of Sub-actions 2.5, 2.8 and 4.5, one version is given and the numbers supporting and opposing the Sub-action are recorded.

With regard to the criteria recommended for the selection of residential houses for consideration for voluntary buy-back, the majority of the Taskforce (8 out of 11 possible votes) supported Option 1 and a minority (1 out of 11 possible votes) supported Option 2. There was no support for Option 3. Refer to **Appendix D** for description of the Options.

➤ Table 2: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
1	<p>Provide for the voluntary buy-back of low flood immunity residences:</p> <p>Management Measure No. 1 – Non Structural Measures – Component 1.3</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 3)</p> <p><i>Based on preliminary findings for properties that may be subject to 2 year ARI creek flooding, i. e. on average 1 in 2 year flood immunity, the Taskforce recognises voluntary residential property buy-back will be one of the long term solutions to creek flooding and to overland flow flooding and that State and Federal Government financial support will be required to ensure this important initiative is adequately funded.</i></p> <p>This can be achieved by:</p> <p>1.1 Establish how many properties and houses are subject to frequent creek and overland flow flooding, and to what extent.</p> <p>1.2 Using the Voluntary Residential House Buy-Back criteria outlined in Appendix E, review arrangements in other states and territories concerning Local Government purchasing houses where the flood immunity is unacceptably high, including funding arrangements and responsibilities. On completion of review, finalise policy for voluntary residential property buy-back.</p> <p>1.3 As part of the review, consider arrangements in other states and territories concerning Local Government purchasing land for use as detention areas, i.e. after completion of modelling and assessment of multiple benefits such as environmental and recreational. On completion of review, if practical, develop policy for voluntary land buy-back for the creation of flood water detention areas, particularly if the land is flooded regularly and there is little opportunity to economically develop further.</p>	<p>Approx 400 properties may have floor levels affected by ARI 2 flooding @ current market value = \$120M.</p> <p>Assume 50% of property owners will want to stay and of the remaining 50%, some may not be affected by flooding to floor levels – assume 20% = \$60M.</p> <p>If cost is spread over 20 years = \$3.0M/ year and allows for purchase of ~ 10 houses per year.</p> <p>Annual ancillary costs, eg. expenses, removal etc. are estimated to be \$0.5M per year.</p> <p>Total estimated cost is \$3.5M/ year (in 2005 dollars).</p>
2	<p>Review and strengthen, where necessary, land use planning controls in City Plan to ensure no adverse impact from flooding:</p> <p>Management Measure No. 1 – Non Structural Measures – Component 1.1</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 1)</p> <p><i>Council should undertake a comprehensive review of land use planning controls as specified in City Plan to ensure that development (greenfield) and redevelopment (infill) take into account their cumulative impact, and that there are no adverse impacts on properties from flooding and that ecological functions are retained.</i></p> <p>This can be achieved by:</p> <p>2.1 Option A (Supported by 6 votes out of 10 possible votes) - Create 'Flooding Code' as a Primary Code in City Plan specific to both greenfield and infill developments. All Sub-actions relevant to this new Flooding Code are to be considered for inclusion in it.</p>	<p>Estimated cost is \$150K.</p>

➤ Table 2: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>Option B (Supported by 2 votes out of 10 possible votes) - The City Plan should consider flooding and climate change as significant.</p> <p>Option A is to be adopted.</p> <p>2.2 Control filling within overland flow paths, waterway corridors and floodplains especially with regards to 'cumulative impact'.</p> <p>2.3 Reassess the allowance in City Plan of 1.0m of fill to be placed without approval in Waterway Corridor, overland flow paths and flood risk areas.</p> <p>2.4 Option A (Supported by 6 votes out of 10 possible votes) - Prohibit development and filling inside City Plan Waterway Corridors. The objective is to protect and enhance the water flow, water quality, ecology, and open space, and recreational and amenity values of the City's waterways, subject to ground truthing of the Waterway Corridor.</p> <p>Option B (Supported by 4 votes out of 10 possible votes) - City Plan review to incorporate performance criteria that specifically address flooding and require no adverse impact to downstream, upstream and adjacent properties or ecological processes, taking into full account the cumulative effect.</p> <p>Option A is to be adopted.</p> <p>2.5 Restrict further filling and development within the area of 100 year ARI or Defined Flood Event flood to satisfy the new 'Flooding Code' in Sub-action 2.1. (6 votes for, 2 against out of 8 possible votes).</p> <p>2.6 Develop guidelines/ practice documents for specific catchments, specifically for the issues of the catchment or potential new development areas.</p> <p>2.7 Investigate if the planning process can reduce the magnitudes of peak flows.</p> <p>2.8 Make provision in Council Policy, City Plan and Codes to not allow the practice of cut and fill in Waterway Corridors where there will be an adverse effect on the incremental flood storage. (7 votes for, 1 against out of 8 possible votes).</p>	
3	<p>Review and strengthen, where necessary, development and building controls in City Plan to ensure no adverse impact from flooding:</p> <p>Management Measure No. 2 – Structural Measures – Component 2.2 (Priority No. 1 Action with Taskforce Ranking No. 4)</p> <p><i>In conjunction with Key Action 2, City Plan and building legislation need to be enhanced to ensure controls are adequate to ensure that developments and buildings do not adversely impact on flooding or drainage of properties that are upstream, downstream, and adjacent. State Government has a key role to play in this Action by enhancing relevant legislation and controls.</i></p>	<p>Estimated cost is \$100K.</p>

→ Table 2: Lord Mayor's Taskforce on Suburban Flooding
 – Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>This can be achieved by:</p> <p>3.1 As a matter of priority and subject to a successful trial, Council identifies and places drainage and overland flow easements on BiMAP and flags in City Plan 2000. Seek amendment to IPA to require easement owners to sign/ approve an application for development on a property. It needs to be a requirement for applications that owners of rights over land, eg. easement owners, approve of applications (currently only the owner and the developer need to sign applications).</p> <p>3.2 Amend the City Plan House Code to require that 'lots on land that is subject to flooding' are to be code assessable against the requirements of the 'Flooding Code' recommended in Action 2 Sub-action 2.1.</p> <p>3.3 Review arrangements in other states and territories concerning Local, State and Federal Government responsibility and funding for 'house-raising' as a means of reducing flood damage and, if a local Government responsibility, determine policy on house raising. House raising will not be considered where offer of Voluntary Buy-Back has been declined (refer Appendix D).</p> <p>3.4 Update current building regulations/ controls/ advice and guidelines that relate to the 'flood proofing' of properties in flood-prone areas. Standards will apply to both new construction and redevelopment works.</p> <p>3.5 Consider relaxing 8.5m roof height where relaxation is required to achieve non-flood habitable areas where houses are identified as being in one of the flooding categories.</p> <p>3.6 Subject to a cost benefit assessment, where infill development is proposed and the condition status of existing drainage infrastructure is not known, the carrying capacity is to be established prior to development approval.</p> <p>3.7 Review City Plan Waterway Code Performance Criteria to determine if developer contribution is sufficient to maintain biodiversity and stormwater management in waterway Corridors and land that is subject to flooding.</p> <p>3.8 Amend and strengthen codes/ policies based on appropriate quality modelling. Develop a best practice document to support codes and policies.</p> <p>3.9 Review building standards for infill development to promote suspended floors to avoid need for cut and fill.</p> <p>3.10 Accept alternate solutions on remnant blocks in built up areas where a better outcome for water quality and sustainability would result from development.</p> <p>3.11 Recognising that industrial developments have large roof and hard surface areas, Council should encourage integrated water management measures in these developments.</p>	

➔ Table 2: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>3.12 Identify appropriate water cycle outcomes including development footprints for industrial lots where there are areas of valuable eco-hydrological functions including flood storage and waterway functions.</p> <p>3.13 Maintenance plans for existing structural flood controls, eg. mitigation schemes, detention basins, the three water supply reservoirs, should be in place to ensure their flood readiness and effectiveness.</p>	
4	<p>Determine and establish an appropriate forum to consult with and provide feedback in respect of Council's flood risk management planning process and the implementation of Taskforce's recommendations:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.1</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 6)</p> <p><i>Council should include stakeholders in the planning process by creating a Reference Group. The Reference Group will be a consultative body rather than one that directly determines Council Policy.</i></p> <p>This can be achieved by:</p> <p>4.1 Ensure consistency in Council's policies and practices.</p> <p>4.2 Ensure planning controls on new development on existing sites achieve no adverse impact on flooding.</p> <p>4.3 Council to work with EPA on SEQ Coastal Management Plan to ensure that flood mitigation is included as a consideration along side environmental protection.</p> <p>4.4 Council to liaise with State Government to ensure that planning legislation is amended, if necessary, in order that proposed developments take full account of cumulative effects on flooding so that developments do not adversely impact on flooding or drainage of properties that are upstream, downstream, and adjacent to the subject site.</p> <p>4.5 Lobby State Government for the removal of injurious affection provisions of IPA - (3 votes for, 2 against out of 7 possible votes).</p> <p>4.6 Strategic permits from State Government should be negotiated to facilitate flood mitigation design, construction and maintenance works.</p> <p>4.7 Provide copies of the Taskforce Report to those responsible for the preparation of the state flood risk management policy and the SEQ disaster communication strategy.</p> <p>4.8 Ensure flood information provided is supported by accredited independent professional experts, for quality assurance and verification.</p>	<p>Estimated cost is \$200K – includes additional position to implement Taskforce's recommendations.</p>

➤ Table 2: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>4.9 Solutions should be multi purpose, eg. include socio-economic, ecological, amenity, natural resource and cultural aspects of land use across flood-prone areas, as well as the associated flood risk and hazard.</p> <p>4.10 Solutions should address whole of catchment issues.</p> <p>4.11 Flood management budget to be guided by clear criteria transparent to the community.</p> <p>4.12 Review maintenance funding and, if necessary, increase budget allocation.</p> <p>4.13 Identify opportunities and determine the appropriate nature and means for community consultation in Council's flood risk management planning process. External stakeholders and representatives of flood-prone communities should be represented at this forum. Special attention should be paid to improving consultation and awareness with flood-prone communities.</p> <p>4.14 Clarify within Council that Water Resources is the lead agent in Council for Waterway Corridors, to eliminate inter-agency conflicting agendas/ interpretations.</p> <p>4.15 Clarify flood risk management roles and responsibilities within Council's business units and amend if necessary.</p> <p>4.16 Provide feedback on the reviews of City Plan and Local Laws to ensure the recommended mix of Management Measures from this report are incorporated into the appropriate statutory instruments, eg. land use plans, codes of building and development conditions, local emergency plans, etc.</p> <p>4.17 Review consultative arrangements, particularly with regards to the provision of financial support, with Federal and State agencies and other SEQ Council's and amend if necessary.</p> <p>4.18 Provide feedback on what is acceptable risk of flooding in houses in older areas.</p>	
5	<p>Establish Flood Information Data Base:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.3</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 2)</p> <p><i>Council has extensive flood information and should identify, review and document the flood information needs of all stakeholders, including the community, business, Council and State Government. Council should consider providing flood information on individual properties free of charge (currently residents pay \$16 for this report).</i></p>	<p>Initially review/ evaluate upgrade to existing systems.</p> <p>Estimated cost is \$150K.</p> <p>Note that the provision of free flood information will result in loss of approx \$300K of annual revenue.</p>

➔ Table 2: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>This can be achieved by:</p> <ul style="list-style-type: none"> 5.1 Develop a Business Case for Council having a specific flood data management system to assist with the management and use of flood and flood management data and information. Base on existing purpose designed Flood Information Management Systems (FIMS) and Decision Support Systems (DSS). Consider whether current Council databases could form the basis of such a system. 5.2 Liaise with State Government (NRM) concerning likely data and information requirements under the proposed Queensland flood policy, and ensure that data and information collection, storage and retrieval procedures conform with the proposed requirements. 5.3 Review the extent to which Council's current flood and flood management data and information are geo-referenced and determine whether geo-referencing of further data is required. 5.4 Create a record/ register of the history of flooding in Brisbane and a process to keep the records current, including historical information about filling and potential flooding. Make available to the public. 5.5 Make accurate flood lines available to public. 5.6 Make flood studies held in archives available to public. 5.7 Produce special building overlays and maps showing major and minor overland paths. 5.8 Make all information on flooding available to the community free of charge. 5.9 Develop electronic database to record 'as-constructed' information, connections to pipe systems, etc. 5.10 Council to devise and institute appropriate cost codes to track time and expenses spent on flood risk management across Council's various business units. 5.11 Ensure the Flood information Data Base is available to Flood Emergency Managers. 	
6	<p>Investigate the establishment of local flood advice, forecasting and warning systems:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.5</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 8)</p> <p><i>Ensure that flood information is timely and adequate for the purposes of flood management decision-making (eg. flood warning, flood defence, evacuation and routine flood information). Given that State and Federal Government agencies have responsibilities for forecasting and emergency services, this Action needs to be undertaken in partnership with these agencies.</i></p>	<p>Total estimated cost is \$1.65M.</p> <p>\$150K for initial review/ evaluation of upgrade to existing systems.</p>

➤ Table 2: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>This can be achieved by:</p> <ul style="list-style-type: none"> 6.1 Determine whether significant flood plain changes have affected the relevance of current forecasting and upgrade if necessary. 6.2 Network at the local level to achieve better gathering of information. 6.3 Ensure that flood forecasting and warning activities are well coordinated and consistent. 6.4 Provide feedback to the community on the impact of major storm events (post storm advice/ learnings). 6.5 Make Council's FloodWise system SMS and web enabled. 6.6 Provide flashing light warning systems on all roads at creek crossings. 6.7 Provide flash flooding warning to residents prone to creek flooding. 6.8 Review Council's flood advice activities with the view to defining scripting and standard operating procedures etc., to ensure that advice is reliable and effectively delivered under varying caller circumstances. Assess the need to provide training in these procedures and deliver any necessary training. 6.9 Develop and test programs to improve the flood awareness and flood readiness of flood-prone communities and individuals. 6.10 Determine 'standard' warning advices and formats that are suitable for dissemination to the community. 6.11 Council/ SES to provide specific information from 'on ground' staff, eg. use GPS technology as part of flood advice/ information systems. 6.12 Develop internet solutions and use of radio and TV for communication of flood forecasts - needs to be specific. 6.13 As part of the flood risk management process, ascertain what flood affected residents need most for preparation for flooding. 6.14 Set up a Council/ community flood warning network, eg. a pyramid based structure – designated Council officer/ catchment community contact/ community web or network. 	<p>\$150K for Council wide scripting and standard operating procedures etc.</p> <p>\$100K for flashing lights at crossings (5 x \$20K sites).</p> <p>\$200K for systems development – 'FloodWise' on web.</p> <p>\$900K for telemetry stations (30 x \$30K sites).</p> <p>\$150K for communications technology.</p>
7	<p>Develop external education programs to improve the Community's understanding of flooding:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.4</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 9)</p> <p><i>Develop external education and communication programs for residents and businesses to improve their understanding of flooding issues and to enable them to respond to possible flooding of their property.</i></p>	<p>Estimated cost is \$500K</p>

Table 2: Lord Mayor's Taskforce on Suburban Flooding – Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>This can be achieved by:</p> <p>7.1 Clearly explain the requirements of City Plan to the community, developers and private certifiers.</p> <p>7.2 Make the community aware of the impact on downstream infrastructure from installation of pipes and hard surfaces, eg. increased runoff.</p> <p>7.3 Inform the community of the facts about creek flooding. For example, clearing instream and riparian vegetation can worsen flooding.</p> <p>7.4 Undertake targeted information campaigns rather than broad scale campaigns.</p> <p>7.5 Inform community about effects of debris in creeks.</p> <p>7.6 Advise community of the need to obtain information about flooding before purchase of property.</p> <p>7.7 Determine how to ensure the community accepts, as being accurate, Flooding Reports/ Investigations and general information provided by Council (a key part of the education process).</p> <p>7.8 Increase community awareness of the multi-benefits of waterway catchments and floodways, and the need to balance their functions, eg. ecological and flood capacity.</p> <p>7.9 Inform community on how to behave during flood, preparedness, crisis and post event, eg. through safe driving and children's play safety (creeks/ drains/ bike paths) etc.</p> <p>7.10 Each year, conduct a summer campaign to prepare community for flooding eg. via internet, TV etc.</p> <p>7.11 Assist flash flood affected communities with education material regarding flash floods.</p>	
8	<p>Ensure a 'whole of catchment' process is undertaken when selecting Capital Works projects:</p> <p>Management Measure No. 2 – Structural Measures – Component 2.1 (Priority No. 1 Action with Taskforce Ranking No. 5)</p> <p><i>Council's process for the selection of capital works projects should be reviewed and priority given to the approval of projects that take into account a suite of possible solutions to reduce flooding impacts on residential areas. Programming should be orderly and selection should be undertaken on a 'whole of catchment' basis, i.e. no job should be considered in isolation, except where overland flow issues need to be dealt with.</i></p> <p>This can be achieved by:</p> <p>8.1 Priorities for works/ actions designed to reduce flooding impacts are</p> <ul style="list-style-type: none"> • residential habitable living areas • residential utility areas • commercial floor areas • yards. 	<p>Existing Council process.</p> <p>Estimated cost is \$20K to review process</p>

➤ Table 2: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>8.2 When developing priorities of works, the benefits of the project are to be quantified and specifically state what ARI flood event these works are focussed on, or what risk is being minimised including cost versus benefit and frequency of benefit.</p> <p>8.3 Give priority to work in low lying areas particularly downstream of development.</p> <p>8.4 Maximise capacities of waterways, floodplains, etc. subject always to no worsening downstream.</p> <p>8.5 Consider flood mitigation schemes as an option in all cases.</p> <p>8.6 Provide relief drains for bottlenecks.</p> <p>8.7 Include opportunities for social benefits eg. recreational parks from flood mitigation works, in assessing cost benefits.</p> <p>8.8 Include use of detention basins, infiltration systems and other storage schemes, as options in all cases.</p>	
9	<p>Review the creek and local flooding data needs of all stakeholders, including the community, and if necessary, upgrade current flood study procedures and modelling methodology:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.2</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 7)</p> <p><i>Review the creek and local flooding data needs of all stakeholders, including the community, to ensure that appropriate data in appropriate formats are generated and delivered by flood studies.</i></p> <p>This can be achieved by:</p> <p>9.1 Audit existing processes.</p> <p>9.2 Use 'plain English' wording for simplified reports/ recommendations.</p> <p>9.3 Implement a Quality Assurance (QA) system to engender confidence in the process.</p> <p>9.4 Develop a strategic approach to modelling across city.</p> <p>9.5 Select and adopt, wherever appropriate, a suite of 'standard' analytical methods best suited for flood studies in Brisbane.</p> <p>9.6 Assess how the cumulative impact from new development is determined.</p> <p>9.7 Develop a simple and effective standard procedure for undertaking flood damage assessment studies during flood studies.</p> <p>9.8 Involve the community and get their feedback during the process of doing flood reports/ investigation.</p> <p>9.9 Include historic information in flood study reports</p> <p>9.10 Develop improved flood models for larger catchments eg. Oxley.</p> <p>9.11 Audit catchment by catchment to determine if developments have had adverse effects on downstream catchments.</p> <p>9.12 Catchment audits should consider urban infill projections.</p>	<p>While this is a Priority 1 this work will take 2-3 years to complete.</p> <p>Estimated cost is \$500K/ year.</p>

→ Table 2: Lord Mayor's Taskforce on Suburban Flooding
– Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>9.13 Monitor works that have been established to ensure benefits have been realised.</p> <p>9.14 Seek solutions that have multiple benefits, eg. environmental, social and economic (such as reduced maintenance or repair).</p> <p>9.15 Determine the nature, names and means of defining the 'hydraulic categories' used as a basis for prescribing land use controls in flood-prone areas.</p> <p>9.16 Adopt a procedure for assigning 'hazard categories' as a basis for prescribing land use controls in flood-prone areas.</p> <p>9.17 Collect flood behaviour data needed for a 'flood hazard analysis', develop a 'standard' procedure for assessing hazard in flood studies, and ensure that the necessary data are generated by flood studies.</p> <p>9.18 Establish the size and significance of overland flow and creek tributary flooding problems in Brisbane and assess the feasibility and accuracy of developing a 'rapid means' of addressing these problems.</p> <p>9.19 Use local catchments, for which comprehensive flood study results are available, as case studies to develop procedures for analysing overland flow and creek tributary flooding.</p> <p>9.20 Review past Stormwater Management Plans to set up infrastructure plans for areas to be redeveloped.</p> <p>9.21 Before any new filling is approved within a floodplain, modelling should be undertaken to determine whole of catchment impacts, including cumulative impacts.</p> <p>9.22 Ascertain whether or not development across the city is increasing impervious areas. Determine what the real impact is on creek and overland flow flooding.</p>	
10	<p>Review Council's legal liabilities:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.7</p> <p>(Priority No. 1 Action with Taskforce Ranking No. 10)</p> <p><i>Council's objective should be to clearly define and meet its legal and administrative responsibilities and obligations under existing and proposed state and federal legislation and initiatives and under common law. Previous investigation has been conducted on Council's legal position regarding flooding. This work is contained in the document 'Risk Based Approach to Flood Management - Benchmarking Component'. As a section of this report has direct relevance to the implementation of various Components of this strategy, it has been included as Appendix E.</i></p> <p>This can be achieved by:</p> <p>10.1 Clearly define Council's flood risk management obligations under federal and state legislation and arrangements and under common law duty of care requirements.</p>	<p>Estimated cost is \$50K for specialist legal advice.</p>

➤ Table 2: Lord Mayor's Taskforce on Suburban Flooding
 – Priority 1 Key Actions and Sub-actions

Action no.	Priority 1 Key Actions and Sub-Actions	Comments
	<p>10.2 Review Council's administrative obligations under the Local Government Finance Standard.</p> <p>10.3 Determine Council's legal liability if the public is provided with incorrect flood advice.</p> <p>10.4 Determine what liabilities Council incurs from providing flood risk data to the insurance industry for premium setting purposes.</p> <p>10.5 Investigate requirements for compensation/ purchase of properties that may be used as retention/ detention basins due to future development. These are likely to be small acreage properties.</p> <p>10.6 Determine Council's responsibility to provide flood forecast and flood warning advice to the public.</p>	

➔ **Table 3: Lord Mayor's Taskforce on Suburban Flooding – Priority 2 Key Actions and Sub-actions**

Action no.	Priority 2 Key Actions and Sub-Actions	Comments
11	<p>Liaise with industry and State Government to determine if flood levels can be included on rates notices etc:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.4</p> <p>(Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>11.1 Investigate and implement the recording of flood risks on Rates Notices, Property Searches and Tenancy Agreements.</p>	
12	<p>Review roles of Private Certifiers and Council:</p> <p>Management Measure No.2 – Structural Measures – Component 2.2</p> <p>(Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>12.1 Council to consult with Private Certifiers to ensure Building Approvals are processed in accordance with City Plan and State Government Acts and Regulations. Consultation will include review of adverse outcomes and working together to agree improvements/ amendments to City Plan, State Government Acts and Regulations, joint training and information sharing.</p>	
13	<p>Review, strengthen and enforce Local Laws relating to the environment and waterway corridors:</p> <p>Management Measure No.1 – Non Structural Measures – Component 1.2</p> <p>(Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>13.1 Ensure Local Laws relating to the environment are enforced, eg. Natural Assets Local Law (NALL).</p> <p>13.2 Strengthen the provisions of City Plan, Codes and Local Laws to prevent and remove unauthorised filling and rehabilitate areas affected within waterway corridors.</p> <p>13.3 Undertake a review of the powers of the BCC to effectively require removal of unauthorised structures and illegal filling that are blocking overland flow paths, subject to audit and risk assessment.</p> <p>13.4 Increase resources for checking developer and builder compliance.</p>	
14	<p>Check the design capacity of existing infrastructure within flooding 'hotspots':</p> <p>Management Measure No. 2 – Structural Measures – Component 2.1</p> <p>(Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>14.1 Develop a matrix analysis of culvert/ bridge flow capacities at hotspots or flooded property clusters to determine if upgrading structures is economically viable.</p>	

➤ **Table 3: Lord Mayor’s Taskforce on Suburban Flooding – Priority 2 Key Actions and Sub-actions**

Action no.	Priority 2 Key Actions and Sub-Actions	Comments
	<p>14.2 Artificially increase infiltration in detention basin designs, bearing in mind soils in SEQ minimise the use of infiltration.</p> <p>14.3 The actual capacity compared to design capacity of stormwater drainage should be established by developers prior to development approval of infill multi-unit development.</p>	
15	<p>Review and strengthen, where necessary, Council’s Local Area Plans, Natural Assets Local Law, Waterways Policy and Wetlands Policy to ensure vegetation within waterway corridors is adequately protected whilst flooding discharge capacity is not reduced.</p> <p>Management Measure No. 1 – Non Structural Measures – Component 1.2</p> <p>(Priority No. 2 Action with no Taskforce Ranking)</p>	
16	<p>Review and strengthen, where necessary, waterway environmental controls in City Plan to ensure no adverse impact from flooding:</p> <p>Management Measure No.1 – Non Structural Measures – Component 1.2</p> <p>(Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>16.1 Encourage the use of Water Sensitive Urban Design (WSUD) in greenfield and infill development including:</p> <ul style="list-style-type: none"> • Incorporate rainwater storage tanks in all new and existing buildings – residential and commercial. • Reduce hard surface areas, eg. tracked driveways. • Provide a pervious layer under car park surfaces with infiltration trenches from recessed edged garden beds to provide for water conveyance and tree root development. • Retaining walls should have agricultural pipes to manage sheet flow that will affect downstream properties. <p>16.2 Encourage recycling of stormwater runoff from development sites.</p> <p>16.3 City Plan to include a map of 100 year ARI flood line for all waterways.</p>	
17	<p>Design principles and guidelines are to ensure natural drainage solutions are given priority:</p> <p>Management Measure No. 1 – Non Structural Measures – Component 1.2</p> <p>(Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>17.1 Ensure natural drainage is given priority.</p> <p>17.2 Work within waterways must have an adequate environmental solution identified otherwise retain the existing natural processes.</p> <p>17.3 Avoid reactive low return solutions, eg. removing instream vegetation may cause weed growth and erosion/ sedimentation.</p>	

→ Table 3: Lord Mayor's Taskforce on Suburban Flooding
– Priority 2 Key Actions and Sub-actions

Action no.	Priority 2 Key Actions and Sub-Actions	Comments
18	<p>Establish and facilitate Community Groups to work with Council on local flooding issues:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.4 (Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>18.1 Establish 'friends of stormwater drains' community groups.</p> <p>18.2 Logan City Council method of staking of peak levels should be considered.</p> <p>18.3 Council to explore how community participation can be integrated with existing community engagement in catchment management to maximise the potential synergies and build greater overall community capacity in water management issues. This community development approach could be applied to the following:</p> <ul style="list-style-type: none"> • flood awareness raising • local warning systems • local flood level monitoring • consultation on remedial priorities • community support/ assistance to flood affected residents/ businesses. <p>18.4 Undertake post storm interviews to gather data on local flooding levels to verify modelling predictions and indicating the peak levels of local flood events.</p>	
19	<p>Review procedures for Council to provide interim financial support and counselling to the community after flood events:</p> <p>Management Measure No. 4 – Flood Emergency Measures – Component 4.1 (Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>19.1 Include the need to establish local community response/ support for flood victims from flood damage (to help with clean up, including minor flooding events which can be distressing for people, such as elderly people).</p>	
20	<p>Work with the Insurance Council and other relevant agencies:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.6 (Priority No. 2 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>20.1 Determine the feasibility of using flood risk data for premium setting purposes, and the nature, required quality assurance checks, format and means of transmission of such data.</p> <p>20.2 Estimate the additional workload, costs and feasibility associated with flood studies to generate the flood risk data required by the insurance industry.</p> <p>20.3 Determine if flood insurance for rental property tenants is possible.</p>	

Table 4: Lord Mayor's Taskforce on Suburban Flooding
 – Priority 3 Key Actions and Sub-actions

Action no.	Priority 3 Key Actions and Sub-Actions	Comments
21	<p>Maintenance funding should encourage the use of natural rehabilitation options:</p> <p>Management Measure No. 1 – Non Structural Measures – Component 1.2</p> <p>(Priority No. 3 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>21.1 Review funding criteria for maintaining infrastructure systems to increase the emphasis on instream solutions.</p>	
22	<p>Adequately fund maintenance programs to ensure existing infrastructure works to capacity:</p> <p>Management Measure No. 2 – Structural Measures – Component 2.1</p> <p>(Priority No. 3 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>22.1 Review maintenance programs and ensure they are adequately funded.</p> <p>22.2 Any upgrades or new works should be designed to minimise maintenance and should be funded to be maintained to an adequate standard.</p>	
23	<p>Establish the capacity of the local stormwater infrastructure network:</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.2</p> <p>(Priority No. 3 Action with no Taskforce Ranking)</p> <p>This can be achieved by:</p> <p>23.1 Review and upgrade stormwater pipe capacity in older areas of Brisbane.</p> <p>23.2 Identify potential overflow routes that can alleviate flood impact and develop a plan to maintain, improve and construct route, including the possibility to purchase properties subject to agreed criteria (note: pipes only help minor events and do not help major events or blockage systems).</p>	
24	<p>Develop internal training programs to improve the understanding by elected Council representatives, managers and BCC staff of flood risk management.</p> <p>Management Measure No. 3 – Flood Preparedness Measures – Component 3.4</p> <p>(Priority No. 3 Action with no Taskforce Ranking)</p>	

5. Priority 1 - Key Actions To Reduce The Impact Of Flooding

As detailed previously, the Taskforce has allocated a priority level to each of the recommended Actions. The Taskforce recommends that Council commence those Actions allocated Priority 1 (Immediate Actions) as soon as resources and commitments allow, and have them substantially completed over the period September 2005 – September 2006.

The rationale behind the selection of these Actions is presented below. For ease of reference, the ten Priority 1 Key Actions are also presented in Table 1 of the Executive Summary.

➔ Key Action 1

The Taskforce reviewed data indicating that a substantial number of houses are subject to creek and overland flow flooding from high frequency flood events (i.e. the 2 year ARI). It appears that many of these houses were approved under older development conditions that were less stringent than those currently in use. It may not be feasible to improve the flood immunity of such houses by flood mitigation works.

Based on preliminary findings for properties that may be subject to 2 year ARI flooding, i.e. on average 1 in 2 year flood immunity, the Taskforce recognises voluntary residential property buy-back will be one of the long term solutions to creek flooding and to overland flow flooding, and that State and Federal Government financial support will be required to ensure this important initiative is adequately funded.

The Taskforce therefore recommends:

(Key Action 1) Provide for the voluntary buy-back of residences with low flood immunity.

This can be achieved by:

(Sub-action 1.1) Establish how many properties and houses are subject to frequent creek and overland flow flooding, and to what extent.

(Sub-action 1.2) Using the Voluntary Residential House Buy-Back criteria outlined in Appendix D, review arrangements in other states and territories concerning Local Government purchasing houses where the flood immunity is unacceptably high, including funding arrangements and responsibilities. On completion of review, finalise policy for voluntary residential property buy-back.

(Sub-action 1.3) As part of the review, consider arrangements in other states and territories concerning Local Government purchasing land for use as detention areas, i.e. after completion of modelling and assessment of multiple benefits such as environmental and recreational. On completion of review, if practical, develop policy for voluntary land buy-back for the creation of flood water detention areas, particularly if the land is flooded regularly and there is little opportunity to economically develop further.

Notes:

Some residents may not wish to move from their homes despite the flooding problem, therefore an alternate form of support may be required. Council could investigate entering into agreement with these property owners that allows Council to purchase the property at some point in the future instead of the property being placed on the market.

It is recommended that an amount of \$3.5M per year be provided to reduce the number of at risk dwellings.

➤ Key Actions 2 and 3

The Taskforce found that aspects of planning, and development and building controls in City Plan need to be strengthened to deal with the following issues:

- Land use planning may not be effectively preventing or managing development in waterway corridors and floodplain areas.
- City Plan should address the effects that cumulative filling of waterways and floodplains have on flooding to downstream, upstream and adjacent communities.
- City Plan and existing Local Laws for the mitigation of local, creek and floodplain flooding may be ineffective or not adequately enforced (eg. by failing to prevent unauthorised or unlawful filling of sites).
- State Government legislation and permit conditions may be impeding the implementation of effective flood mitigation measures.
- Development across the city is increasing impervious areas, causing runoff to increase and reach creeks faster than in undeveloped catchments.

Council should undertake a comprehensive review of land use planning controls as specified in City Plan, to ensure that development (greenfield) and redevelopment (infill) take into account their cumulative impact, and that there are no adverse impacts on properties from flooding, and that ecological functions are retained.

City Plan and building legislation need to be enhanced to ensure controls are adequate to ensure that developments and buildings do not adversely impact on flooding or drainage of properties that are upstream, downstream, and adjacent. State Government has a key role to play in this Action by enhancing relevant legislation and controls.

The Taskforce therefore recommends:

(Key Action 2) Review and strengthen, where necessary, land use planning controls in City Plan to ensure no adverse impact from flooding.

This can be achieved by:

(Sub-action 2.1) Option A (Supported by 6 votes out of 10 possible votes) - Create 'Flooding Code' as a Primary Code in City Plan specific to both greenfield and infill developments. All Sub-actions relevant to this new Flooding Code are to be considered for inclusion in it.

Option B (Supported by 2 votes out of 10 possible votes) - The City Plan should consider flooding and climate change as significant.

Option A is to be adopted.

(Sub-action 2.2) Control filling within overland flow paths, waterway corridors and floodplains especially with regards to 'cumulative impact'.

(Sub-action 2.3) Reassess the allowance in City Plan of 1.0m of fill to be placed without approval in Waterway Corridor, overland flow paths and flood risk areas.

Sub-action 2.4) **Option A (Supported by 6 votes out of 10 possible votes)** - Prohibit development and filling inside City Plan Waterway Corridors. The objective is to protect and enhance the water flow, water quality, ecology, and open space, and recreational and amenity values of the City's waterways, subject to ground truthing of the Waterway Corridor.

Option B (Supported by 4 votes out of 10 possible votes) - City Plan review to incorporate performance criteria that specifically address flooding and require no adverse impact to downstream, upstream and adjacent properties or ecological processes, taking into full account the cumulative effect.

Option A is to be adopted.

(Sub-action 2.5) Restrict further filling and development within the area of 100 year ARI or Defined Flood Event flood to satisfy the new 'Flooding Code' in Sub-action 2.1. **(6 votes for, 2 against out of 8 possible votes).**

(Sub-action 2.6) Develop guidelines/ practice documents for specific catchments, specifically for the issues of the catchment or potential new development areas.

(Sub-action 2.7) Investigate if the planning process can reduce the magnitudes of peak flows.

(Sub-action 2.8) Make provision in Council Policy, City Plan and Codes to not allow the practice of cut and fill in Waterway Corridors where there will be an adverse effect on the incremental flood storage. **(7 votes for, 1 against out of 8 possible votes).**

Notes:

The estimated cost for this Action is \$150K.

(Key Action 3) Review and strengthen, where necessary, development and building controls in City Plan to ensure no adverse impact from flooding.

This can be achieved by:

(Sub-action 3.1) As a matter of priority and subject to a successful trial, Council identifies and places drainage and overland flow easements on BiMAP and flags in City Plan 2000. Seek amendment to IPA to require easement owners to sign/ approve an application for development on a property. It needs to be a requirement for applications that owners of rights over land, eg. easement owners, approve of applications (currently only the owner and the developer need to sign applications).

(Sub-action 3.2) Amend the City Plan House Code to require that 'lots on land that is subject to flooding' are to be code assessable against the requirements of the 'Flooding Code' recommended in Action 2 Sub-action 2.1.

(Sub-action 3.3) Review arrangements in other states and territories concerning Local, State and Federal Government responsibility and funding for 'house-raising' as a means of reducing flood damage and, if a local Government responsibility, determine policy on house raising. House raising will not be considered where offer of Voluntary Buy-Back has been declined (refer **Appendix D**).

(Sub-action 3.4) Update current building regulations/ controls/ advice and guidelines that relate to the 'flood proofing' of properties in flood-prone areas. Standards will apply to both new construction and redevelopment works.

(Sub-action 3.5) Consider relaxing 8.5m roof height where relaxation is required to achieve non-flood habitable areas where houses are identified as being in one of the flooding categories.

- (Sub-action 3.6) Subject to a cost benefit assessment, where infill development is proposed and the condition status of existing drainage infrastructure is not known, the carrying capacity is to be established prior to development approval.
- (Sub-action 3.7) Review City Plan Waterway Code Performance Criteria to determine if developer contribution is sufficient to maintain biodiversity and stormwater management in waterway Corridors and land that is subject to flooding.
- (Sub-action 3.8) Amend and strengthen codes/ policies based on appropriate quality modelling. Develop a best practice document to support codes and policies.
- (Sub-action 3.9) Review building standards for infill development to promote suspended floors to avoid need for cut and fill.
- (Sub-action 3.10) Accept alternate solutions on remnant blocks in built up areas where a better outcome for water quality and sustainability would result from development.
- (Sub-action 3.11) Recognising that industrial developments have large roof and hard surface areas, Council should encourage integrated water management measures in these developments.
- (Sub-action 3.12) Identify appropriate water cycle outcomes including development footprints for industrial lots where there are areas of valuable eco-hydrological functions including flood storage and waterway functions.
- (Sub-action 3.13) Maintenance plans for existing structural flood controls, eg. mitigation schemes, detention basins, the three water supply reservoirs, should be in place to ensure their flood readiness and effectiveness.

Notes:

Priority Action 3 should be undertaken in conjunction with Priority Action 2.

The estimated cost for this Action is \$100K.

➤ Key Action 4

The Taskforce concluded that Council should refine its flood risk management planning process to address the concerns of all stakeholders, including the community. Council should also review selection priorities in drainage works programs to ensure that they reflect current community expectations/ needs. Communication between the community, Council and Federal and State agencies needs to be strengthened.

Council should include stakeholders in the planning process by creating a Reference Group.

The Taskforce therefore recommends:

(Key Action 4) Determine and establish an appropriate forum to consult with and provide feedback in respect of Council's flood risk management planning process and the implementation of Taskforce's recommendations.

This can be achieved by:

- (Sub-action 4.1) Ensure consistency in Council's policies and practices.
- (Sub-action 4.2) Ensure planning controls on new development on existing sites achieve no adverse impact on flooding.

- (Sub-action 4.3) Council to work with EPA on SEQ Coastal Management Plan to ensure that flood mitigation is included as a consideration along side environmental protection.
- (Sub-action 4.4) Council to liaise with State Government to ensure that planning legislation is amended, if necessary, in order that proposed developments take full account of cumulative effects on flooding so that developments do not adversely impact on flooding or drainage of properties that are upstream, downstream, and adjacent to the subject site.
- (Sub-action 4.5) Lobby State Government for the removal of injurious affection provisions of IPA - **(3 votes for, 2 against out of 7 possible votes)**.
- (Sub-action 4.6) Strategic permits from State Government should be negotiated to facilitate flood mitigation design, construction and maintenance works.
- (Sub-action 4.7) Provide copies of the Taskforce Report to those responsible for the preparation of the state flood risk management policy and the SEQ disaster communication strategy.
- (Sub-action 4.8) Ensure flood information provided is supported by accredited independent professional experts, for quality assurance and verification.
- (Sub-action 4.9) Solutions should be multi purpose, eg. include socio-economic, ecological, amenity, natural resource and cultural aspects of land use across flood-prone areas, as well as the associated flood risk and hazard.
- (Sub-action 4.10) Solutions should address whole of catchment issues.
- (Sub-action 4.11) Flood management budget to be guided by clear criteria transparent to the community.
- (Sub-action 4.12) Review maintenance funding and, if necessary, increase budget allocation.
- (Sub-action 4.13) Identify opportunities and determine the appropriate nature and means for community consultation in Council's flood risk management planning process. External stakeholders and representatives of flood-prone communities should be represented at this forum. Special attention should be paid to improving consultation and awareness with flood-prone communities.
- (Sub-action 4.14) Clarify within Council that Water Resources is the lead agent in Council for Waterway Corridors, to eliminate inter-agency conflicting agendas/ interpretations.
- (Sub-action 4.15) Clarify flood risk management roles and responsibilities within Council's business units and amend if necessary.
- (Sub-action 4.16) Provide feedback on the reviews of City Plan and Local Laws to ensure the recommended mix of Management Measures from this report are incorporated into the appropriate statutory instruments, eg. land use plans, codes of building and development conditions, local emergency plans, etc.
- (Sub-action 4.17) Review consultative arrangements, particularly with regards to the provision of financial support, with Federal and State agencies and other SEQ Council's and amend if necessary.
- (Sub-action 4.18) Provide feedback on what is acceptable risk of flooding in houses in older areas.

Notes:

The estimated cost for this Action is \$200K, which includes provision for a temporary position to implement the Taskforce's Key Actions.

➤ Key Action 5

The Taskforce identified the need for a data set of properties affected by historical flooding and potentially flood prone properties (those below Council design standards). Council should review how creek and local flooding events, and construction and maintenance works are recorded.

Council has extensive flood information and should identify, review and document the flood information needs of all stakeholders, including the community, business, Council and State Government. Council should consider providing flood information on individual properties free of charge (currently residents pay \$16 for this report).

The Taskforce therefore recommends:

(Key Action 5) Establish Flood Information Data Base.

This can be achieved by:

- (Sub-action 5.1) Develop a Business Case for Council having a specific flood data management system to assist with the management and use of flood and flood management data and information. Base on existing purpose designed Flood Information Management Systems (FIMS) and Decision Support Systems (DSS). Consider whether current Council databases could form the basis of such a system.
- (Sub-action 5.2) Liaise with State Government (NRM) concerning likely data and information requirements under the proposed Queensland flood policy, and ensure that data and information collection, storage and retrieval procedures conform with the proposed requirements.
- (Sub-action 5.3) Review the extent to which Council's current flood and flood management data and information are geo-referenced and determine whether geo-referencing of further data is required.
- (Sub-action 5.4) Create a record/ register of the history of flooding in Brisbane and a process to keep the records current, including historical information about filling and potential flooding. Make available to the public.
- (Sub-action 5.5) Make accurate flood lines available to public.
- (Sub-action 5.6) Make flood studies held in archives available to public.
- (Sub-action 5.7) Produce special building overlays and maps showing major and minor overland paths.
- (Sub-action 5.8) Make all information on flooding available to the community free of charge.
- (Sub-action 5.9) Develop electronic database to record 'as-constructed' information, connections to pipe systems, etc.
- (Sub-action 5.10) Council to devise and institute appropriate cost codes to track time and expenses spent on flood risk management across Council's various business units.
- (Sub-action 5.11) Ensure the Flood information Data Base is available to Flood Emergency Managers.

Notes:

The estimated cost to establish flood information management system is \$150K. Providing free flood information will result in loss of approx \$300K of annual revenue for this service.

➤ Key Action 6

Residents want effective flood forecasting for creek, waterway and floodplain events, and flood warning systems. Council should ensure that flood information is timely and adequate for the purposes of flood management decision-making (eg. flood warning, flood defence, evacuation and routine flood information).

The Taskforce therefore recommends:

(Key Action 6) Investigate the establishment of local flood advice, forecasting and warning systems.

This can be achieved by:

- (Sub-action 6.1) Determine whether significant flood plain changes have affected the relevance of current forecasting and upgrade if necessary.
- (Sub-action 6.2) Network at the local level to achieve better gathering of information.
- (Sub-action 6.3) Ensure that flood forecasting and warning activities are well coordinated and consistent.
- (Sub-action 6.4) Provide feedback to the community on the impact of major storm events (post storm advice/ learnings).
- (Sub-action 6.5) Make Council's FloodWise system SMS and web enabled.
- (Sub-action 6.6) Provide flashing light warning systems on all roads at creek crossings.
- (Sub-action 6.7) Provide flash flooding warning to residents prone to creek flooding.
- (Sub-action 6.8) Review Council's flood advice activities with the view to defining scripting and standard operating procedures etc., to ensure that advice is reliable and effectively delivered under varying caller circumstances. Assess the need to provide training in these procedures and deliver any necessary training.
- (Sub-action 6.9) Develop and test programs to improve the flood awareness and flood readiness of flood-prone communities and individuals.
- (Sub-action 6.10) Determine 'standard' warning advices and formats that are suitable for dissemination to the community.
- (Sub-action 6.11) Council/ SES to provide specific information from 'on ground' staff, eg. use GPS technology as part of flood advice/ information systems.
- (Sub-action 6.12) Develop internet solutions and use of radio and TV for communication of flood forecasts - needs to be specific.
- (Sub-action 6.13) As part of the flood risk management process, ascertain what flood affected residents need most for preparation for flooding.
- (Sub-action 6.14) Set up a Council/ community flood warning network eg. a pyramid based structure – designated Council officer/ catchment community contact/ community web or network.

Notes:

Given that State and Federal Government agencies have responsibilities for forecasting and emergency services, this Action needs to be undertaken in partnership with these agencies.

The total estimated cost for this Action is \$1.65M - \$150K for initial review/ evaluation of upgrade to existing systems, \$150K for Council-wide scripting and standard operating procedures etc., \$100K for flashing lights at crossings (5 x \$20K sites), \$200K for systems development ('FloodWise' on web), \$900K for telemetry stations (30 x \$30K sites) and \$150K for communications technology.

➤ Key Action 7

The Taskforce identified the need to provide the community (and other key stakeholders) with better education on the following issues:

- the extent of local flooding that occurs throughout Brisbane;
- the accuracy of information/ results of flood report/ investigations undertaken by Council; and
- 'best practice' flood risk management principles.

Council should develop external education and communication programs for residents and businesses to improve their understanding of flooding issues and to enable them to respond to possible flooding of their property.

The Taskforce therefore recommends:

(Key Action 7) Develop external education programs to improve the community's understanding of flooding.

This can be achieved by:

- (Sub-action 7.1) Clearly explain the requirements of City Plan to the community, developers and private certifiers.
- (Sub-action 7.2) Make community aware of the impact on downstream infrastructure from installation of pipes and hard surfaces, eg. increased runoff.
- (Sub-action 7.3) Inform the community of the facts about creek flooding. For example, clearing instream and riparian vegetation can worsen flooding.
- (Sub-action 7.4) Undertake targeted information campaigns rather than broad scale campaigns.
- (Sub-action 7.5) Inform community about effects of debris in creeks.
- (Sub-action 7.6) Advise community of the need to obtain information about flooding before purchase of property.
- (Sub-action 7.7) Determine how to ensure the community accepts, as being accurate, Flooding Reports/ Investigations and general information provided by Council (a key part of the education process).
- (Sub-action 7.8) Increase community awareness of the multi-benefits of waterway catchments and floodways, and the need to balance their functions, eg. ecological and flood capacity.
- (Sub-action 7.9) Inform community on how to behave during flood, preparedness, crisis and post event, eg. through safe driving and children's play safety (creeks/ drains/ bike paths) etc.
- (Sub-action 7.10) Each year, conduct a summer campaign to prepare community for flooding eg. via internet, TV etc.
- (Sub-action 7.11) Assist flash flood affected communities with education material regarding flash floods.

Notes:

The estimated cost for this Action is \$500K.

➤ Key Action 8

Council's process for the selection of capital works projects should be reviewed and priority should be given to the approval of projects that take into account a suite of possible solutions to reduce flooding impacts on residential areas. Programming should be orderly and selection should be undertaken on a 'whole of catchment' basis, i.e. no job should be considered in isolation, except where overland flow issues need to be dealt with.

The Taskforce therefore recommends:

(Key Action 8) Ensure a 'whole of catchment' process is undertaken when selecting Capital Works projects.

This can be achieved by:

(Sub-action 8.1) Priorities for works/ actions designed to reduce flooding impacts are

- residential habitable living areas
- residential utility areas
- commercial floor areas
- yards.

(Sub-action 8.2) When developing priorities of works, the benefits of the project are to be quantified and specifically state what ARI flood event these works are focussed on, or what risk is being minimised, including cost versus benefit and frequency of benefit.

(Sub-action 8.3) Give priority to work in low lying areas particularly downstream of development.

(Sub-action 8.4) Maximise capacities of waterways, floodplains, etc. subject always to no worsening downstream.

(Sub-action 8.5) Consider flood mitigation schemes as an option in all cases.

(Sub-action 8.6) Provide relief drains for bottlenecks.

(Sub-action 8.7) Include opportunities for social benefits eg. recreational parks from flood mitigation works, in assessing cost benefits.

(Sub-action 8.8) Include use of detention basins, infiltration systems and other storage schemes, as options in all cases.

Notes:

The estimated cost to review the process is \$20K.

➤ Key Action 9

Council should review the creek and local flooding data needs of all stakeholders, including the community, to ensure that appropriate data in appropriate formats are generated and delivered by flood studies.

The Taskforce therefore recommends:

(Key Action 9) Review the creek and local flooding data needs of all stakeholders, including the community, and if necessary, upgrade current flood study procedures and modelling methodology.

This can be achieved by:

- (Sub-action 9.1) Audit existing processes.
- (Sub-action 9.2) Use 'plain English' wording for simplified reports/ recommendations.
- (Sub-action 9.3) Implement a Quality Assurance (QA) system to engender confidence in the process.
- (Sub-action 9.4) Develop a strategic approach to modelling across city.
- (Sub-action 9.5) Select and adopt, wherever appropriate, a suite of 'standard' analytical methods best suited for flood studies in Brisbane.
- (Sub-action 9.6) Assess how the cumulative impact from new development is determined.
- (Sub-action 9.7) Develop a simple and effective standard procedure for undertaking flood damage assessment studies during flood studies.
- (Sub-action 9.8) Involve the community and get their feedback during the process of doing flood reports/ investigation.
- (Sub-action 9.9) Include historic information in flood study reports.
- (Sub-action 9.10) Develop improved flood models for larger catchments eg. Oxley.
- (Sub-action 9.11) Audit catchment by catchment to determine if developments have had adverse effects on downstream catchments.
- (Sub-action 9.12) Catchment audits should consider urban infill projections.
- (Sub-action 9.13) Monitor works that have been established to ensure benefits have been realised.
- (Sub-action 9.14) Seek solutions that have multiple benefits, eg. environmental, social and economic (such as reduced maintenance or repair).
- (Sub-action 9.15) Determine the nature, names and means of defining the 'hydraulic categories' used as a basis for prescribing land use controls in flood-prone areas.
- (Sub-action 9.16) Adopt a procedure for assigning 'hazard categories' as a basis for prescribing land use controls in flood-prone areas.
- (Sub-action 9.17) Collect flood behaviour data needed for a 'flood hazard analysis', develop a 'standard' procedure for assessing hazard in flood studies, and ensure that the necessary data are generated by flood studies.
- (Sub-action 9.18) Establish the size and significance of overland flow and creek tributary flooding problems in Brisbane and assess the feasibility and accuracy of developing a 'rapid means' of addressing these problems.
- (Sub-action 9.19) Use local catchments, for which comprehensive flood study results are available, as case studies to develop procedures for analysing overland flow and creek tributary flooding.
- (Sub-action 9.20) Review past Stormwater Management Plans to set up infrastructure plans for areas to be redeveloped.

(Sub-action 9.21) Before any new filling is approved within a floodplain, modelling should be undertaken to determine whole of catchment impacts, including cumulative impacts.

(Sub-action 9.22) Ascertain whether or not development across the city is increasing impervious areas. Determine what the real impact is on creek and overland flow flooding.

Notes:

The estimated cost for this Action is \$500K/ year over three years.

➤ Key Action 10

Council's objective should be to clearly define and meet its legal and administrative responsibilities and obligations under existing and proposed state and federal legislation and initiatives and under common law. Previous investigation has been conducted on Council's legal position regarding flooding. This work is contained in the document '*Risk Based Approach to Flood Management - Benchmarking Component*'. As a section of this report has direct relevance to the implementation of various components of this strategy, it has been included as **Appendix E**.

The Taskforce therefore recommends:

(Key Action 10) Review Council's Legal Liabilities.

This can be achieved by:

(Sub-action 10.1) Clearly define Council's flood risk management obligations under federal and state legislation and arrangements and under common law duty of care requirements.

(Sub-action 10.2) Review Council's administrative obligations under the Local Government Finance Standard.

(Sub-action 10.3) Determine Council's legal liability if the public is provided with incorrect flood advice.

(Sub-action 10.4) Determine what liabilities Council incurs from providing flood risk data to the insurance industry for premium setting purposes.

(Sub-action 10.5) Investigate requirements for compensation/ purchase of properties that may be used as retention/ detention basins due to future development. These are likely to be small acreage properties.

(Sub-action 10.6) Determine Council's responsibility to provide flood forecast and flood warning advice to the public.

Notes:

The estimated cost for specialist legal advice is \$50K.

6. Flood Mitigation Funding

At the time of the 1974 flooding, flood mitigation works were being carried out under a scheme of funding which was split:

- 40% Federal, 40% State and 20% Local.

Under this funding, the following schemes were constructed:

- Zillman Waterholes
 - channel widened from Groth Road to Sandgate Road
- Breakfast/ Enoggera Creek
 - dam strengthened and raised
 - channel widened from Kelvin Grove Road to Brisbane River
- Kedron Brook
 - channel widening and deepening Webster Road to Shaw Road
 - channel works Sandy Creek tributary from Magura Street to Kedron Brook
- Stable Swamp Creek
 - channel widened and deepened from Boundary Road to Beaudesert Road
 - northern tributary channel widened and deepened from Orange Grove Road to Musgrave Road junction with the main branch
 - detention basin constructed in Beryl Roberts Park
- Norman Creek
 - channel widened and straightened from Deshon Street to Brisbane River
- Oxley Creek
 - channel widened from Sherwood Road to Brisbane River
 - non-tidal channel constructed on the flood plain in the vicinity of Sherwood Road together with a culvert under Sherwood Road

In addition to the construction schemes listed above, there was a program of purchase of properties.

This program finalised in approximately 1991 with the completion of the work in Norman Creek.

Currently the programs of funding available are:

➤ Regional Flood Mitigation Program (RFMP)

This program is funded 1/3 Local, 1/3 State, 1/3 Federal, and is managed by the State Government. The program applies to the regions of the state i.e. it does not apply to Brisbane except perhaps in the outer fringes that may be considered 'regional'.

The current State budget is approximately \$3M therefore, state wide projects are currently worth approximately \$9M.

➤ Natural Disaster Mitigation Program (NDMP)

This program is also funded 1/3 Local; 1/3 State; 1/3 Federal and managed by the State Government. It is relevant to all parts of the state. Council has had several projects of a planning nature funded under this program, eg. 'Natural Disaster Risk Management Planning'.

The current financial year State budget is approximately \$2M (including ongoing projects) therefore state wide projects are currently worth approximately \$6M.

7. Conclusion And Recommendations

This report describes a framework that will allow Brisbane City Council to implement a process of flood risk management based on best practice principles.

Implementation of the framework will involve significant work and will take some time. To be effective, it is essential that Council allocate adequate resources over an appropriate time frame to implement the strategy. It is suggested that ideally, the major elements of the framework should be in place and functioning before the start of the 2006-07 flood season (November 2006). Three levels of priority have been defined in **Section 4** for the various implementation actions, with **Section 5** providing further details of the Priority 1 Key Actions recommended for immediate start.

The Taskforce recommends that:

- 1 The ten Key Actions that have been allocated to Priority 1 be started as soon as resources and commitments allow and that they be substantially completed over the period September 2005 to September 2006.
- 2 The Actions allocated to Priority 2 be started no later than July 2006 and that they be substantially completed by December 2009.
- 3 The Actions allocated to Priority 3 be started no later than July 2007 and that they be substantially completed by December 2016.
- 4 Council create a temporary position within Water Resources Branch for a period of up to twelve months. The primary role of the position will be to ensure that the Taskforce's Priority 1 recommendations are actioned and a framework is established for implementation of the intermediate and long term recommendations.
- 5 The Reference Group reviews the progress of implementation of Recommendation 1 in July 2006.
- 6 The Reference Group reviews the progress of implementation of Recommendations 1, 2 and 3 in July 2008.

List Of References

BCC 2003, *Review of Brisbane River Flood Study*, prepared by Independent Review Panel (Russell Mein (Chair), Colin Apelt, John Macintosh, Erwin Weinmann) for Urban Management, BCC, Brisbane

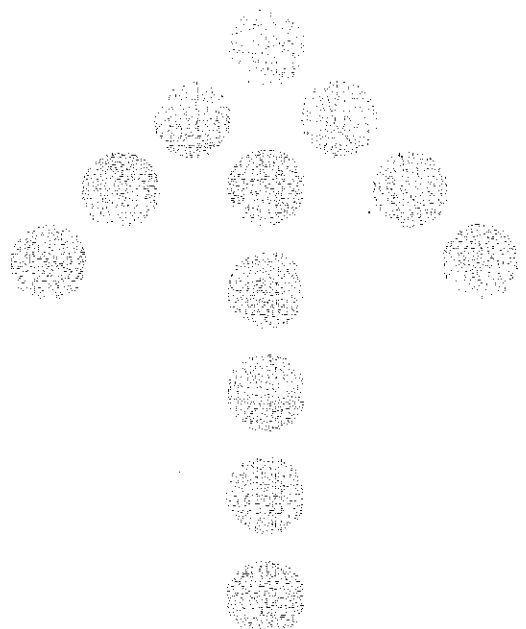
BCC 2004a, *A Framework for Flood Risk Management by Brisbane City Council (Draft)*, prepared by Water Matters Pty Ltd for Urban Management, BCC, Brisbane

BCC 2004b, *Risk Based Approach to Flood Management - Benchmarking Component*, prepared by Water and Environment Group, City Design, BCC for Urban Management, BCC, Brisbane

BoM 2001, *Known Floods in the Brisbane and Bremer River Basin*, updated by Peter Baddiley for BoM, http://www.bom.gov.au/hydro/flood/qld/fld_history/brisbane_history.shtml

BTRE 2002, *Benefits of Flood Mitigation in Australia Report 106*, BTRE Publishing, Canberra, ACT

CSIRO 2000, *Floodplain Management in Australia: Best Practice Principles and Guidelines*, SCARM Report 73, CSIRO Publishing, Collingwood, Victoria



Appendix A – Lord Mayor’s Taskforce Terms Of Reference

➤ Lord Mayor’s Taskforce Terms Of Reference

Background

There has been a long history of flood events in Brisbane. Every summer there are a number of severe thunderstorm events that cause local flooding. Some recent flood events occurring across the City include:

- Friday, 9 March 2001 several parts of Brisbane experienced severe flooding from significant thunderstorms. The areas most impacted were Stable Swamp Creek and Norman Creek in Brisbane’s south and Cabbage Tree Creek in the north. At several recording stations, rain intensities in excess of the 100 year average recurrence interval rainfall were recorded.
- Sunday 7 November 2004, another significant storm event focused rain on similar areas in Brisbane’s south with severe flooding occurring again in Stable Swamp Creek and in Bulimba Creek.

Brisbane has not experienced a major river flood event since 1974, but inevitably there will be future potentially damaging river floods.

Affected residents have asked for action to reduce the frequency and impact of flooding on their homes. The Lord Mayor has responded by establishing a taskforce to review the flooding problems in Brisbane after seeking the input of the Establishment and Coordination (E&C) Committee to these Terms of Reference.

The Best Practice Principles and Guidelines for Floodplain Management in Australia identifies three distinct types of flood risk problems. These are:

- **Existing Flood Risk**
 - The risk to existing buildings and developments on flood-prone land.
- **Future Flood Risk**
 - The risk to those buildings and developments that will be built in the future on flood-prone land. Future flood risk does not materialise until these buildings and developments are built. Future developments need to be considered in terms of their cumulative effect on flood behaviour and not in terms of the individual impact, development by development. Flooding is managed through a combination of non-structural (for example, flood education and awareness) and structural means (for example, setting minimum flood immunity levels for new developments; pipes to convey stormwater). Water Sensitive Urban Design (WSUD) is an innovative way to manage and incorporate a whole of water cycle approach into urban developments. WSUD provides many benefits in the management of the water cycle, and can contribute to reducing the impacts of flooding.
- **Residual (or Continuing) Flood Risk**
 - Refers to risk of floods generally and in particular to those floods that exceed or overwhelm structural flood management measures already in place. Unless structural measures are designed to withstand the Probable Maximum Flood (and this is generally not cost-effective or socially acceptable) they will be overwhelmed by a sufficiently large flood at some time in the future.

There are six types of flooding events that can occur in Brisbane:

1. Tsunami
2. Dam Break
3. Storm Tide
4. River Flooding
5. Creek/ Waterway Flooding
6. Local Flooding (eg. from overland flow)

The first two types of flooding listed above are extremely rare. Storm tide (associated with tropical lows) and River Flooding occur more regularly than Tsunami and Dam Break. Creek/ Waterway Flooding and Local Flooding are the most common form of flooding in Brisbane. The examples provided in the beginning of this section fit into these flood types.

→ Role

The role of this taskforce is to examine all possible strategies to reduce the effect of significant rain events on areas of the city prone to flooding. The Taskforce will consider all flooding issues, but will focus on creek/ waterway/ floodplain and local flooding.

→ Objectives

1. Consider the existing, future and residual flood risks and examine actions to reduce the impact of flood events on residents in flood prone areas.
2. Determine longer-term strategies to reduce the impact of flooding in the city.
3. Evaluate the feasibility and likely costs of the actions and strategies.
4. Provide specific recommendations and create a prioritised list of work to be undertaken.

→ Outcome sought

It is expected that the taskforce will produce a report providing opinions, recommendations and advice on the strategies and options available to reduce the affects of significant rain events on areas of the city prone to flooding. No option shall be excluded from the review.

Membership of Taskforce:

1. **Chair – Professor Colin Apelt** – Former Head of the Department of Civil Engineering, University of Queensland and Member of the Brisbane River Flood Study Independent Expert Panel;
2. **Cr Helen Abrahams** – Chairperson Environment and Sustainability Committee;
3. **Cr Carol Cashman** – Lord Mayor’s Spokesman on Planning and Development;
4. **Peter Borrowes** – CEO SEQ Water and specialist knowledge on flooding in general;
5. **Trevor Bray/ Peter Redshaw** - Community Representative Northside and President of Concerned Residents of Zillman Waterholes - CROZWS;
6. **Wayne Cameron** - Community Representative Bulimba Creek Catchment Coordination Committee (B4C) and President and Manager Southside Catchment and Volunteer Centre;
7. **Tracy Comans** – Community Representative Southside (Rocklea resident);
8. **Upali Jayasinghe** – Department of Natural Resources & Mines (NR&M), State Flood Risk Management Policy, State Government Representative;
9. **Leo Jensen/ Andrew Hall** - Planning Institute of Australia and President PIA (Qld);

10. **Andrew McPhail** – Brown Consulting (QLD) Pty Ltd, Business Representative;
11. **Daniel Musson** - Insurance Australia Group Ltd and Queensland State Manager;
12. **Brian Stewart** - Urban Development Industry Association and Chief Executive Officer (CEO); and
13. **Andrea Young** - Social Planner.

➤ Responsibilities of Members

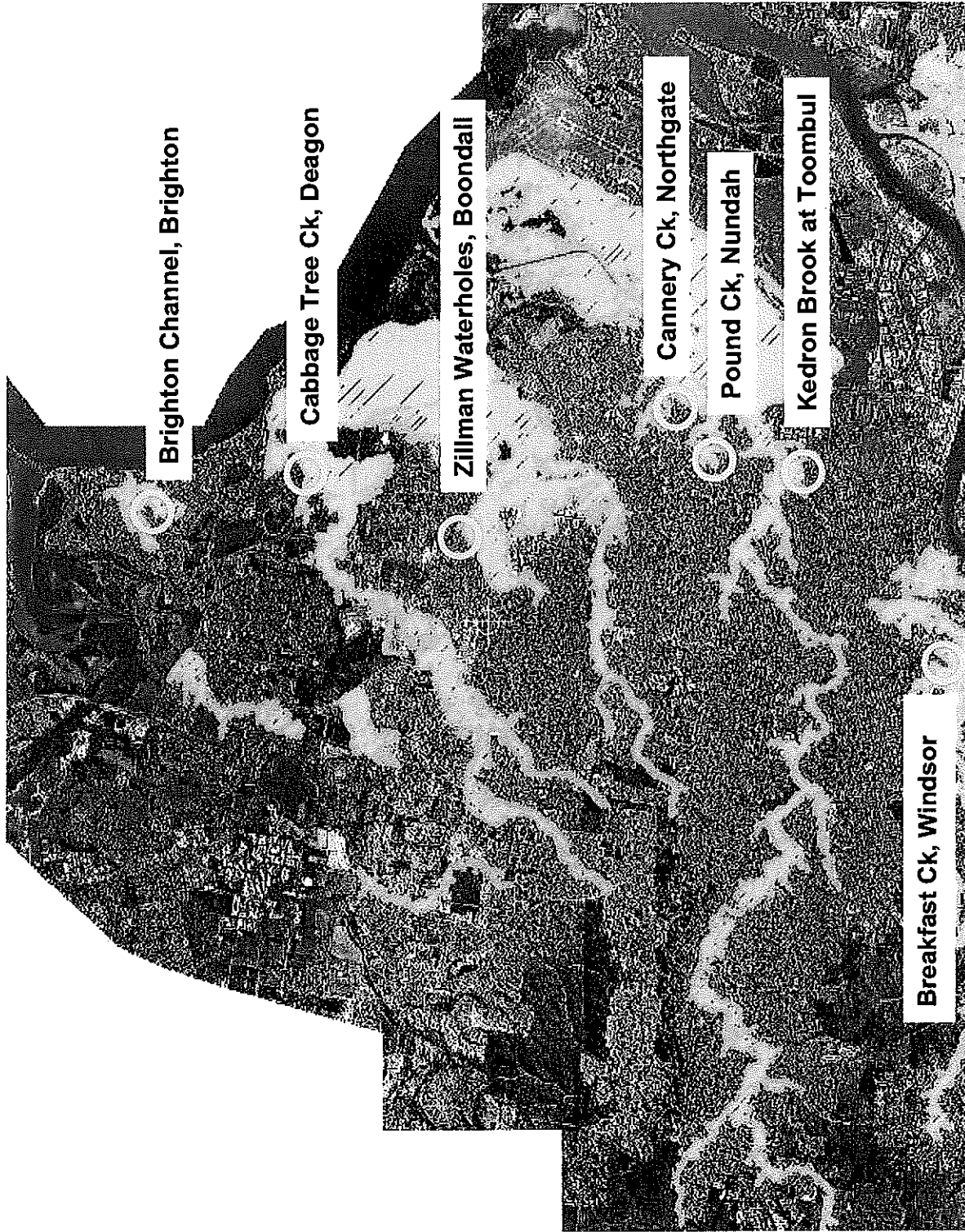
- To identify key strategies and assess all the options to reduce the impacts of flooding in Brisbane.
- To attend and participate in meetings of the taskforce, including reading briefing materials provided prior to meetings
- To develop a taskforce report to be presented to E&C (Civic Cabinet) by not later than 30 June 2005.

➤ Timing

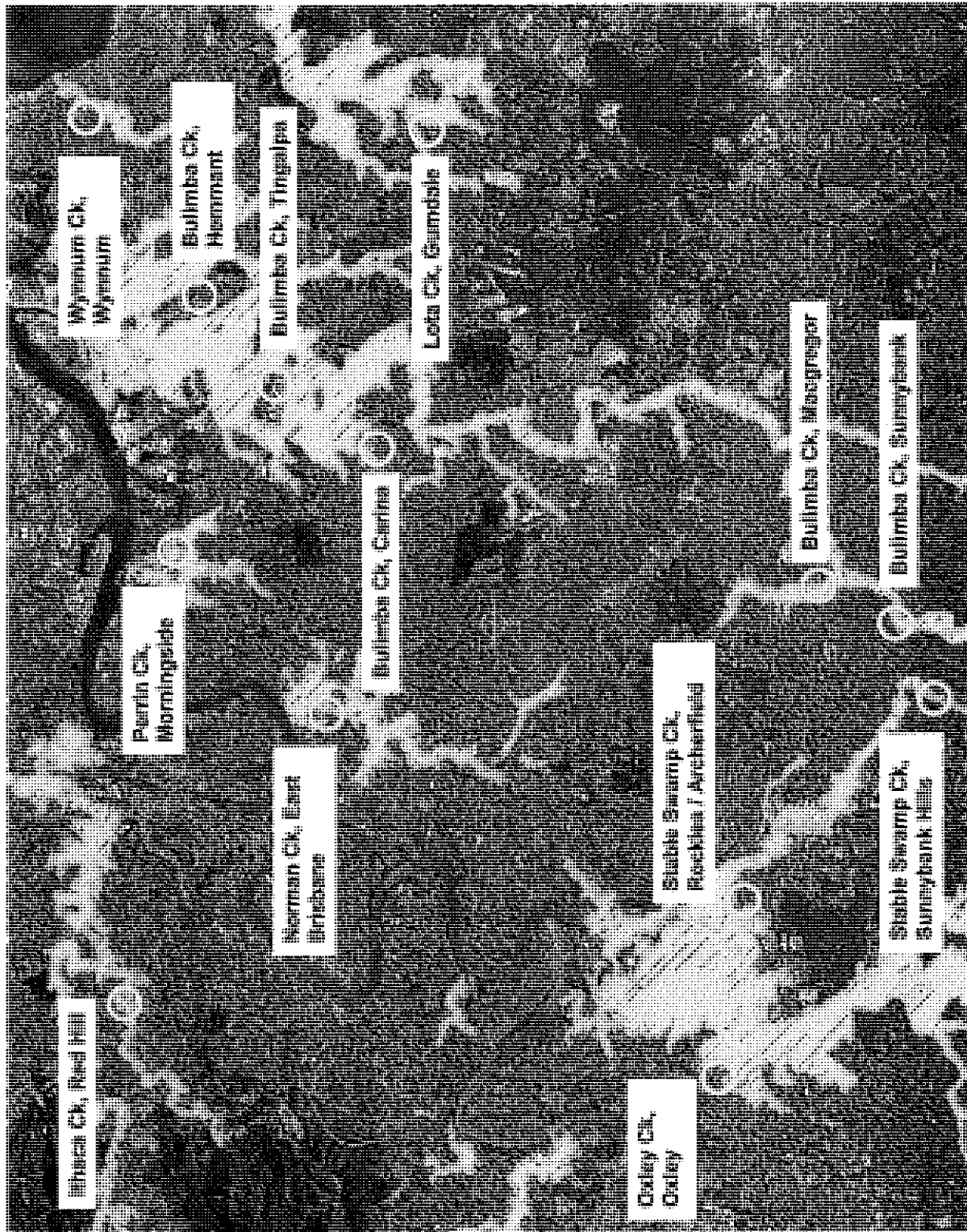
The taskforce will meet for the first time in January 2005. It will provide a Stage 1 report by the end of February 2005 identifying flooding areas and issues the taskforce will consider. The taskforce is likely to meet on up to six occasions prior to the delivery of the report by 30 June 2005. The taskforce report is to be presented to E&C (Civic Cabinet) by 30 June 2005, and the taskforce will dissolve by the end of 2005. Support in drafting the report can be provided by Council's Water Resources Branch.

Appendix B – Creek Flooding Hotspots

Hotspots Inundation Map - Northside



Hotspots Inundation Map - Southside



Appendix C – Brisbane’s Flood History

I love a sunburnt country, a land of sweeping plains,
Of ragged mountain ranges, of drought and flooding rains.
From Dorothea McKellar’s poem “My Country”

History Of Flooding In Brisbane

The City of Brisbane has evolved around its rivers and creeks. Much of Brisbane’s growth has occurred on floodplains over many years of development.

The Brisbane flood that still attracts the most coverage is the Brisbane River flood of 1974. This resulted from widespread heavy rain over the catchment from the remnant of a cyclone that dumped 642 millimetres of rain on Brisbane in just over 36 hours. Many Brisbane suburbs near the river were inundated and creek tributaries backed up. In some places the Brisbane River was more than 3km wide at the height of the flood. It is estimated that over 13,000 houses were effected by the 1974 flood. While there had been consideration of a new dam on the river, once waters receded there was increased pressure, and Wivenhoe Dam was completed in 1985.

Wivenhoe Dam was built to significantly reduce the impact of flooding on Brisbane residents. If the 1974 event were to be duplicated today, flood levels in the vicinity of Jindalee and Oxley would be approximately 3 m lower and in the CBD approximately 1.5 m lower.

The rainfall in 1974 also caused major flooding in several creeks of Brisbane, especially in Oxley, Kedron Brook and Breakfast Creeks.

After the 1974 river flood, major mitigation works began along Brisbane’s creeks. Works were managed under a 40/40/20 Federal/State/Local Government Flood Mitigation Program, which extended until as recently as 1991. A buy back scheme was also introduced. The worst affected properties - those between Northey Street and Breakfast Creek at Windsor - were subject to compulsory resumption. The remaining properties were resumed on a voluntary basis.

Due to the recurrent creek flooding in the 60’s and 70’s, major mitigation schemes carried out included:

- Breakfast/Enoggera Creek (approx late 1970’s):
 - Raising of the Enoggera Dam wall to provide additional flood detention.
 - Widening of the tidal channel from Kelvin Grove Road to the river which was the second lot of works along the creek, the first being after the 1931 floods.
- Zillman Waterholes (approx late 1970’s)
 - Widening the channel from Groth Road to Sandgate Road.
- Kedron Brook (approx late 1980’s)
 - Deepening and widening the channel from Webster Road to Shaw Road (NOTE that the Kedron Brook floodway was constructed in the late 1970’s so that filling for the airport would not increase flooding.)
- Stable Swamp Creek (approx mid 1980’s)
 - Deepening and widening of the creek’s main channel from Boundary Road to Beaudesert Road.
 - Deepening and widening of the north tributary channel from Musgrave Road to Orange Grove Road.
 - Construction of a Detention Basin on the north Tributary in Beryl Roberts Park.

- Oxley Creek (approx late 1980's)
 - Widening the main channel from Sherwood Road to the river.
 - Excavate a channel in the flood plain in the vicinity of Sherwood Road.
- Norman Creek (completed in ~1991)
 - Tidal channel widening from Logan Road to the river.

Council has had a rainfall recorder in place on Brisbane's south side since 1971. Collation of rainfall data for the last 34 years, including the 1974 event, indicates that the recent rains of 2001 and 2004 have been significantly higher than other recorded events during that period. It has been the exceptional high rainfall, which has caused the recent major creek flooding. It should be noted that throughout the 90's the 'El Nino' meteorological influence tended to reduce rainfall.

The community has a perception that flooding from creeks is worsening mainly due to increased development in the catchment.

It is commonly stated, "We live in a modern city; how can developments be allowed on flood prone land?" There are many areas of Brisbane that were subdivided in the late 1800's and early 1900's at which time there was simply a lack of knowledge about flooding and how it would impact on a rapidly growing city. We now know that many low lying areas of the city have been developed that would not be in accordance with today's development standards. Unfortunately this situation will remain, as it is not possible to rebuild the city to meet with today's standards.

Traditionally houses were built on stumps, raised off the ground to allow for both air circulation and the flow of water underneath houses during the frequent summer storms. To accommodate today's lifestyle, we are seeing the traditional Queenslander raised and enclosed underneath and many new developments build on the ground.

In the older areas of the city, which were subdivided and piped well before current town planning and drainage standards, the stormwater flowing overland finds the quickest path downhill to the local waterway, generally through people's backyards.

In new and emerging areas of the city, the subdivision design ensures that the stormwater flows exceeding pipe capacity are carried in the roadway. This reduces the potential for flooding of residences.

Council, in partnership with the community, is endeavouring to continue to improve the function, quality, amenity and accessibility of Brisbane's waterways. Although several of the major flood mitigation schemes implemented by Council since 1974 have been successful in reducing the impacts of creek flooding, flooding can never be eliminated.

❖ Table 5: Brisbane's Flood History

Date	Flood Details
1893	There were 2 major floods and a third minor flood in between. Both major floods were significantly higher in flood levels than 1974. Major impacts included Victoria Bridge being washed away, the steamboat Lucinda washed into the Botanical Gardens in the first flood and washed out again in the third flood.
1931	Major flooding in some creeks, eg. Breakfast Creek. Following this flood the first mitigation works carried out to cut off some loops along Breakfast Creek creating parks such as Downey Park and Finsbury Park.
1951	Major creek flooding along Norman Creek.
29-30 Mar 1955	Moderate flooding in the lower Brisbane River catchment and low lying suburbs. One life lost.
17-20 Nov 1961	1 hour 75 – 125mm rains in Upper Brookfield area led to flash floods causing destruction of roads and bridges. Heavy rains in Brisbane Metropolitan area caused local flash flooding in many suburbs, the worst hit areas being Mt. Gravatt and Sandgate.
12 Jun 1967	Widespread severe local flooding from metropolitan creeks with damage in the excess of \$1million. Traffic at standstill; rail traffic halted on some lines. 500 people evacuated from low lying areas.
15 Jan 1968	Brisbane River in minor flood causing inundation of some low river front reaches in the metropolitan area in conjunction with high tides and heavy local runoff.
24 Oct 1970	Flash flooding in Brisbane metropolitan area in Kedron Brook and Enoggera Creek resulting in damage to furniture and fittings in private homes. Several people drowned.
12 Feb 1972	Severe local flooding in Brisbane City metropolitan creeks following falls of 175mm - 225mm in 24 hour period.
2-3 Apr 1972	Heavy rain in Brisbane metropolitan creek catchments caused major flooding in suburban areas, resulting in damage to property and household furniture.
July 1973	Minor flooding in Brisbane metropolitan creeks, particularly Enoggera-Breakfast creeks and Kedron Brook
25-29 Jan 1974	Major river and creek flooding. Brisbane River reached the highest level this century and since 1893. Lower flood prone areas suffered extreme damage; 14 lives were lost, some 8,000 householders were affected. Business houses and industry generally suffered millions of dollars in losses. Estimated damage approximately \$200 million in 1974 money values.
7-8 May 1980	Brisbane metropolitan creeks reached minor flood levels. Traffic disabilities occurred, especially along Oxley Creek.
3 Nov 1981	Local flooding with traffic disabilities for Brisbane metropolitan creeks.
21 Jan 1982	Widespread moderate to heavy rainfall caused local flooding in the Brisbane metropolitan area.
30 May 1982	Moderate to heavy rain in Brisbane metropolitan area caused local flooding and traffic disabilities in some flood prone suburbs.
8 Apr 1984	Stream rises and local flooding in Brisbane metropolitan area due to heavy rainfall in southeast corner. Gale force winds and heavy rainfall caused widespread electrical failures, local flooding and traffic disabilities and property damage.
17 Aug 1985	Thunderstorms in the Brisbane metropolitan area caused local flash flooding.
27 Oct 1985	Flooding in low lying areas of metropolitan Brisbane due to heavy rain.
Jul 1988	A man drowned when his car was swept away in a flooded creek in a southern Brisbane suburb.

25 Apr 1989	Severe local flooding occurred in Brisbane metropolitan area.
24-25 Feb 1990	Moderate to heavy rainfall in Brisbane metropolitan area produced flooding in low lying areas.
Mar 1992	Minor flooding occurred in some Brisbane metropolitan creeks causing minor traffic problems.
1994 - 1996	Successive years of isolated creek flooding eg. Zillman Waterholes in 1994, Oxley Creek in 1996
May 1996	Heavy rainfalls and flooding throughout Brisbane catchment with 7 day rainfall totals up to 600mm. Tidal surge and gale force winds caused higher than normal tides in Brisbane River, contributing to flooding in low lying areas. The storage level in Wivenhoe Dam rose from 57% to nearly 90% of Full Supply Level. Flood levels were the highest recorded since January 1974.
1999	Severe rain in the upper catchment leads to a severe flood, mainly captured by Wivenhoe Dam
9 Mar 2001	Flash flooding of 200 - 300 mm in a 2 - 3 hour period. Heaviest rainfalls in Beenleigh-Logan area and southern suburbs of Brisbane where severe local flooding caused traffic disruptions and damage to cars and houses. Worst affected creeks included Norman, Bulimba, and Stable Swamp Creeks and their tributaries. About 300 properties were flooded and there was one death.
Nov 2004	Major flooding in Stable Swamp and Bulimba Creeks

Source: adapted from BoM 2001, *Known Floods in the Brisbane and Bremer River Basin*, updated by Peter Baddiley for BoM, http://www.bom.gov.au/hydro/flood/qld/fld_history/brisbane_history.shtml and Brisbane City Council information.

Appendix D – Criteria For Voluntary Residential House Buy-back

➤ Voluntary Residential House Buy-Back Criteria

Consider buy-back where the developed floor level is flooded at 2 year ARI event.

Options for determining 2 year ARI event levels, for creek or overland flow flooding, are:

- Option 1 use the "2 year ARI event" flood depth as determined by modelling i.e. use the calculated probability with respect to flooding.
(Option 1 has majority support with 8 of 11 possible votes); or
- Option 2 use the "2 year ARI event" flood depth added to the sum of any recent flood depths (within last 10 years).
(Option 2 has minority support with 1 out of 11 possible votes); or
- Option 3 use the "2 year ARI event" flood depth multiplied by the number of times the dwelling has been affected by flooding in recent flood events (within the last 10 years).
(Option 3 did not receive any support with 0 votes).

Table 4 below provides examples of how all three Options will determine 'a flood' level.

- AND** Purchase is by voluntary agreement only.
- AND** There is no infrastructure solution which is cost –beneficial in reducing flooding and does not worsen flooding in other parts of the catchment.
- AND** Land is zoned for one of the residential uses i.e. not industrial/ commercial.

For houses that meet the above criteria, priorities are:

- 1 Single level house where habitable floor area is flooded or, if ever the case, a two level house where the upper floor level is flooded.
- 2 Two level house 'built in under' where the lower level contains a habitable floor area.
- 3 Two level house where the lower level contains utility floor area only.

Safety is the prime consideration as the selection of a 2 year ARI event together with the priorities selected give highest attention to those properties flooded most often. In particular the selection provides highest priority to occupants of single level dwellings who have 'nowhere to go' once the floor is flooded. In comparison occupants of two level houses can move to the higher floor.

Additional issues for consideration:-

- Method of communication and adoption of these criteria and process requires further internal Council consideration.
- Once full extent of 2 year ARI event inundation is determined, Council should work with State and Federal Governments to establish funding arrangements for a long term city wide Voluntary Buy-Back Scheme.
- Where an offer of voluntary buy-back is declined by the owner:
 - options for being able to purchase the property on next available sale should be investigated
 - no further development of habitable and utility areas will be permitted on such a property
 - such a property will not be eligible for subsidies for house raising and/or other mitigation.
- Council should reflect the intended future use of these sites in the Planning scheme.

- Buy-back of Priority 2 and 3 houses as part of a 'grouping' is not appropriate while Priority 1 locations remain on offer.
- Cost-benefit analysis of infrastructure solutions is to consider all houses affected by a 2 year ARI event flood regardless of the priority, i.e. in this case 'grouping' should be taken into account when considering implementing an infrastructure solution.
- If there is a widespread event or if there has been local long term flooding with unique circumstances which generate great need / want for buy-back or a infrastructure solution, then this would require separate criteria to be assessed at the time.
- Where the flooding probability analysis has been called into question by recent frequent flooding Council should reassess the flooding probability for the area and if necessary re-run the appropriate model.

Example of how options determine flood depth:

We have two examples, both with modelled 2 year ARI event flood depth of 0.5m over the developed floor level.

Example 1 - has had no recent flooding (in last 10 years)

Example 2 - has had three recent floods (in the last 10 years) over the ground level measured to be at depths of 0.2m, 0.3m and 0.7m.

❖ Table 6: Voluntary Residential House Buy-back Options Ranking

Rank System	Example 1: No recent floods	Example 2: 3 recent floods	Scenario Result
Option 1 - 2 year ARI event modelled depth only	0.5	0.5	Both examples rank equal
Option 2 - 2 year ARI event depth plus sum of any recent flood event depths	0.5	1.7 i.e. 0.5 + (0.2 + 0.3 + 0.7)	Example 2 ranks higher
Option 3 - 2 year ARI event depth as multiplier of modelled event plus number of recent flooding events	0.5 i.e. 0.5 x (1 modelled event)	2.0 i.e. 0.5 x (1 modelled event + 3 flooding events)	Example 2 ranks higher

... it would be contrary to the Council's public duty for it, now being aware of the dangers and disadvantages ... to permit a developer to create the risk of their occurrence.

Planning and Environment Court, (P&E Appeal No. 2124 of 1997), *Tricare Australia Limited v Gold Coast City Council*, Reasons for Judgement, Skoien S.J.D.C.

If there is a known existing flooding problem and a council approved development that aggravates the flooding problem, a council could be liable unless it undertook flood mitigation works. This is a serious issue for councils and highlights the need for strong planning scheme provisions and development assessment processes that allow the council to refuse potentially dangerous development applications.

➔ Cumulative impact

Many planning approvals in the past have been based on individual developments showing only minimal worsening of the adverse impacts of flooding, but many authorities have ignored the cumulative impacts of development in floodplains ('development creep' over time) and increased exposure to flooding.

Gold Coast City Council has defined "cumulative impact" in its planning scheme Constraint Code No 8 *Flood Affected Areas* as: *the impact of development in combination with other development.*

Brisbane has established flood regulation lines along its creeks where it believes that the cumulative impacts of development are sustainable.

Councils have an obligation to ensure that the impacts of proposed development are assessed in combination with other development; *Rudd v Hornsby Shire Council* (1975) 31 LGRA 120; *Carmichael v Sunderland Shire Council* (1972) 25 LGRA 435.

In *Nifsan vs Gold Coast City Council* (1997) P & E No: 54 of 1996, the judge could:

... not be persuaded that the proposed development would not adversely impact on flood behaviour in and near that development or elsewhere in the Merrimac-Carrara floodplain ...

The judge also cited the need for 'consideration of the cumulative effect of loss of storage on the floodplain'. The judge's findings indicated:

- The need to be able to provide good flood information;
- The need for councils to have clear conditions for development on floodplains; and
- Recognition by the court of the need to consider the cumulative impacts of development.

➔ Dwelling floor levels

In his judgement of *Dovemont Pty Ltd v Noosa Shire Council*, (1995) P&E Appeal No. 276 of 1995., McLauchlan Q.C. D.C.J. stated

... the Q100 flood level is a generally accepted engineering standard in relation to the construction of residences (the requirement usually being that the first habitable floor of the residence should be at least 300 millimetres above the Q100 flood level) ...

thereby providing additional support for the necessity of 'freeboard'.