CRCWSC Research Synthesis

Discussion Paper | CRC for Water Sensitive Cities

IDEAS FOR CATALYSING FLOOD RESILIENT DESIGN

CRC for Water Sensitive Cities

Australian Government
Department of Industry and Science

Business Cooperative Research Centres Programme

Publisher: Cooperative Research Centre for Water Sensitive Cities

Level 1, 8 Scenic Blvd, Bldg 74
Monash University
Clayton VIC 3800 Australia

p. +61 3 9902 4985
e. info@crcwsc.org.au
w. www.watersensitivecities.org.au

Date of publication: September 2018

An appropriate citation for this document is:

CRC for Water Sensitive Cities (2018), Ideas for Catalysing Flood Resilient Design. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

Disclaimer

Executive Summary

About this report

This Ideas Report outlines concepts and initiatives identified by stakeholders at a workshop that spanned 12 and 19 March 2018. These ideas respond to the need for, and can catalyse the uptake of, flood resilience design for urban development; guidance for the designs themselves are described in a separate report titled Flood Resilient Building Guidance for Queensland Homes (2018) Brisbane River Catchment Flood Studies.

The concepts and initiatives described in this report are for others to take forward; the report is not an endorsed action plan nor does it provide detailed implementation pathways for the ideas within. As such these ideas are presented for further interpretation and detailed investigations to develop actions.

What is flood resilient design?

Conventional approaches to flood protection look to ensure a building's floor level is located above a defined flood event datum, with the result that the community often considers the building now 'safe' from the effects of flood. Experience shows that this can be an expensive exercise yet offers little long-term assurance because flood levels may be revised higher in the future, or a flood event exceeding that allowed for by the defined flood datum may occur.

Flood resilient design offers an alternative, based on the two approaches of: 1) keeping water out of buildings and 2) allowing water to enter a building in a controlled way to enable a faster clean out and return to normal occupation. (Davidson, 2013). These approaches have strong merit both for buildings already subject to flood impacts, and for new construction that is above a defined flood datum where there is a desire for additional flood resilience.

Findings and ideas

Floods are a familiar event in many cities and towns across Queensland. Despite the significant costs of flooding – in building damage, clean up and rebuilding costs – it is common to see flood affected buildings replaced with like-for-like designs post flood. Similarly, new development generally adopts standard design where it is not possible to build above a certain height.

The workshop participants explored the question: why are flood resilient designs not used more widely? Barriers and opportunities (Table 1) were then converted into ideas that will embed flood resilient approaches as part of "business as usual' in flood prone areas. In broad terms, it was considered important to increase industry capacity and capability as well as engage industry in the development of a suite of flood resilient design tools.

In brief, the Ideas were:

- Catchment Planning Integration
- Living with Water
- Broad Participation
- 'Roll Back' the Flood

Table 1 – Summary of barriers and opportunities for flood resilient deign identified at the Ideas for Flood Resilience Workshop in March 2018.

Barriers included	**Opportunities** included
Limited awareness of flood resilient design and its benefits: 'there's no demand for it'. No incentives or requirements to consider flood resilient design: 'its optional'. Gaps in skills to implement flood resilient design. A focus on lot scale during rebuilding and a propensity to replace like-for-like post flood.	Tools that establish standardised flood resilience ratings, provide information on flood risks and advice on suitable designs. Increasing industry capacity and capability, as well as engaging industry and the insurance sector in the development of a suite of flood resilient design tools. Creating incentives through financing and regulatory pathways. Incorporating integrated catchment planning principles in local level planning to understand flood resilience opportunities at a catchment or floodplain scale.

Next steps

A Strategy for Change can be developed to implement the ideas in this report and to drive practice to move beyond 'business as usual' approaches. A possible blueprint for such a Strategy for Change has been developed in the UK, and could provide a basis for capturing the ideas and working collaboratively to deliver them over time in a consistent program. This is further discussed in the section titled 'Next Steps'. This collaboration would involve a range of government agencies and private organisations, such as insurers, banking institutions, architects, builders and certifiers. It may require State Government leadership to facilitate its management, and could be focussed through groups representing industry, developers and the community.

→

The Brisbane River flooding – January 2011.

Introduction

The summer of 2010/2011 devastated flood prone areas throughout Queensland. The Brisbane River flood of January 2011 caused loss of life and property damage throughout the catchment and significantly impacted both rural and major population centres. Large numbers of homes and businesses were inundated requiring significant re-construction work or, in some cases, total rebuilding.

Flooding caused similar devastation in Bundaberg, Rockhampton and other areas in 2013 and most recently, flood damage from cyclone Debbie caused significant damage in and around Proserpine and in the Logan area. These events highlight the need for a considered approach to building and development works to make cities and towns more resilient to the effects of flooding.

Flood resilient design and construction is an important part of any response to flood risk, particularly in areas where it is not practical to reduce the impact of flooding through structural flood mitigation or in areas where there is a need to manage residual risk.

It is recognised that there is likely to be a portfolio of approaches to incorporate flood resilient design into properties but at present there is little guidance, standards or training available to assist the delivery of flood resilient design. This report addresses these needs.

About the Ideas for Catalysing Flood Resilient Design workshop

A one-and-a-half-day research synthesis workshop was held in March 2018 to identify and resolve barriers to the adoption of flood resilient design principles at the local level in Queensland.

The workshop ran in parallel with other activities by James Davidson Architects to develop Flood Resilience Building Guideline for Queensland Homes (2018) Brisbane River Catchment Flood Studies. The workshop outputs were subsequently used to inform this guidance and to offer pathways to implement flood resilient building design in Queensland.

The workshop was undertaken as part of the wider Brisbane River Catchment Strategic Floodplain Management Plan and facilitated by the CRC for Water Sensitive Cities (CRCWSC) together with James Davidson Architects. Individuals from Government, the construction industry, the insurance industry, building design practitioners and building certification consultants participated and contributed their knowledge and experience to the discussions without implying organisational support or endorsement of the ideas generated.

What is flood resilient design?

Conventional approaches to flood protection ensure a building's floor level is located above a defined flood event, and result in the community considering the building to be 'safe' from the effects of flood. Experience shows that this can be an expensive exercise yet offers little long-term assurance because flood management needs to consider and respond to a range of flood events rather than a fixed flood level.

Flood resilient design offers an alternative, based on the two approaches of: 1) keeping water out of buildings and 2) allowing water to enter a building in a controlled way to enable a faster clean out and return to normal living. (Davidson, 2013). This approach has merit both for buildings already subject flood impacts, and to increase the flood resilience of new construction that is already above a defined flood datum.

When used in conjunction with floor elevation, an affordable and resilient design solution becomes possible, where non-habitable rooms on the ground floor of a house are treated as sacrificial (and washable) and are constructed of waterproof materials and resilient construction detailing. Upper, habitable, levels remain above the flood event to provide an acceptable level of protection from floods (Flood Resilient Building Guidance for Queensland Homes (2018) Brisbane River Catchment Flood Studies).

Making properties more resilient to the impacts of flooding will reduce the scale and disruption of these events and allow people and businesses to quickly return to normal following a flood, as illustrated in the figure below.

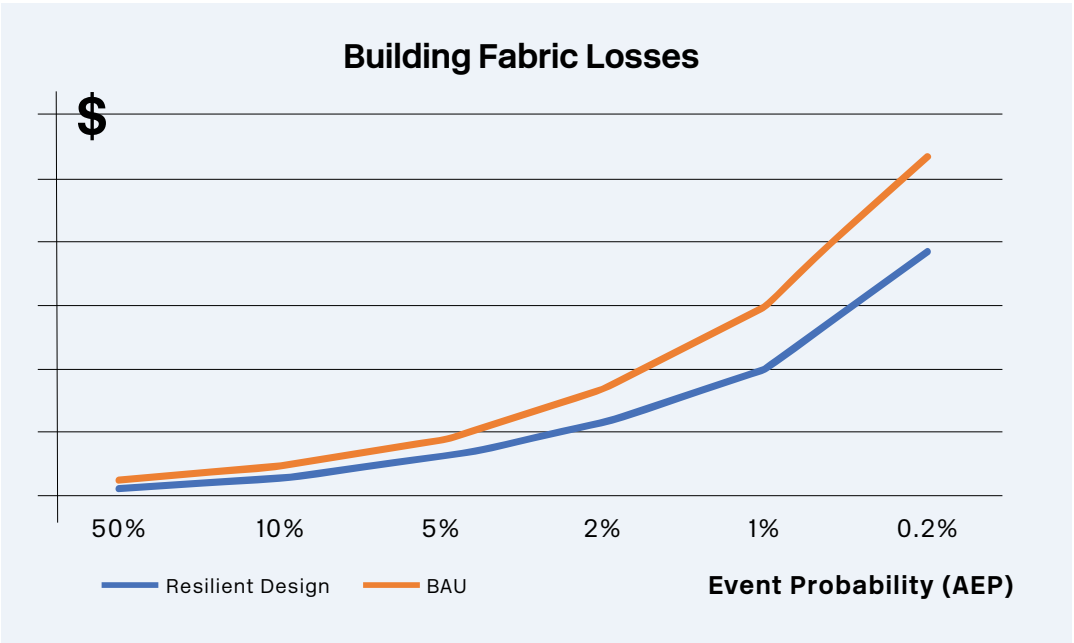


Figure 1 - Building control measures assist in reducing flood related physical losses (Image credit – James Davidson Architects)

→

Flood Resilient Building Guidance for Queensland Homes (2018) Brisbane River Catchment Flood Studies defines flood resilient building design as:

The use of materials, construction systems and design typologies that can withstand substantial and multiple inundations in actively mitigating the effects of, and minimising the cost of flooding to enable home owners to safely store belongings prior to an inundation event, and easily clean, repair and quickly move back in after such an event, with minimal long-term disruption to family and finances.

Ideas

Four key ideas were developed through the workshop process. These ideas have been broken down into some smaller groupings, interact with different parts of the building and development process, and have varying institutional interfaces. The key ideas are summarised as:

- System Mapping and Interventions
- Living with Water
- Broad Participation
- 'Roll Back' the Flood.

These ideas are discussed in the following sections of this document.

Brisbane after the flood

Idea 1. Catchment Planning Integration

An understanding of the system which governs development in Queensland is an important step in developing and implementing ideas for flood resilient design. A system map is outlined in Figure 2. This idea addresses the need for a more integrated approach to catchment management. Key components include:

- The **Planning Act (2016)** establishes the system through which land use planing and development assessment occurs, though building works can be approved under the **Building Act (1975)** without necessarily requiring approvals under the Planning Act. For example, building works to residential homes often only need an approval under the Building Act, but multi residential development is likely to trigger an approval under the Planning Act, and subsequent approvals under the Building Act would be required. This Act provides head of power for a State Planing Policy and Regional Plans.

- The **Building Act (1975)** regulates building development work, building classification, building certification and pool safety inspections.

- The National Construction Code (NCC) (incorporating the **Building Code of Australia** (BCA)) is 'called up' by the Building Act.

- Similarly, the **Queensland Development Code** (QDC) is called up by the Building Act, so the provisions are binding on building works.

- The **State Planning Policy** (SPP) expresses the State's interests in land use planning and development. This includes State interest polices concerning Economic growth, Safety and resilience to hazards and Infrastructure. A local government is required to reflect the State interest policies in its planning schemes.

- The **Regional Plan** a strategic document that guides growth and development in regions while protecting each region's natural resources along with the interests of the State. ShapingSEQ: South East Queensland 2017 is the regional plan that applies to South East Queensland.

- **Local Government Planning Schemes** are required to reflect the policies of the State Planning Policy and a Regional Plan. Generally development assessment is carried out against a planning scheme with the responsible local government approving the development application against the provisions in the scheme. A local government may approve a development application with or without conditions. Where proposing building works, a building permit under the Building Act may also be required.Typically, approved development is also subject to conditions and if building works are proposed will require further approvals for this work to be obtained under the Building Act.

- **Neighbourhood or Local Area Plans** can provide further clarity about the desired land use and infrastructure outcomes for discrete areas of towns and cities. As flooding is typically a municipality-wide issue it is usually dealt with more broadly through zoning or overlays which act at a larger scale than Neighborhood Plans. A flood hazard code will then be triggered for development in a flood hazard zone or overlay which could contain the flood resilient design standards. These plans could be used to describe integrated catchment objectives or similar.

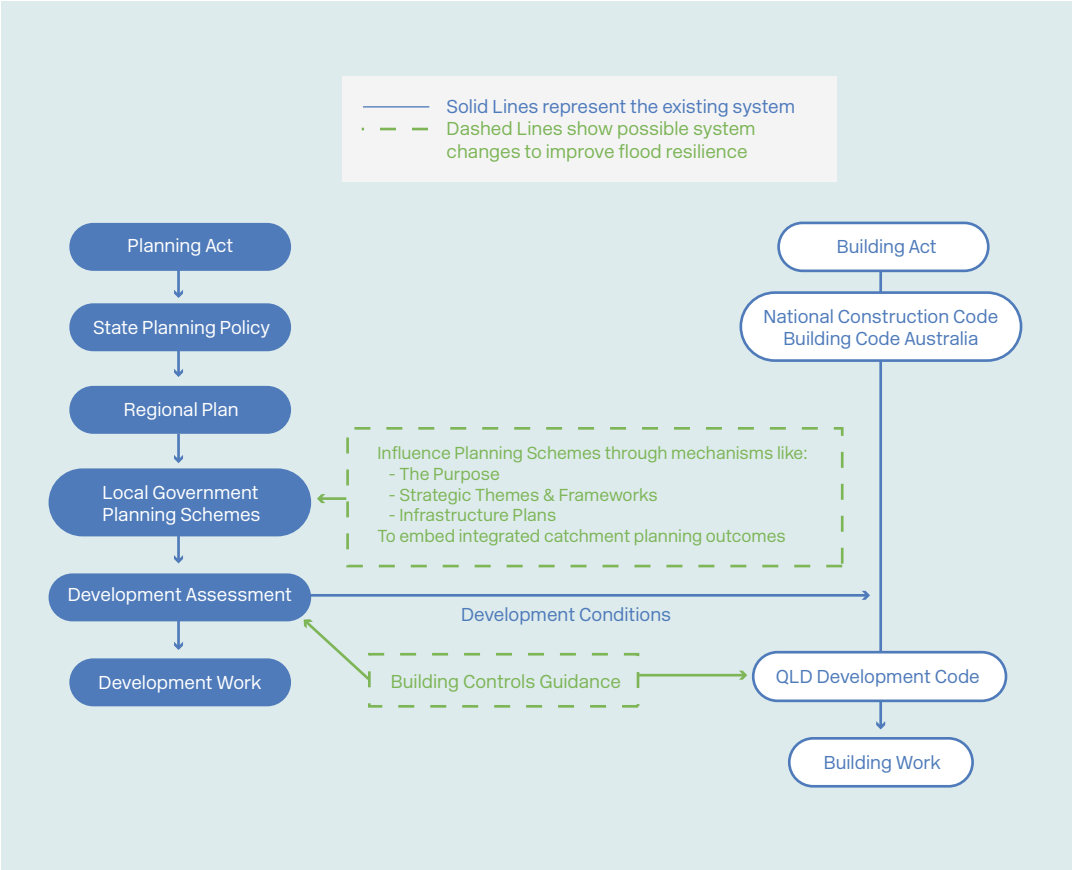


Figure 2 – Considerations for Influencing Planning Schemes to Achieve Better Flood Resilience

→

Integrated catchment planning

Integrated catchment planning takes a catchment scale perspective to planning and seeks to (1) integrate land use and water management outcomes and (2) align planning requirements across jurisdictional boundaries to deliver these outcomes. It promotes opportunities in the wider catchment such as landscape restoration and water quality improvements. To achieve this integration, a number of factors should be considered:

- The need for the implementation of building controls to be simple, not 'bogged down' in planning system controls.
- A need to understand how building controls could interact with the QDC or Planning Schemes.
- Addressing current restrictions on local authorities specifying flood compatible building design principles in their planning schemes. Local governments identify flood hazard areas and can specify the type of development in a flood hazard area but not the building specifications or design, nor can local governments apply this approach to establish flood resilient design outside of define flood hazard areas.
- The widespread application of integrated catchment planning principles through planning controls to create a catchment scale response to flood resilience. This may include harnessing the interaction between building controls and other instruments such as the QDC, neighbourhood plans or planning schemes. Examples of this approach may include:
    - Ensure an appropriate guideline is developed and the QDC is updated.
    - Giving integrated catchment planning a head of power.
    - 'Rolling back the flood' (or reducing the level of flooding) by significantly increasing stormwater harvesting to offset stormwater excess as a result of development.
    - Development in 'islands' i.e. providing safe haven for property and people, without necessarily quarantining areas from ever developing.
- Similarly, widespread integration between all of the elements that impact on flooding including , for example, planning, engineering, natural resource management.

Harmonising planning controls and building controls

The Planning and Building systems are separate instruments, performing different functions. This separation is necessary to prevent situations where a building certifier cannot approve a building application because of conflict between the planning conditions and building provisions. Notwithstanding this, harmonising the interaction between planning and building systems is critical to implementing flood resilient design. An investigation could be undertaken into ways of harmonising these parts of the system, such as:

- Through the awareness and dissemination of the Flood Resilience Guidance documentation.
- Through the Neighbourhood Plan mechanism higher up in the system which could be used to map 'Designated Flood Resilience Design Areas' or similar. This would then cascade through the planning system and ultimately be considered by Certifiers for buildings.

Actors in the system

In addition to mapping the 'instruments' that make up the system, there are also a range of 'actors' who implement or influence the system. Various 'actors' may interpret the system differently and understanding these differences provides insights into pathways for change. Examples of these perspectives are outlined in Table 2.

Table 2 - Actors in the planning system

'Actors'	System Elements	
	Local Government Planning Schemes	**Building Approvals**
Flood Engineers	Provide information such as the extent of anticipated flooding under various scenarios via flood studies, models or projections. **Opportunity**: Engineers can provide technical input to support policy makers and regulators.	May provide information about flood levels, overland flow or other impacts to be considered in Building Approvals.
Land Use Planners	Consider inputs from flood engineers (e.g. flood models) and may incorporate this into planning schemes. **Opportunity**: Land use planners can help to embed new thinking or policy.	Provide the overarching framework that building approvals operate within.
Builders and Building Certifiers	Deals with Decision Notices and associated conditions of approval which may include flooding (e.g. setting minimum floor levels, design and certification requirements).	Highly involved, and have good knowledge and regular interaction. **Opportunity:** As regular users, builders and certifiers can influence and support change in building controls.
Policy makers and Regulators	Will seek input and technical advice from stakeholders during the policy process. **Opportunity**: Policy makers and regulators can drive reforms when they understand the issues and are equipped to ask the right policy questions and to target the right places in the system.	In some respects this is similar to their interpretation of planning schemes, though they rely on building certifiers for advice in this part of the system.
Homeowners / Community	Typically avoid the planning system as it's considered to be complicated and costly to work with. **Opportunity**: by creating incentives or other signals to influence property owners' behaviour and choices, market forces can become a driver of change.	Will often have a close relationship with a builder and may also deal with a number of certifiers, particularly if there are significant issues, such as, flooding to deal with.
Financiers and Insurers	Historically this group has had little to do with planning schemes or building approval processes. For insurers this appears to be changing as they make more informed assessments of their exposure and how to mitigate this. **Opportunity**: If financiers and insurers see a business case in improved flood resilience they may create new products to support this outcome.	As for Planning Schemes. **Opportunity**: This group can offer incentives for development that manages flooding in a pro-active way.

Idea 2. Living with water

This idea shows how to better manage the impacts of water in flood prone areas, accepting that it is not possible to exclude flood waters in flood prone areas.

Embracing flood resilient design

Making properties more resilient to the impacts of flooding can benefit individuals and society as a whole by reducing the scale and disruption of flooding and allowing people and businesses to get back to normal as soon as possible following a flood event. At present, property owners and the building industry are largely unaware of these benefits. Where awareness exists, it is often prejudiced as likely to be costlier than replacing like-with-like following flood damage, undertaking a renovation or embarking on a new build.

It therefore follows that people need new incentives to adopt flood resilient design. At present there are no financial incentives for those who adopt flood resilient building design, and existing standards and codes do little to actively encourage flood resilient design as it is largely seen as optional. There are many incidences where there are conflicts with other design standards such as Energy Efficient Design. Furthermore, when there is a demand for flood resilience to be incorporated into a building, builders and building certifiers are not well placed in terms of skills and knowledge to meet it.

Some of the reasons people do not consistently prepare their properties for flooding, despite a requirement to do so if their lot is located in a flood prone area, include:

- They do not know that they are at flood risk, or do not accept the level of risk as they have never experienced a flood.
- Any flood they have experienced is considered as a ‘once in a lifetime experience’.
- They believe that the government should be managing the flood risk as there is nothing they can do.
- There are no formal requirements to do so.
- Perception of cost exceeding benefits.
- Little or no incentive from insurance industry or government.
- Lack of provisions in existing standards and codes.
- Conflicts with other design standards.
- Lack of skills.

Flood Resilient Building Guidance for Queensland Homes (2018) Brisbane River Catchment Flood Studies is a first step in bridging the gap between the concept of flood resilient design and the practical incorporation of these measures within residential buildings.

Broader participation of the building industry is also needed to encourage this take up. The challenges for broad participation include the following:

- Awareness
- Skills
- Conflicts with other standards and codes
- Commercial building inclusion.

Calculating the benefits: a building calculator

Traditionally, 'flood immunity' has been achieved by locating houses above a predetermined level based on a predetermined flood event. This is costly and offers little long-term assurance that future floods will not be higher as a result of climate change, use of new data and new models, or unforeseen catchment impacts nor does it provide options for those with houses in which floor levels cannot practicably be raised.

Despite this, it is likely that the perception of additional cost is a barrier. The wider, non-monetary benefits of improved materials and better design are not well publicised.

Aside from promoting the benefits of flood resilient design, it is important to recognise the market supply and demand issues, especially given the perception that it is costlier. Some guidance material outlining the return on investment associated with flood resilient design should be investigated and made available to the industry.

More research should be undertaken to understand the benefits of flood resilient design in terms of return on investment, i.e. for every $1 spent of flood resilient design, what savings can be achieved over the life span of a building in reduction in damage. Flood Resilient Building Guidance for Queensland Homes (2018) Brisbane River Catchment Flood Studies will assist by examining the economic considerations of flood resilience within design to assist property owners in making decisions.

The wider monetary and non-monetary benefits could then be presented in the form of a web-based tool or calculator. There are already numerous online calculator tools to help people estimate the cost of residential building, and a similar tool could be developed to promote the wider economic benefits for flood resilient design.

Flood resilience rating tool

At present the existing provisions relating to the construction of building in flood hazard areas within the National Construction Code (NCC), the Queensland Development Code (QDC) and the Construction of Buildings in Flood Hazard Areas (CBFHA) largely focus on levels and structural integrity for achieving compliance. The QDC covers design but not water-resistant materials. CBFHA mentions material requirements but offers no details on what this involves or how to understand the level of exposure and vulnerability of a building to flood risk nor how to manage this through flood resilient design. In contrast, AS3959 covers the construction of buildings in bushfire prone areas, has specific building requirements based on different categories of risk (bushfire attack level) associated with bushfire. The existing, fragmented approach to flood resilient design specification could lead to inadequate construction being undertaken representing poor value for money.

The Insurance Council of Australian provides a Building Resilience Tool (http://www.resilient.property/) that allows users to describe their home, review their risk and identity potential improvements to reduce that risk. This tool covers a range of risks, including flooding.

Current provisions for flood design in both the NCC and QDC could be improved with materials and construction specification (Flood Resilient Building Guidance for Queensland Homes (2018) Brisbane River Catchment Flood Studies). There is a need for greater clarity on the effectiveness of flood resilient design recognising that each property is likely to have different exposure and vulnerability. To bring the flood hazard Australian Standard in line with the bushfire Australian Standard, there could be a simple but site-specific system for measuring flood exposure and vulnerability: creating a flood resilience rating system. A rating tool will provide guidance to the building industry, help the insurance sector assess risk and allow governance to prioritise investment.

The National Construction Code is produced by the Australian Buildings Codes Board. To request a change to this standard a Proposal for Change can be submitted, and is assessed by the Building Codes Committee.

Development/risk model code

Many buildings in Queensland have been constructed with an open undercroft to keep the property cool in the Queensland climate. These undercrofts are often converted to habitable areas (with or without approval) in flood prone areas, putting building and chattels at risk. Embracing flood resilient design below and above the defined flood level (DFL) provides an opportunity for property owners to maximise their properties' potential whilst limiting potential damage from flooding.

This could be achieved by creating a mandatory provision as part of planning scheme, in addition to any defined flood level. Potential options for this could be:

- Any development below the DFL – mandatory use of flood resilient design.
- Any development between the DFL and higher level (say 0.5% AEP) – mandatory use of flood resilient design.
- Relaxing criteria associated with planning and flood depths up to ~200mm above the DFL and development could still take place if flood resilient design was incorporated.
- The drafting of a model code or planning scheme policy for development/building in flood prone areas for dissemination to Local Authorities. Alternatively, a requirement could be drafted for developers to demonstrate how use of the resilient design renders development as compatible with the hazard(s), including climate change, and is therefore acceptable. Implementing these options requires an amendment to Section 13 of the Building Regulation 2006 which describes which building provisions may be included within a planning instrument.

Materials and product standards

A further option could be a rating system for flood resilient materials and products to indicate their fitness for purpose and link this to the flood resilience rating for a consistent approach to delivery.

Web based tool

Web based tools could provide independent advice explaining how to incorporate flood resilient design into properties. Such a tool has been developed in the UK[1] . Initially this tool could be developed as a pilot to be rolled out following a flood to support property owners undertaking repairs. Furthermore, this advisory service could be linked to a grant scheme to ensure the effective use of any grants in these repairs.

[1] https://floodresilience.net/

Business resilience guidance

Although this project was undertaken with a focus on residential building, there is a similar need to raise the commercial sector's awareness of the benefits of flood resilient design. At the time of writing, the project team are aware of work at Griffith University for NCCARF examining two retail outlets in Lismore that have embraced flood resilient design in the rebuilding of their properties following the flooding in 2017. The output could be developed into case studies to demonstrate the benefits of flood resilient design.

Guidance documents could also be produced to show business owners and employees how to prepare for flooding (e.g. Figure 3). Business Queensland has a flood preparation checklist which could be used as a basis for a publication to illustrate the concepts and ideas of flood resilient design.

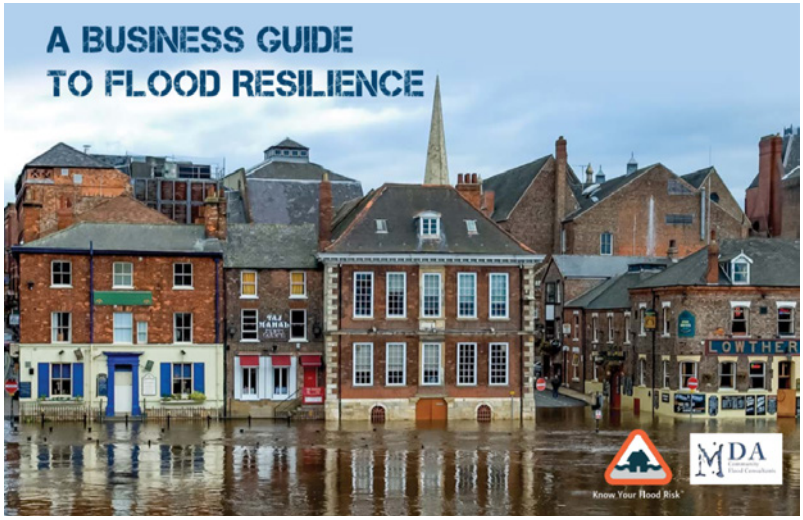


Figure 3 - The UK Business Guide to Flood Resilience[2] contains simple illustrations showing low cost ideas and longer-term investment ideas for business. An interactive website supports this guidance - http://floodresilientbusiness.co.uk/

→

[2] See http://www.knowyourfloodrisk.co.uk/sites/default/files/FloodGuide_ForBusinesses.pdf

Idea 3. Broad Participation

This idea connects the different parts of industry playing a role in flood resilience. There are a number of parts to this as follows:

No incentives

Recovery after flood events involves refurbishment of existing building to previous designs, with no compensation - monetary or otherwise - for improvements. At present, there are no incentives for individual property owners to make their properties more flood resilient during a rebuild, so the opportunity for improved flood resilience is not leveraged.

Insurance companies

It is likely that some of the first properties to incorporate flood resilient design are those undergoing repairs following a flood event – the repair of which would often be funded through insurance. Therefore, insurance companies are likely to play a large role in normalising flood resilient design if they can realise an economic benefit by reducing future flood liabilities.

Premium reductions could be embedded within the flood insurance quote structure. Precedent exists through similar initiatives which attract savings on insurance premiums for properties with smoke detectors, window locks etc. In addition, there would need to be a measure derived to demonstrate the effectiveness of the flood resilience within properties. The scaling of flood resilience effectiveness could be linked to a flood resilience rating system created as part of strengthening the current provisions existing codes and the Australian Standard for Construction of Buildings in Flood Hazard Areas.

Understanding how people can be incentivised to incorporate flood resilient design into properties needs further dialogue with the insurance sector.

Government

Incentives could also be offered through government rebates or grants. Precedent for such a scheme exists, such as Brisbane City Council's previous rainwater tank rebate program, or Flood Resilient Houses program (https://www.citysmart.com.au/floodwise/). This program achieved its goals and helped Brisbane become more water efficient. Rebates could be offered to property owners embracing flood resilient design in the place of other initiatives such as voluntary house purchase, particularly for those properties at risk of frequent flooding and where there is unlikely to be any viable infrastructure solutions.

Existing government grant schemes that offer financial assistance to people in disaster declared areas to help with immediate and urgent needs could be modified or extended. The Queensland Government has also offered a structural assistance grant for those without insurance or who are unable to claim insurance to facilitate repairs to properties. Future schemes could include the provision for flood resilient design to assist retrofitting of flood damaged properties and create a resilience grant.

Banking and finance sectors

Schemes currently exist in the banking sector offering discounted loans to fund the installation of solar panels and other green technology. There is the opportunity to see if these schemes could be extended to fund flood resilient design as part of renovations or new builds.

Planners

Planning schemes typically use a defined flood level as the principle response to building in flood prone areas. This can lead property owners to assume that if they build above this line, then they are 'safe' from flooding. This does not promote a true reflection of flood risk across a floodplain.

The majority of development pressures in Queensland are in places where there is adequate information on riverine flood risk, planning scheme overlays for land affected by riverine flooding and planning controls based on defined flood levels. Some Councils have also included overlays for overland flow flood risk. These overlays, while useful for defining areas designated as flood prone, do not allow a detailed understanding of varying profiles of flood risk across the floodplain and appropriate building form responses to manage this risk.

The draft Brisbane River Catchment Strategic Floodplain Management Plan – Technical Evidence Report (BMT, 2017) uses a risk-based approach to characterise the variation in risk across the floodplain, identifying areas of greatest concern in terms of both current and future conditions. The Plan advocates the use of 'potential hydraulic risk' as fundamental to informing risk-based land use planning. This principle of using a risk-based approach to mapping flood prone areas is encouraged, and would help the community understand the total flood risk against the inherent weakness of a single defined flood level approach.

Conveyancing lawyers

When purchasing a property in Queensland the onus is on the purchaser to undertake research through their conveyancing solicitors. Most solicitors will understand 'standard' property searches but there is an opportunity to undertake additional searches for flood information. At present this is optional. Making these searches mandatory would make property owners aware at point of purchase of the flood risk at the property. This is the case in New South Wales where zoning or planning certificates exist and contain information about planning controls and other property issues that affect that piece of land, including flooding.

In situations where flood overlays or flood investigations are not available, an alternative approach could be adopted. It is likely that local, anecdotal evidence of flooding will exist in an area, and prospective property owners could be encouraged through a due diligence check list to seek this information during the conveyancing process. The due diligence checklist could be created by councils or the Queensland Reconstruction Authority to provide purchasers with simple guidance on what to ask to satisfy themselves of the likely flood risk. Although this does not replace the certainty of a formal flood assessment, it will at least, heighten the awareness of the issue to a prospective purchaser of property.

Supporting industry participation

The ideas in this report can be supported by a program to promote flood resilient design across the industry. Target audiences may include:

- Engineers Australia
- Australian Institute of Architects
- Planning Institute of Australia
- Stormwater Queensland
- Local Government Association of Queensland
- Master Builders Queensland.

Figure 4 - Examples of documents from the UK that assist individuals with design choices within their properties. These documents were produced by a cross section of organisations and provide an example of approaches to widely promote flood resilience.

→

Skills gap analysis

Skills within these sectors may need to be improved to deliver better flood resilience outcomes. An industry group could be convened to identify the skills gap and design appropriate training programs.

Idea 4. Roll back the flood

It is recognised that the climate is changing, and it is likely that existing flood risk may alter in the future due to increased rainfall intensity and sea level rise. The results from climate change simulations on the Brisbane River Catchment Flood Study (BMT, 2017) indicate that the existing 1% AEP flood would occur with higher frequency and the 1%AEP flood could be considerably higher for the higher end climate prediction.

The Queensland Strategy for Disaster Resilience (QG, 2017) sets a number of outcomes that result in Queenslanders being better prepared for disasters and being engaged and invested in efforts to reduce exposure to disaster risk and building resilience.

There is potential, using the ideas outlined below, to pro-actively manage our catchments, implementing catchment wide changes over a long time period, so that runoff rates are reduced, hence, flood risk is reduced.

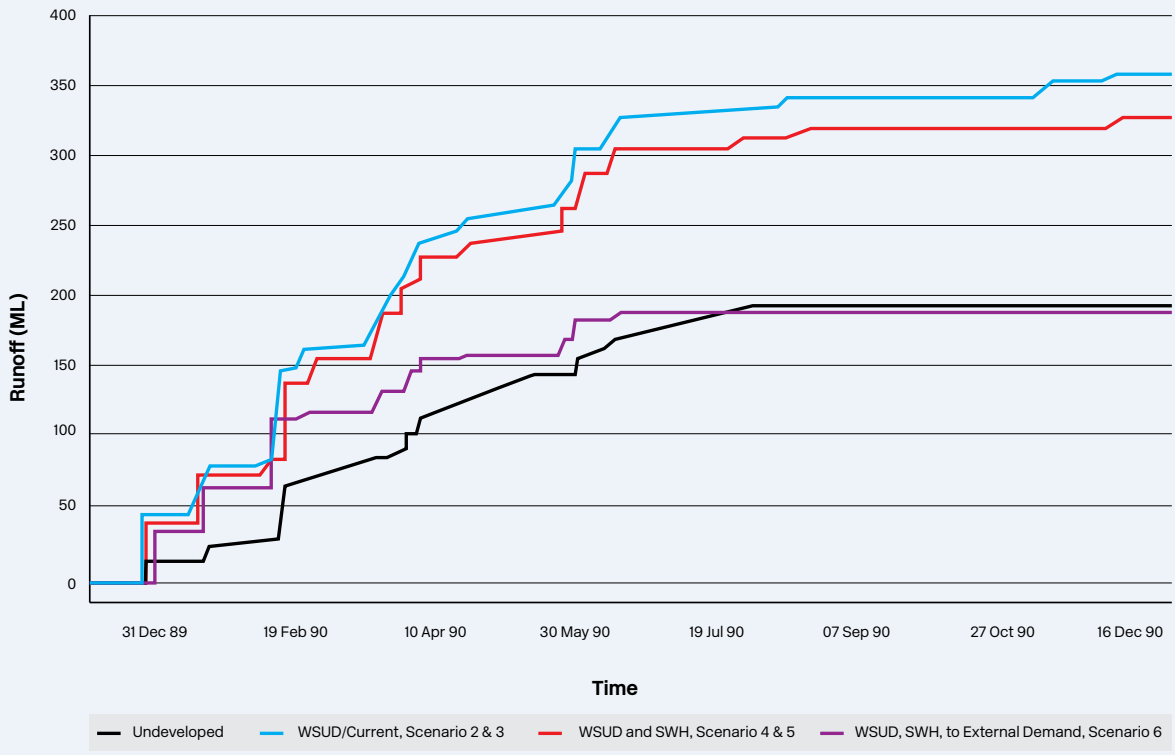
Landscape management and WSUD

The Brisbane River Catchment Strategic Floodplain Management Plan - Technical Evidence Report (BMT, 2018) acknowledges that future development is planned to occur within the floodplain. The report states that 'new development can reduce the available floodplain storage, block flow paths and reduce rainfall infiltration causing increased runoff'. Therefore, it is recommended that flood resilient design should not just manage the existing climate and flood response. Opportunities exist to consider an integrated catchment planning approach as a way to build catchment resilience over a longer time horizon.

To achieve this, BMT (2018) considered the potential of landscape management techniques, such as revegetation and WSUD, to slow, filter and store flows. These were examined with the context of wider riverine flood mitigation and it was expected that the potential benefits would be limited to smaller flood events. The study recommended that further research be undertaken to quantify the benefits in extreme events. Similarly, investigations for Maroochy City Council (Bligh Tanner, 2008) demonstrated that harvesting of stormwater as a local water supply can reduce the stormwater excess resulting from urbanisation, and in turn, if applied consistently across catchments, may 'roll back' existing flood impacts. Figure 5 shows the relationship between the total volume of runoff from a normalised catchment over a 1 year period under various development scenarios including undeveloped, typical detached housing style development, typical development incorporating stormwater harvesting and high density development. This suggests that the emphasis in ShapingSEQ on higher density infill development as the 'engine room' accommodating population growth in SEQ provides a medium to long term opportunity to reduce the effective fraction impervious in catchments under-going re-development, hence reduce stormwater runoff rates and, therefore, the extent of inundation. Further investigation and consideration of policy change would be required to achieve this outcome. Other considerations for developing catchments could include a small reduction in the footprint of buildings and hard stands (site cover) and a proportional increase in green areas, resulting in reduced fraction impervious and improved eco-system services including greater urban cooling potential and reduced diffuse load stormwater pollutants entering waterways.

There are other benefits that accrue from a water sensitive approach:

- By reducing the fraction imperious in catchments, there is more water retained within soil structures and therefore available to the natural ecological systems.
- Or, as in the example above with significant stormwater harvesting, the effective fraction impervious is reduced, therefore runoff frequency is reduced, and the impact on the ecology of waterways is reduced.
- At the same time, an alternative water source to the municipal supply is obtained reducing reliance on the network, and this water can be used for irrigation, amongst other things. With greater vegetation cover, particularly trees, and more irrigation, for example to sports fields and road verges, the effects of 'urban heat islands' can be mitigated.



↑ Figure 5 – Stormwater runoff scenarios highlighting reductions possible through the wide spread adoption of landscape actions such as water sensitive urban design (WSUD) and stormwater harvesting (SWH) (Source – Bligh Tanner).

Development 'Waterprint'

Water Futures (JDA, 2017) considered the different zones across the Brisbane River catchment and provided a framework to consider resilience issues and living with water by connecting initiatives across this wider catchment. The principles of zones and connecting initiatives can also be applied at local and property scales by pro-actively managing land use to mitigate flooding (using measures other than dams and weirs). Some of the ideas for re-development are illustrated in the following architectural typology sketches which show how to maintain greater space for green and blue infrastructure, whilst maintaining development yields to accommodate population growth.

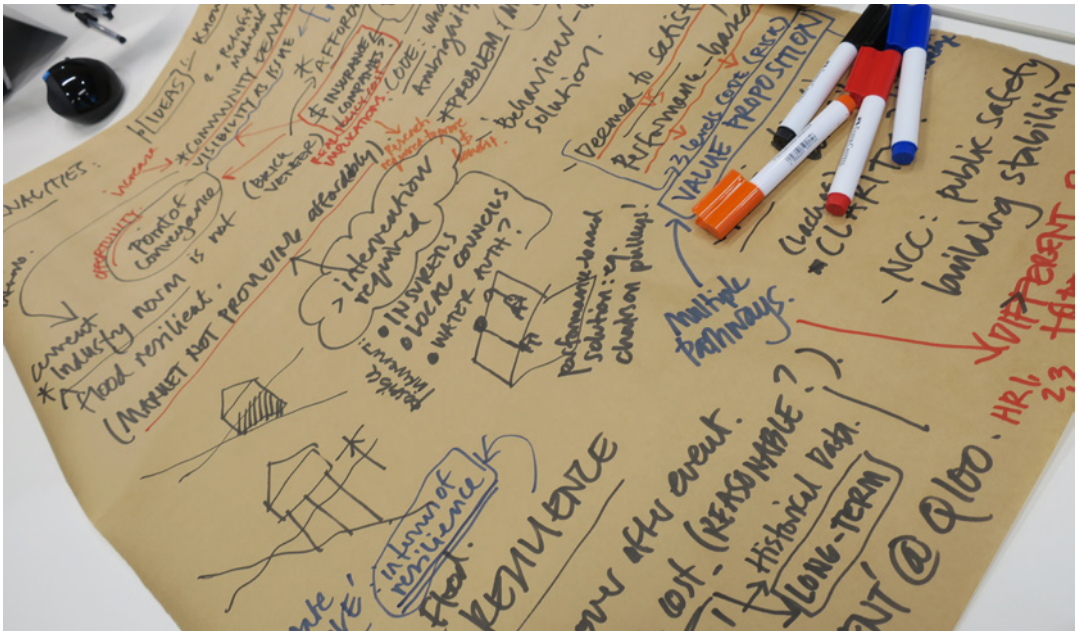
Figure 6 – Arden Macaulay Island City, Monash University Urban Laboratory, 2017. Drawing: Alexander Williams.

Figure 7 - Arden Macaulay Island City, Monash University Urban Laboratory, 2017. Drawing: Alexander Williams.

Next steps

It is recommended that a Strategy for Change be developed to manage the actions identified within this Report.

At present there is a general lack of community pressure for these challenges to be addressed. These challenges should be addressed in a coordinated way, requiring engagement with the industry at multiple levels. A strategy to do this should be developed in the first instance.



The range of ideas to assist people in preparing their properties or development for flooding are all possible to deliver but it is recognised that no single organisation can be responsible for the broader take up of flood resilient design principles. A strategy like this should encourage the industry to move beyond 'business as usual' so that:

- Existing and new buildings are more flood resilient.
- Catchments are actively planned to improve flood outcomes.
- There is greater community awareness about how to deal with and adapt to floods.

There are a range of government organisations from state to local government and private organisations such as insurers, banking institutions, architects, builders and certifiers who would need to be actively involved in developing a Strategy for Change.

Changing long standing practice is something that needs active encouragement and enabling frameworks. CRCWSC research shows that for long lasting, effective change there are three key ingredients as illustrated below:

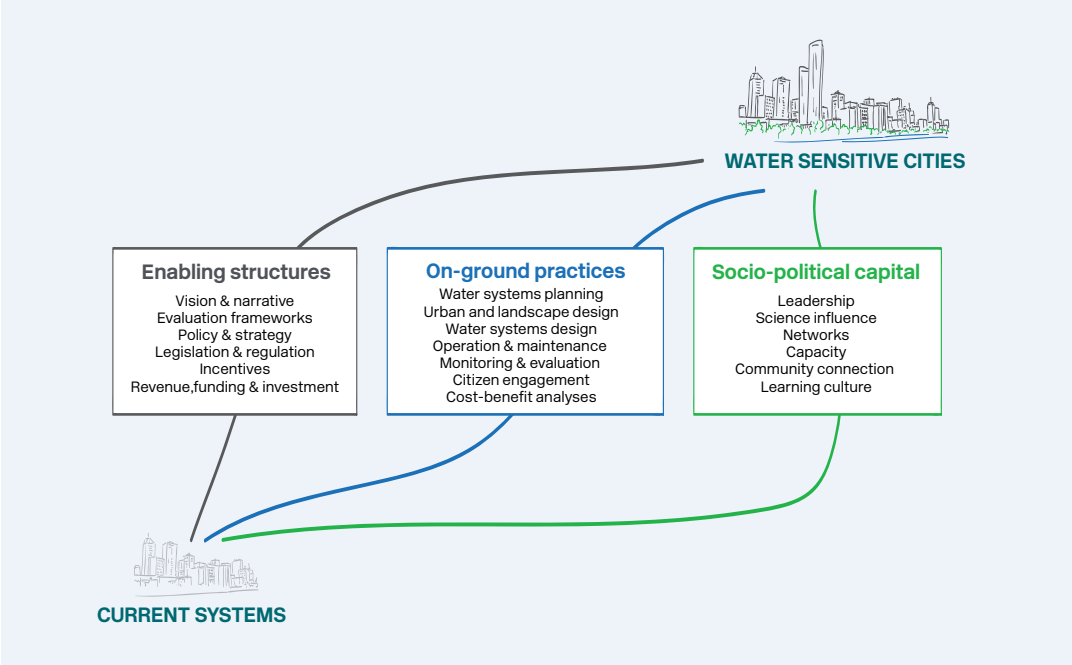


Figure 8 - Transition pathways to a water sensitive city (source – CRCWSC)

A further breakdown of the change process has been developed as illustrated below.

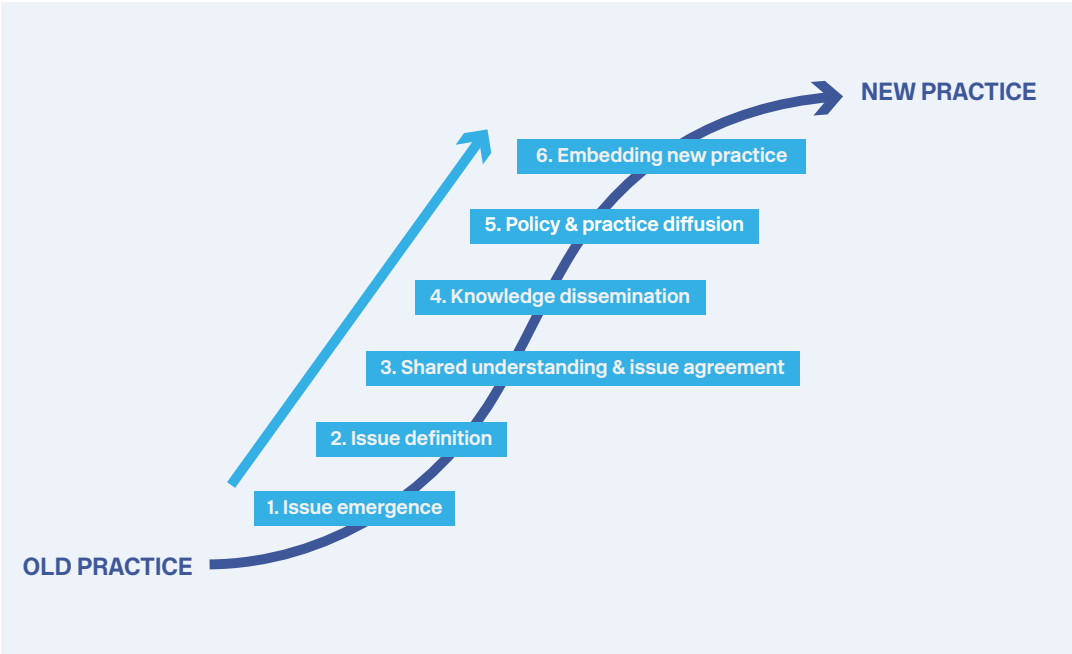


Figure 9 - stages of a transition pathway (source – Brown et al 2016)

The Strategy for Change requires leadership and vision from State Government. It is recommended that the actions identified within this report are divided amongst a number of task groups following a broader level of consultation with the various private and public-sector entities which would need to work together.

Figure 10 - A blueprint for a Strategy for Change was developed in 2016 in the UK. This could be a basis for capturing the ideas, and collaboration needed to deliver them, in a consistent and considered program of effort. (accessed at https://www.bre.co.uk/filelibrary/Centre-for-Resilience/Property-Flood-Resilience-Action-Plan.pdf)

The Ideas, their role in building and development and the institutions that may be required to act on the ideas is summarised in Table 3.

Table 3 – Proposed task groups to enable the industry to work collaboratively to progress the ideas in this report.

Idea	Action	Impacts who?	Institutional Lead
Living with Water	Embracing flood resilient design	Builders Owners Regulators	Local Authorities State Government
	Building calculator	Builders Owners	Financiers / Insurers
	Flood resilience rating tool	Owners Builders Manufacturers	Local Authorities
	Development / risk model code: Develop a minimum standard for use by resource constrained councils.	Owners Regulators	State Government
	Materials and product standards	Owners Regulators Manufacturers	State Government
	Business resilience guidance	Owners Regulators	State Government

Table 3 – Proposed task groups to enable the industry to work collaboratively to progress the ideas in this report (continued).

Idea	Action	Impacts who?	Institutional Lead
Broad Participation	Insurance premiums	Owners	Insurers
	Grant Schemes	Owners	State Government
	Financing	Owners	State Government
	Risk based planning	Owners Regulators	State Government
	Web information: including regionally specific information.	Owners Builders	State Government
	Flood information as part of property purchase	Owners	Local Government
	Industry participation	Professional Institutions	State Government
	Skills gap analysis	Owners Builders Regulators	Professional Institutions
Roll Back the Flood	Landscape Management and WSUD	Regulators Development Industry	Local Government
	Waterprint	Owners Development Industry	Local Government
System Mapping and Interventions	Integrated Catchment Planning	Regulators Development Industry	Local Government
	Harmonising planning controls and building controls	Regulators	State Government

Workshop presenters and experts

Dr James Davidson

Dr Briony Rogers

Prof Nigel Bertram

Jo Tinnion

A/Prof Steve Kenway

Chris Tanner

References

Bligh Tanner

BMT, 2017, Brisbane River Catchment Flood Study

BMT, 2018, Brisbane River Catchment Strategic Floodplain Management Plan - Technical Evidence Report

Brown, R., Rogers, B., Werbeloff, L (2016) Moving towards Water Sensitive Cities: A guidance manual for strategists and policy makers. Melbourne, Australia, CRC for Water Sensitive Cities.

Davison, J (2013) Accommodation water Churchill Fellowship Final Report – December 2013, Dr James Davidson).

JDA, 2017, Water Futures, James Davidson Architect, accessed at http://www.jamesdavidsonarchitect.com.au/JDA_SEQ%20WATERFUTURES_lowres_150130.pdf

MDA & RBA, 2016, Know your flood risk, 2016a, Homeowners guide to flood resilience a living document

MDA, 2016 Know your flood risk, 2016b, A Business guide to flood resilience

Flood Resilient Building Guidance for Queensland Homes (2018) Brisbane River Catchment Flood Studies

Queensland Government, 2017, ShapingSEQ

About the CRCWSC

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) was established in July 2012 to help change the way we design, build and manage our cities and towns by valuing the contribution water makes to economic development and growth, quality of life, and the ecosystems of which cities are a part.

The CRCWSC is an Australian research centre that brings together many disciplines, world-renowned subject matter experts, and industry thought leaders who want to revolutionise urban water management in Australia and overseas.

Research synthesis

Research synthesis is key to successful research application and adoption.

A facilitated design process, Research Synthesis brings together the CRCWSC's many research areas and disciplines with government and private industry partners to develop practical "ideas" for addressing specific industry-based challenges.

Research synthesis is a highly effective tool for exploring collaboration and innovation. The open-minded environment of a research synthesis design workshop is founded on science, and no individual organisation leads or owns the conversation. This supports an un-biased dialogue that enables the discovery of new and creative ideas.

CRCWSC Research Synthesis

Discussion Paper | CRC for Water Sensitive Cities

CRC for Water Sensitive Cities

Email	admin@crcwsc.org.au
Phone	+61 3 9902 4985
Address	CRC for Water Sensitive Cities
	Level 1, 8 Scenic Blvd, Bldg 74 – Monash University
	Clayton, VIC 3800, Australia

CRC for
Water Sensitive Cities

Australian Government
Department of Industry and Science

Business
Cooperative Research
Centres Programme