PLANNING AND RETROFITTING FOR RECURRENT FLOODS

John Minnery

School of Geography Planning and Environmental Management, University of Queensland, Queensland, Australia

INTRODUCTION

Natural hazards threaten everybody living in vulnerable areas. With the increasing concentration of people, infrastructure and facilities in them, urban areas are becoming particularly vulnerable to hazards (Pelling 2003, Perrow 2007). Hazards become disasters when they impact on human beings and their artefacts. The people and institutions involved include, amongst others, those participating in the land use planning process.

This paper deals with three aspects of flood hazards that are crucial for an understanding their interactions with land use planning. One is the nature of flood hazards themselves, because many aspects of these are not widely appreciated. The second is the particularly difficult problem of retrofitting settlements for floods. It is far easier to plan for floods in greenfield settings than it is to try to correct past misjudgements that affect already built up areas. But first the paper provides a framework for the discussion, extending that of governance (Minnery, 2007) into an urban institutional framework.

THE INSTITUTIONAL FRAMEWORK

There are many shapes to institutional theory, not least because it derives from many sources: institutional economics (Coase 1937, Ostrom 1990, Peukert 2001, Weingast 1996, Alexander 2001, 2007), neo-Marxist theory (Harvey 1982, Brenner 2004), structure-agency approaches in sociology (Giddens 1984, Healey 1998, 1999), urban politics (March and Olsen 1989, Lowndes 2001) and organisational sociology (DiMaggio and Powell 1991, Scott 1995) amongst others. This multiplicity of sources is clearly identified in Teitz (2007: 17) in his discussion of planning and "the new institutionalisms". The framework used in this paper does not try to find a consensus amongst these different approaches but rather seeks to identify the elements of institutional theory that are relevant to an understanding of flood hazard management. The key elements are the institutions involved (government and non-government, formal and informal, structured and unstructured) and the rules of the 'game' in which they are involved (involving both formal and informal, written and unwritten, legal and extra-legal 'rules'). Healey (1999: 113) notes that, "[a]n institution … is not understood as an organization as such, but as an established way of addressing certain social issues, for example, in the relationships through which what we understand as family are produced and reproduced..." Institutionalism also emphasises "the importance of particular forms of understanding that are seldom explicitly articulated – classifications, routines, scripts, and other rationalizing and rationalized schemas or, in other words, institutional myths" (Amin and Thrift 1994: 12).

This approach to institutions has a parallel in considering the importance of urban 'governance' as compared with urban 'government'. Governance includes the elements of the formal roles and structures of government but extends beyond it to include the roles and actions of the private sector and the community sector (Minnery 2007). In the words of Chhotray and Stoker (2009: 3) governance is "about the rules of collective decision-making in settings where there are a plurality of actors or organisations and where no formal control system can dictate the terms of the relationships between these actors and organisations."

This wider 'collective decision-making' setting with a plurality of actors also characterises the institutional framework, although the range of institutions is far wider than that normally considered in 'governance'. We must also add to the institutions themselves the formal and informal 'rules' under which the various actors carry out their activities as well as the institutional myths and schemas. Like urban governance, urban institutions are multi-level. Marks (1993: 392, cited in Maldonado *et al.* 2010: 11) defines multi-level governance as, "... a system of continuous negotiation among nested

governments at several territorial tiers" [in which] "supranational, national, regional and local governments are enmeshed in territorially overarching policy networks" (Marks 1993: 402-3, cited in Maldonado *et al*. 2010: 11). So the approach to institutions when dealing with floods has to involve the wide range of institutions themselves, at multiple levels, the rules by which they operate and the less well defined myths and schemas that shape them.

HAZARDS, DISASTERS AND FLOODS

Natural hazards, especially floods, have always been with us. They will continue into the future. But the links amongst flood hazards, flood risk and disasters are often poorly understood. Whilst most flood modelling is hedged about with caveats about data, the poorly understood interactions amongst variables and the general problems of predicting future events, policy-makers and those advising them ask for some degree of certainty when they are dealing with peoples' properties. Policy-makers like to gain the illusion of certainty that land is flood-free or it is floodable, as well as knowing the potential costs of protecting floodable land. In an institutional sense the decision-making institutions involve myths about predictability and certainty of modelling as well as myths about being able to identify safe and unsafe locations, for in fact almost all land is potentially floodable because flooding can be caused by local intense rain events, rivers overflowing their banks, or overland water flow that could affect almost any locality (although for some land the probability of flooding is very low indeed). Commonly a compromise is reached, where land with a low risk of flooding is distinguished from land with a higher risk of flooding.

There are different ways of measuring and expressing flood risk and many people misunderstand the expressions. One way is using the 'mean return period' of a flood hazard. The World Meteorological Organization (1999: 31) defines the 'mean return period' (MRP) of a hazard as "the average time between occurrences of a particular hazardous event" and thus a 'T-year flood' means that, "[i]n each year, there is a 1/T probability on average that a flood of magnitude Q_T or greater will occur. The 100-year flood is a commonly applied T-year flood," A related measure is the 'annual excedence probability' (AEP) which identifies the risk of flood levels exceeding a certain level. Again this is usually expressed as either a percentage or as a 'T-year' flood. But reliable records of floods in Australia have been available for only around 200 years. Calculating a mean return period on such a short baseline is fraught with difficulties. Modelling river and water flows to assess probabilities from rainfall, runoff and related data is also difficult.

Perhaps the most serious danger in identifying a critical level of risk is that it is taken by some to imply that land above that level is immune from flooding. Under the heading "Wrong Q-flood safety benchmark failed 10,000 homes" a report in Brisbane's *Courier Mail* of March 8th, 2011, after the January 2011 major flood, said that, "[a]lmost 10,000 Brisbane properties believed to be safe from inundation were flooded in January. Brisbane City Council figures show about 2685 homes, 1992 commercial and industrial properties and 5078 unit blocks were flooded when they should have been safe after being built above the Q100 level, a one-in-100-year flood event." In a similar vein, Pielke (1999: 416, citing FIFMTF 1992: 8-3) quotes an example of a Mid-western (US) Mayor who claimed that, "after the 1965 flood, they told us this wouldn't happen again for another 100 years." A related problem was identified by the Australasian Fire and Emergency Services Authority Council (2011: 17) in their submission to the Commission of Inquiry into the 2011 Queensland floods: "The problem with using the 1:100AEP as a datum point for land use planning is that it ignores the real probability of larger floods occurring. Communities may also be misled in their understanding and acceptance of flood risk, particularly by the use of phrases such as '1 in 100 year flood'… AFAC submits that land use planning outcomes should be required to consider the consequences of all probable floods including worst case scenarios, not just one, arbitrarily selected level."

In parts of Europe, spatial planning describes the risk of flooding at a range of levels, ranging from 1:50 to 1:1250 (Böhm *et al.* 2004: 259). This is a far more nuanced approach to flood risk. It does not pretend to provide a flood-free and a floodable boundary but identifies flood risk along a continuum.

An even more nuanced approach is one that assesses risk not just in terms of the exposure and the hazard (including floods) but one which includes the idea of vulnerability as well, as identified in the 'risk triangle' (Crichton 2002, Geoscience Australia 2010). In the 'risk triangle' the greater the magnitude of any one of the three sides of the triangle (hazard, exposure and vulnerability) the greater is the overall resulting risk. Reducing any one of these three sides reduces the overall risk. Crichton (2002), with whom the risk triangle is often associated, criticises the UK approach, even

though it has differential risk ratings of 1000 years for central London, 200 years for the rest of the coastal area, and between 20 to 100 years elsewhere (2002: 247). Crichton's more nuanced approach relates risk to the uses involved: services that need to keep operating during floods, such as hospitals, phone services, and electricity supply should not be located in flood hazard areas at all; for residential uses, he suggests a scale ranging from 1000 years for sheltered housing and housing for the aged to 50 years for caravan parks with seasonal occupation (but he suggests 200 years for most residential uses) (2002: 247-8). Crichton is approaching risk from the point of view of the insurance industry and "shows what level of risk is acceptable for private insurance at normal terms" (2002: 248).

Godber (2005) shows in her study of perceptions of flood risk in the Nerang River floodplains on the Gold Coast there are considerable differences between local government and development industry perceptions of risk (mainly specified in quantitative terms, using the Queensland 1 in 100 baseline) on the one hand and the local residents' perceptions on the other (where quantitative assessment of risk was poorly understood). In this sense the institutional 'rules' of the flood risk 'game' are being interpreted differently by the different players. Many of the residents in Godber's survey were recent arrivals who had not experienced a flood in the locality. Personal and institutional memory was missing.

APPROACHES TO FLOOD MITIGATION

Given these different ways of assessing the risk of floods, there are clearly also different ways of dealing with this risk. Three main overlapping approaches to mitigating the impacts of floods are identified by Kundzewicz (2010: 10):

- "Modify susceptibility to flood damage (actions taken before flood). [Actions can include] legislation, land-use planning and management, zoning [such as] delineation of areas where certain land uses are restricted or prohibited…, development control of flood hazard areas, buy-out of land and property located in floodplains…, flood proofing (by elevation, barriers, or sealing…), … flood insurance schemes, … community self-protection teams.
- Modify flood waters, [which can include] flood defence infrastructure including dams and flood control reservoirs, … improvement of channel capacity to convey a flood wave, enhancing source control via watershed management, …
- Modify impact of flooding (during and after flood), [which can include] detection of the likelihood of a flood forming, forecasting of future river stage / flow conditions, … dissemination of warning, response by the public and the authorities, evacuation, financial aid (insurance claims, loans, tax deduction, debt reduction), … reconstruction of damaged buildings, infrastructure and flood defences, … "

Each of the three approaches includes techniques that are used by, or utilise, the land use planning system. There is a clear link between land use planning and flood hazard mitigation.

RETROFITTING

Many suburbs and towns have already been flooded several times in their settlement history. Hazard mitigation and land use planning are both future-oriented, but both are easiest to practise on 'greenfield' or undeveloped land. Many planning jurisdictions have promulgated policies aimed at mitigating hazards in new development (for example, the Queensland State Planning Policy 1-03 that deals with floods, bushfires and landslip (QDLGP & QDES 2003)) but these do not apply to existing settlements. Dealing with already built-up areas, or retro-fitting settlements, presents a whole raft of addition difficulties. The question then arises as to how the various institutions involved, including governments, the private sector and the community, might mitigate the risks and potential impacts of natural hazards in already built up areas.

Many barriers are faced in implementing the retrofitting of flood hazard risk mitigation. Barrett (2011: Appendix A: 3-4) identifes the reasons he feels a 'flood retreat' strategy (discussed below) as a way of dealing with the risk of floods in already built up areas might not be supported. They include:

> "1) The property being the occupier's main or only asset;

2) Mortgage commitments on such assets substantially 'tying' owner/occupiers, given the difficulty of selling up a 'flood-affected' asset, or using such asset as collateral for relocating elsewhere;

3) Strong community ties to, and social networks within, the area, or considered higher convenience to work, education, transport, hospitals, by comparison with potential alternative flood-free areas, particularly where financially disadvantage applies;

4) The physical attributes of the community, in preference to other areas, particularly once a flood has subsided and the area cleaned up;

5) A belief that the chances of it happening again are slight or 'worth the risk';

6) Non- awareness of the nature or potential benefits of any realistically alternative reconstruction/re-housing/re-establishment programme; the cost and timeframe for implementation of such; or the impacts of such on resident lifestyles or business;

7) The lack of comprehensive 'flood retreat' programmes, or means to implement them, or even good examples of other successful such programmes."

Despite these and other barriers the need to find ways to retrofit settlements for flood mitigation is critical. The importance of considering the interactions between development of urban areas and flood impact is clearly identified by Grigg (2011: 3) in his submission to the Queensland Flood Commission of Inquiry. He compares the impacts of the 1974 flood, which reached a height of 5.45 metres at the Brisbane City Gauge, with that in 2011, when the height reached the lesser value of 4.45 metres. In the 1974 flood, "approximately 13,000 buildings were damaged (about 1,000 commercial buildings, 2,000 industrial buildings and 10,000 residential buildings)" but in 2011, "14,972 buildings were damaged (3,314 non residential buildings and 11,658 residential buildings)." He further notes that the "Brisbane City Council has determined that 9,755 properties were flooded in the January 2011 flood with floor heights above the currently adopted Q100 flood level (3.3 metres on the BCG). In January 1974 the comparable figure would have been approximately 3,300." In other words the damage to property in 2011 was far worse than the damage to property in 1974 even though the height of the river flood waters was lower in 2011; Grigg identifies continuing development of areas vulnerable to flooding as the principal cause of the difference.

The remainder of this the paper explores some of the approaches which are being used or explored in retrospectively dealing with flood mitigation, focusing on floods in Southeast Queensland. The over-riding issue, though, as noted by Kundzewicz (2010: 12), is that, "if people build in a floodplain, there is no solution" but "if endangered locations have already been developed, a remedy is that humans, and infrastructure, move out of harm's way."

The contrast between dealing with floods on greenfield sites and in existing built-up areas was well described by the Brisbane Lord Mayor's Task Force on Suburban Flooding, set up in 2005 (LMTFOSF 2005). The Task Force notes (2005: 2) that "[s]ubstantial areas in Brisbane are prone to flooding", so that

> "[i] 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 … This reduces the potential for flooding of residences"

but

> "[i]n 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" (2005: 2).

This is the fundamental issue underpinning the question of retrofitting cities for flood hazards. Standards have changed, knowledge has improved and regulations have been upgraded; but the

improved standards, improved knowledge and upgraded regulations cannot be applied retrospectively without considerable economic, political and social impact.

The problems of retrofitting flood hazard management have assumed greater urgency, however, with the push for urban consolidation, regeneration and more efficient (higher density) use of existing urban areas. In Brisbane many suburbs that are now being considered for intensifacation of use were developed in the 19th or early 20th centuries. Their layout, infrastructure and location were appropriate more than 100 years ago. Although the hard infrastructure such as sewerage systems and water pipes may have been upgraded over the years the street systems, property boundaries and locations of housing are likely to reflect knowledge and concerns before the great floods of 1893 and 1974 and 2011. As noted by the LMTFOSF (2005: 7): "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."

So long as development continues in vulnerable areas a need for retrofitting will remain. It must be noted that the responsibility for consideration of potential flooding in urban development rests not just with private developers but also with relevant semi-government instrumentalities. The Australian Water Association (2011: 14) in its subission to the Queensland Floods Commission of Inquiry claimed that Queensland's Urban Land Development Authority intended continuing developing land in 13 of its 14 fast tracked development projects despite half being on lots below the Q100 flood level.

RETROFITTING STRATEGIES

Barrett (2011: 3) identifies what he calls 'flood adaption' strategies and 'flood retreat' strategies as the two fundamental ways of dealing with flood danger in built up areas. 'Flood retreat' includes removing housing, commercial enterprises, businesses and services from areas that are particularly vulnerable to flooding to areas that are less threatened and changing the use to one that is less vulnerable to flood damage (such as open space), as noted above. An example from the United States is reported by Kundzewicz (2010: 12): "After the Great Flood of 1993, the US Interagency Floodplain Management Review Committee (IFMRC, 1994, Galloway, 1999) recommended that the administration should fund acquisition of land and structures at risk from willing sellers in the floodplain. The number of families relocated from the vulnerable floodplain locations in the Mississippi Basin is of the order of 20,000 (Galloway, 1999)."

Some suburbs of Brisbane flood frequently even with local rains rather than major river floods. A flood retreat (or 'buy-back') strategy has been tried in these localities. The Lord Mayor's Taskforce on Suburban Flooding recommended the voluntary buy-back of houses where habitable floors were likely to flood every two years (LMTOSF 2005, BCC 2010). The Taskforce (2005: 3) noted that such a scheme had been developed earlier in Brisbane, 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." This scheme had ceased by 2005 (LMTFOSF 2005: 9), but it was resurected after the 2011 floods. Although the buy-back scheme was identified as a high priority action by the 2005 Taskforce, it was reported soon after (in February 2006) that "Brisbane City Council will take more than 20 years to buy back 400 flood-prone homes 'that should never have been built"' (Dudley 2006: 12). Only five homes were slated to be bought back in the 2005/06 financial year. The Lord Mayor was quoted as saying that the homes would be bought only where flooding could not be eased by infrastructure work. The reason given for the delay in purchasing the homes was the lack of State and federal government financial support. The State Department of Local Government and Planning is quoted in the same report as saying that "[t]he viewpoint of Government hasn't changed and that is that it's the council's responsibility. It was the council as an entity that approved those homes being built where they are" (Dudley 2006: 12). The Department did offer a 40% subsidy on flood mitigation work (including cleaning sediment around creek choke points, waiving fees for flood reports, and developing an education program). Although there is supposedly clearly structured relationships between the formal institutions of state and local government both were attempting to change the rules by which they operated.

Cost to government is obviously a barrier to such a buy-back scheme and just as clearly there is an inter-governmental blame game at work. It is interesting that until the 1990s Queensland planning legislation reserved the final decision on all rezonings for the State Minister so even when Councils had approved a change they were acting as delegates for the State government and the Minister could over-ride a Council decision. So technically the ultimate responsibility for earlier decisions could be said to rest with the State government. It is even possible that some may have been approved through the Planning and Environment Court on appeal against council refusals. Only detailed empirical study would identify where the 'fault' for the final approval lies. But the council did progress with the buy-back, so that in the June 2006 budget some $5million was set aside, ironically in the midst of a drought (*Courier Mail* 2006: 12). By 2011 only 45 homeowners had taken up the council's offer (at a cost of about $18million); but as the scheme was still in place after the 2011 floods, enquiries escalated then (Vogler 2011: 4). By this time, however, the State Premier was quoted as being more sympathetic to helping finance the scheme so intergovernmental relationships in implementing such a policy can change. The rules of the game had proved to be maleable.

A related flood retreat approach is for settlements to be moved from flood-prone land to higher ground. A good Australian example is the move of the town of Gundagai, NSW, out of the flood plain of the Murrumbidgee River after the floods that occurred in 1852 and 1853 (Australian Government 2008). This was, however, when the population of the town was relatively small. A similar shift is now taking place on a voluntary basis for the town of Grantham in Southeast Queensland after the flash flooding there in January 2011. Residents "will soon be able to apply for land swaps to council-owned higher ground after Premier Anna Bligh yesterday declared Grantham the first town to be fast tracked for rebuilding under the new Queensland Reconstruction Authority" (Helbig 2011: 12). The relocations will be voluntary, but although some residents were covered by flood insurance they are still reluctant to return to the town after being evacuated (MacDonald 2011). Implementing such a policy depends on receiving land being available.

These examples show how both the state and local governments are involved. However, a political and administrative problem facing retrofitting approaches extending beyond 'flood retreat' strategies is that of the potential local government liability for changes that affect existing properties. The Gold Coast City Council (2010: 2-3) for example, in its submission to the Queensland Floods Commission of Inquiry, noted that if it was to identify areas that were potentially at increased risk of flooding through the impacts of climate change the values of these properties was likely to decline and council could be subject to claims for compensation. As the council notes (2010: 2) "The current legislative framework may not provide adequate support to local authorities, who wish to publish the latest credible information, yet fear that doing so may open them to claims for legal liability, or compensation." This local government concern could be addressed by state government legislative changes, but at an unknown political cost.

On the other hand, if houses are to be rebuilt after a flood rather than applying a 'flood retreat' strategy it makes sense to incorporate the flood experience into the built form. The level of the 2011 flood has been accepted by the Brisbane City Council as an interim flood level. Council will now consider applications to raise houses in flooded areas above the 8.5metre standard height for a roofline above the ground that applies across the whole of Brisbane -- i.e., the habitable areas of houses can be built to the 2011 flood level plus a 500mm safety margin even if this takes the roofline to greater than 8.5metres (BCC 2011). This is possible with the kind of flexible building structure exemplified in the Queenslander house on stumps.

Rebuilding needs resources, so an important participant in flood policy is the private insurance industry. In the long run the attitude of the industry to insuring houses in very vulnerable areas could change peoples' attitudes to living in such places. The insurance industry is supportive of strategies that would reduce the financial impacts of disasters (through building levees and other flood mitigation infrastructure, developing appropriate building codes, and encouraging settlement in areas that are not vulnerable to hazards) as well as working with local communities. For example, the Goodiwindi council has worked to strengthen the town flood levee, so Suncorp insurance has reduced flood premiums to reflect the significantly reduced risk there (Milliner 2011).

The wider community as an 'institution' has a range of roles in relation to river flooding. The Brisbane community's attitude to its river has changed dramatically in the last 40 years or so, but in a way that has significantly increased the potential for loss from major floods. The schemas and myths have altered over time. The local authority played a role in this change: "Under Mayor Sallyanne Atkinson's

leadership in the 1980s, Brisbane became badged as the River City" (Humphreys 2011: 21). The community embraced the river as a focus for a range of activities and as an element of the city's psyche: from the redevelopment of the industrial and warehousing area south of the CBD into the Expo 88 site and then into South Bank; with the construction of cycleways and walkways along the river; to the Citycat catamaran ferry system; and to the new Gallery of Modern Art with its huge glass frontage onto the river. But such a community embrace of the river is not without its enhanced level of threat. The newly enhanced lands were flooded in January 2011 (including South Bank and the lower levels of the Gallery of Modern Art). Institutional memory of the 1974 flood had faded, perhaps influenced by the myths of flood protection centred around the construction of the Wivenhoe dam, which was widely believed, although not by hydraulogists, to have flood-proofed Brisbane.

Attitudes of the community to hazards and disasters play an important role in determining what can be done in retrofitting for a future disaster. They can assume the power of institutional myths. Newspaper reports after the January 2011 floods often emphasised the resilience of Queenslanders. There were numerous reports of people who had been flooded in 1974 and again in 2011 but still intended to stay where they were. This attitude of staying where you are in the teeth of risk and potential loss was reinforced through a number of politicised statements: "We know that times have been tough in Grantham, but the people of Grantham are strong. They know how to bounce back and they will have us standing behind them and helping them every step of the way", said Queensland Premier Anna Bligh, quoted in Helbig (2011: 12). People often have an attachment to place, to their home and to their history that is not shaken by the fact that their place has been demonstrated to be vulnerable to disastrous events. The implication is that strong communities can overcome such difficulties, even if the disasters have occurred several times in the past and are likely to occur again.

There is also a social justice issue: if low income families are not able to access insurance monies (either because their house was not insured against the particular kind of flood event, or because they chose not to insure, or because they did not have the resources to insure their property) they may not have the resources to move and so become forced to remain with their housing investment, despite the future risk. This problem is exacerbated in a number of ways, but also for those who do have the resources to rebuild. Government and private post-disaster financial assistance often is predicated on the assumption that the householder intends rebuilding their flooded dwelling.

Retrofitting existing settlements to mitigate the impacts of disasters means working to create more resilient settlements. Godschalk (2003: 137) describes resilient cities as being made up of a "sustainable network of physical systems and human communities." Physical systems include the constructed and natural environment components of a city but the human communities are made up of the social and institutional components of that city. Godschalk argues that "resilient cities are constructed to be strong and flexible, rather than brittle and fragile" (2003: 137). In order to reach this level of resilience, "governmental, nongovernmental, and private sector organisations need to work together" (2003: 137). Although Godschalk places emphasis on the need to proactively pre-plan to achieve resilience, he recognises the importance of retrofitting. He discusses the examples of Berkeley in California and Tulsa in Oklahoma which "exemplify long-term persistence and innovation in risk-reduction policies and programs" (2003: 138). Berkeley, following a 1989 earthquake and a 1991 wildfire, has the highest rate of retrofit to combat natural hazards in the San Francisco Bay area, including seismic retrofit for municipal buildings and schools and fiscal incentives for home owner seismic safety actions (including a loan program and "a free home repair program for low income seniors or disabled people" (2003: 138)). Tulsa has faced tornadoes, violent thunderstorms and flooding from the Arkansas River, but has now "established a floodplain clearance effort that removed some 875 buildings by 1993", a stormwater utility fee, "watershed development regulations, an aggressive public awareness program, master drainage plans supported with a capital funding program, and floodplain recreation and open space areas" (2003: 138).

These examples and those from Southeast Queensland show that retrofitting to create more resilient cities is possible. Godschalk's flood-based example shows that both 'flood retreat' and 'flood adaption' strategies can work. His examples also refer to a number of strategies that have also been partially implemented in Southeast Queensland following the major 1974 flood and the region's continuing local and suburban flooding, but in a rather *as hoc* and unsystematic way.

CONCLUSIONS

Australian urban planning policy for mitigating the impacts of floods has tended to focus on new, greenfield developments. Whilst this is important it does not deal with the substantial areas of already vulnerable housing, commercial uses and industry in existing towns and cities. Dealing with these already built-up areas is difficult. A number of barriers to mitigating the impacts of floods exist, some of which have been identified here. Identifying these barriers and the ways they can be overcome is aided by the use of an urban institutional framework. We identified both a 'flood retreat' and a 'flood adaption' strategy as possibilities but the examples in Southeast Queensland showed how the cost to government of relocation became a barrier when the fomal institutions of state and local government played a 'blame game' over past decisions in an attempt to alter the rules under which they interacted. But the informal institutions of community attitudes and perceptions also raised difficulties, because community understanding of flood risk was inadequate. The rules about the way that the formal and informal institutions in the region deal with floods have also been altered by the myths and beliefs held by the community – in, for example, their belief in the impact of the Wivenhoe dam and in Brisbane's gradual change from ignoring to embracing its role as a river city. Even this very preliminary look at retrofitting for flood mitigation shows that success will come only when governments of all levels, organised and informal community institutions, and the relevant private sector operators work together. An institutional framework helps to explicate the current and potential roles of these actors, but also draws attention to the significance of the myths and schemas that shape the rules by which the institutions interact. Perhaps just as importantly it shows that these values and myths, and so the rules of interaction, can change over time so that retrofitting existing urban settlements to better deal with floods can become a reality.

REFERENCES

Alexander, E. R. (2001) A transaction-cost theory of land use planning and development control: Towards an institutionalist analysis of public planning, *Town Planning Review*, 72(1), 45-76.

Alexander, E. R. (2007) Instutionalist perspectives on planning: Why? Where? How? In N. Verma (ed) Institutions and Planning*, op. cit.*

Amin A. and Thrift, N. (1994) Living in the global. In A. Amin and N. Thrift (eds) Globalization, institutions and regional development in Europe*,* Oxford, UK: Oxford University Press, 91-108.

Australasian Fire and Emergency Service Authorities Council (2011) Submission to the Queensland Floods Commission of Inquiry, April 2011, AFAC, East Melbourne. Available at http://www.floodcommission.qld.gov.au/submissions/view-submissions-a-to-z Accessed 4th August, 2011.

Australian Water Association (2011) Submission to the Queensland Floods Commission of Inquiry, April 2011, Available at http://www.floodcommission.qld.gov.au/submissions/view-submissions-a-to-z Accessed 4th August, 2011.

Barrett, R., McC. (2011) Submission to the Queensland Floods Commission of Inquiry: Land use and planning considerations in response to the SEQ floods of 10/11 January, 2011, Saunders Havill Group, Brisbane. Available at http://www.floodcommission.qld.gov.au/submissions/view-submissions-a-to-z Accessed 4th August, 2011.

Bell, S. & Hindmoor, A. (2009) Rethinking Governance: The Centrality of the State in Modern Society*,* Port Melbourne: Cambridge University Press.

Bosher, L., Dainty, A., Carillo, P., Glass, J. & Price, A. (2009) Attaining improved resilience to floods: A proactive multi-stakeholder approach, *Disaster Prevention and Management,* 18(1), 9-22.

Brenner, N. (2004) New state spaces: Urban governance and the rescaling of statehood, New York, NY: Oxford University Press.

Brody, S. D., Kang, J. E. & Bernhardt, S. (2010) Identifying factors affecting flood mitigation at the local level in Texas and Florida: The role of organizational capacity, *Natural Hazards*, 52, 167-184.

Chhotray, V. and Stoker, G. (2009) Governance theory and practice: A cross-disciplinary approach*,* Houndsmills, UK: Palgrave Macmillan.

Coase, R. H. (1937) The nature of the firm, *Economica (New Series)*, 4(16), 386-405.

Crichton, D. (2002) UK and global insurance responses to flood hazard. In S. P. Simonovic (ed) Non-structural measures for water management problems*,* Proceedings of the International Workshop, London, Ontario, October, 2001, IHP-V Technical Documents in Hydrology No. 56, Paris: UNESCO International Hydrological Programme, 239-251.

DiMaggio, P. J. & Powell, W. W. (1991) Introduction. In W. W. Powell & P. J. DiMaggio (eds), The New Institutionalism in Organisational Analysis, Chicago, Ill: University of Chicago Press, 1–38.

Galloway, G. E. (1999) Towards sustainable management of river basins: challenges for the 21st century. In P. Balabanis, A. Bronstert, R. Casale & P. Samuels (eds) Ribamod. River Basin Modelling, Management and Flood Mitigation. Concerted Action, Proc. of the final workshop, Wallingford, 26-27 February 1998, Luxembourg: Office for Official Publications of the European Communities, 235-250.

Geoscience Australia (2010) What is risk? Available at http://www.ga.gov.au/hazards/risk-and-impact-analysis/what-is-risk.html Accessed 27th July, 2010.

Giddens A. (1984) The constitution of society, Cambridge, UK: Polity Press.

Godber, A. (2005) Urban floodplain land-use – acceptable risk? *Australian Journal of Emergency Management,* 20(3), 22-26.

Godschalk, David. R. (2003). Urban hazard mitigation: creating resilient cities, *Natural Hazards Review*, 4(3), 136-43.

Gold Coast City Council (2011) Submission to the Queensland Floods Commission of Inquiry. Available at http://www.floodcommission.qld.gov.au/submissions/view-submissions-a-to-z Accessed 4th August, 2011.

Harvey, D. (1982) The limits to capital, Oxford, UK: Basil Blackwell.

Grigg, T. (2011) Muddy waters: The reality of Brisbane River flooding, submission to the Queensland Floods Commission of Inquiry. Available at http://www.floodcommission.qld.gov.au/submissions/view-submissions-a-to-z Accessed 4th August, 2011.

Healey, P. (1998) Building institutional capacity through collaborative approaches to urban planning, *Environment and Planning A*, 30, 1531-1546.

Healey, P. (1999) Institutionalist analysis, communicative planning and shaping places, *Journal of Planning Education and Research*, 19(2), 111-122.

Holway, J. M. & Burby, R. J. (1993) Reducing flood losses: local planning and land use controls, *Journal of the American Planning Association*, 59(2), 205-216.

Interagency Floodplain Management Review Committee (IFMRC) (1994) Sharing the challenge: Floodplain management into the 21st century. A blueprint for change, Washington DC: IFMRC.

Kundzewicz, Z. W. (2002) Non-structural flood protection and sustainability. In S. P. Simonovic (ed) Non-structural measures for water management problems, Proceedings of the International Workshop, London, Ontario, October, 2001, IHP-V Technical Documents in Hydrology No. 56, Paris: UNESCO International Hydrological Programme, 8-27

Lord Mayor's Task Force on Suburban Flooding (LMTFOSF) (2005) Strategies to reduce the effect of significant rain events on areas of Brisbane prone to flooding. Brisbane: Brisbane City Council.

Lowndes, V. (2001) Rescuing Aunt Sally: Taking institutional theory seriously in urban politics, *Urban Studies*, 38, 1953-1971.

March, J. & Olsen, J. (1989) Rediscovering Institutions. New York, NY: Free Press.

Minnery, J. (2007). Stars and their supporting cast: State, market and community as actors in urban governance, *Urban Policy and Research,* 25(3), 325-345.

Ostrom, E. (1990) Governing the commons: The evolution of institutions for collective action, New York, NY: Cambridge University Press.

Petrow, T., Thieken, A. H., Kreibich, H., Bahlburg, C.H. & Merz, B. (2005) Improvements in flood alleviation in Germany: Lessons learned from the Elbe flood in August 2002, *Environmental Management*, 38, 717-732.

Peukert, H. (2001) Bridging old and new institutional economics: Gustav Schmoller and Douglass C. North, seen with old instutionalists' eyes, *European Journal of Law and Economics,* 11(2), 91-130.

Queensland Floods Commission of Inquiry (2011) Interim Report, August 2011, Brisbane: Queensland Floods Commission of Inquiry. Available at http://www.floodcommission.qld.gov.au/publications/interim-report. Accessed 4th August, 2011.

Scott, R. W. (1995) Institutions and Organisations. Thousand Oaks, CA: Sage.

Simonovic, S. P. (ed)(2002) Non-structural measures for water management problems, Proceedings of the International Workshop, London, Ontario, October, 2001, IHP-V Technical Documents in Hydrology No. 56, Paris: UNESCO International Hydrological Programme.

Stevens, M. R., Song, Y. & Berke, P. R. (2010) New Urbanist development in flood prone areas: Safe development or safe develoment paradox? *Natural Hazards*, 53, 605-629.
Teitz, M. B. (2007) Planning and the new institutionalisms. In N. Verma (ed) *op. cit*., 17-35.
Verma, N. (ed)(2007) Institutions and Planning, Amsterdam: Elsevier.
Weingast, B. (1996) Political institutions: rational choice perspectives. In R. Goodin & H. Klingemann (eds) A New Handbook of Political Science, Oxford: Oxford University Press, 167–190.