Urban Floodplain Land-use – Acceptable Hazard? : A Case Study of Flood Risk Perception on the Guragunbah Floodplain (Nerang River System), Gold Coast.

Introduction

Across Australia, urban floodplains continue to be developed despite the acknowledgement by expert hazard/ risk assessors that there is a flood risk (Handmer, 1995; Lambley, 1996; Smith, 1998; Granger *et al*, 1999, Granger *et al*, 2000, Granger *et al*, 2001). Even within legislative environments such as the Queensland Government, that does require the consideration of natural hazards within land-use planning decision frameworks, development continues to occur within environments considered 'at-risk'. This project suggests that a factor in this continued growth is the way in which the various stakeholders involved in the decision-making framework define flood risk acceptability.

For land-use and development to continue, a level of flood risk must be defined as acceptable for an area. One stakeholder group - the local government, usually establishes this level. While the planning legislation dictates that the local government makes the final land-use and management decisions, each stakeholder in the development process will perceive the hazard and define their *own* level of 'acceptable' flood risk. It is assumed through the decision-making process that the local governments have set acceptable risk standards that are appropriate to the needs, perceptions and vulnerability of the stakeholders within the floodplain community. However, evidence suggests that urban community vulnerability to hazards such as flooding is increasing (Laska, 1990; Green *et al*, 1991; Montz, 1992; Chan, 1995; Shrubsole and Scherer, 1996; Smith, 1998; Fordham, 1998, 1999; Hewitt, 1983, 1999; Cannon, 1994; Varley, 1994; Blaikie et al, 1994; Handmer, 1995; Melick, 1996; Tobin and Montz, 1997; Bolin and Stanford, 1998; Young, 1998; Granger, 1999; Granger *et al,* 1999, 2000; 2001;). This leads us to question exactly how comprehensible and acceptable the policy flood risk standards (such as the 100-year event) are to the exposed floodplain/ flood affected area occupants and their choice in land-use.

Background to the study

Floodplain management in Queensland has traditionally been the responsibility of individual local government areas. The minimal state and federal government involvement has lead to a wide variety of responses at the local government level, from basic acknowledgement through to award winning management strategies. In the last seven years, more guidance has come from higher levels of government in the form of the Australian/ New Zealand Standard 'Risk Management Framework' (AS/NZS 4360 1995), adopted in 1995 (Salter, 1996, 1997; Angus, 1997, 1998; Standards Australia, 1999), and the Australian National Floodplain Management Guidelines, adopted in 1996 (SCARM, 2000). Both

frameworks, which can be adopted by individual local government areas, prescribe processes by which risks should be identified, assessed and treated within a community and legislative environment.

In Queensland today, there are attempts underway to formally draft a state planning policy specifically related to land-use within hazardous areas, such as on floodplains/ flood affected land. In an attempt to reduce the levels of community vulnerability to flooding and assist local governments that may have not yet have had the financial opportunities to assess their own levels of flood exposure and community perception, it has been suggested that a base design flood level (acceptable flood risk) be defined within the policy. It is anticipated that this level, currently proposed as the 1 in 100 year flood event, be adopted as the design standard unless individual local governments can prove another level is suitable through detailed flood risk analysis and mapping that also includes a community vulnerability assessment and consultation process (Personal Interview with Queensland Department of Emergency Services Representative, 18 April 2002). The 1 in 100-year flood event is already the design standard adopted by many local governments throughout the State, as well as internationally – but who decides this level is acceptable and how does it compare with other stakeholders definitions of acceptable flood risk? And do the stakeholders really understand what this flood risk benchmark represents? This project seeks to answer the following questions:

1. *Does* a generally accepted level of flood risk exist for the urban floodplain or do variations exist in the way in which the stakeholders perceive risk?
2. What effect do/ may any differences in acceptability have on community vulnerability?
3. Can the decision-makers within the local government justify the level of risk acceptability they set or are they being too restrictive or relaxed when it comes to acceptable land-use?
4. And are the stakeholders making land-use decisions based on a level of risk and associated consequences they understand and accept?

The Case-Study Local Government Area

A local example of land-use planning and management within an 'at-risk' flood affected environment – the Guragunbah floodplain urban area located on the Gold Coast - forms the case study of this project. The Guragunbah (Carrara-Merrimac) floodplain management area is located within the lower catchment of the Nerang River floodplain system. This area is highly desirable as it represents a transition zone between the coastal and hinterland regions and lifestyles of the Gold Coast. The flood-affected areas were originally drained for dairy farming in the early 1900s, but population growth during the 1960s and 70s saw the land converted to include waterway systems and a combination of residential, tourist/recreational, commercial, special facilities, industrial and open space land-use. Residential suburbs and human made lakes and canal systems now also surround the area.

Until 1995 the flood-affected areas were under the jurisdiction of two separate city councils, whose boundaries fell just to the east of the study area. The amalgamated Gold Coast City Council, formed in 1995, acknowledged the potential urban flood problem and set about reviewing the development practices and planning for the city's floodplains and river systems. This review resulted in the formation of the Carrara-Merrimac Floodplain Advisory Committee (representatives from GCCC, state government, the development industry and the community) and development of the Guragunbah Structure Plan, associated planning codes for flood-affected environments and a Nerang River Mitigation project, for which the Council received recognition in 1999. The Guragunbah floodplain is now managed as a special development area (GCCC, 2001), a status that allows the local government to place conditions and restrictions on development and land-use. This classification as a special development area and the associated land-use planning indicates that the local government decision-makers have acknowledged the flood risk as a potential hazard. This provides an opportunity to study an area that has been identified for the potential risk that any land-use may be subject to and examine how the stakeholders involved in this process define acceptable flood risk.

The Study to Date

This study initially set out to examine how a local government authority integrates hazard management into land-use decision-making frameworks; what processes operate for development and management to continue; and also to identify who the stakeholders and decision-makers in the floodplain land-use/management planning processes are. Researchers examining floodplain management initiatives at local government levels have concluded that in order to sustain increasingly (vulnerable) urban communities, it is necessary to integrate hazard management into legislated land-use planning processes (Handmer, 1996; May, 1997; Burby 1998a, 1998b; Burby et al, 1998; Burby et al 1999; Burby et al 2000). To date, there has been little advancement is this area with the research highlighting such inhibitive issues as the way in which the hazard is perceived and rationalised by those responsible for management and planning; relationships between government units and levels; and resource availability (Lambley, 1990; Handmer, 1996; May, 1997; Burby 1998a, 1998,b; Burby et al, 1998; Burby et al 1999; Burby et al 2000).

A descriptive model of how hazard management in general could, theoretically, be integrated into the land-use planning process according to current legislation was generated. Following the adoption of the Integrated Planning Act in 1998, the Queensland State Government does regulate the way in which applications for land-use are assessed and subsequent decisions made by local government. There is also the Australian Standard Risk Management framework for identifying, assessing and treating risk (Salter, 1996, 1997; Angus, 1997, 1998; Standards, 1999). From these two pieces of legislation, a descriptive model of how land-use planning and management decisions regarding a potentially hazardous (floodplain)

environment could occur was developed. It was hypothesised that hazard management was integrated into the land-use decision-making framework at three main stages:

1.) At the *Consultation* stage, When the Department of Emergency Services, the Department of Natural Resources and the Department of Local Government and Planning may act in a referral capacity, helping assess the suitability of the proposed development within the hazardous environment. The hazard management strategies and organisational units are used, for example, to:

- Determine planning conditions for the special development area; and assessment evaluation criteria or objectives for the development proposals, and their application;
- Determine the likely influence of the development on the existing flood risk and surrounding properties; and whether the development is suitable for the area and if any modifications or conditions are required.

2.) At the *Assessment and Decision* stages, When the council may use the hazard management generated evaluation criteria and referral agency recommendations to:

- Determine what kind, if any, conditions need to be placed on the project during the formal assessment of the proposal;
- To support their condition to conditionally approve or reject the development application; and
- To determine what level of mitigation may be required;

3.) At the *Follow-Up and Monitoring stage,* If allowed to proceed, the relevant authorities may use hazard management monitoring strategies (such as re-evaluating level of risk), standards or officers to inspect the site and ensure that the conditions prescribed are being followed, and that the development matches with that which was actually approved.

Based on interviews with stakeholders, direct observation of planning meetings and the examination of planning documents, a second descriptive model of observed processes was then generated for the study area local government. The model of observed processes indicated that there is a set framework within the local government study area for the managing the potentially hazardous (flood-affected) environments, establishing regulations and evaluating land-use proposals. While the planning framework operating within the local government study area did not differ from that prescribed by the current Qld legislation, the way in which hazard management is incorporated into the process was different than originally anticipated. Within this local government case-study setting, the hazard management framework is actually integrated in a top down manner, after a citywide assessment of potential hazards and during the establishment of initial planning standards and schemes for the city. The planning standards and codes are then applied during the development assessment process prescribed by the State Government (IDAS framework). In the case of the Gold Coast City Council, an assessment of natural hazard risk was undertaken shortly after the

amalgamation of the former Gold Coast and Albert shire Councils, following the AS/NZS Hazard Management framework. Flooding was identified as such a significant potential threat to the city, that a specialised Flood Strategies Section (consisting of hydrological engineers as well as social planners) was established to guide the council's land-use planning and management of the floodplains and flood affected environments, as well as to examine the community's perceptions of flooding and eventually develop an education campaign on the potential flood risk (projects currently underway). The Flood Strategies Section, following the Federal Government's Floodplain Management Guidelines, established the land-use planning standards, which are applied by the hydrologists within the planning directorate. In order to make a recommendation to the council's planning committee, the town planning officers use the hydrologist's assessment of the land-use proposal against the planning code for flood-affected environments.

Within the study area, counter disaster planning occurs separately to the process identified above. The hazard management frameworks were found to be integrated into the planning structure primarily during the initial assessment identifying the city's potential hazards and then through the establishment of policies and regulations. The Counter Disaster Planning Process works off the initial hazard assessment, parallel to the planning process and with the Flood Strategies Section. Information regarding land-use and community demographic characteristics across the city is fed back into Counter Disaster Planning Process and used to identify and make provisions for vulnerable sections of the community. A project currently underway involves the use of Geographical Information Systems to map land-use and community characteristics in relation to likely impacts from the hazards that may affect the city (Personal Interview with Gold Coast City Council Counter Disaster Planning Unit Representative, 12 April 2002; Betts *et al*, 2001; Betts, 2002).

From the model of observed processes, it was possible to identify four main stakeholder groups involved in the decision-making process:

1. *The Local Government* (hydrological engineers, town planners, sub-division coordinators, statutory planners, development assessment and compliance officers, building and technical services operators, planning, environment and transport officers, referral agencies, pre-application advisors, building certifiers, social planners, and local area representatives);
2. *Hazard Managers* (members of the Disaster District Control Group, Local Government Counter Disaster Committee, disaster coordinators, members of the flood strategy group);
3. *Development Industry* (major corporate landholders, developers and real estate agencies); and
4. *Floodplain Occupants* (those residing within the residential and commercial developments on the floodplain).

While the descriptive model illustrated the processes that operate to manage land-use on the floodplain and flood-affected environments, it also identified another significant factor – the foundation of acceptable flood-risk levels or benchmarks. At the initial stage of deciding upon 'acceptable' flood risk standards, the

study area local government has adopted a 'design flood' for land-use planning purposes (the 1 in 100 year event) (Gold Coast City Council Full Council Meeting, 25 May 1995). From this standard, the Flood Strategies Section set acceptable benchmarks for the range of land use alternatives (residential, commercial, industrial, recreational, special facilities and transport routes) based on a process of risk assessment involving a 'risk management strategy for each likely land use' (Betts, 1999:5) and identifying the factors that may effect accessibility to the land-use (such as flood characteristics, population characteristics, what emergency management is in place and the topography of the area) (Betts, 1999). The model of observed processes also illustrated four other stages at which some level of 'acceptable' flood risk is decided upon and adopted by the stakeholders identified above:

1. Developers perceiving a land-use demand;
2. Assessing development proposals;
3. Making the final decisions regarding the appropriateness of proposals (weighing development constraints and benefits); and
4. Occupants choosing to locate within the floodplain/ flood affected environment.

The identification of the five stages at which an acceptance of flood risk occurs, allows further investigation into exactly what level of flood risk each stakeholder group finds 'acceptable', how they interpret the information they receive, and whether the local government's assumptions about the community stakeholders are accurate.

'Acceptable' risk has generally been a characteristic examined within a wider framework of risk perception research. Research within the broader hazards area has tended to concentrate on how residents perceive risk and what demographic characteristics make communities vulnerable, and we have a fairly good understanding as to why residents continue to locate in a hazardous environment and how they adapt and perceive flood risk (White, 1945,1961; Kates, 1964, 1967, 1971; Burton *et al*, 1964a, 1964b, 1968; Kates *et al*, 1961; Baker and Pattern, 1974; White and Haas, 1975; Bradshaw, Simpson-Housely, 1978; Waterstone, 1978; Macey, 1979; Hansson, Noulles and Bellovich, 1982; Bradway Laska, 1986; Beatley and Bower, 1986; Pilisuk, 1987; Laska, 1990; Montz, 1992; Kasperson and Dow, 1993; Chan, 1995; Shrubsole and Scherer, 1996; Mesch and Manor, 1998; Prater and Lindell, 2000). Variables such as age, experience and length of residency, as well as heuristics or mental tools such as information recall, are significant in the continued occupancy of hazardous areas, hazard knowledge, perception and mitigation (White, 1945,1961; Kates, 1964, 1967, 1971; Burton *et al*, 1964a, 1964b, 1968; Kates *et al*, 1961; Baker and Pattern, 1974; White and Haas, 1975; Bradshaw, Simpson-Housely, 1978; Waterstone, 1978; Macey, 1979; Hansson, Noulles and Bellovich, 1982; Bradway Laska, 1986; Beatley and Bower, 1986; Pilisuk, 1987; Laska, 1990; Montz, 1992; Kasperson and Dow, 1993; Chan, 1995; Shrubsole and Scherer, 1996; Mesch and Manor, 1998; Prater and Lindell, 2000; Gillespie *et al*, 2002). We have some understanding of how other stakeholders such as developers and real estate agents perceive the flood risk, but such groups have not

been extensively studied (Kaiser *et al*, 1987; Shrubsole, 1996). We do not really have a good understanding of how local governments arrive at an 'acceptable' level of risk enabling them to justify their planning decisions, although there are studies examining the ways in which hazards are managed by local government authorities (Childs *et al*, 1996; Handmer, 1996; Chan, 1997; Sjoberg, 2001; Gillespie *et al*, 2002).

According to Slovic (1979, 1980), acceptable risk is a position we arrive at after compromising benefits and costs of exposure to the risk. It may not necessarily be the 'ideal' level of risk, rather one based on our decision-frames – what level of knowledge, perception and understanding we have about the risk and its consequences, what alternatives we are aware of and can undertake (and at what cost/benefit), our planning horizon etc. Further research has indicated that acceptability can be influenced by the perceived voluntariness of exposure, catastrophic potential and equitable distribution of costs, benefits and risk; the characteristics and credibility of the decision-maker; and the political, social, environmental and economical context in which the risk is being evaluated and decisions made (Fischhoff *et al*, 1978, 1984; Vlek *et al*, 1981; Renn and Swanton, 1984; Slovic, 1987; Slovic *et al,* 1980,1995; Lave, 1989; Philley, 1992; Pasman, 1993; Rohrmann, 1994; Baird, 1996; Pilgrim, 1999).

Further on from this, the literature shows that stakeholders do not always share similar hazard perceptions or definitions of acceptable risk - different-groups within society have different decision-frames. Throughout the research, levels of acceptability and risk perception among various social groupings have been examined (Fischhoff *et al*, 1978, 1982; Slovic, 1987; Slovic *et al,* 1980,1995; Cutter, 1994; Gutteling and Wiegman, 1996). Further developments in this broad field examined the effects of internal judgement processes or heuristics; societal amplifications of risk messages; and cultural biases resulting from levels of community participation (Tversky and Kahneman, 1974; Marris, Langford & O'Riordan 1998; Lupton, 1999a,b). Although the current terminology favours 'stakeholder groups', variations between experts and laypersons have consistently been found to exist (Green, Tunstall and Fordham, 1991; Jassanoff, 1993; Lazo, Kinnell and Fisher, 2000; Wright, Pearman and Yardley, 2000; Rowe and Wright, 2001; Sjoberg, 2001). Experts were more likely to base their perceptions on statistics and probabilities, while laypeople based their, more subjective, perceptions on experience, perceived controllability, equitability, familiarity and the level of catastrophe they associated with the hazard (Fischhoff, 1978; Slovic *et al*, 1980; Covello *et al*, 1981; Renn and Swanton, 1984).

The level of satisfaction and trust in those responsible for managing, regulating and protecting society from risks has also emerged as a significant determinant of risk acceptability. Starr (1987) suggested that 'public acceptance of any risk is more dependent on public confidence in risk management than on the quantitative estimates of risk consequences, probabilities and magnitudes' (Starr, 1987:98). The body of risk perception and 'acceptability' research, now moving forward into examining the way in which organisations manage

and regulate hazards (both natural and technological), continues to support the original finding that stakeholders (scientists, planners, and occupants, for example) do not share a common definition of risk or hazard perception, and also differ in the ways in which the information they receive is interpreted (particularly how probabilities and numerical statements are comprehended) (Gough, 1990). Recently, there has been fairly extensive research into this issue, particularly from a medical perspective (Golding, *et al*, 1992; Walston, 1994; Corso, 2001; Edwards, 2002). Research in the area of risk communication has also found that stakeholder groups (again, technical 'experts' and the general public) interpret risk measures and messages differently (Sewell, 1971; Kaiser *et al*, 1987; Bradbury, 1989; Fiorino, 1989; Kraus *et al*, 1992; De Rodes, 1994; Shrubsole *et al*, 1996; Fordham, 1998; Sjoberg, 1998; Flynn, 1999). Such findings have implications for the ways in which the decision-makers of potentially hazardous environments arrive at an assumed level of acceptable risk, acceptable consequences and acceptable use. Therefore, can one decision-making group (such as the local government) really establish a level of flood risk that is generally accepted by all floodplain stakeholders?

This project focuses on whether there are inconsistencies within and between groups responsible for making acceptable risk decisions, and how these inconsistencies within the decision-making framework may translate into land-use decisions resulting in the continuing development of floodplain and flood-affected environments and increasing community vulnerability, and makes the following hypotheses:

1. The occupants of the flood affected areas have little personal experience with flooding in their current locations and therefore, have low perceptions of the actual levels of flood risk they may be exposed to. Because the occupants have low perceptions of flood risk, they will not be willing to accept a high level of flood exposure within their suburbs or to their properties.
2. The way in which flood risk is currently presented is not well understood or interpreted by those currently exposed to the risk. Presenting risk in a non-technical manner, such as through scenarios using simple language and photos illustrating flood events in familiar areas, will help the occupants to better understand the flood hazard in their local area and elicit more accurate portrayals of what occupants consider to be an acceptable flood risk.
3. The acceptable flood risk benchmarks, established by the local government, for land-use within flood-affected areas do not match the level of flood risk deemed acceptable by the occupants of the flood-affected areas.
4. The stakeholders have inaccurate perceptions of the levels of flood risk other stakeholder groups define as acceptable, these discrepancies occur because decisions regarding other stakeholder's perceptions of risk are made without direct consultation.

Examining Stakeholder's Perceptions of Acceptable Risk

The next stage of the project has involved communicating with the stakeholders in order to establish their perceptions of the hazard and an 'acceptable' level of flood risk; and also, to examine how acceptable risk levels compare with the development of floodplain/ flood-affected environments within the city.

Representatives of the land-use planning, hazard management agencies and development industry were interviewed using a semi-structured approach. In order to gain a cross-section of occupants, five suburbs that surround the Guragunbah management area in the lower catchment were selected, based on their proximity to the study area and their composition of a variety of land-uses. Both residential and commercial occupants were approached and while commercial occupants showed genuine interest in the topic, the majority of those contacted did not have the time to participate. As a result, it was decided to focus on the residential occupants. A pilot survey was completed in early August and after a couple of minor adjustments to the questionnaire, the full survey commenced in late August.

The questions used in both the semi-structured interviews and the questionnaire were based around five themes:

1. How do the stakeholders perceive the flood risk?
2. What level of flooding are stakeholders prepared to accept and what level of flood-risk responsibility do the stakeholders assume they have?
3. How do the stakeholders perceive each other's levels of acceptable risk and responsibility?
4. How do the stakeholders interpret the way in which flood risk information is presented to them and does the way in which the information is presented have an effect on the level of risk that stakeholders are willing to accept? And
5. How accurate/ relevant are the government/policy set standards of 'acceptable' flood-risk and land-use?

The questionnaire consisted of 27 basic scaled response questions addressing the topics identified above. In order to examine whether risk presentation has any effect on risk acceptance and if the occupants accurately interpret the current presentation formats and terminology, three levels of flood risk were identified – minor (1 in 5/10), moderate (1 in 20/50) and major (1 in 75/100). The flood risk levels were presented to respondents in three ways, in styles two and three the flood severity/ associated level (such as 1 in 20, 1 in 100) was not disclosed to the respondents in an attempt to further examine how the flood risk is perceived and whether there are alternative means of deriving and presenting acceptable risk:

1. In numerical terms, such as a 1 in 20, 1 in 50 and 1 in 100 year event, as well as %AEP;

2. By way of verbal statements or scenarios based on simple language that provided an indication of the likely effects of flooding on roads, services and residential areas in the case of minor, moderate and major flooding (the severity of flood was not disclosed to respondents); and
3. Photo illustrations of actual flooding within the study area corresponding to the three levels of identified flood risk (the photo dates and flood severity were not disclosed to the respondents).

At this stage of the project (data collection is nearing completion), basic descriptive data analysis of the questionnaires is taking place, while content analysis of the interview transcripts is also continuing.

Tentative Results and Conclusion

The major outcome of the study will be an illustration of how the various stakeholders perceive the flood risk and acceptable risk within a 'real world' setting, providing an opportunity to amend existing frameworks for more effective hazard management and land-use planning outcomes. The model will present inconsistencies in the perception of acceptable risk against the current context of management and land-use planning. The research will also examine the potential of two alternative presentation formats (pictorial and scenario) in the communication and measurement of acceptable flood risk. While it is noted that the results for the case study within this project are unique to this region, it is anticipated that the model could be used to facilitate the integration of land-use planning and hazard management processes in other local government areas. Based on initial descriptive analysis of data collected to date, some trends can be identified:

1. There are differences in the way that the various stakeholder groups perceive, comprehend and define flood risk and acceptable flood risk. Not surprisingly, the occupants had generally low levels of flood risk perception and little direct experience with flooding at either their current or previous residences. One of the more interesting points raised during the study, has been the interpretation of if and when flood affected land ceases to be 'at risk' of flood events, i.e., the majority of residents and some development industry representatives suggested that raising flood affected land above a specified design level (such as the 1 in 100 year event) removed the flood exposure/ risk. This is not a view shared by hazard managers or the local government, who suggest the counter view that while flood immunity has been increased, it is impossible to completely remove flood risk. The indication that the majority of residents located within flood-affected areas do not believe they are at risk has implications for levels of community vulnerability, future educational campaigns and counter disaster planning.
2. When, how and by whom flood risk information should be offered to stakeholders also presented itself as a contentious issue. There is a general perception within the community that the responsibility for education and mitigation of flood risk falls solely onto the local government,

with the local government and developers perceived by the occupants, as the originators of the current flood exposure situation. Understandably, representatives from the local government and development industry do not share these views suggesting instead, that the responsibility of flood mitigation and education is a whole of stakeholder issue.

3. The data also suggest that way in which flood risk information is presented to the general public does have an effect on the way in which risk is comprehended. This study presented flood risk in three ways: probability estimates, scenarios and pictures of actual flood events in the study area. The results suggest, and support previous findings, that the occupants generally could not interpret probability statements accurately enough to estimate likely effects and frequencies of flood events presented in such terms as 1% AEP. Occupants were far more likely to accurately associate the scenarios and pictures with the levels and frequencies of flooding they represented. These findings also have significant implications for the design of future education initiatives and the very concept of how acceptable risk is defined in policy and presented to decision makers outside of the legislative environment.

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