

MUDDY WATERS: THE REALITY OF BRISBANE RIVER FLOODING

Submission to Queensland Floods Commission of Inquiry

by

Trevor Grigg

1. INTRODUCTION

The Brisbane River flooding in January 2011 has demonstrated, as was the case in 1974, that the community at large appears to have been poorly equipped to appreciate the extent of the flood hazard, to interpret flood warnings, to understand flood maps, and to have formulated flood evacuation strategies relevant to their property.

Another factor of real concern is that properties in the flood plain in 1974 have been permitted to be re-built and further development permitted, often in established areas, without in many cases adequate consideration of flood proofing of buildings and the on-going flood risk. The 2011 flood has been essentially a re-run of the 1974 flood for many property owners and renters/lessees in the flood plain.

Arguments regarding eligibility for flood insurance payouts repeat themselves yet again over definitions of “flooding” in policies and insurance company decisions concerning the causes of the flooding. The stress and hardship being experienced by those who have suffered property damage and loss of income (if only for a period) are, in many cases, those least likely to have access to the financial resources and support to re-build their lives in a timely manner and without long term negative impacts on their overall well being.

Brisbane, the “River City”, has a significant, manmade flood hazard which needs to be actively managed in the interest of all of the community.

But a resolution to the economic and social problem of the flood hazard cannot be found by engineering means alone and the chosen flood hazard reduction strategy must embrace a combination of engineering and non engineering measures.

However, the **fragmentation of responsibilities for flood plain management between local, State and Commonwealth Government agencies makes a coordinated strategy more difficult to achieve.** An organizational structure which directly overcomes this fragmentation is urgently required.

The challenge is what lessons can we learn and what actions should we now take to avoid yet a further damaging repeat of the experience of the latest two major flooding events in the life of the Brisbane River – the January 1974 and the January 2010 floods.

2. THE FLOOD HAZARD AND FLOOD PLAIN MANAGEMENT

The **flood hazard is manmade.** Therefore, it is the task of those responsible for the management of the flood plain to promote human occupance and utilisation of it in a manner in harmony with the natural flooding regime. That is, the **focus of flood plain management should be mitigation of the flood hazard, as distinct from simply the flood itself.** There is a range of complementary measures which would be expected to be in place in a comprehensive flood plain management strategy for any developed, major river catchment such as the Brisbane River Catchment. These measures are summarized in tabular form below:

Flood Hazard Mitigation Measures

Class of Measure	Typical Measures
1. Bear losses	--
2. Modify flood	Levees, channel improvements, detention basins, storage reservoirs
3. Modify flood hazard	Flood warnings, emergency evacuation, development regulations, flood proofing, flood plain zoning, watershed management, educational and informational programs
4. Modify (distribute) loss bearing	Relief and rehabilitation programs, flood insurance

This categorization of flood hazard mitigation measures is used in this submission as a framework to evaluate the current state of flood plain management in the Brisbane River Valley and to make recommendations for the future. It is suggested that the recommendations are of wide applicability to all major river catchments throughout the State of Queensland at the present time.

A brief description of each type on measure is provided, followed by commentary and recommendations.

3. STRUCTURAL (ENGINEERING) MEASURES

Flood storage reservoirs and other structural measures such as levees, channel improvements, etc., are engineering measures which aim to alter or modify the flood.

The dedicated flood storage compartments in the Wivenhoe and Somerset Dams are examples of such measures. The combined flood storage in these two dams significantly decrease the probability of a flood of any given height occurring downstream than would otherwise be the case. However, **major flooding can and will still occur** from time to time downstream of the dam from flood waters emanating from the catchments above and/or below Wivenhoe Dam. Indeed, while the Wivenhoe Dam commands about 40 per cent of the total Brisbane River catchment area, the catchment of the river not “controlled” by it can also cause, under certain rainfall conditions, substantial flooding in the urban areas of Ipswich City, Moreton Shire and Brisbane City. The January 2011 flood is a good example of this. That this is the case is still **not well understood by the large sections of the community**. There is **urgent need for an extensive public education program on the fundamentals of the flood hydrology of the Brisbane River catchment and the flood mitigation capacity and limitations of the Wivenhoe and Somerset Dams**.

Experience around the world, as well as in the Brisbane River catchment itself, highlights that following the construction of engineering measures such as the Somerset Dam (in 1943) and then the Wivenhoe Dam (in 1984), **encroachment of additional activities onto the floodplain, in the absence of other complementary flood plain management measures, is almost inevitable**. Failure to take and remain committed to such action will inevitably see the flood hazard reduction value of the engineering measures erode over time as development intensifies in the flood plain.

The flood plain of the Brisbane River is more intensely developed now than it was in January 1974. In the January 1974 flood, approximately 13,000 buildings were damaged (about 1,000 commercial buildings, 2,000 industrial buildings and 10,000 residential buildings) for a flood height at the Brisbane City Gauge (BCG) of 5.45 metres. It has been reported that in the January 2011 flood, 14,972 buildings were damaged (3,314 non residential buildings and 11,658 residential buildings) for a flood height of 4.45 metres on the BCG. A flood of that magnitude in January 1974 would have damaged about 7,900 buildings (2000 non residential and 5,900 residential buildings).

The Brisbane City Council has determined that 9755 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.

Attitudes that lead to overdevelopment of flood plains tend to be encouraged if the whole community bears the costs of flood mitigation schemes and if only flood plain occupants receive the benefits. If the community at large has to bear the cost of flood mitigation works, then **the community has an obligation to ensure that people do not locate in areas of high, socially unacceptable, flood hazard or that they take agreed measures to mitigate the hazard in less hazardous areas, even if they are aware of the hazard and claim that they are prepared to accept it. Public agencies have a major responsibility to ensure that this obligation is meant.**

4. EDUCATION AND INFORMATION PROGRAMS

Probably the most difficult problem to deal with in attempting to implement a strategy to mitigate flood hazard is the public's perception of and response to the hazard. Their perception (if any) of a flood hazard is based more on direct experience or the opinions of local personalities rather than on what can be gleaned from specially prepared publications or from abstract discussions in the media. Even if they are officially informed of the existence of a flood risk, they often still choose to pretend that it does not affect them. Rarely are they advised what they can do to reduce their own flood damage. Public understanding is very important for the successful implementation of any non-structural flood hazard mitigation measures.

In the context of the lower Brisbane River Valley, more should have and could have been done. For example, not enough effort has been expended on **publicly correcting and refuting dissemination of false or misleading information regarding the flood hazard for specific existing properties or new property developments.** The Wivenhoe and Somerset Dams do not provide complete flood protection and this myth should be squashed at every opportunity. **Mandatory disclosure to new owners and renters/lessees of properties regarding the flood hazard at their location should be in force and periodically communicated to them.** This can be achieved by a variety of complementary methods including via property title deeds, property rate notices, property leasing documents, and property sale documents.

Meaningful flood warnings which occupants of flood prone properties can readily relate to their specific properties do not exist. This requires more attention to **flood hazard mapping, enhanced flood profile (height) predictive modeling capability, and more gauges as reference points** along the Brisbane River, especially at or near the mouths of tributary creeks such as Oxley Creek and Breakfast Creek. Authorities need to assist property occupants to **develop property specific and area specific flood evacuation plans linked to flood warnings.**

An added complication is that flooding in the urbanized lower Brisbane River Valley can be caused not only by river flooding (and associated "back water" flooding in the tributary creeks and rivers of the Brisbane River), but also by tributary creek and river flooding and by overland flow of storm water which

exceeds the capacity of the storm water drainage system. Each source of flooding has its own unique height, depth, velocity, duration and extent of inundation and, therefore, impacts differently, if at all, on individual properties. This submission focuses primarily on river flooding. However, the same principles with regards to flood hazard management apply in each instance.

5. FLOOD PLAIN ZONING AND BUILDING CODES (FLOOD 'PROOFING')

The **purpose** of controlling the use of land in the flood plain is:

- **to ensure that flood hazards are made no worse by ill-conceived new development**, especially in cases of rapid urban and industrial development;
- **to prevent over-enthusiastic development in response to reduced risk of flooding resulting from structural measures**, such as the construction of the Wivenhoe Dam; and
- **to adjust existing flood plain uses to the recognized flood risk**. This is usually a rather slow process, as it must await the natural redevelopment of land and buildings. (It is asserted that this is a **major weakness in current flood codes**.)

Flood plain zoning can be implemented only if areas at risk from flooding can be clearly defined and only if land-uses compatible with varying degrees of risk can be agreed to. **An appropriate flood plain mapping program is therefore a critical first step in the preparation and implementation of a flood plain zoning scheme**. It is common to distinguish at least two zones of hazard: the floodway and the floodway fringe. The floodway is the central section of the flood plain that carries the high frequency flows and which for the less frequent flooding events is characterized by deep water, high velocities and much entrained debris. The floodway fringe, inundated less frequently, is an area of shallower, lower velocity flow and, hence, an area where sediment deposition can also be a problem to development. Clearly, different zoning controls are appropriate to each area. The difficulty is in deciding from the range of flood severities the flood magnitude and/or frequency to be used to define the boundaries of the hazard zones.

Unfortunately, there is **no floodway zoning for the lower Brisbane River**. This must be addressed. There is still the ongoing **need to reach a consensus on the frequency of flooding in the River. The integrity of flood zoning schemes and flood warning and evacuation systems depend on it as does the implementation of risk based flood insurance**. The effort in **modeling the flood flows and associated flood height profiles along the river** must be ongoing and adequately resourced. It is unclear as to whether a calibrated hydraulic model exists for the Brisbane River below Wivenhoe Dam. If this is the case, then this must be corrected as a matter of priority.

Building codes should complement flood plain zoning. The codes should address the design and materials of construction of buildings which will be erected on flood prone land. Flood proofing is simply the name given to the steps taken to reduce and/or eliminate flood damage to buildings in flood prone areas through these codes. Important factors in flood proofing design include the depth of inundation, water velocity, flood duration, water contamination, rate of rise and fall, advance warning time, debris load and wave action.

Flood proofing, because it is directed at individual buildings, is also highly dependent on the actions of the owners for its continued success. **Flood warning systems can play an important role in the success of flood proofing**.

There are now Flood Codes within Planning Codes, but **for infill development and re-development, including intensification, in established areas, the codes are relaxed to allow non compliance with flood immunity levels and other conditions required for new sub divisional development**. Instead a flood risk management evaluation proposal is required. However, no general criteria are set and the **Codes are almost silent on matters pertaining to the specifics of flood proofing** and

property specific flood evacuation plans. That is, the **Codes do not seek to proactively correct the mistakes of the past with regards to occupance of the flood plain.** In this regard, it will be important to ascertain just how many buildings damaged by the January 2011 flood have either been constructed or re-developed since January 1974 and what specific steps, if any, were taken to address the known flood hazard and on what basis specific developments were approved. The impact of the flood on a number of CBD office tower developments would suggest, prima facie, that much more specificity in regards to flood proofing of buildings needs to be built into codes. At one and the same time, there is a need to address any **legal impediments limiting/preventing future development/redevelopment in the flood plain without triggering compensation claims, such as for injurious affection, from property owners.**

There are also questions that need posed regarding **the location of key components of some key public utility infrastructure in flood exposed locations and the degree of flood proofing that exists for such assets.** What are the policies of utilities with regard to flood hazard management? In the case of the electricity transmission and distribution infrastructure, for example, supply interruptions caused by flood water inundation can have major implications for public health and safety, business continuity and property damage both during and after the flooding events until such time as supplies are fully restored.

6. PERMANENT EVACUATION

It is not always physically possible or financially feasible to proof all buildings in flood prone areas. In other cases it is simply unwise to allow certain buildings to remain in designated floodways. In such cases, permanent evacuation is an alternative. It is, however, an alternative beset with potentially difficult to resolve socially disruptive overtones. It is often **best approached as a desirable long-term strategy** if flooding is relatively infrequent. The Brisbane City Council has been quite effective in this regard with respect to tributary creek flooding where flood inundation of some buildings has occurred at much greater frequency than for river flooding. This approach **needs to be extended to flooding by the Brisbane River** which requires a different set of criteria to be applied than those used for properties in the creek floodways.

7. FLOOD WARNINGS

Flood warnings do not reduce damage, rather they provide the opportunity for other damage reducing activities to be put in train. The value of flood warnings for flood hazard mitigation is therefore highly dependent on the flood plain occupant's response to the warnings. **Flood maps** (see below) **that are readily interpretable at an individual property level, are absolutely essential,** if the warnings are to have any real value. The **warnings should only come from one agreed, authoritative, widely publicized, institutional source** to avoid confusion and conflicting advice.

Warnings should include specific information regarding current and predicted peak flood heights, including the estimated time of the peak, at all established river gauges. There is a **need for more gauges** to be located along the river, especially at the mouths of tributary rivers and creeks.

Methods for communicating flood warnings must take into account that the loss of electricity supply to many properties during flooding events will deny access by many residents to TV broadcasts and the internet. Responsible agencies need to develop the capability to **make effective use of social digital media. Agency web sites and web site strategies need to be designed to be able to handle high volumes of connections during flooding events** when the information stored on these sites is needed most by the community.

8. RELIEF AND REHABILITATION PROGRAMS

These programs represent an after-the-event response to a flood hazard. They are, of course, an **important financial and humanitarian gesture** by both public and private sections of the community. For maximum effectiveness they **need to be carefully planned well before any flooding event**. Policies for the distribution of flood relief funds should be well established and not derived in the aftermath of a major damaging flood. Available funds should be allocated in a timely, targeted and equitable manner. It is **important that assistance policies not act as disincentives** into the future for those within the community who have adopted sound flood proofing strategies for their properties or those who taken out relevant flood insurance cover.

Relief and rehabilitation programs do represent, in large part, the costs imposed on the whole community, and not just on the flood plain occupants, from unwise use of the flood plain. They should generally not be viewed as flood hazard mitigation alternatives in their own right. The programs merely provide a vehicle for spreading the flood losses beyond those directly impacted. As such they **do little or nothing to encourage improved use of flood plains**.

9. FLOOD INSURANCE

Flood insurance is not a flood damage mitigation measure, rather it is a mechanism whereby flood damage costs can be converted into a regular series of premium payments (albeit at a somewhat higher cost overall to the insured individual). Flood insurance is probably best at covering residual damages after other structural and non-structural measures have been implemented. To be of value in promoting wise use of flood plains, **insurance rates should be actuarially based on the flood risk**, which will vary across the flood plain. Due account in the setting of premium levels should be given to flood proofing measures implemented by property owners.

Flood insurance is best approached from a national perspective so that insurance risks can be spread across a wide diversity of flood plains. It is suggested that flood **insurance should be mandatory for all properties in defined flood zones**. If a comprehensive insurance scheme is introduced it may be necessary to subsidise rates for existing flood plain occupants as a transition arrangement, but with restrictions on eligibility if further development of a property is undertaken. Subsidisation for existing properties should also be conditional on the adoption of a sound flood plain management plan and strategies by the responsible public agencies for land use and development planning in the river catchment.

Resolution of definitional issues and the production of plain English and universally consistent wording of flood insurance policies are long overdue reforms.

10. FLOOD MAPS

Flood hazard maps are essential for the implementation of the flood hazard mitigation measures, particularly for proofing, zoning, warnings, and insurance. **Flood plain maps should show the areas at risk, the frequency of flooding, depths of inundation, flood profiles (that is, flood heights and their relationship to major gauge locations), etc. They should be readily interpretable at the individual property level.** No reasonable flood plain management strategy can be developed in the absence of flood hazard maps

The maps should be of particular use to finance companies, banks, insurance companies, housing societies, and potential property buyers or renters.

The preparation of flood plain maps and, in particular, the design of maps suitable for easy public comprehension is of the highest priority. **Current mapping efforts fall short of what is required.**

11. SUMMARY OF COMMENTS AND RECOMMENDATIONS

- The Flood Hazard and Flood Plain Management
 - Brisbane, the “River City”, has a significant, manmade flood hazard which needs to be actively managed
 - fragmentation of responsibilities for flood plain management between local, State and Commonwealth Government agencies makes a coordinated strategy more difficult to achieve
 - the flood hazard is manmade
 - the focus of flood plain management should be mitigation of the flood hazard, as distinct from simply the flood itself

- Engineering Measures – Wivenhoe and Somerset Dams
 - major flooding can and will still occur and this is not well understood by the large sections of the community.
 - urgent need for an extensive public education program on the fundamentals of the flood hydrology of the Brisbane River catchment and the flood mitigation capacity and limitations of the Wivenhoe and Somerset Dams
 - encroachment of additional activities onto the floodplain, in the absence of other complementary flood plain management measures, is almost inevitable
 - the flood plain of the Brisbane River is more intensely developed now than it was in January 1974

- Education and Information Programs
 - the community has an obligation to ensure that people do not locate in areas of high, socially unacceptable, flood hazard or that they take agreed measures to mitigate the hazard in less hazardous areas, even if they are aware of the hazard and claim that they are prepared to accept it. Public agencies have a major responsibility to ensure that this obligation is meant.
 - need to publicly correct and refute dissemination of false or misleading information regarding the flood hazard for specific existing properties or new property developments
 - mandatory disclosure to new owners and renters/lessees of properties regarding the flood hazard at their location should be in force and periodically communicated to them
 - meaningful flood warnings which occupants of flood prone properties can readily relate to their specific properties do not exist
 - comprehensive flood hazard mapping, enhanced flood profile (height) predictive modeling capability, and more gauges as reference points along the Brisbane River are needed
 - assist property occupants to develop property specific and area specific flood evacuation plans linked to flood warnings

- Flood Plain Zoning and Building Codes (Flood ‘Proofing’)
 - an appropriate flood plain mapping program is a critical first step in the preparation and implementation of a flood plain zoning scheme
 - there is no floodway zoning for the lower Brisbane River
 - need to reach a consensus on the frequency of flooding in the River. The integrity of flood zoning schemes and flood warning and evacuation systems depend on it as does the implementation of risk based flood insurance
 - modeling the flood flows and associated flood height profiles along the river must be ongoing and adequately resourced
 - flood warning systems can play an important role in the success of flood proofing

- for infill development and re-development, including intensification, in established areas, the codes are relaxed to allow non compliance with flood immunity levels and other conditions required for new sub divisional development
- codes are almost silent on matters pertaining to the specifics of flood proofing
- codes do not seek to proactively correct the mistakes of the past with regards to occupance of the flood plain
- remove any legal impediments limiting/preventing future development/redevelopment in the flood plain without triggering compensation claims, such as for injurious affection, from property owners
- the location of key components of some key public utility infrastructure in flood exposed locations and the degree of flood proofing that exists for such assets deserves closer attention
-
- Permanent Evacuation
 - best approached as a desirable long-term strategy
- Flood Warnings
 - flood maps that are readily interpretable at an individual property level, are absolutely essential
 - warnings should only come from one agreed, authoritative, widely publicized, institutional source
 - need for more flood gauges
 - methods for communicating flood warnings must take into account that the loss of electricity supply to many properties
 - make effective use of social digital media
 - agency web sites and web site strategies need to be designed to be able to handle high volumes of connections during flooding events important financial and humanitarian gesture
- Relief and Rehabilitation Programs
 - need to be carefully planned well before any flooding event
 - important that assistance policies not act as disincentives into the future for those within the community who have adopted sound flood proofing strategies for their properties or those who taken out relevant flood insurance cover
 - do little or nothing to encourage improved use of flood plains
- Flood Insurance
 - insurance rates should be actuarially based on the flood risk which will vary across the flood plain
 - is best approached from a national perspective
 - should be mandatory for all properties in defined flood zones
- Flood Maps
 - should show the areas at risk, the frequency of flooding, depths of inundation, flood profiles (that is, flood heights and their relationship to major gauge locations)
 - should be readily interpretable at the individual property level. Current mapping efforts fall short of what is required for sound flood plain management.

12. REFERENCES

Grigg, T.J. (1977). *A comprehensive evaluation of the proposed Wivenhoe Dam on the Brisbane River*. Prepared for the Co-ordinator General's Department, Queensland State Government. June.

Grigg, T.J. (1982). *Non structural flood mitigation measures*. Queensland Division Technical Papers, The Institution of Engineers Australia (Queensland Division), Vol.23, No.13, pp 23-26.

Grigg, T.J. (2011). *Mitigating flood hazard – Lessons learned and lessons ignored – The Brisbane River Experience*. Queensland Planner, Vol.51, No.1, pp 18-20.

11 March 2011