LEVEES – DEFENCE OR DISASTER?

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Levees have been used for centuries around the world to protect communities from the impacts of floods but recent experience and research is causing a rethink on the adequacy and management of levees in Australia and overseas.

The FEMA report

The failure of the New Orleans levees from storm surge focussed attention in the USA on the adequacy of levees as a means of protection and the risks that they pose.

The US Association of State Floodplain Managers reports that following Hurricane Katrina, the US Federal Emergency Management Agency (FEMA) convened an interagency committee to examine and make recommendations on current levee programs.

Amongst its recommendations were:

- The level of risk to buildings behind levees should be defined.
- A risk classification system for levees should be devised.
- Levees should meet standards for annual inspection, maintenance, operation and certification.
- A spatially referenced inventory of levees nationwide should be completed.
- A public awareness and outreach program should be developed to improve public understanding of the risks associated with levees.
- Federal resources should be made available for the analysis and remediation of publicly owned levees.

Interestingly, some of these initiatives have already been commenced by the NSW State Emergency Service as discussed later in this article.

The FEMA Committee also observed that

- Property owners behind levees should be required to share in the mitigation of risk through the purchase of flood insurance.
- State and local agencies need incentives and support to carry out their levee related responsibilities.
- Levees in highly urbanised areas should provide protection up to the 1 in 500 flood.

The latter is the level of protection to which levees along the Po River in Italy are being upgraded but falls well short of the minimum 1 in 1,250 level stipulated in Dutch legislation for all levees. In Holland highly urbanised areas have a 1 in 4,000 protection or higher.

Recent USA Experience

Interestingly, in June of this year, floods along the Mississippi and its tributaries approached or exceeded the 1 in 500 level in many places and levees were overtopped in major cities and towns. Tens of thousands of people saw their homes destroyed: something which would have been avoided had levees been upgraded to the size recommended in the FEMA report.

Many of these places experienced similar flooding in 1993 and Gerald E. Galloway, as an Army brigadier general, led the White House study of the 1993 Mississippi flood. He is now a professor of engineering at the University of Maryland and recently wrote regarding the June 2008 floods,

"The sad truth is that while we learned a lot from the 1993 flood about how to prevent losses, we have not acted on those lessons (or those from Hurricane Katrina, for that matter). After the 1993 flood, President Bill Clinton ordered a White House study to determine what could be done to reduce future flood damage. The study concluded that the 1993 flood was a significant but not unprecedented rainfall-river event, and that such floods would probably occur again. It pointed out that people and properties were at risk of flooding not only in the Midwest but across the country, and that many did not understand the hazard they faced.

"The study labelled the flood protection system in the upper Mississippi Basin 'a loose aggregation of federal, local, and individual levees and reservoirs . . . [that] does not ensure the desired reduction in the vulnerability of floodplain activities to damages.' It found that responsibility for flood programs was scattered among federal, state and local governments, creating a situation in which no one was in charge overall. It noted the lack of an accurate inventory of the number and condition of levees in the Midwest, and it reported that levees protecting many population centers were woefully undersize.

"The report recommended that those living behind levees be required to obtain flood insurance. Many of these residents, like those in New Orleans before Katrina, didn't understand the risks they faced: Levee conditions hadn't been adequately monitored, and even when problems were found, the needed funds hadn't been made available. Simply put, responsibility for dealing with floods had not been adequately defined.

"Unfortunately, since then, the order of the day has been discussion, not action. Levees are the heart of the problem, yet little has been done to determine their location and condition. In 2006, the Bush administration submitted a $30 million supplemental funding request to initiate a national levee inventory and assessment program, and the Corps of Engineers began work. But Congress provided no money in 2007 or this year, and the program stalled. Last year, Congress passed the National Levee Safety Act to formally establish an inventory and inspection program, but once again no funds have been provided to support or even begin the work.

"The presidential order defining the responsibilities of federal agencies for activities in the flood plain is 31 years old and woefully out of date. Most states and communities are reluctant to limit or control construction of levees or to ensure the safety of levees in their jurisdictions. Only two states have active inventories of levees, and few formally approve new levee construction, perhaps because the federal

government has always been there to pick up the tab for the damage after a flood. No effort is underway to address, as part of a national flood policy, the level of protection needed for urban areas.

"Efforts to require insurance for those living behind levees, to extend mandatory insurance requirements to other vulnerable areas and to better map flood risks all await action in Congress. Because we have not been able to adequately communicate flood risks, the penetration of flood insurance into at-risk areas continues to be low. In spite of the fact that there are known deficiencies, repair and maintenance of levees across the country has proceeded slowly, mostly because federal funds have not been made available. States and communities, whose prime responsibility is public safety, seem willing to wait rather than take action on their own. (A significant exception is California, where a voter-approved $5 billion bond issue will provide funds to begin the repair of unsafe or badly damaged levees.)"

Australian Situation

The situation in Australia is not much better. The devastating floods of the 1950s were the catalyst for much of the early levee construction across the country with some of the levees being hastily thrown up as the floodwater rose.

Since that time, levees have been built to protect farmland, towns and cities with varying degrees of engineering design. Quite often the height of the levee has been determined by "rule of thumb" using the flood of record plus some freeboard to determine an appropriate level of protection.

Many levees have been designed with the assumption that they will not be overtopped. When they overtop they will fail in an uncontrolled manner and the flow direction and velocities can be such that even greater damage is caused that if the water rose in the absence of the levees.

Even where spillways have been incorporated in the more modern levee designs, controlled overtopping can still result in a rate of rise behind the levee that can be dangerous and cause significant losses if those behind the levees have not taken appropriate actions in anticipation of the overtopping.

The failure of most of Grafton's 12,000 people to evacuate when levee overtopping was forecast in 2001 is well documented. Had the floodwaters risen a few more centimetres, most of the town would have been under water.

Many levees are at risk of failure well before they are overtopped because either poor design, construction or maintenance places them at risk of slumping, piping or scouring as waters rise.

Maintenance is a significant issue. Often this is because there is no certainty as to who owns the levee. In some instances, they have been thrown up by various players during a flood and orphaned after the event. In other cases, state governments have implemented schemes but the organisation originally charged with their upkeep has disappeared through successive restructures, corporatisation or privatisation.

Victoria and NSW are the two states which most rely upon levees. In Victoria, it is very unclear as to who is responsible for most of the levees. In NSW, many of the

levees are the responsibility of local government but they do not have, or do not make available the funds to maintain them. While Federal and State governments have often contributed substantial funds to the construction of levees they rarely contribute anything to their upkeep.

NSW SES Review

The NSW SES, concerned about the unknown risk levees pose, commissioned WMAwater to provide current information for 59 levees throughout NSW. The project focussed on ascertaining critical information on levee design and condition, and the impact of flooding behind each levee in the event of levee failure or overtopping to help the SES better plan flood emergency management.

The investigations revealed:

- levee design often did not consider emergency management requirements
- there is no requirement for new information relating to the levee or flood behaviour to be provided to the SES
- there was minimal documentation for a number of levees
- information was often difficult to obtain from Councils or levee owners
- there was confusion regarding ownership and responsibility for levees.

The NSW SES has developed recommendations for the establishment of a formal process that requires Councils (or levee owners) to audit, document and provide the necessary details regarding levee design and behaviour in a consistent manner.

Referable Structures?

If levee maintenance is such a significant issue, it begs the question why can't regulation be used to compel levee owners to maintain them. This is what is done with large dams and even flood detention basins. Levees in a sense are no different to these structures except that they are built parallel rather than perpendicular to the flow.

Norm Himsley, Head of the NSW Dams Safety Committee, told Floodplain Manager that this was seriously considered by the NSW Government when it set up the Committee 30 years ago. The decision was made at that time to limit its responsibilities to dams.

Similarly, Siraj Perera of the Department of Sustainability and Environment in Victoria said that each time they review their dam safety rules they consider whether levees should be included, but to date have decided not to.