

# **Submission – Warragamba Dam Raising Project SSI - 8441 – Chas Keys – Kotara, NSW**

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## **Required Statements**

There is no material in this submission which may not be published.

I accept the Department's submission disclaimer and declaration.

I object to the proposal to raise Warragamba Dam as a flood mitigation measure on the grounds that the Environmental Impact Statement has significant deficiencies. It fails to address the likely long-term implications of raising the dam as far as development on the floodplain below the dam is concerned. The psychology and politics the project will unleash will encourage further development of areas that will remain liable to severe and dangerous flooding even after the dam is raised. The results will be an enlarged floodplain population downstream of the dam and more private and community assets being exposed to the risk of flooding, not to mention greater difficulties being created when severe floods occur and large-scale evacuation is necessary.

I have made no political donations over the past two years.

## **Introduction**

In my view, the Environmental Impact Statement is severely flawed. As a retired emergency manager (Deputy Director General, New South Wales State Emergency Service, 1997-2004) with extensive past involvement in planning for floods including those on the Hawkesbury-Nepean River system and with much experience as a researcher, consultant and writer in the fields of floodplain and emergency management since 2004, I have grave reservations about the long-term consequences of raising the dam. The Environmental Impact Statement in my opinion does not address some critical issues. Its deficiencies are more in what it does not say – in other words the gaps in its coverage – than in what it does. These deficiencies mean that the downstream costs emanating from raising the dam are severely under-estimated.

In particular the Environmental Impact Statement fails to consider the political and psychological consequences which are likely to flow from the raising of the dam. There are sound reasons to believe that the claimed benefits in terms of such things as the 'evacuability' of the floodplains below the dam will over time be at risk of substantial reduction. There is a psychology attached to structural mitigation devices (such as levees, dams and flood bypasses) and this has been well demonstrated in Australia and elsewhere: these devices can create circumstances under which decisions are made that increase the populations of the areas which have been given a measure of protection from floods. The protection is, for one thing, only partial: the flood problem will never be eliminated because it cannot be. For another thing, a known and oft-demonstrated phenomenon known as the 'levee paradox' illustrates why the proposal to raise the dam could over time erode whatever mitigative benefits might be achieved by raising it.

The levee paradox is at the heart of the problems which the raising of Warragamba Dam are likely to create as far as emergency management is concerned. I address this matter in considerable detail rather than questions relating to above-dam environmental and heritage consequences which will

follow from the raising of the dam should it occur. These issues are mentioned only cursorily in this submission.

## **The Levee Paradox**

The paradox works this way. A flood-liaable community, concerned about the negative consequences of periodic flooding, petitions government (for example its local council) for protection. Usually what is sought is in the form of structural devices like levees, but the preferred protection may be by other means — for example a dam to store floodwaters for gradual post-flood release, or diversion banks to train floodwaters around the community. When the protection is provided and proves its worth by keeping floods out, the community becomes satisfied that the flood problem has been overcome or has at least been rendered much less frequent. The community attitude towards floods changes.

A community psychology then takes root: the view develops that the protected areas can now be utilised differently — for example by permitting additional or intensified residential or other development. A climate develops that promotes decisions which lead to such new development, and accordingly the value of personal and/or community assets in these protected areas is increased. Then a big flood overtops the levees or causes their failure, or exceeds the capacity of the mitigation dam to store the floodwaters. The result is that there is more damage (and potentially more lives lost) than there would have been had the additional or intensified land use not occurred in the first place.

The psychology underlying the paradox is not difficult to comprehend but it is in practice difficult to guard against. To a degree it arises merely as a result of the passage of time without significant flood effects being felt in the community. Politicians can unwittingly validate the process: by seeking to claim credit for the mitigation provided, they are apt to exaggerate its capabilities. This can lead them to overstate the protection provided and to fail to recognise that mitigation devices almost always only palliate the problem rather than eliminating it. The costs of 'complete' mitigation are usually prohibitive or fail the cost-benefit arithmetic usually required to justify mitigation projects. Yet the protected community frequently sees the mitigation provided as 'solving' the problem in its entirety. This tendency is strengthened when the levees (or other mitigation devices) keep floodwaters at bay for many years or even decades.

In general, people do not appreciate how big extreme floods, which are generally not frequent in occurrence at particular locations, can be. People certainly do not have — and they cannot be expected to have — a clear understanding of the proportions of the Probable Maximum Flood (the biggest flood thought by hydrologists to be possible) in the area they live in. Almost always, the estimated level a PMF would reach at a location is much higher than known floods of record at that location or indeed than the level to which a levee would normally be constructed. Even floods well short of PMF proportions are likely to be much larger than even life-long residents of an area have experienced.

It cannot be expected that residents of an area will have an appreciation of enormous floods: their thinking about flooding and the risks to their interests will be guided by the almost inevitably much smaller floods they have experienced. New residents, of course, may have no appreciation at all of the nature of the potential flood problem their area might experience.

Nor are residents of a community the only people affected by the psychological situation that develops when structural mitigation is provided. Vested development interests, noting that land has not been flooded since the mitigation was instituted and thus appears to have been rendered flood-

free, come to see financial opportunities in the increase or intensification of development there. Lobbying of the council or the government occurs in an effort to obtain permission to develop the land or to redevelop it at higher levels of investment intensity. Thus further assets are created which will be at risk should the capability of the mitigation device(s) provided be exceeded as is inevitable.

There is a saying in floodplain management circles: "There are two types of levees, those that have failed or been overtopped and those that will be." While one does not expect that a raised Warragamba Dam will fail, its ability to hold all the floodwater created on the streams which it commands must certainly be expected to be exceeded at some stage. Moreover, extreme floods on the tributaries which enter the system below the dam will occur from time to time and could cause significant flooding on their own.

The phenomenon of the levee paradox has been often demonstrated and has been much written about in the literature of floodplain management both overseas and in Australia (Erickson, 1986; Tobin, 1995; Pielke, 1999; Smith 1998). It could be called the 'Achilles heel' of flood mitigation endeavours and needs to be recognised as such. Interestingly, the paradox has not been noted in the NSW Floodplain Development Manual (NSW Government, 2005), the state's official guide to development on floodplains, something which may have helped ensure that it was further manifested. Nor does it appear to have featured in the papers of the annual conferences and other deliberations of Floodplain Management Australia (formerly the Flood Mitigation Authorities of New South Wales), the body that represents councils in lobbying for government funding to deal with the problems created by floods).

Many manifestations of the paradox have been recognised in Australia. Two examples will suffice to demonstrate its power, though others could be cited. The paradox is under-appreciated in floodplain management and governmental circles and very hard to avoid in the long run.

## **Brisbane, Queensland**

In Brisbane, a riverside city much affected by flooding over its history, the very severe 1974 flood produced government action to mitigate the impacts of flooding: this action came in the form of the construction of a dam (Wivenhoe Dam) 80 kilometres upstream of the city. When the dam was completed in 1985, comments at the opening ceremony by prominent political figures (including state premier Joh Bjelke-Petersen and some of his ministers), and similar comments repeated frequently in the media over subsequent years, appear to have played a major part in convincing the people of Brisbane that the flood problem was in effect no more. Then, in 2011, an extreme rain event caused such rises in the water level behind the dam that the impounded water eventually had to be released in substantial amounts to negate the possibility of dam failure. This water contributed to the flooding downstream.

The operation of the dam during the event was probably sub-optimal, especially in terms of delays in releases, but a later investigation (Queensland Floods Commission of Inquiry, 2012) found that the peak flood levels reached in Brisbane had been appreciably reduced. A measure of mitigation had been achieved, therefore. But since 1974 there had been much new residential development in low-lying areas and the number of dwellings which took in water was greater in 2011 than in 1974 despite the fact that the peak level reached in 2011 within the city was lower than in the earlier flood. Hundreds of development applications had been approved by the Brisbane City Council in areas affected by the 1974 event.

In essence, a myth of flood immunity had been fostered in Brisbane after the construction of the dam (Cook, 2018; 2019). This myth had become embedded in people's minds and in the regime and

mechanisms by which land development and property sales took place in the many flood-labile areas of Brisbane. It affected developers, councillors, council officers and residents alike, and real estate agents in brokering sales of low-lying properties near the Brisbane River frequently touted the idea that the flood threat had been overcome as a result of the construction of the dam. Wivenhoe provided a measure of flood mitigation but the notion that the flood problem had been overcome in its entirety was shown in 2011 to be false, and dangerously so.

It is clear that the existence of the dam and the political and psychological influences that developed in the wake of its construction were major factors leading to residential and other development in areas where such development was inappropriate. Complacency and a false sense of security were promoted, and more property and additional people were placed at risk of flooding than was the case before the dam was built. The 'extra' cost to the community would have been many millions of dollars. Politically, it is difficult to see how this outcome could have been averted.

## **Maitland, NSW**

Maitland is a city on the lower Hunter River with a long history of flooding, some of it catastrophic. The levee paradox there can be seen as far back as the nineteenth century, when 'dams' (levees) were constructed to keep flood flows out of a former river channel in the Oakhampton area which was used initially for grazing farm animals. Construction of the levees led to a shift to more intensive use of the area so the fertile floodplain could be used more profitably, vegetables and fruit orchards displacing the livestock. Later, houses were built along a street that crossed the former channel. Flooding in 1893 destroyed the orchards and in 1955 21 houses were swept away (Keys, 2016, p155; 2020, p143). This example provides evidence of two separate cases of land use intensification, each catastrophically ended by a large flood. The orchards were not replaced after 1893 and neither were the houses after 1955: these uses of land which was always flood-labile were lost at great cost to farmers and residents respectively. Had the levees not kept most floods off this natural flow path, the flooding that would have been experienced more frequently would, almost certainly, have discouraged the land use intensification (and especially the building of houses) in the area and the community's vulnerability would not have been increased to the degree that it was. The development of housing, especially, would have focused more on higher ground.

After the 1955 flood, the biggest seen in Maitland since the beginning of European settlement during the second decade of the nineteenth century, the state government on the city's behalf embarked on a project to revamp the town-protecting levees constructed over the previous several decades. These structures, not built to sound engineering standards, had been overtopped or breached on a number of occasions and most catastrophically so in 1955. So successful were the new levees that soon after the turn of the twenty-first century, the city was able to celebrate fifty years of floods having been kept out of its built-up areas.

In the meantime, though, the Central Business District had experienced considerable decline, the population of the inner city had fallen away and many of the houses there were at or reaching the end of their useful lives. A report commissioned by the Council (City Plan Urban Design, 2009), with little if any floodplain management expertise apparent among its authors, recommended a strong push towards urban renewal and rebuilding in the residential areas: a tripling of the residential population of the inner city, taking it back to pre-1955 levels, was advocated. This growth was expected to reinvigorate the commercial fortunes of the CBD.

The Maitland City Council, arguably complacent about the flood risk after such a long seemingly flood-free period as far as its built-up areas were concerned, concurred with the report's

recommendations but found that the state's flood policy greatly restricted redevelopment in the area behind the levees. Its response was to petition the state government to alter the regulations by, for example, allowing floors to be set at such a level that up to half of a new dwelling's habitable space could be below the designated flood planning level which was set at the height estimated to be reached in the 1% Annual Exceedance Probability (AEP) flood. The regulations required that all of the habitable floor space be above this level, a discouragement to development. Shortly afterwards, the Council sought permission for 'docking facilities' for flood rescue boats to be created at first floor level in new buildings in the same area. This, it was argued, would facilitate 'evacuation' during floods.

The state's Minister for Planning rejected both requests. What had happened was that the councillors, noting the effectiveness of the levees over what must have seemed to them a long time, had sought to renew and intensify development in the levee-protected areas. In doing so they had arguably forgotten or come to disregard the lessons of 1955. In effect their efforts to have the regulations modified in favour of development would actually have **promoted** a restoration of the area's former vulnerability in the face of flooding. The Minister's decisions indicated that such an outcome was not desirable; indeed it would have represented a contradiction of the state's flood mitigation objectives.

Maitland became a case, then, of the potential for the levee paradox to be demonstrated being forestalled by a ministerial decision that defended the existing regulations. As in Brisbane, the passage of time without flooding, the result seemingly of flood mitigation initiatives, had been used in an attempt to promote development that almost certainly would one day be found to be unwise. Inner-city Maitland remains liable to flooding when a flood exceeding the proportions of the 1955 event occurs: this is unlikely to occur frequently, but it will occur at some stage. Modelling by Maitland's floodplain management consultants indicates that an extreme flood could peak more than a metre higher in Maitland than the flood of 1955 (WMAwater, 2010). Even this flood would almost certainly not reach as high as the PMF which has not yet been calculated for Maitland.

The cautionary note here is that there will from time to time be challenges to existing regulations regarding the use of floodplain land and the nature of the building that is permitted upon it. One might expect, perhaps, that councillors noting that there has been no severe flooding for some decades will become complacent and will be tempted to accede to pressures to redevelop flood liable land that ideally should never have been utilised for urban purposes. There is no guarantee that future ministers for planning will necessarily reject such challenges as the Minister for Planning did in the case of Maitland in the second decade of the present century. The problem of flood liability does not disappear, but pressures for development are ever present in growing communities like Maitland and regulation intended to keep communities safe requires constant vigilance.

## **The Case of the Hawkesbury-Nepean River Valley**

The valley of the Hawkesbury-Nepean River has, like Brisbane and Maitland, a history of periodically catastrophic flooding and successive local councils and state governments have long grappled with the problems floods bring. The valley is near the edge of the Sydney Metropolitan area and as such amounts to a 'natural' location for suburban development. Development pressures are strong and current plans are for houses to accommodate on floodplain land above the level of the 1% AEP flood about 120,000 more residents by 2050 than the number that live there today. This growth, if it occurs, would represent a virtual doubling of the residential population on the floodplain and a like augmentation of community and commercial assets including schools and shops. Unfortunately the potential height range of flooding in the valley is unusually great, thanks to the existence of a 'choke'

to flood drainage below Windsor, which means that very deep inundation of buildings is a real possibility over a wide area. Few viable structural options for flood mitigation are available: hence the proposal to raise Warragamba Dam so that much floodwater can be temporarily impounded for release after any downstream floodwater has drained away.

The difficulty, as is often the case, is that the community's vulnerability to floods cannot be overcome simply by raising the dam or, indeed, by instituting other structural measures. If the dam is raised, flooding will be palliated to a degree but it will be far from eradicated. In part this is because floodwaters arise in most Hawkesbury-Nepean flood events from sub-catchments which are not controlled by the dam: the upper Nepean River and the Grose River are the main such cases. Evacuation from areas below Warragamba, always problematic in infrequent big floods, will be rendered necessary less often than it currently is but more difficult to manage given the larger numbers of people who will have to be moved in advance of flooding. This is, without doubt, the most difficult flood management environment in the state with a potential for very large numbers of deaths (in the hundreds or even thousands in extreme events worse than have been seen in European times) if evacuation is not well managed. In genuinely big floods the people who will need to evacuate, in challenging time frames, will number in the tens of thousands.

The potential for the levee paradox to be demonstrated in this environment was shown in sharp relief in March 2021 when, during the biggest flood on the river at Richmond and Windsor for thirty years, the Minister for Emergency Services suggested on Sydney radio station Triple M that raising Warragamba Dam might enable the government to release more low-lying land for residential and other development (Keys, 2021). This brings up the possibility that land below the current planning level might be made available to accommodate Sydney's future growth: the metropolis is short of land, after all, and there is absolutely no sign of the pressure for it to grow coming to an end. Sydney is and long has been, after all, a major focus of immigrants to Australia. A continuation of its magnetism could create pressure to identify 'new' land for urban development. The potential here, given the measure of mitigative capability which would be embodied in any raising of the dam, is for a relaxation of planning controls such that more people would be made vulnerable to the ravages of floods. This would be true even if that vulnerability were to be realised less frequently.

The spectre thus arises that there will be considerable damage done to natural vegetation and heritage resources upstream of a raised Warragamba Dam by the temporary storage of floodwaters while the flood risks and danger downstream will be visited on more people than is currently the case. Mitigation benefits, bought at the cost of the upstream environment, might be severely eroded downstream. This, surely, is far from an optimal outcome for public policy; indeed it represents considerable policy confusion and contradiction. The statement of the Minister for Emergency Services cited above, made during a flood, is surely indicative of this. When placed against the 'pause' instituted on development in the Hawkesbury-Nepean valley by the Minister for Planning at the same time (because of uncertainty about the adequacy of evacuation routes), some inconsistency of thinking among government decision-makers is evident.

To alleviate the flood problems of communities downstream of Warragamba will require costly investment in evacuation routes and community flood education and training regardless of whether the dam is raised. Neither of these matters appears to be on the agenda of the state government at present, yet the evacuation management capability of the State Emergency Service and the emergency management system for the scale of flooding which is possible in the Hawkesbury-Nepean valley remains untested. Meanwhile the SES's impact by way of educating the people of the Hawkesbury-Nepean about floods, the dangers floods pose and the need on infrequent occasions for

large-scale evacuations to be undertaken cannot be said to have been an untrammelled success. The task is an extremely difficult one and more resources need to be committed to it.

Better evacuation routes and more effective community flood education (and training of residents and employers in the form of drills) are critically needed already to develop and maintain community readiness, and the complexities and costs associated with these measures will only grow if more and more people, business and community facilities are permitted to occupy the floodplain. This is a very important matter which to all intents and purposes is not addressed by the Environmental Impact Statement.

The build-up of the residential population in the valley of the Hawkesbury-Nepean River has been going on for decades. Governments and councils of all persuasions have promoted it, in recent times despite the growing evidence of the dangers it poses, and the situation has become critical in terms of the risk to community safety. Extreme floods requiring the evacuation of tens of thousands of people are not likely to occur frequently, but they should be regarded as inevitable nevertheless. Much more needs to be done to address the issue, but the raising of Warragamba Dam should not be part of the government's strategy. Quite apart from the environmental costs that will be imposed upstream of the dam, any raising will simply encourage further development in areas that are bound to be flooded at some stage whatever is done at the site of the dam. This growth in population and investment will occur in an environment in which reductions in these things would be more appropriate in the community interest.

The dam-raising policy is both extremely costly in monetary and environmental terms and fraught with contradiction. There is much false economy in it, because the question of the levee paradox (which of course cannot be quantified without knowing in advance just how much and what types of development will result directly or indirectly from the raising of the dam) is not considered. Accordingly, the policy should not be proceeded with.

## **Conclusion**

The proposal to raise Warragamba Dam is flawed in terms of the stated objective of flood mitigation and the Environmental Impact Statement does not adequately address the problems the raising will cause in the areas which are intended to be given a measure of protection from floods. Inevitably, at some stage in the future, the reality of the levee paradox will be demonstrated yet again if the dam is raised. The politics and psychology involved in the future development of the area will be powerful and the cost of that development to the community of the Hawkesbury-Nepean valley in the future will potentially be very high in economic terms and perhaps also in terms of the loss of human life. It is difficult to see any positives in any of this when the problem is properly framed. Unfortunately, the Environmental Impact Statement has not been framed appropriately.

The best flood mitigation programmes usually combine structural measures (like levees, flood bypasses and flood storage dams) and non-structural measures (like land use planning, property buybacks from the most severely flood prone areas and community flood education and training). For the valley of the Hawkesbury-Nepean River, major structural 'fixes' are severely problematic either because they cannot possibly work in the environment of the area (levees, for example) or because they will have severely detrimental consequences. The government's preferred project, the raising of Warragamba Dam, is in the latter category: it will have deleterious environmental consequences upstream of the dam and is likely to unleash processes downstream that are under-appreciated and will undermine the very flood mitigation outcomes which are sought. The fact that

the costs associated with these processes may not be known for many years (or indeed generations) does not limit the truth of this statement.

The Environmental Impact Statement does not provide a convincing rationale for the government's flood mitigation proposal which focuses very largely on one major but severely flawed measure despite the fact that some comments are made in support of such things as community education about the flood threat. Unfortunately some critical negative consequences which the dam-raising measure would surely promote over the long term (and which will be hard to guard against) are ignored. Raising the dam would represent a flood mitigation endeavour which is likely to undermine the very mitigative purposes which the proposal seeks to espouse. It would not represent sound government policy and should not be implemented. The government should look elsewhere, at a multi-faceted approach involving a range of non-structural approaches and incorporating a stronger commitment to flood education and training than has hitherto been attempted.

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