

1. This a SECOND OBJECTION AGAINST approval of the proposal to raise Warragamba Dam, submitted by James Irish.
2. My qualifications and experience relevant to the assessment of flood mitigation proposals are outlined in the first objection.
3. Separate objections are being submitted because the first is concerned with what I regard as inadequacies in the exhibited EIS as a basis for determining the proposal. This document is concerned with *how* to address the problem of flooding downstream of Warragamba Dam, on the assumption that the project is not implemented but the flood risk remains.
4. The State Government's 2013 *Hawkesbury-Nepean Flood Management Review* concluded that "*there was no simple solution or single infrastructure option that could address all of the flood risk*" (EIS, page 1, Executive Summary).
5. This implies one or more 'infrastructure' elements (=structures) *and* non-structural components. Yet the exhibited EIS fails to include a portfolio of responses, optimized to work in combination; it compares several structural and non-structural options *as though they were mutually exclusive* and assumes that other elements of the Task Force plan will be implemented.
6. The complementary measures needed to ensure that the residual risk is effectively managed (were the proposed raising of the Dam to proceed) are certain to have social, economic and environmental effects, and would almost certainly merit an EIS. The failure to identify a package of structural and complementary non-structural components, and to optimize the package *prior to* the decision to prepare an EIS for just one proposal, is inexcusable.
7. UNLESS A PACKAGE IS IDENTIFIED AND ASSESSED IN A SINGLE EIS there is the strong likelihood, were raising of the Dam to be approved and implemented, that those components will be forgotten, incompletely implemented, or sub-optimal. Furthermore, there is the ongoing risk of flood damage (or a rush of further inappropriate development on the floodplain) in the time before commissioning of the raised Dam (if it ever occurs). A RESPONSE to the interim (or permanent) risk should have been included as a component of the proposal which is the subject of this EIS.
8. The difficulty of nominating a single proponent or set of agencies as joint proponents for a single EIS is acknowledged, but was not insurmountable. It is unforgiveable, an opportunity lost – unless the decision-maker and/or the Government reject the conclusions of this EIS and commission yet another attempt to manage the public-sector response to the flood risk (as I urge below).

9. This has been a top-down and therefore narrow attempt to deal with the public-sector aspects of response to the risk, led initially by InfrastructureNSW and then delegated to WaterNSW. If you start with an engineering agency, one won't be surprised to get an engineering solution which ignores many relevant components of an adequate response and fails to engage with those who would develop the non-structural components.
10. Flooding in the Hawkesbury-Nepean valley is an example of what is now called a *wicked problem*: there are no easy solutions, and *any* response will be contested. Wicked problems call for a different paradigm for resolution from the processes for making decisions about the kinds of problems best delegated to technical experts.
11. Flooding, as it might affect the safety of Warragamba Dam, is *not* a 'wicked' problem. Like dam construction, it is a matter which must be delegated to experts. We are assured that, since the raising of the dam and construction of an auxiliary spillway completed in 2002, the dam is 'safe'. What constitutes adequate safety for a structure recognized as a referable dam requires the consent of the Dams Committee in accordance with the legislation in force from time to time and the policies of the Committee; it cannot be an issue resolved by a consultation with a group of planners, residents, or politicians.
12. The wicked problem is the flood risk for communities downstream of the Dam, and the attempt to resolve them primarily by an engineering solution. Each of the proposals for an engineering solution raises serious and potentially unresolvable difficulties, as different interest groups were to bound the contest the outcome, and most to be disappointed at whatever outcome was decided *by use of the processes adopted by WaterNSW*.
13. The situation has been exacerbated, in my opinion, by the history leading to the proposal. It was proposed and assessed several years ago, but a new government decided not to proceed with it. The flood risk remained and flood experts couldn't sleep easily, so persuaded government to set up a Hawkesbury-Nepean Valley Flood Management Taskforce, which carried out its work between 2014 and 2016. The constitution and processes of that body limited the imagination of what might be done, and failed to adequately consider the social, environmental, heritage and cultural aspects of the wicked problem. This was inevitable given the inadequate community representation and input.

14. What is needed now, in my opinion, is a process led by and managed from the grassroots, who identify a team to lead the process, employ consultants as they consider necessary, but who refuse to be dictated to or led by so-called 'experts' or politicians (state or local) with their own agendas. In short, a process driven by the self-interest of those at risk, obliged to negotiate differences between sub-groups of the affected community and to present elements of an achievable resolution: a kind of best second-best, or consensus. This will be messy, take time, but will ultimately produce something which could be implemented (likely in stages, with some urgent issues given priority). This process seeks *consensus*, not of experts, but of those who choose to continue living or working on the floodplain.
15. More than twenty years of efforts to resolve the wicked problem using the conventional, top-down structural approach have failed. Further attempts might be made, but the recent history points to likely anger at any solution rammed through by technical specialists, and/or litigation with its associated cost and delay.
16. Why not try an approach which is unfamiliar to many technical specialists, but with a solid record of success? This would be messy, slow, but would be almost assured of being accepted because all stakeholders consider that their viewpoints have been considered. Note the plural for *viewpoints*: many stakeholders do *not* begin with a single viewpoint, but most may be willing to converge onto a consensus.
17. There is a large research literature on the suggested approach. It has been taught in various university courses *in Australia* for more than three decades, but it is hardly known by bureaucrats, planners or engineers. It differs fundamentally from alternative dispute resolution or arbitration.
18. I do not claim expertise in applying the suggested approach. A simple internet search would identify Australian champions of it as well as the most regularly-cited authors internationally. It has been proposed for use with wicked flood problems, and it can also be used for sub-sets of a larger wicked problem. Wicked problems are invariably nested, and need to be resolved as they exist in the minds of those affected (nested, and overlapping).
19. In the absence of humans, floods downstream of Warragamba Dam would interest geomorphologists and ecologists, but almost no one else. But humans now use the floodplain intensively, and are invested in ongoing occupation of the floodplain. Their investment in remaining has financial and emotional aspects. They cannot be expected to take kindly to being told what to do, what to think, or how to 'behave'. As a minimum, there must be good-faith negotiation between interest groups. But mere negotiation won't necessarily generate a consensus.

20. I will sketch below some ideas which may require careful consideration, and pass on some well-established ideas about actualising a community-lead process. Experts will have more and better things to say about this than me – someone trained as an engineer and who for many years primarily saw flooding through that lens but who now realises the limitations of that approach when confronted with a wicked problem.
21. The key issues are, in my opinion, the **financing of flood risk** and the **suitability a combination of structural and other strategies for ameliorating the risk** so that financing the residual risk is achievable. Inevitably, it will be a **combination of strategies**.
22. What hasn't been considered at all (at least in the EIS and its predecessor documents)? I will discuss below the advantages of flood insurance as an environmentally-benign strategy for flood risk financing, critique the flood insurance currently available, and suggest a different but analogous method, which I've called 'flood bonds', in homage to the Australian drought bonds of former years.
23. What else *HASN'T* been carefully considered in the EIS as elements of a portfolio of tools to reduce the flood risk, so that residual risk financing becomes feasible? We have at least the following, though the inventive minds activated by a grassroots-lead process would doubtless nominate others:
 - *selective* buy-backs of properties at extreme risk;
 - *selective* cancellation of implied future consent to development contained in documents outlining preferred sites for future development;
 - lowering the FSL of Warragamba Dam by a few metres (probably episodically, driven by La Nina forecasts), in conjunction with identification of new sources of water, incentives for reductions in consumption and for the increased use and acceptance of recycled water;
 - acceptance of the idea that we need to retreat, in an orderly and compassionate manner, from the high-risk areas of flood-liable land. This will require a rethinking of simplistic criteria such as the 100-year flood as the main metric for defining flood-prone development – particularly given the variability of flood magnitudes in Australia (the largest variability anywhere in the world), the consequential uncertainty in estimating the level of the 100-year or other 'design flood', and the certainty that flood risk is not stationary;
 - recognition that the risk will likely change over the next few decades, whereas the decisions made now may bake-in limitations on future adjustments;
 - limitation on the right of property owners to undertake work up to a certain value as 'maintenance' when it in fact exacerbates potential losses;
 - likewise, limitations on 'improvements' below a threshold amount, which currently attract less scrutiny than would a new dwelling or major modification;
 - buy-backs of such implicit rights to maintain or improve existing development.

None of these is suggested as easy to implement: there are no ‘low-hanging fruit’, just some lower than the impossible fruit in the canopy. None is essential. Messy and even inconsistent implementation might be the norm until a new social contract regarding floodplains is achieved.

24. The environmental advantages of insuring flood risk

I have written many papers on this, and there is a huge literature from the USA. In outline, ***flood insurance provides price signals to each occupant of the flood plain***. Even if the signals (premiums) are imprecise, they are the only price signal many will ever receive; they are regular (annual renewals), and they reflect the current understanding of the quantum of each occupants’ risk.

If flood insurance is considered unaffordable by an occupant of the floodplain, then *prima facie*, their occupation is an (economically) inconsistent use of the floodplain. Subsidies can be provided in the short term *to existing users* to allow an orderly adjustment of land-use.

Flood insurance aims to compensate defined losses *after* a flood. It cannot compensate for the emotional distress and other unquantifiable losses. It is, however, well-suited to financing the residual risk as the feasible alternative measures (whether structural or non-structural) are implemented. *If* a proposed means of reducing flood risk is uneconomic, the reduction in premiums which would (in a perfect market) follow its implementation would be less than the average annual benefit of the proposal. A *notional* flood insurance scheme can be used to assess the feasibility of other components of risk reduction. But – like a benefit-cost ratio – it would not be determinative; social and other objectives also need to be considered.

25. The problems with conventional insurance which includes flood cover

The principal objections to the use of flood insurance, whether provided by a government agency, or as an add-on to a traditional householder or business (property or BI) policy, are:

- unaffordability for the worst-affected;
- limited capacity of current insurers to sensibly rate each risk;
- adverse selection (those who suspect their risk is larger than rated by the insurer buy the coverage, while those with grounds for believing their risk is lower decline the cover), which means that the cover cannot be provided sustainably;
- the inequity of automatic inclusion of flood risk, and the associated loss of a feedback mechanism between premiums, land-use controls and flood-tolerant materials, contents and construction;
- the absence of an informed and technically competent reinsurance market for excess-of-loss catastrophe cover for the ‘retail’ insurers;
- high transaction costs – for marketing, underwriting and assessment of claims, which can exceed half of the premium revenue;
- freeloading: those without insurance cover still expect to be compensated for at least part of their losses after a flood.

It is remarkable how little discussion of flood insurance is to be found in the exhibited EIS. What is to be found in Chapter 4 and Appendix M displays a touching naivety. The members of the recent select committee of the Legislative Council which inquired into matters concerning the proposal to raise Warragamba Dam, as well as members of the Taskforce, were, in my opinion, duced in their interactions with the Insurance Council of Australia.

Knowledge of how insurance works is remarkably scant in the community as well as among engineers, lawyers, planners and even financial professionals outside the insurance industry.

26. Overcoming most of those obstacles

Some but not all of these obstacles might be overcome if conventional flood risk cover were provided through a mechanism akin to the former drought bonds.

In outline, a bond is a promise to pay a defined amount of the occurrence of a defined event. There is no need to demonstrate an insurable interest or a loss. Hence, there are no costs for assessing a loss. Since the promises to pay will ultimately mature, the body offering the bonds must be of the highest probity and capacity to pay. This body could be a public-sector one, a contractor engaged for specific services by a government agency, or a consortium of insurers or others with an appetite for risky investments. In return, the body would receive payments from those who potentially will benefit, which we might call the bond purchase price to differentiate it from the premiums charged for insurance cover. This price might be annual, a levy on rates, or a once-only cost (perhaps at the time of purchasing a flood-labile property).

I envisage a voluntary scheme. Subsidies might be offered to some classes of purchasers to encourage uptake.

The defined event which triggers payments would, it is envisaged, be exceedance of a nominated flood level at a specified place. A referee would announce occurrences. Multiple ‘flavours’ of bonds could be offered for sale in various sub-catchments downstream of the Dam. For example, the trigger points of various flavours might be set at about the fifty, one hundred, two hundred year... *etc* flood levels at various locations, but it’s the level rather than the precise exceedance frequency which matters. Each bond would have a value of (say) \$10,000, indexed. Buyers could purchase multiple bonds, though there may be an initial limit on how many could be purchased in relation to each property, though a mature scheme may have no requirement to have a beneficial interest in a flood-affected property.

I presented a paper at an international conference on insurance economics at Barcelona in 2001 on the pure-risk pricing of such bonds and the additional cost which could reasonably be charged by the seller for carrying the risk (which is the opportunity cost of the capital needed to underwrite the scheme). Marketing and administration costs are considered to be modest. (I don’t have a copy of the paper at my current address; the conference was held between 24 and 26 July 2001, was sponsored by the journal *Insurance: Mathematics and Economics*, and was the fourth such conference.)

A pilot scheme could be used to iron-out problems, to measure the interest in the product, and to promote demand for it in other localities. I envisage that it would appeal to both businesses and householders. Other flavours can easily be imagined.

27. Peer-reviewed papers on how to go about resolving a wicked problem

For a description of the ubiquity of wicked problems in public policy arenas, see:

Head, B.W., 2008. Wicked problems in public policy, *Public Policy* 3(2), 101-118.

Wicked problems require a different approach from *tricky* problems. See, for example,

Greenlees, K., and Cornelius, R., 2021. The promise of panarchy in managed retreat: converging psychological perspectives and complex adaptive systems theory, *Journal of Environmental Studies and Sciences* **11**: 503-510.

Panarchy has been defined as “a conceptual model that describes the ways in which complex adaptive systems involving people and nature are nested within one another, are interdependent, and are linked across different spatial and temporal scales”: L.H. Gunderson and C.S. Holling, Panarchy: understanding transformations in human and natural systems, 2002.

Another term sometimes found on how to resolve wicked problems is *paradiplomacy*: diplomacy, often concerning layered environmental issues, by non-state-actors.

28. Some peer-reviewed papers on why we should consider an orderly retreat from flood-labile land

For summaries of the US experience and a literature review, see:

Mach, K.J., *et al.*, 2019. Managed retreat through voluntary buyouts of flood-prone properties, *Scientific Advances* **5**, eaax8995.

Siders, A.R., 2019. Managed retreat in the United States, *One Earth* **1**, 216-225.

Greenlees, K., and Cornelius, R., 2021. The promise of panarchy in managed retreat: converging psychological perspectives and complex adaptive systems theory, *Journal of Environmental Studies and Sciences* **11**: 503-510.

James Irish, 17 December 2021