HAS YOUR FLOOD STUDY A USE-BUY DATE?

R. TOOHEY

† Asset Engineer, Eurobodalla Shire Council, Moruya, NSW
Royce.toohey@eurocoast.nsw.gov.au

ABSTRACT
Many place their faith in an adopted flood study or floodplain risk management study. Decisions are made as to the viability of developments, the impacts on a community, etc. They are stored in our office libraries, put on Council websites, etc and used when a proposal is put to Council or the impact on a parcel of land is required to be known.

Like many other planning documents they have a limited lifespan. The question is – How old do you let them get?

It is the purpose of this paper to consider some of these matters, using Eurobodalla as the example, and ask the question – is your study still applicable and how long for. By looking at what has transpired over the last 30 years, it is hoped to answer the question - In 50 years, will it still be current?

Eurobodalla has had a number of studies undertaken over the years and has used them in their planning and decision making process. Often they are found no longer appropriate. Examples will be cited including the Moruya River, Reedy Creek, and the South Batemans Bay CBD.

It is easy to accept the determinations in a flood study or a floodplain risk management study but eventually these are outdated or no longer applicable. Councils must ensure that their studies are applicable and relevant.

BACKGROUND
Eurobodalla has had a number of studies, both small and large, done over time. Over the last 30 years, we, as a profession, we have experienced significant changes in:

- Rainfall modelling – AR&R; ARI/AEP; Climate change
- Landscape changes – land clearing ⇒ increased runoff co-efficient; restoration of riparian zones ⇒ potentially decreased run-off
- Development changes – buildings removed/added; increase in CBD footprint; increased densities of existing residential areas
- Changes in damages costs – Inflation; rising costs; PVDs
In 2005 DIPNR, in conjunction with Eurobodalla Shire, had an assessment undertaken by URS P/L of what was outstanding in respect of flood studies across the Shire. Eurobodalla is now undertaking a review of our Moruya River Flood Study (MRFS) and the Moruya River Floodplain Risk Management Study (MFRFRMS). This has been brought around by two factors:

- The need to know what impacts climate change will have on the behaviour and impacts of flood events with the Moruya River floodplain; and
- Completion of most of the works identified in the Moruya River Floodplain Risk Management Plan (MFRMP).

As part of the considerations for the review, the following questions have arisen:

- What effect has the extended dry period over the last 50 years had on flood frequency of the river
- What is the average age of other flood models – urban/rural/coastal
- Why do people update? – age; political pressure; completion of works; better data available (ALS/photogametry)

FLOOD STUDY PROCEDURE

Flood studies are prepared in accordance with the NSW Floodplain Development Manual. This involves the undertaking of a flood study then a Floodplain Risk Management Study followed by a Floodplain Risk Management Plan to put the recommendations of the Study in place. The flood study analyzes the catchment and determines the discharge, allowing the extent of flooding to be determined. The Floodplain Risk Management Study looks at the risk to life, property and the environment. Whilst the Floodplain Risk Management Plan sets out the actions required to mitigate the effects of the flood event.

FACTORS THAT MAY HAVE CHANGED

Flood Frequency

Council’s Integrated Water Cycle Management Plan reviewed rainfall records at Moruya Heads for last 100+ years. This indicated a dry period up to 1900, when the Centenary drought occurred, followed by a wet period till about the end of the 2nd World War. Since then we have been experiencing another dry spell. Moruya’s flood of renown was in 1925 (1:115 year ARI) with most of the other significant flood events occurring in that wet period. No major flood has been recorded since the 1970’s, potentially due to the change in climate, so this raises the question - is the FFQ skewed? When the MRFS was prepared, the modelled events were compared to known events and the FFQ to verify the results.

Up until the early 1990’s, it was common practice to determine the frequency of a flood event (ARI) from flood frequency (FFQ) curves where known flood heights are plotted against time on a log-normal graph. From this we determined the level of the 1:100 event and set a flood planning level based on that. Now we determine the rainfall for varying ARIs and determine the height of water required to discharge that flow. This sets flood heights for nominated events, commonly the 1%, 5%, and 20% AEP events.

The Moruya Flood Development Control Plan, as with many other DCPs, defines the flood planning level as the 1% flood event plus freeboard. Often we as practitioners have adopted the same
level but there can be a difference.

*Change in Hazard*

The hazard from a flood event is the combination of flow velocity and depth of flow. In the case of the Moruya River, a chart was developed by Patterson & Britton to assist in the determination of hazard (Figure 1).

Knowing the flood level and the existing surface, the hazard can be determined and therefore appropriate development controls can be applied. If either factor changes, this can change the hazard category and therefore the restriction placed on a property. If the discharge has changed due to rainfall variation or there has been a significant change in the landform, this will alter the hazard. Therefore it can be seen that hazard may not be constant over the long-term.

*Climate Change*

The consensus of opinion is that there will be an increase in the intensity of storms (DECC 2007). This change is demonstrated in Figure 2.

Whilst the precipitation models used in the flood study can accommodate variations in intensity and precipitation, this requires the re-running of the model with those higher intensities. Typically, the older models only determined the 1% AEP and the PMF rainfall events. With the assessment of climate change the models have to be almost redeveloped to determine the new, anticipated 1% event.

For coastal councils, there will also be anticipated sea level rises. What will be the effect of any sea level rise and how sensitive is the river to backwater effects from a higher sea level.

Some suggest that the freeboard will allow for these effects but this then diminished the allowance for waves, etc. When will the freeboard be no more?

*Landscape*

Co-efficients have been developed to estimate how much water will be absorbed and how much will run-off. Whilst this may not have much impact on a large river system such as the Moruya River, in areas such as South Batemans Bay differing levels of development and styles of development have occurred since the 1980’s.

Due to the lengthy dry spell having been experienced in over the last 10-15 years in the south-east of the state, there will probably be less initial run-off from lower intensity storms. Yet with...
higher intensity storms, there may be significant higher run-off due to the lack of adequate ground cover in the upper reaches of a river system or catchment.

The corollary to this is that there has been significant environmental awareness over the last 10 years, leading to many revegetation projects. Their cumulative impact cannot be known unless there is a new flood study.

**Development**

In the 15 years since the MFRMS was prepared there has been significant change in the Shire. Whilst a 2D model of the Moruya CBD was developed as part of the MFRMS, this is not the case for other areas. In the case of Reedy Creek, a number of scenarios from existing development to a fully developed catchment were undertaken.

The change in the Shire is not only limited to buildings. Over the last 15 years there was initially a drift away from rural areas to the city. This has now been replaced by the sea-change and tree-change philosophies. This is particularly born out in Eurobodalla with a significant rise in retirement villages and similar. The style of development within the Shire has also changed, e.g., there is a caravan park on the northern side of the Moruya River that has been allowed to developed more (elevated) cabins in place of on-site vans. The potential impact downstream needs to be considered. Development has also continued to occur at Moruya South Head, thereby increasing the number of persons potentially isolated during a flood event.

**Flood Damage Assessment**

To assess appropriate works, there is a need to develop estimates of potential damage. Whilst we can increase damage estimates by inflation, other factors come into play. These include the level of finish, equipment and fittings and increase in the level of personal goods as the level of affluence increases.

Since the studies were prepared, revised damages curves have been developed but these are often only applied in new studies and not used to determine if proposed actions are still warranted.

On the opposite side, construction costs have risen lately at a rate higher than the CPI and therefore the previous published BCR of a project may not now be true.

**LIFE CYCLE COST**

Assets need replacing. This not only applies to roads, water mains, etc but also flood mitigation works and studies. Roads are typical designed for a 50 year life, reinforced concrete pipes often for 100 years. Throughout their life, they are monitored, assessed and maintained. But what happens to studies. When have they exceeded their life and, if they have, can they continue to function adequately?

Reedy Creek FS exceeded its life because it did not determine the PMF nor other intermediary events. The mitigation works identified are still applicable, but the study was not adequate for making planning decisions or assessing the impacts of changes.

As discussed many times, there is a constant battle for limited funds. The question needs to be asked, what has the greater priority – new studies or revised studies. Often the perceived answer is new studies because there is no information on that location of waterway but don’t we have a responsibility to have the best and most up-to-date information (s733 (1) of the Local...
EUROBODALLA’S FLOOD STUDIES

Eurobodalla has a number of waterways, both small and large. Of the major rivers, only the Moruya has had a flood study done due to the impact on the adjacent township. Council has either undertaken or had prepared a number of studies for smaller waterways and systems as the need arises.

Moruya

The first flood study for Moruya was undertaken by GHD on behalf of the PWD in 1981. This produced a series of flood maps that were used to identify areas within the Moruya floodplain affected by flooding as well as a Floodplain Management Plan.

This initial study was replaced by the MRFS in 1991 (prepared by Webb McKeown & Assoc. on behalf of the PWD). To complement this, the MRFRMS (1989) and the MRFRMP (1990’s) were prepared by Patterson & Britton. To date, the majority of the works in the MRFMP have been undertaken. The extent of the CBD has increased since the study and the original 2D model now no longer covers an adequate area.

Reedy Creek

In 1989 a series of studies for 4 watercourses across the Shire were prepared for Council by GHD P/L. Each of the studies determined the 1:20 ARI and the 1:100 ARI events for the watercourse. The Reedy Creek Flood Study was reviewed in 2005 when development was reactivating and it was found that no PMF data was available. The initial study and model did not provide any hydraulic categorization nor hazard categorization. The FRMS also found that the previously recommended detention basins would no longer have any significant impact or even able to be built.

South Batemans Bay Drainage Study

Prepared in 1984 by Wiling & Partners as a preliminary analysis for a proposed development, this study looked at flows through a section of South Batemans CBD. A recent development proposal required the proponent to determine the impact of the development on the existing flows and the immediate area. The review of the study found that it was using rainfall intensities that have since changed and that significant development changes have occurred within lower reaches of catchment which changed the flow characteristics and flood storage capacity. In particular it showed that a number of commercial developments were now at risk from flooding.

OTHER CONSIDERATIONS

Unleashing the Monster

Flood information in Moruya has had a chequered career. For many years, sections of the community have not believed the flood levels adopted due to on-going argument about the actual level of the 1925 flood event, accuracy of rainfall predictions and indicated flow behaviour. Raising the subject of a revision could “unleash a monster”. The previous planning process took 15 years. Are we brave enough to open old wounds and take on the challenges or do we “tweak” what we have.
1D vs 2D
Eurobodalla has been asked a number of times does it need to update its 1D model to a 2D model. The general answer has been no as the flow characteristics are relatively straight-forward but the opportunity is there to with a review of the MRFS.

The argument is given that 2D allows for better graphical representation and better velocities. This may allow better determination of the hazard on a particular parcel of land and therefore development restrictions. This will allow the production of individual flood certificates and better emergency management.

Cost
Previously it required extensive surveys to be undertaken to determine the cross-sections of the floodplain. This can now be done using ALS. The result of this is an increased Benefit-Cost Ratio (BCR), making updates more appealing than previously.

Improvements in Technology
Technology has increased significantly. ALS allows us to survey the floodplain quickly and obtain better cross-section profiles than previously. Does this allow better predictions of flows? Not necessarily, as we still have to assume Manning’s N-values or similar.

With the increased computing power available at the desktop, different scenarios can be modelled and the result known faster than previously. This increase in computing power also allows Council to hold a copy of the model rather than rely on the developer of the model.

CONCLUSION
A flood study is not a static document. Many facets can change with time including initial parameters, floodplain characteristics, property values, and demographics. The opportunity has arisen to review the Moruya River Flood Study. Council is pursuing this by building a new flood model as it realises that the current study does not reflect the current situation. As opportunities arise, other studies are also being reviewed.

We all, as flood practitioners, have an obligation to have the most correct and up to date information we can. We cannot leave our studies on the shelf!

REFERENCES