

THE JUNE 2007 LONG WEEKEND STORM AND FLOOD EVENT IN THE CITY OF LAKE MACQUARIE, NSW - RISK REDUCTION ACTIONS AND LESSONS LEARNT OVER FIVE YEARS

Introduction

Commencing Friday 8 June 2007 and leading into the holiday long weekend, an intense 'east coast low' weather system event caused major flash flooding and widespread wind damage in Lake Macquarie City, NSW as well as in Newcastle and the greater Hunter and Central Coast regions of NSW.

As a result of this severe flood / storm event, the (then) New South Wales Premier, Morris Iemma, at 9.30pm on the 8 June 2007, declared the Hunter and Central Coast regions Natural Disaster Areas.

All low lying areas and townships surrounding Lake Macquarie waterway were affected for approximately 24 hours by the high lake level (exacerbated by the elevated level of the Pacific Ocean at Swansea Heads as a result of the extreme low-pressure weather system). Further, all Lake feeder catchments in the northern region of the City recorded near-record or above-record flood levels.

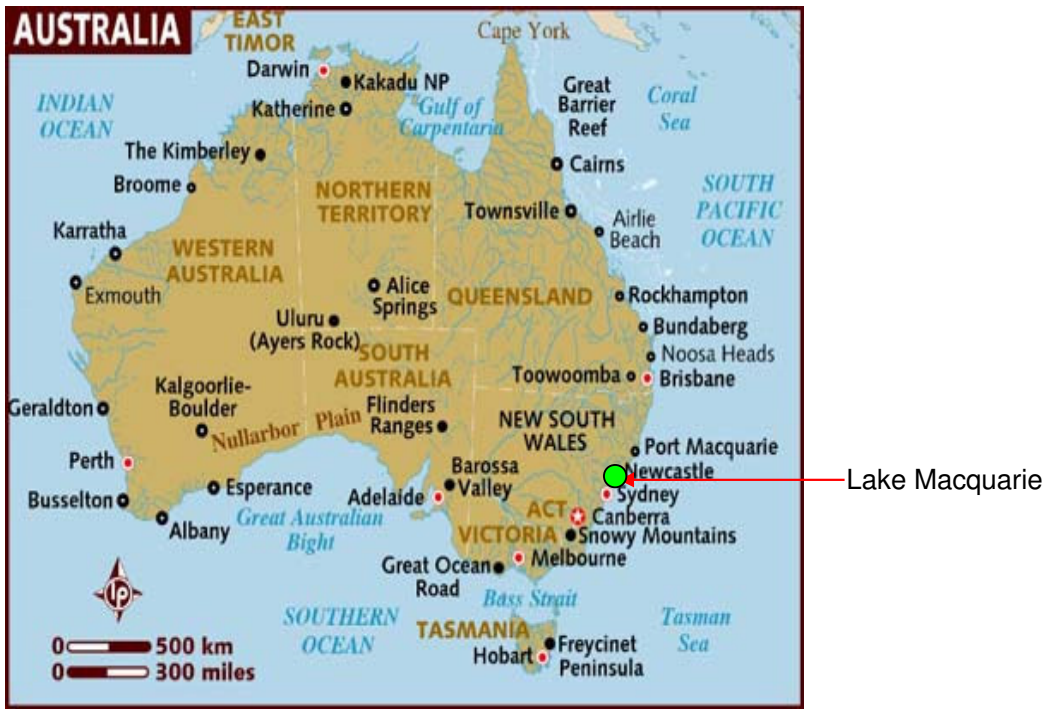
As Lake Macquarie Council's Senior Sustainability Officer (Natural Disaster Management), the author was personally involved in gathering flood intelligence information (photos, flood levels, statements, etc) during and after the event. Results from the event were collated and strategies put in place to cater for similar events in the future. Council has since initiated and implemented various strategies, actions and community education programs aimed at engendering awareness and preparedness for future natural disaster events.

This paper discusses the impacts of the natural disaster event, key lessons learnt and actions emanating from the learnings, to prepare the community for future similar or worse events.

The paper concludes by discussing the implications of the event and how Council has approached institutionalising the learnings and actions by embedding them in Council's culture and programs.

The Event:

Over the June 2007 long weekend period, the City of Lake Macquarie (LMCC), a local government area on the NSW central coast and lower Hunter region, was affected by an intense east coast low weather system. This weather system produced cyclonic winds and accompanying torrential rainfall, resulting in the City's worst natural disaster on record. On-shore cyclonic winds averaging 93 km/hr (maximum recorded gust 135 km/h) were accompanied by heavy rainfall (340mm of rainfall recorded in the 24-hour period Friday to Saturday). The whole City was at a flashpoint, with unprecedented flash flooding of urban drains, major creeks, natural watercourses and the main Lake Macquarie waterway which outlets to the Pacific Ocean at Swansea Heads.



A Flood Watch alert for the greater Hunter Region was issued by the Bureau of Meteorology at 1726 hrs on Thursday 7 June 2007. The Flood Watch indicated that a low-pressure system off the NSW mid North Coast was expected to deepen and produce widespread heavy rain over the Hunter Region of NSW during Thursday 7 and Friday 8 June. The report further warned the possibility of moderate to major flooding occurring as result of the developing intense 'east coast low' low-pressure system.

The above warning turned out to be prescient. During the morning of 8 June, on-shore cyclonic winds (speeds averaged 93 km/hr - maximum gust 135 km/hr recorded by Bureau of Meteorology) affected land, Lake and ocean alike, resulting in the now historic grounding of the bulk carrier *Pasha Bulker* at Nobby's Beach, Newcastle.

During late afternoon of Friday 8 June, the worst local storm in 33 years produced record intensity in the Lake Macquarie region. At the urban peak of the storm, 80mm of rainfall in a one-hour period was recorded at Croudace Bay, which was the epicentre of the greatest regional intensity. In the 24-hour period from 12.00am Friday to 12.00am Saturday, 340mm of rain was recorded at Croudace Bay.

On Saturday morning 9 June 2007, Lake Macquarie waterway (the Lake) rose one metre above its normal level and peaked at 6.00 am to a level of 1.1m Australian Height Datum (AHD), equating at the time to a 1 in 35 year Annual Recurrence Interval (ARI) probability flood event and only 100mm below the highest observed Lake waterway flood level of 1.2m AHD, recorded in June 1949 (Note: the average daily level of Lake Macquarie waterway is 0.1m AHD).

All low lying areas and townships surrounding Lake Macquarie waterway were affected for approximately 24 hours by the high lake waterway level (exacerbated by the elevated level of the Pacific Ocean at Swansea Heads as a result of the extreme low-pressure weather system). Worst affected areas adjacent to the Lake foreshore were the townships located on the eastern side of the Lake namely, Swansea, Pelican, Marks Point, Belmont South, Belmont, Valentine and Warners Bay. The high Lake level receded by late afternoon Saturday 9 June.

There were also extensive lake foreshore and revetment damages due to wind/wave action and erosion as a result of the storm. An example of the above was the extensive damage caused to the Speers Point-Warners Bay cycleway (estimated \$750k).

Lake sub-catchments in the northern parts of the City recorded near-record or above-record flood levels. Further, many urban stormwater systems experienced major flash flooding caused by the intensity of rainfall and subsequent blockages by numerable objects, in many cases, motor vehicles washed into the streams. Bridges at the townships of Cardiff, Glendale, and Wakefield were extensively damaged by the storm. Worst affected suburbs for urban stormwater flooding included Cardiff, Glendale, Warners Bay, Barnsley, Belmont, Windale and Gateshead. In a number of cases, due to the proliferation of rainfall intensity and blockages, the 1 in 100 year ARI flood was exceeded. Cardiff Central Business District was the worst affected area with \$2 million damage losses to businesses (source "*The Star*" newspaper, 25 October 2007).

Had the storm event been slightly larger, there may well have been devastating results for the region.

Impacts

Unlike previous floods on record at Council, the June 2007 long weekend flooding affected the entire City of Lake Macquarie and left a damages bill which surpassed the 1989 Newcastle earthquake figures and at the time, was officially ranked as the sixth most costly natural disaster in Australian history (in terms of insured losses and 2007 adjusted dollar amounts). Note: The event would now be number seven on the list - the Queensland floods of Dec 2010-Jan 2011 were costlier - \$2.387 billion in insured losses – Source: Insurance Council of Australia Historical Disaster Statistics at <http://www.insurancecouncil.com.au/industry-statistics-data/disaster-statistics/historical-disaster-statistics> (accessed 09/04/13).

On 3 July 2007, the Insurance Council of Australia (ICA) confirmed that 58,000 claims resulting from the June 2007 long weekend storm event had been lodged by Hunter Region residents, with insurance claims exceeding \$550 million. On 6 August 2007, the ICA further confirmed that 63,000 claims had been lodged in the Hunter Region as a result of the storm event at a total cost of \$750 million. In addition, on 23 August 2007, the Hunter Business Chamber reported that insurance companies had received \$1 billion in claims from 65,000 claims lodged. The *Newcastle Herald* newspaper reported on 18 September 2007 that, 100 days on from the storm, a spate of late insurance claims had pushed the cost of the storm event to a staggering \$1.48 billion from 90,000 claims lodged. The ICA's Disasters Database (<http://www.insurancecouncil.com.au/industry-statistics-data/disaster-statistics/historical-disaster-statistics>, accessed 06/03/13) also gives the original cost of the event (insured losses) as \$1.48 billion).

Post-storm statistics issued by the NSW State Emergency Service (SES) indicate that 3,552 calls for assistance were recorded in the Lake Macquarie precinct over the June long weekend period. Council and SES Records show that 200+ people in the Cardiff and Barnsley region were evacuated to the local *Club Macquarie* and 60 residents from Dora Creek township were evacuated to *Morisset Country Club*.

Approximately 40 reports of landslip affecting private/public property were received. In the waste management area of Council, statistics show that 2,200 truckloads of green waste were taken to four designated sites to shred. Further, 2,000+ tonnes of green waste and 3,000+ tonnes of household waste was taken to Awaba Waste Management facility. As an added consequence of the storm event, there were over 2,500 storm-related Service Requests lodged with Council's Customer Service Centre from 8 June to 22 June 2007. There were also over 10,000 phone calls received at the Customer Service Centre. An indicative storm damage bill for Lake Macquarie City was put at \$20 million (majority covered by the National Disaster Relief Fund). This figure does not include personal insurance claims.

On a regional basis, power authority *Energy Australia* recorded 93,000 calls for assistance, (the most in history), with an estimated 100,000 homes and businesses without power by Saturday morning 9 June 2007. The SES deployed 6,000 volunteers who responded to 10,000 calls for assistance. The SES issued evacuation orders for over 4,000 residents, rescued 500+ from the floodwaters and performed 19,951 storm-related tasks in an 18-day period. There were 3,800 calls made to the NSW Department of Community Services assistance line. Tragically, there were nine regional deaths recorded as a result of the event (no deaths recorded in Lake Macquarie).

Lake Macquarie City Council played a vital role in deploying operational crews to handle emergency issues (road closures, work teams) as well as providing on-call operational staff (customer service calls, flood intelligence, emergency management,

Risk Reduction Learning and Actions at LMCC

Lake Macquarie City Council has learnt over five years to combine technical knowledge, infrastructure investment strategic planning and community engagement into integrated programs as the basis for future planning and preparedness, in an endeavour to meet the challenges head on and to change the behaviours of the community, governments and authorities alike.

Subsequent to the 2007 event, Council has been actively involved in building the 'environmental security' of the Lake Macquarie City community by boosting resilience to deal with similar future events. Council has also endeavoured to embed and institutionalise learnings and actions so that the procedures stay in the organisation and are not lost when staff leave.

When it comes to natural disaster resilience, Council's vision is "to reduce communities' vulnerability to natural hazards by encouraging stakeholders to build community resilience."

This vision is supported by the broad objectives of: reducing community vulnerability to natural hazards; supporting local governments and others to build community resilience and increase self-reliance; promote innovation through a focus on building partnerships between sectors, supporting sustainable neighbourhoods and encouraging a regional or catchment area approach to mitigation and adaptation to the potential impacts of climate change.

Council has initiated and implemented various strategies, actions and community education programs aimed at engendering awareness and preparedness for natural disaster events.

The following section discusses the resulting actions that have been undertaken by Council to implement the learnings.

Learning: *The community needs to be know what it can do to be prepared for natural disaster risks*

Action: *Establish an Emergency Ready Lake Macquarie website*

Council's website has been revised to focus on natural disaster risk, and advice and preparedness tips on flooding and severe storms, emergency management and climate change.

Website link: <http://www.lakemac.com.au/environment/natural-disaster>

This program was commenced by Council during 2010 (with some funding obtained from the Emergency Management NSW *Natural Disaster Resilience Grants Scheme*) and focuses on key areas of preparedness for natural disaster events, namely:

- * *Be Prepared* - prepare an emergency plan; prepare an emergency kit; sign up for emergency warnings and alerts
- * *Stay Informed* - stay tuned to local radio, TV, websites or other media; stay in touch with family neighbours and friends; access emergency alerts
- * *Stay Safe* - when to evacuate; when to return home; who to contact for recovery assistance

The website, launched in February 2012, was developed in consultation with key agencies (NSW State Emergency Service, NSW Rural Fire Service, NSW Fire and Rescue and NSW Police).

Website link: <http://www.lakemac.com.au/emergency-ready>

Learning: The community needs to be engaged and connected to be prepared, respond to and recover from, natural disasters

Action: Launch the Be Ready Be Safe City-wide Engagement Campaign

A four-year campaign commenced in July 2011, to reduce the impacts and effect of natural disasters and climate change on the City and its residents by making them better prepared for future events, more aware of how to behave in an emergency, and more knowledgeable about future risks. The overall goal of the campaign focussed on reducing the risk exposure to the impacts of natural disasters on the City's residents and businesses with the objective of increasing residents' and businesses' capacity to act before, during and after a natural disaster.

Desired outcomes were to make residents and businesses well informed of impacts of natural disasters in their area; know what to do before, during and after a natural disaster and to ensure that 5,000 residents and businesses are signed up to the Australian Early Warning Network (EWN).

Campaign activities to date have included providing a campaign toolkit; undertaking mass media advertisements; Council website news stories/webpage banners; issuing community newsletters; issuing information brochures, conducting public place displays; conducting school natural hazards workshops; promoting the Council subsidised EWN emergency alert service; Emergency Ready Business initiatives; informing residents about existing study and plan publications; undertaking research; seeking external stakeholder partnerships; encouraging business and staff engagement; conducting giveaways and incentives to add value and enhance motivation of residents to participate in campaign activities; proactively focusing on vulnerable communities and individuals in an endeavour to reduce their risk to natural disasters.

This project collaborates with community support agencies such as the Australian Red Cross, the NSW SES, and the NSW Rural Fire Service, and is aimed at working with at-risk communities and individuals to identify needs and distribute relevant information about emergency preparedness, response and recovery.

The *Emergency Ready Lake Macquarie* website project was integrated with this campaign.

Learning: There needs to be clear and manageable emergency planning

Action: Draft Lake Macquarie City Flood Emergency Sub-Plan, 2011/2012

This plan is a sub-plan of the Lake Macquarie City Local Disaster Plan (DISPLAN) and Volume 1 of the Lake Macquarie Local Flood Plan. The plan was prepared in accordance with the provisions of the NSW State Emergency Management Committee in accordance with the provisions of the State Emergency and Rescue Management Act 1989 (as amended).

Council has provided vital input to the NSW State Emergency Service who coordinated the draft plan. The draft plan (yet to be finalised) covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures

from flooding within the Lake Macquarie City Council local government area and draws on historical data and intellectual intelligence data gained from the 2007 storm / flood event.

Learning: Involve the community in preparedness and awareness programs

Action: Utilise the Sustainable Neighbourhoods Program to engender community participation in natural disaster awareness and preparedness

Lake Macquarie City Council's innovative environmental programs and initiatives have consistently yielded positive outcomes and in the years since 2007 and they continue to achieve outstanding results for the environment and the City (community and business alike).

Council is committed to caring for its local environment through strategic planning and development assessment, capital works, community engagement, education and monitoring programs. Through Council's collaboration with City residents, twenty local *Sustainable Neighbourhood* groups have been established (to date) to work on a range of community-based sustainability projects including caring for the natural environment and building a resilient and connected community, along with an umbrella group to support the Sustainable Neighbourhood network.

Through its *Sustainable Neighbourhoods Program*, initiated in July 2008, Council collaborates with City residents to plan and implement community actions to work on a range of community-based sustainability projects, including addressing threats to the environment (natural disasters), neighbourhood by neighbourhood. The program includes a community planning process involving the development of a neighbourhood vision, the articulation of local values and challenges, and the implementation of actions to achieve the neighbourhood vision.

Through the Sustainable Neighbourhoods Program, Council has engaged the members of 25,600 households, representing around 31% of Lake Macquarie households, in dialogue on sustainability issues, including natural disaster awareness and preparedness. In addition, a total of 2,340 residents have actively engaged in the program to undertake community-based projects and activities to take care of the local environment, and build resilient and connected communities.

In 2011 / 2012, eight Sustainable Neighbourhood groups launched their Sustainable Neighbourhood Action Plans and with support from Council are currently working on a range of community-based sustainability projects that involve amongst other things, caring for the natural environment and building neighbourhood capacity.

The outcomes arising from the Sustainable Neighbourhoods Program extend beyond its environmental sustainability focus. The extent and nature of the community engagement process itself has significantly contributed to Council's understanding of the values and challenges for City residents, and the issues that are important to them.

Learning: Encourage community education, capacity building and awareness

Action: Encourage residents and businesses to register with the Australian Early Warning Network (EWN)

Another community education initiative was launched by Council in 2010, to encourage Lake Macquarie City residents and businesses to register with the *Australian Early Warning Network (EWN)*.

The EWN monitors and tracks potentially dangerous weather systems and uses the network to issue advanced warning alerts to the community, government and businesses directly in the path of impending severe weather and other threat events such as a thunderstorm with the potential for hail, flash flooding or damaging winds; heatwaves; bushfires and tsunamis.

Lake Macquarie City Council has piloted subsidised membership of the Australian Early Warning Network, providing free alerts for up to 5,000 residents, businesses, SES volunteers and LMCC staff, at a cost to council of \$10,000 for the financial year. After signing up to the EWN, subscribers receive free alerts which are sent via email, to mobile phones (via SMS), landline phones (in life-threatening emergencies only), and via the EWN website.

In the calendar year 2012, there were 38 alerts sent out by the EWN to subscribers in Lake Macquarie City, some of which covered multiple warnings (e.g. for large hail, flash flooding, damaging winds). These included:

- NSW Severe Thunderstorm Warning – 15 alerts
- NSW Severe Weather Warning – 16 alerts
- NSW Flood Watch – 1 alert
- NSW Bushfire Watch and Act – 2 alerts
- NSW Fire Weather Warning – 4 alerts

To complement the EWN program launch, Council conducted a media campaign to encourage residents / businesses towards taking further steps to become *Emergency Ready*, to include:

- * Preparing an Emergency Plan – this outlined what a family should do prior to the event of severe weather threatening their property and lives
- * Preparing an Emergency Kit – advice issued to form a kit to include as a minimum, long-life food, water, pet food, medications, extra keys, kids toys, plastic document wallet, torch and battery operated radio.

Website link - Sign up to the Australian Early Warning Network at:

https://www1.ewn.com.au/lake_macquarie/register.aspx

Learning: Encourage community preparedness and awareness

Action: Produce and distribute a Dora Creek FloodSafe brochure in collaboration with the NSW State Emergency Service and the local Sustainable Neighbourhood Group

The Dora Creek *FloodSafe* brochure is an informative locally branded and NSW SES sanctioned leaflet relating to flood awareness and evacuation procedures. It is a catchment specific brochure elaborating on the generic SES *FloodSafe* guide and

includes Council's logo, local radio stations and frequencies, local imagery and local Dora Creek flood information and maps.

The SES and Dora Creek Sustainable Neighbourhood Group (entitled *Climate Ready Dora Creek*, established by Council in 2008), conducted a doorknock in October 2012, to distribute and discuss the Dora Creek *FloodSafe* brochure, Council's 'Are You Emergency Ready?' brochure and SES *Home FloodSafe* toolkits. A survey of local residents was also conducted to gather information on people's experiences in the June 2007 storm / flood event, their level of preparedness, and to gauge their interest in attending a future Council / SES workshop(s) on flood awareness / preparedness.

The SES *Home FloodSafe* toolkit comprised a plastic zip wallet containing flood preparedness material, viz. SES cover letter explaining the kit and outlining that the household is in a flood affected area; SES fridge magnet (132 500 number); a magnetised Home Emergency Kit information flyer; a *Home FloodSafe* toolkit flipchart which gives a list of actions to consider before, during and after a flood; questionnaire for residents to complete.

Website links to Dora Creek *FloodSafe* brochure:

<http://www.lakemac.com.au/page.aspx?pid=109&vid=10&fid=443&ftype=True>, and

<http://www.ses.nsw.gov.au/communitysafety/floodsafe/floodsafe-guides>

Learning: Encourage environmental education

Action: Align with the Living Smart Festival and Australia Day Festival to spread the word and deliver advice

Council has conducted one-day festival events (*Living Smart Festival and Australia Day Festival*) at Speers Point Park near Lake Macquarie waterway at its entrance to Cockle Creek for a number of years and since 2007, these festivals have been used to promote natural disaster preparedness and education. The Living Smart Festival specifically focuses on environmental education and Council's Sustainability Department has used the festival campaign to distribute material and advice related to natural disaster preparedness. Council has encouraged Lake Macquarie City residents to sign up for Australia Early Warning Network alerts. Festival patron residents have also been given information brochures regarding the various natural hazards most likely to affect them and advised on how to put together a 'Home Emergency Kit' and 'Home Emergency Plan',

Learning: Be alert and aware to the dangers of rising floodwaters on roadways ..

Action: Install Flood Depth Height Recorders and Signs at flash points

A comprehensive program was undertaken in 2010 / 2011 to install flood depth height markers (0 metres – 2 metres) and complementary flood warning signs (Road Subject To Flooding – Indicators Show Depth) at various flashpoint locations throughout the City (Dora Creek, Boolaroo, Marks Point, Toronto, Blackalls, Jewells Crossing, Gateshead) where flooding of roads and thoroughfares may impact. The markers have been linked to Council's GIS system via coordination in order that they can be easily located and replaced if damaged.

Learning: Turn forecasts into warnings for real time natural disaster events

Action: Implement an Integrated a Citywide Flood Warning System

Installation of flood warning systems have been identified as a priority action in a number of flood risk minimisation plans. Council is currently in the process of implementing an integrated citywide flood warning system, inclusive of the Lake waterway and its key catchments, to link with the existing telemetred system operating at Kalang Road, Dora Creek township, administered and maintained by Manly Hydraulics Laboratory with Council monetary support. The new system incorporates existing water level gauge stations already in place at various locations in the City (e.g. on Cockle Creek at Barnsley), the existing flood warning system located at Dora Creek, and new facilities at appropriate locations. It is envisaged that the citywide flood warning system will replicate and complement the Dora Creek system. The Dora Creek Flood Warning System components include data capture via appropriate instrumentation, data recovery via telemetry, data analysis, alarm activation and predictive scenario modelling. The system monitors rainfall, stream flow, ocean tides and creek levels and is known as Dora Creek *FloodWatch*. Alarm facilities are activated when the *FloodWatch* exceeds a pre-determined water level. In addition to triggering alarms, *FloodWatch* uses a hydrological model of the catchment and flood routing based on tailwater conditions to predict future flooding scenarios for abating, persisting and worsening rainfall conditions. Access to water level records is available via direct telephone contact, alarm warnings via SMS messaging and web access.

Learning: Reduce the impact of flooding and flood liability on individual owners and occupiers and reduce private and public losses resulting from flooding

Action: Undertake flood studies and flood risk management studies/plans for prioritised City catchments

Council, through its Floodplain Management Committee, formulates comprehensive flood study, floodplain risk management study, floodplain risk management plans and implementation programs for significantly affected major creeks and catchments within Lake Macquarie City, in accordance with the NSW State Government's current *Floodplain Development Manual*, April 2005.

Subsequent to the 2007 storm / flood event, Council has completed flood studies and/or floodplain risk management studies and plans for the major catchments

Council's *Lake Macquarie Waterway Flood Study (June 2012)* and *Lake Macquarie Waterway Flood Study and Risk Management Plan (June 2012)* incorporate the implications of sea level rise, as well as the June 2007 storm / flood event.

Learning: Liaise more with insurance agencies and other stakeholders

Action: Work with Insurance agencies and other stakeholders to develop natural disaster insurance information to assist with formulating premium reductions for residents and businesses in the City of Lake Macquarie

Since 2007, Council has undertaken various activities with the insurance industry to ensure that they are utilising Council flood information appropriately, and to assist them to use the most current information to more accurately price insurance premiums in order to reduce costs to residents and businesses, and to provide incentives to reduce risks from flood and other natural disasters.

Initiatives include:

- Delivering further information to residents and businesses about natural disaster risks and insurance;
- Consulting with insurance companies to develop clearer, more easy to understand insurance information (e.g. improved Product Disclosure Statements);
- Investigating resilient building design guidelines for flood, storm and bushfire mitigation, to reduce risk and thereby insurance premiums; and
- Encouraging the insurance industry to offer reduced insurance premiums on developments that apply design options that mitigate natural disaster risk exposure.

Learning: Enhance Council's development and compliance procedures relative to natural disaster risk management

Action: Development Assessment and Compliance Measures

Since 2007, Council has adopted new initiatives for development consent conditions to complement existing controls. Floor levels of all habitable and commercial buildings are required to be constructed a minimum 500mm above the 1 in 100 year average recurrence interval (ARI) flood level (where available) and industrial buildings constructed as a minimum to the 1 in 100 year ARI flood. Where properties are affected by projected future sea level rise, the flood level relevant to the life of asset is applied.

As part of a review of management actions emanating from newly completed flood risk management studies / plans, property modification measures such as installation of flood barriers at doorway entrances to buildings were recommended as an acceptable modification solution. Floods such as the 2007 event have placed immense pressure on planning, prevention and response resources. The general consensus amongst many authorities is that the public must become more self sufficient in times of emergency so that they are better prepared and less reliant on outside assistance, at least in the first stages of crisis.

Lake Macquarie City Council now encourages acceptable solutions for development in flood prone areas. Flood barrier systems provide an alternative to minimum floor heights in some circumstances. Flood barriers are a rapid deployment protection system, which is low cost and effective for residential properties and robust and flexible for commercial and industrial premises. Its main benefit is that each barrier offers the equivalent protection of fifty sandbags, yet they are deployable in just minutes by one adult. The flood protection system consists of doorway barriers that are extendable via a unique modular system. They are especially suitable for businesses requiring increased flood protection measures.

The flood barrier create a watertight seal against the doorway frame. This lightweight effective door guard takes 2 minutes to install and comes complete with the equipment needed to successfully protect a valuable asset from the effects of flooding.

Flood barriers for commercial businesses are designed to extend in a modular form. Stanchions are locked into previously installed ground fittings. The barriers are then positioned laterally between the stanchions, providing a proven and effective protection system for large structures and openings.

Flood barriers have been installed at a number of new developments in the City to complement developments where minimum floor levels were considered onerous or impracticable to the development. Recent Lake Macquarie City examples of flood barrier system installations are the four retail stores at the front of the Woolworths

complex in the main street of Swansea; a convenience store located in the main street of Swansea township and Council's new Cardiff Library complex.

Implications of the Event and Institutionalising Learnings and Actions

The potential for future flood losses in all developed and undeveloped areas has been contained by Council's application of ecologically sensitive planning and development controls and sustained community education programs.

The 2007 storm event caused considerable tangible and intangible social disruption and costs to the Lake Macquarie City community at large.

With regard to financial implications, the June 2007 storm / flood event resulted in considerable damages to infrastructure and required an unprecedented deployment of various personnel and allied equipment resources to assist with combat activities related to the event such as road closures, evacuations and the like. Impacts were partially compensated for as the result of the NSW Government declaring the storm event as a 'Natural Disaster' (the majority of the costs to Council were covered by the National Disaster Relief Fund).

Quantifiable environmental risk impact results for the flood event in regard to mortality, morbidity, livelihood, property and natural systems have not been assessed as part of this paper, suffice to say, there were no recorded deaths in Lake Macquarie City and the property damage estimates have been detailed earlier in this report.

Conclusion

The June 2007 long weekend storm / flood event was one of the worst on record for Lake Macquarie City and surrounds as it affected the entire City, in comparison with previous recorded storm/flood events, which were more locality-specific.

Within 24 hours of the storm event, Council deployed survey field staff to collect, capture and collate information and flood height data/intelligence (including photographs), which are now recorded on Council's GIS mapping system and computer database for historical purposes. The collated data assists in the preparation of flood modelling for undertaking flood studies on prioritised floodplains.

Implementing actions emanating from the event will ensure that:

- Flood liable lands are managed having regard to social, economic and ecological costs and benefits to individuals as well as the community;
- Natural disaster management matters are dealt with having regard to community safety, health and welfare requirements;
- Information on the nature of possible future events is available to the public; and
- Appropriate and effective warning systems exist, and emergency services are available during future natural disaster events.