The Australian Journal of Emergency Management

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Front cover: Earthquake aftermath, Afghanistan. Photo: Joe Barr

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The aim of this publication is the exchange of information and views across the Australian emergency management community, therefore, the views expressed in this journal should not be taken to be the views of Emergency Management Australia.

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Editorial

A culture of prevention

Australia's industrialisation has brought many benefits, as well as many risks, to our communities. We are vulnerable to hazards associated with industrial production, hazardous materials transportation, storage, disposal and spillage, explosive factory fires as well as air, land and water contamination. This year disruptions to electricity supply in Queensland, water contamination in Sydney and the gas crisis in Victoria provided brutal proof of the community's vital dependency on technology and infrastructure. The cost to the community of these events has run into billions of dollars.

On top of the technological disasters, half a million people in Australia are affected every year by natural disasters. The average annual bill is $1.25 billion in damages alone. In the wake of the disasters, insurance premiums rise, agricultural production falls, businesses fold, jobs are lost and the local economy takes years to recover.

Although it is difficult to measure, the biggest cost of disasters is the human toll with lives being lost, shattered and changed. For the survivors, their traumatic experience may last a lifetime.

And all these losses are mostly avoidable; or at least could have been reduced if we had implemented an active national strategy to promote and support disaster mitigation; if more Australians recognised the importance and benefits of mitigation; and if we had a Culture of Prevention.

The issue of disaster mitigation is a dominant theme of the 1990's International Decade for Natural Disaster Reduction. One of the original goals for the Decade is to improve the capacity of each country to mitigate the effects of natural disasters.

As a result of a 1994 mid-term review of the International Decade, the United Nations endorsed a number of principles which have particular relevance to a Culture of Prevention:

- Risk assessment is a required step for the adoption of adequate and successful disaster reduction policies and measures.
- Disaster prevention and preparedness are of primary importance in reducing the need for disaster relief.
- Disaster prevention and preparedness should be considered integral aspects of development policy and planning at national, regional, bilateral, multilateral and international levels.
- The development and strengthening of capacities to prevent, reduce and mitigate disasters is a top priority area to be addressed during the Decade so as to provide a strong basis for follow-up activities to the Decade.
- Preventive measures are most effective when they involve participation at all levels, from the local community through the national government to the regional and international level.
- Vulnerability can be reduced by the application of proper design and pattern of development focused on target groups, by appropriate education and training of the whole community.

We can be very proud of our well-developed disaster planning, response and recovery arrangements. Tackling prevention, however, has been much more difficult because of the widespread and uncoordinated involvement of governments at all levels, industries, peak bodies and communities. Accordingly, since 1996, the National Emergency Management Committee, our peak national body for emergency management matters, has been developing a National Framework for Mitigation. The Framework aims to facilitate and support implementation of disaster mitigation encompassing all sectors, community groups and individuals.

The Framework will connect all the organisations who can play a role in advancing the cause of mitigation. It is a means to promote mitigation and exchange information on directions and programs. It will act as a catalyst for action and support for the development of strategies. It is both a national focus for mitigation and a framework for partnerships.

While there is still a long way to go, I am very heartened by the very strong signs from all around the country that disaster mitigation is being given its appropriate priority within the framework of a risk-management approach, and that we are adopting a Culture of Prevention.

Alan Hodges, AM
Director General, EMA

Disaster response with a difference – Afghanistan June 1998

By Joe Barr, Pacific Emergency Management Associates Pty Ltd

Occasionally some of us experience those 'What in the hell am I doing here?' moments. In June 1998 I found myself in one of those moments. I was sitting cross-legged on the carpet of a mud brick house in the village of Shahr-e Buzurg in north-eastern Afghanistan, chewing on one leg of what had obviously been the oldest chicken in the world, awaiting the arrival of the local district 'Commander'. He was galloping on horseback, John Wayne fashion, through the mountains to tell us why he was unhappy with the way the UN and the International Red Cross were delivering earthquake relief in his area of control. Around us were large numbers of his men, armed with AK47s and other weapons and carrying large amounts of ammunition. Across the narrow valley were the damaged buildings of his centre of power while on a small pad in that valley our transport, a Russian Mi8 helicopter was parked. Its Tajik crew (of undoubted skill but varying commitment) was keen to return to Dushanbe in Tajikistan before the afternoon clouds descended and turned this part of the extended Hindu Kush into a centre of cumulo granitus clouds. 'Us' consisted of the Icelandic head of the Red Cross Team, a British representative of a Norwegian NGO, two Afghani interpreters from Kabul and Peshawar, many kilometres away, and myself, from Australia as the local UN team leader. The only way out was our helicopter or a three-day donkey ride.

Earthquake damage

The UNDAC team

Perhaps it all started in early 1995 when I was nominated as the Australian representative to attend the second United Nations Disaster Assessment and Coordination (UNDAC) Team course held in Lausanne in Switzerland during April of that year. Some 30 people from 14 countries attended the two-week course. Most had experience of emergencies in many parts of the world

while the remainder were United Nations staff members with more limited experience who might be appointed to lead teams in the future (the UN likes to have its own staff leading its teams!). If you nominated a major disaster during the last twenty years, someone in that room had spent time on relief there. There were people with experience in El Salvador, Angola, Ruanda, Armenia, Japan, Afghanistan, Turkey, Samoa and many other places. It was an amazing gathering.

During the course we learned how the UN disaster operations were administered and funded, discussed the characteristics of various natural and complex disasters, shared experience of various disaster operations and learned of health precautions. Training was provided on assessment techniques and on coordinating the activities of international government and non-government agencies after disasters. There were sessions on how to behave when held up by bandits or roving paramilitary bands, on negotiation with local military commanders and on dealing with the media. Equipment was tested and used so that we could operate the team's satellite and radio sets. Throughout the course there was emphasis on team-building and international cooperation, cultural and administrative sensitivity. The climax was a 20-hour mission simulation exercise that began at nine-o-clock one evening in our hotel and finished late the following afternoon at a Swiss Civil Defence Training College training ground.

Once trained we returned to our normal jobs and were added to the UNDAC Team list. After two further courses, there are now about 120 Team members from 24 countries around the world. Since July 1993 the UNDAC Team has conducted 46 missions to 37 countries.

The UN Office for Coordination of Humanitarian Affairs (OCHA) office in Geneva administers the team. Its Disaster Response Section monitors disasters around the world and the response to those disasters. When it believes that major international assistance may be needed, OCHA alerts UNDAC Team members by fax through national focal points. Team members respond by reporting their availability for a mission. If the UN, after discussion with its local representatives and the host government, decides to activate an UNDAC Team, a team of two or more with the required skills and experience is selected from the members available and placed on standby or activated to move to the disaster site. Movement may be fast as OCHA aims to be able to get a team to a disaster site anywhere in the world in less than 36 hours. The countries that have provided UNDAC team members meet costs, usually as a result of formal agreements with the UN. Australia is one of a small number of exceptions whose formal agreements are still being negotiated, so funding of missions are handled in other ways.

The Afghanistan earthquake

On 30 May 1998 an earthquake of magnitude 6.9 on the Richter Scale occurred in north-eastern Afghanistan some 70 km west-north-west of the town of Faizabad. This was the second large earthquake in the area in 1998 as a similar sized tremor had occurred nearby on 4 February and sparked a major international relief effort. The May earthquake killed some 4,500 people in Takhar and Badakhshan Provinces. 7,000 families were affected and about 16,000 houses were destroyed or seriously damaged. Aftershocks were still causing damage up to a month after the initial tremor.

The United Nations and a number of non-

Village teams awaiting delivery of relief supplies

government organisations were working in the area and immediately reported on their first impressions of the impact. A joint relief operation was mounted by United Nations, the International Committee for the Red Cross (ICRC), the International Federation of Red Cross and Red Crescent Societies (IFRC) and a range of national and international non-government organisations (NGOs). An UNDAC Team was activated and arrived in Islamabad on 2 June. As the scale of the disaster was appreciated further UNDAC Team members were activated. I was asked to join the team at 9.30pm on Friday 5 June and by 1230pm on Saturday was in the air. Only after arrival in Islamabad in Pakistan was I told that I was expected to lead the whole UN Relief Team in Afghanistan.

The local committee waiting to receive supplies

The affected area

The affected area is in the part of Afghanistan that has not yet been captured by the Taliban government and is ruled by the so-called Northern Alliance of local leaders. It is situated in the region between the Hindu Kush and the Pamirs—rugged country that is an extension of the Himalayas. Land communications are appalling with road access only possible from Tajikistan, and that over roads only suitable for the big six-wheel-drive trucks left over from the Russian occupation. In some areas the road runs along riverbeds and is only passable in dry periods. Broken bridges are a regular problem. Away from the few roads, all land transport is by donkey (a donkey in this region can carry a load of up to 50kg). A few airfields are available but apart from a few Antonov transports operated by the Northern Alliance, the only aircraft that normally fly into the area are the small Beechcraft aircraft operated by the UN and ICRC.

There are a few towns but most of the region's inhabitants live in small mountain villages perched on steep ridges or on narrow river valleys. Almost all homes are built of mud-brick with little reinforcement. Roofs are made of wooden poles laid across between the walls and covered with layers of mud. Whenever the roof leaks, as it invariably does during the winter thaw, extra mud is added and the roofs inevitably become very heavy. Rural people could be considered subsistence agriculturalists. The great stands of pistachio trees that provided an income in the past were almost all cut down for fuel during the fighting that forced the Soviet Union to withdraw from the country in 1989 and during the subsequent civil war. Potatoes and a short variety of wheat are grown during the short summer. Sheep and goats are herded to the high pastures in summer and back to the lowlands in the other seasons. Oxen are used for ploughing – during a month in the country, which included the wheat harvest season, I saw one tractor. Most agriculture is conducted by hand using methods that would not have been unusual in western countries a century ago. The only cash income appears to be obtained from the sale of opium.

The relief operation

Development Assistance in Afghanistan is currently administered from Pakistan as many agencies have learned from bitter experience not to base too many assets in Kabul or other Afghan centres. After discussions in Islamabad, the capital of Pakistan, the UN and IFRC had decided to base their relief operation in Faizabad (sometimes spelt Feyzabad), a town of some 10,000 people located in a river valley at about 1220m just east of the earthquake-affected area. Its great advantage was that it had an airfield with a Russian steel planking runway. This had once been used as a Russian logistics base and also had four helicopter pads. The runway was not ideal (during most of my time in Faizabad we employed a local welder to keep cutting or welding breaks in the planking) but it would take aircraft up to the size of an Antonov 26 or 32 able to carry about 4-5 tonnes of freight. The only other nearby airfield, located west of the affected area, had a longer gravel runway but this was in a marginal state of repair and local support facilities were even more limited.

Helicopter base at Faizabad

A sub-base for operations was established at Rustaq, a smaller town just west of the earthquake affected area, which had no airfield but had open spaces for helicopter operations and a road link to Tajikistan.

Having decided on a base, some base facilities had to be established. Only three buildings on the airfield still had roofs so, by agreement with the local military commander, one was obtained as a UN operations base. As there were no water or other facilities at the airfield, it was decided to accommodate relief workers in Faizabad town. This lay about 4 km away down a road so bad that it took between 25 mins and an hour to traverse by four-wheel drive vehicle on those days when it was not cut by flash-flooding from storms in the hills. The only hangar, now disused, was obtained and repaired to provide waterproof storage for food supplies. It was later supplemented by a framed plastic covered store for other relief supplies. Communications with the outside world were by HF radio or by satellite terminal. All equipment and supplies were flown in by Beechcraft or by UN Antonov.

Before any part of the airfield could be used for relief operations it had to be checked for mines by the UN Mine Clearance Team. The check found no mines in the area used but the team did remove live mortar rounds, grenades and ammunition. Fortunately the highest risk area for mines, around a previous Soviet strongpoint at the corner of the airfield, was not required. This are was reputed to have some thousands of land mines in it.

No aircraft are based at Faizabad and the warring military authorities operate the only remaining aircraft in the country. The UN had two chartered Antonov aircraft available, one in Pakistan and one in Tajikistan. A single Mil MI8 helicopter capable of carrying up to 2 tonnes of

Relief supplies being unloaded

supplies could be available between peace monitoring missions in Tajikistan (which had also been in a state of civil war). These were obviously not going to be enough and a world-wide appeal for helicopters was made. ICRC quickly chartered two further Mi8s and other helicopters continued to trickle in until at the peak, the last week of July, we were operating nine Mi8s (variously capable of carrying between 2 and 4 tonnes), two Mi26s (capable of lifting up to 15 tonnes each at this altitude) and a Bell Longranger for liaison and assessment.

Assessment of the disaster

No reliable census of the region has been conducted since 1979 and recent fighting had forced many population movements. Reports from those who had walked to main towns to seek help after the earthquake indicated that there had been many deaths and widespread damage but it was impossible to estimate the total impact from these reports. The first priority was to get medical and assessment teams into the affected area. As soon as helicopters were available, small teams made up of overseas and local relief personnel were delivered to badly affected areas to provide first aid, identify serious casualties for evacuation to Faizabad hospital and assess the numbers of casualties and the degree of damage.

Two major problems immediately became obvious. Firstly the local culture did not permit male doctors or nurses to examine, or even speak to, women and girl children. Despite the hard work of the available women doctors, nurses and other relief workers, there were never enough of them to visit all women and new casualties were still being discovered a month later in remote villages.

The second problem was that there were no available detailed or accurate maps of the area. It is likely that the Russians have such maps but a request for them was never answered. Fortunately the pilots of the first Tajik Air helicopters had served with the Soviet forces in the area during the 1980s and knew many of the villages (this was fortunate, as some of them could not read a map!). As future pilots would be unlikely to have this knowledge, an early support request was for hand-held GPS receivers so that teams could record the position of villages. These positions were passed back to Islamabad to be entered in a geographical information system from which a map was developed throughout the operation. Updates were sent to the operational area regularly for planning and flight crews.

This initial assessment found just under 4,000 people dead, 200 missing and 370 injured. Medical teams continued to work in the affected area and treated more than 4,000 people for all causes before the end of the operation. As the shortage of medical staff was probably the greatest continuing problem, it was only as a result of continuous strenuous effort and dedication from the staff from the Red Cross, Medecin sans Frontiers, Merlin and other non-government organisations that this result was possible.

A number of villages had completely disappeared, having slipped down the steep slopes or been buried by landslides. In others, virtually every house had collapsed, many casualties having been caused by roof poles slipping off walls during the long tremor. The roofs then fell into the houses burying the occupants under timber and earth. Debris also fell on the limited food stores left after a long winter, so food was short. The earthquake had also diverted many streams leaving nearby villages with water shortages or depleted or polluted supplies. Landslides throughout the area had resulted in the loss of some wheat crops due for harvesting while other slopes showed signs of slippage that rendered them unsafe.

Relief operations

In the first week after the earthquake only two or three helicopters were available and these were fully committed to casualty evacuation and assessment and medical team deployment. Initially there were few supplies to deliver, mainly limited wheat stocks from the local World Food Programme store and a few tarpaulins and rolls of plastic sheeting. The weather in the first two weeks was sometimes marginal for helicopter operations with low cloud around the hills (which rose to 4,000 metres) and afternoon storms. Deliveries of other supplies from Pakistan and Tajikistan began to increase later in the week and gradually stocks of needed items built up. As the main casualty evacuation workload was cleared, it was possible to begin shelter and food deliveries. Most of the shelter, medical and miscellaneous supplies were delivered by air to the two airfields in the area in up to six Antonov sorties per day. The helicopters, which returned to Dushanbe in Tajikistan overnight, also brought in some supplies but their main load was fuel to enable them to operate for as long as possible. A World Food Programme convoy of wheat that had been despatched before the earthquake for development purposes was also on its way but was delayed by poor roads. Its whereabouts was unknown for about a week and it eventually arrived in the third week.

In the eastern part of the affected area, relief could only be delivered by helicopter or donkey, as there were no roads. In the end it was only necessary to move about 100 tonnes by donkey but when the weather was bad, plans were being prepared for deliveries using up to 2,000 donkeys in convoy. The western part of the area was slightly better off as it had a road link to Tajikistan and there were roads into the earthquake area, which were gradually being cleared by a French non-government organisation. Using these it was possible to deliver supplies to freight heads for collection by donkey teams from individual villages.

An aerial view of landslides in the hill areas

As helicopter numbers increased, so did the effectiveness of the relief operation. Assessments they continued throughout the operation and the scale of needs became daunting. The following is the table for Faizabad alone on 26 June:

At the peak of the relief operation, helicopters delivered up to 75 tonnes per day despite limited flying hours. All available relief supplies had been delivered by 9 July when the international relief team withdrew.

Practicalities

The following comments on practicalities of the operation show how different it was from a relief operation in this part of the world.

Shelter

As aftershocks continued the local population eventually refused to sleep inside their

houses. This was fortunate as during my second week in-country, one complete village was buried and twenty houses from another slipped down the mountain. Fortunately, because of the caution of the inhabitants there were no casualties. Nevertheless this caution meant that shelter had to be provided for everyone in the area. Initially this took the form of plastic sheeting which could be delivered quickly but tents and tarpaulins were provided as soon as they were available. Culturally the sharing of shelter with other families was unacceptable and additional tarpaulins had to be supplied to meet purdah needs in this strict Muslim society.

	Item	Supplied to 26-6-98	Total needed to complete deliveries	Current stock
Food (mt)	Wheat grain	283.75	323.40	105.45
	Vegetable oil	14.10	16.25	22.00
	Pulses	19.75	40.75	5.20
Non-food	Tents	204	2821	1576
	Plastic sheeting (rolls)	479	293	31
	Tarpaulins	180	5869	601
	Blankets	14180	16650	3250
	Water containers	3318	2748	1336
	Cooking sets/pots	3430	3219	277
	Soap	5374	12472	28440

Distribution

Fortunately the relief teams were able to build on the experience of the previous earthquake to identify channels for distribution. Each village had a mosque and a local council based on that mosque so those councils were given responsibility for distribution of supplies. Supplies were distributed to villages on the basis of assesed population, casualties and damage and this basis was explained to the councils but the details of distribution were left to the council. Random monitoring checks showed that distribution was generally fair although the basis of distribution sometimes differed from that intended.

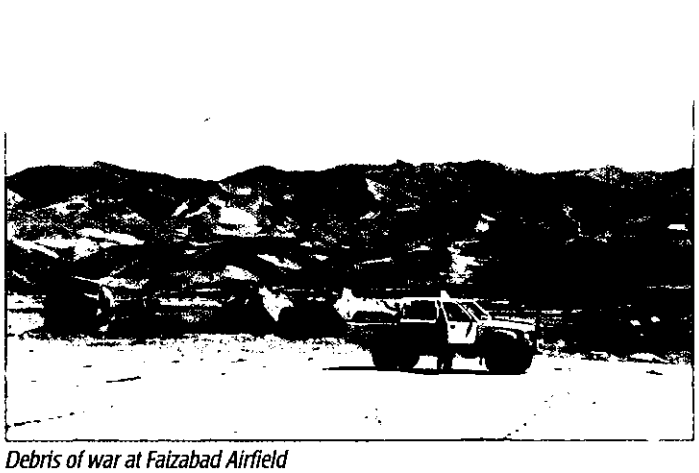
Initially delivery of supplies was dependent on what was available at the base. As a result different villages received different supplies and friction began to develop. Threats were made that villagers might fire on helicopters or kidnap aircrew if they did not receive more equitable treatment. As a result, relief deliveries were suspended for two days and discussions were held with three local strong leaders to solve these and other problems. It was these discussions that found me in the situation described at the beginning of the article. These leaders, known as 'Commanders' were really local war lords with varying but not inconsiderable arsenals of weapons and fighting men under their control. They depended for their power on being able to meet the needs of those men and consequently would drive a hard bargain. The discussions were not always polite or pleasant but in the end it was possible to agree a system that met the needs of the people, the international community and the Commanders. Under the agreement, supplies were delivered to main centres and collected from those centres by donkey convoys from the individual villages. One of the Commander's men and one of the relief team would jointly supervise distribution to the village teams. This system worked well and speeded up deliveries as well as reducing tension.

Air operations

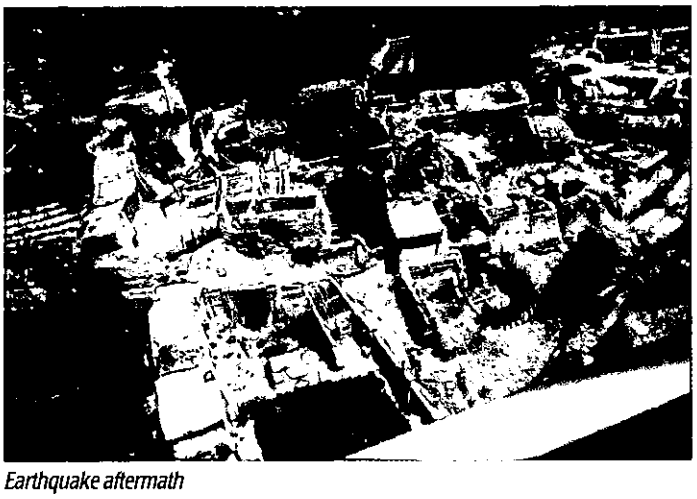
Air operations were not as straightforward as might have been expected. Apart from the runway and weather problems mentioned above (which were augmented by dust reduced visibility on some later days) the main problems related to the basing of the helicopters and the supply of fuel. All helicopters except the Bell were based at Dushanbe in Tajikistan where a local 'godfather' ran the airport and the local charter company supplying some of the helicopters. He seemed determined to make operations profitable to himself and awkward for the international team. Eventually a team of three UN and two Red Cross staff were stationed there permanently just to coordinate that end of the operation. Air movements in and out of the airport were controlled by the 'godfather' and the Russian Border Police, who could and did close the border at various times—occasionally without notice. Part way through the operation the airport controller decided that helicopters that he did not own could not be based at the airport. After extensive negotiations arrangements were made to load them at Dushanbe airport but they would have to 'overnight' at a nearby military base.

Fuel was another constant problem. There was no fuel in the earthquake area and initially drums were collected in Pakistan, flown to Dushanbe to be filled then delivered to Faizabad to refuel helicopters. Unfortunately an early drum had not been properly cleaned and one of the Tajik helicopters had a fuel filter blockage. Thereafter the helicopters would not fuel from the drums and were limited each day to about three hours effective flying using their internal and external fuel and a mobile tank they brought in on arrival in the morning. As later helicopters did not have the same capacity some were limited to only one delivery flight per day. Eventually, when the giant Mi26s arrived, flying in a small fuel bowser and refuelling it each day from the Mi26 solved the problem. Even with this arrangement it was rare for more than four hours to be flown each day.

The capacity of the nine Mi8s used for deliveries varied quite considerably because



Debris of war at Faizabad Airfield



Earthquake aftermath

of different engines and equipment fits. Flying in high country, often in gusty wind conditions, required the maintenance of considerable safety margins. Eventually it was necessary to allocate each individual helicopter its own landing spot and to build loads at that spot to the agreed capacity of the aircraft.

The eventual provision of the six-seat Bell Longranger made a difference to operations out of all proportion to its size. No longer was it necessary to pull a transport helicopter off-line for vital liaison tasks or rapid medical evacuations. For future operations of this type provision of such a resource should have high priority.

Communications

As in most relief operations, communications were vital. All agencies had portable satellite terminals and these were the main link with the outside world. High frequency (HF) radios were used to Dushanbe but the distance to Rustaq, the sub-base, made their use for that vital link marginal. Interestingly, virtually all the HF equipment used was Australian in origin.

Liaison with the National Government

The Northern Alliance is one party to a civil war and only controls a small part of the country. It has limited resources and can hardly be called a national government. The Alliance had no capacity to provide relief and was grateful for the assistance provided to people in its area of control. Although the relief team kept Provincial Governors advised of our activities and flew them to see the damage, there was no joint activity. There was closer cooperation with local 'commanders' who were the real power in their area. They usually had a good idea of the situation throughout their area and, when cooperative, made delivery of relief very much easier.

Security

Despite the widespread carriage of small arms, there were no real security problems. Each part of the airfield was checked for mines and ammunition before it was used and all staff were warned to keep off the derelict military hardware in case of booby traps. Small arms fire and even mortar and rocket fire was often heard in the evenings but this was described by the locals as 'happy shooting' not aimed at anyone. On nights before detachments left town to join the forces fighting the Taliban, the volume of fire was considerably higher as they tested their weapons. The civil war did not intrude on relief activities and the closest threat was a report that Taliban artillery had penetrated to 30 km away but this was never confirmed. Nevertheless, it was necessary to monitor the number of foreign relief workers in the area and to have contingency plans for emergency evacuation.

Relief team conditions

All agencies lived in very basic conditions with staff sleeping on the floor, eating very basic food and using marginally safe water supplies. There was no running water or sewerage and outbreaks of viral diarrhoea were common. Fleas were rife in some of the accommodation and could be very annoying. In general it was found that two weeks in area was enough. After that a break was needed. Few people showed obvious signs of stress but the lightening of pressure when they left was usually very apparent.

Inter-agency cooperation

This was evidently the first major international relief operation on which the UN and Red Cross agencies had worked as the major players in such close cooperation and with the participation of so many NGOs. In general this cooperation worked well in the field with clear lines of responsibility agreed and excellent sharing of information. There were some problems in cooperation outside the country where the agencies were not working so closely together and had some 'turf' baggage. As a result the relief supply priorities set by the teams in Faizabad and Rustaq were not always met and unwanted or excess items appeared occasionally.

To ensure that all agencies were aware of developments there were regular evening briefings attended by all agencies and representatives of the Governor's office at which situation reports were given and plans discussed. These forums were found to be vital for identifying developing needs, setting priorities, smoothing out difficulties and bringing complaints out into the open. They also enabled all participants to share experience more freely. It was surprising how often a small NGO had experience that was of value to all present and might not have been shared without this regular forum.

Even within the UN agencies, which do not always work well together, field cooperation was generally good once the need for sharing information had been understood. All agencies with offices in the region provided staff to work in the field and at any one time I had staff of many nationalities from at least six UN agencies working on a variety of tasks. They often worked outside their direct experience, yet with a willingness and flexibility not often seen in that ponderous organisation.

Support from outside

The whole relief operation was complex. Overall coordination took place at Islamabad in Pakistan where there were also regular coordination meetings. Relief supplies from the rest of the world were delivered to Peshawar in Pakistan or to Dushanbe. They were then flown or trucked into the affected area and distributed from Faizabad and Rustaq.

The difficulty experienced in conducting detailed assessments of the situation and identifying needs led to delays in delivery which caused some friction with earthquake victims who could not see why their priority needs could not be met immediately. Yet most needs were met and met adequately by the end of the operation.

The hardest need to meet was for helicopters. These took time to arrive (some had flown across from the Moscow area) yet we knew in the field that tremendous efforts were being made to facilitate their early arrival. The number eventually supplied was a credit to all concerned.

Relief aircraft also brought in vital equipment for running the relief operation. Most needs were met quickly and without argument with such vital items as bottled water, supplementary foods, stationery and spare parts usually arriving within 48 hours of the request. This level of support took a great pressure off those working in the field

Rehabilitation

Rehabilitation was not the function of this mission but it was very much in the minds of all relief workers. We were aware that the summer was short and that earthquake victims would need more substantial shelter by the end of September. It was also vital that they harvest the surviving crops and get them into safe storage for the winter. Any shortfalls would need to be made up with supplementary deliveries. Some of the relief agencies had no rehabilitation role but the remainder began meeting, under UN auspices, two weeks after the earthquake and projects to develop more earthquake resistant housing and improved water supplies were quickly initiated.

Finally!

What in the hell was I doing there?

I was being challenged, tested and stretched. I was being given a privilege few Australians get (I wasn't the only one—there was an Australian nurse from Wagga Wagga in the Red Cross team and there were at least two New Zealanders in the operation too) to help in the rest of the world.

I was being given the opportunity to apply all that I had learned in seventeen years in emergency management. And, I'll admit, I was enjoying myself.

Damage: the truth but not the whole truth

by Russell Blong
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Introduction

Disaster management at its best is concerned with reducing the risks offered to people, buildings, infrastructure, and a range of economic activities. Too often it is concerned with little more than saving lives, saving the little that can be saved immediately before the impact, cleaning up after the event, and providing short- and long-term disaster relief.

Damage reduction for buildings, infrastructure or economic activity is at least half of what disaster management is about—and it is the neglected half as most emphasis has gone into saving lives and reducing trauma, both physical and mental. The theme of this paper is 'we don't know much about damage, so how can we manage disasters?'

Defining damage

Losses in natural disasters can be divided into *direct* (when damage is produced by physical contact with the hazard agent or debris) and *indirect* (when the losses result from the disruption of normal economic and social activities during and after the impact, for example disruption to transport, industrial or agricultural production and the cost of clean up). Tangible damages can normally be valued in monetary terms, while intangible losses include items that are not normally bought or sold (Handmer, 1989).

This paper is mainly concerned with direct tangible damage to property; in particular the concern is with damage to buildings, particularly small buildings including houses and their contents. While this is a rather limited definition of damage, the emphasis is warranted by Walker's (1987) observation that small buildings comprise more than half the capital value of all buildings and in aggregate they are occupied by more people than large buildings for more of the time. For some communities, small buildings will be 100% of all buildings.

Who pays for damage?

Figuring who pays for damage in Australian natural disasters is no small task. Leigh (1998a, 1998b) produced estimates for four events. These data, summarised in *Figure 1*, are likely to include most direct tangible damage and some indirect or intangible losses from the four events.

Figure 1 indicates that the proportion of the cost borne by the affected parties varied from 9 to 38% and the percentage shouldered by governments (i.e. taxpayers) ranged from 21 to 65%.

Contributions from charity ranged from 2 to 17%, though one might draw the conclusion that the charitable contribution is generally well below 10%. Insurance paid from 9 to 39% of the total cost. The varying proportions paid by each group rely on a host of factors including the size of the disaster, the role of the media, the nature of the damage, and the degree of under- or non-insurance.

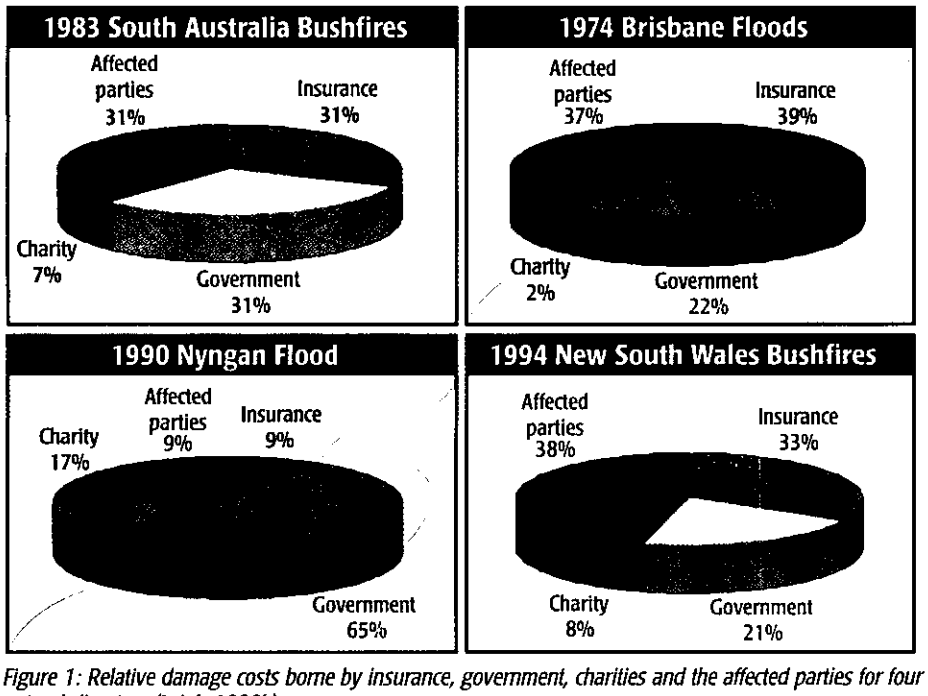

Figure 1: Relative damage costs borne by insurance, government, charities and the affected parties for four natural disasters (Leigh 1998b)

The proportions estimated in *Figure 1* are, no doubt, quite reasonable and it would require a lot of work to improve on them. These estimates probably encompass most of the range in the proportions for bushfires and floods, but they may not reflect the breakdown for other hazards.

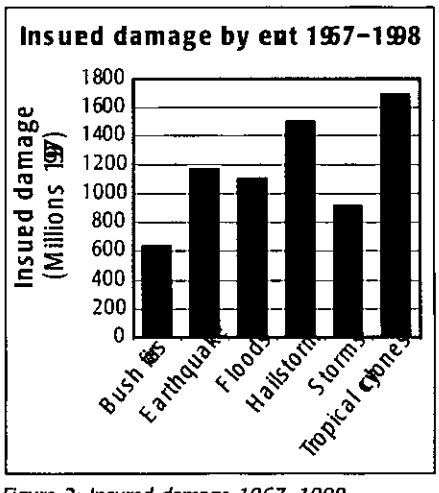

Figure 2: Insured damage 1967–1998 (based on ICA data)

Insurance data

Since 1967 the Insurance Council of Australia (ICA) have collected data on the costs of claims paid resulting from major events. For the early period only those events producing aggregate losses greater than $2 million were included; later this cutoff was changed to $10 million. For most events only the claims paid by ICA members are included. The ICA estimates are dominated by direct tangible damage, but clean-up costs and business interruption payments (indirect tangible losses) will be included in some cases. Some significant companies such as the GIO (with >10% of the national property market), remain outside the ICA so it is likely that these are underestimates.

Expressed in 1997 dollars, the 106 events in the ICA database total $7.068 billion for the period 1967–1998. *Figure 2* indicates that tropical cyclones account for nearly one-quarter of all claims paid, hailstorms more than one-fifth, and earthquakes and floods one-sixth each. *Figure 3* indicates the mean loss per event. Earthquakes plot in a class of their own because of the Newcastle earthquake ($1.124 billion in 1997 dollars), with all other hazards grouped. Of the total payout of $7.068 billion, 47% is for losses in New South Wales and 20% in Queensland.

Fifteen events in the ICA list have produced losses of more than $100 million, including 5 hailstorms, 3 tropical cyclones, 2 floods, 2 bushfires, 2 storms and one earthquake. *Table 1* lists in descending order

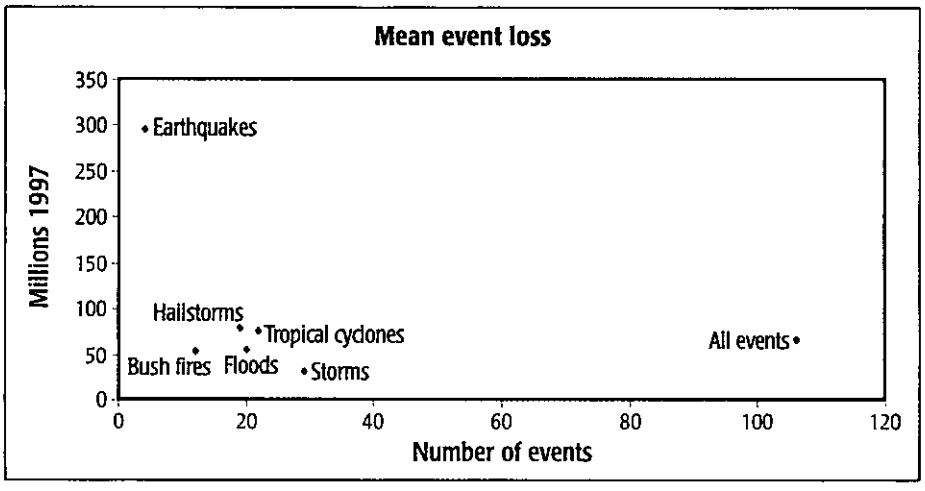

Figure 3: Number of hazard impacts and mean insured losses per event, 1967–1998 (based on ICA data).

those events producing total insurance claims greater than $200 million. These 7 events produced a total loss of $3.453 billion, or nearly 49% of insured losses in the 32-year period. The Newcastle earthquake and Cyclone Tracy together represent 28% of the total insurance payments. It is noteworthy that six different insured perils are included in the seven events (though storms and hailstorms could both be considered thunderstorms).

Table 1 illustrates the dominance of a few events in the insurance loss statistics and that a range of hazards can produce big insurance losses. The most expensive year in the insurance record was 1974 with just two events contributing 16% of the aggregate loss for the 31-year period. The summer of 1989–1990 contributed 21% of the total. *Table 1* suggests that, on average, the insurance industry might anticipate a $200 million loss for a single event once in 4 or 5 years. Such losses come from any of half a dozen hazards.

Insured and total damage

Chris Joy (1991) provided a summary indicating the subjective impressions of ratios of insured loss to total loss based on the experience of an unknown source in the ICA rather than analytical estimates. These estimates are reproduced here as *Table 2*. Zero values indicate that damage produced by these hazards is not insurable.

The 10% ratio for floods in *Table 2* can be compared with the proportions of 9% and 39% in *Figure 1*. Similarly, the 35% for bushfires can be compared with 31% and 33% in *Figure 1*. However, in 1991 Chris Ryan, based on detailed Bureau of Meteorology estimates, suggested the ratio for bushfires was about 12% (Blong, 1992).

The ratio of insured to uninsured losses is complicated by the fact that significant numbers of buildings and contents are uninsured or underinsured. A recent survey by the Insurance Council (ICA, 1966) suggests that 9% of buildings and 39% of contents are uninsured. For owner-occupied houses about 9% of the buildings and about 20% of the contents have no insurance. Surveys following the 1989 earthquake suggest that the uninsured buildings and contents figures were 4% and 40% respectively. Similar figures for the 1994 NSW bushfires were 18% and 52%. Buildings and contents under-insurance percentages are higher than the estimates for un-insurance.

There may well be marked regional differences in non-insurance and underinsurance, reflecting a range of socio-economic factors. Certainly, the proportion of non-insured households (either buildings and contents or just contents) increased from 28.8% to 31.2% between 1988 and 1993 (ICA, 1996).

These aspects suggest that it will be difficult to use a single ratio of insured to total damage for each natural hazard. It is clear that considerable further work is necessary to produce useable estimates of insured and total direct loss ratios.

What gets damaged?

The insurance data, coupled with the broad figures on who pays and the ratios of insured to total costs, indicate that there is a lot of damage out there. One of the big questions is: 'what gets damaged?'

This question can be considered at two levels. Firstly, for some of the insurance data broad breakdowns into classes of insurance are available for some recent events. Some of these data are summarised in *Table 3*. These estimates should be regarded as preliminary, particularly for the 1998 events.

Domestic household losses (buildings and contents) range from 21 to 56% across the 5 events, perhaps suggesting that for more events this range might be as much as threefold. This is perhaps about the same range as for motor vehicles, while the range for commercial losses appears to be greater. While it is not surprising that the motor vehicle losses form such a significant proportion of the total claim for hailstorms, it is more surprising that such claims are so significant in the storms and floods in *Table 3*.

Instructive as *Table 3* is, these data don't get to the core of what gets damaged. Which buildings are most damaged, or damaged most frequently? Unless such estimates can be made, damage management cannot be risk-based.

Table 4 provides a brief example from the 21 January 1991 thunderstorm in Sydney. Damage to buildings was produced by wind gusts up to 230 kmh, hail to 7cm diameter and rainfall exceeding the 1-in-100 year falls in some suburbs. At least 50,000 trees were blown over, snapped off or suffered long-term damage. Household insurance claims numbered more than 28,000 (Blong, 1997). *Table 4* is based on insurance data—presumably, these data suffer from the limitations already discussed.

Table 4 indicates that claims were made for damage to brick houses preferentially and that claims for brick and fibro houses

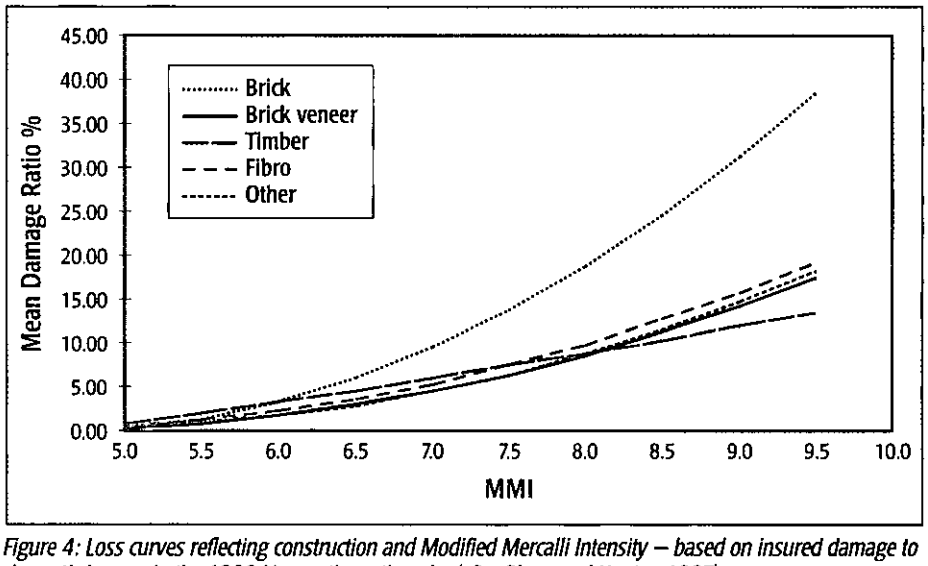

Figure 4: Loss curves reflecting construction and Modified Mercalli Intensity – based on insured damage to domestic houses in the 1989 Newcastle earthquake (after Blong and Hunter, 1997).

Date	Event	Location	$ million (Dec 1997)
1989 *December*	Earthquake	*Newcastle, NSW*	1124
1974 *December*	Cyclone Tracy	*Darwin, NT*	837
1990 *March*	Hailstorm	*Sydney, NSW*	384
1974 *January*	Floods	*Brisbane and Qld*	328
1985 *January*	Hailstorm	*Brisbane, Qld*	299
1983 *February*	Bushfires *(Ash Wednesday)*	*Victoria and SA*	255
1991 *January*	Storms	*Sydney, NSW*	226

Table 1: The big seven insured losses

Hazard	Ratio
Drought	0.00
Bushfires	0.35
Storms	0.35
Floods	0.10
Cyclones	0.20
Earthquakes	0.25
Storm surge	0.00
Coastal erosion	0.00

Table 2: Ratio of insured loss to total loss (Joy, 1991)

were more expensive relative to the sums insured. Surprisingly, there were fewer claims for fibro houses and these claims were cheaper than one might anticipate.

While the data in *Table 4* provide a firmer grip on damage, we still don't know the distribution of damage with respect to the intensity of the storm. It is possible that brick houses were damaged preferentially because they were located in the areas where the storm was most intense, or on the terrain and topography most exposed to the strongest wind gusts, or in those areas with the most trees.

We also need detailed damage surveys that record for each hazard the building elements and contents items that are damaged and the extent of damage to each element or item. Damage surveys only rarely record the incidence of items that are not damaged—a major flaw in the survey methodology. For example, there is a suggestion that houses with (heavy) tiled roofs were damaged preferentially compared with houses with lighter roofing materials in the 1989 Newcastle earthquake. While we have data on the locations of (insured) damaged houses and the costs of repairs down to the level of street addresses we don't know which houses had tiled roofs.

Smith *et al.* (1990) provide a valuable example of a detailed residential damage survey following the 1986 Toongabbie Creek floods in Sydney's west. *Table 5* summarises the Youth and Community Services' (YACS) component of the survey, based on average relief payments to 527 properties experiencing overfloor flooding.

Clearly, *Table 5* allows a great deal to be inferred about the items that are damaged by above floor flooding, contributions to the total cost, the distribution of damage from room to room etc. This particular table does not, however, establish a relationship between the extent of damage to items and the depth of overfloor flooding. Moreover, as Smith *et al.* (1990) point out the damage estimates provided by loss adjusters for a sample of 72 residences averaged 30% more than the YACS estimates in *Table 5*.

There are some valuable data in *Tables 3, 4, and 5*. A variety of damage surveys provide data in relation to a number of natural hazard impacts in Australia, even though many of these surveys can be found wanting from the point of view of the researcher and, I suggest, the disaster manager.

The number of buildings damaged, the proportion of buildings damaged, damages expressed as equivalent buildings, loss ratios, qualitative damage scales, loss curves. Each measure of damage is different. Each measure focuses on a different aspect of damage. Each measure has a different use. Perhaps we need to consider which measures are most appropriate for disaster management?

Researchers and disaster managers need more carefully designed damage surveys—surveys that not only locate damage adequately in terms of latitude and longitude but also place damage in the context of undamaged property. We need damage surveys for all natural hazard impacts. This year alone we have missed opportunities to collect valuable damage data in relation to floods in Katherine, Townsville, East Gippsland, Narrabri and other towns in the northwest of NSW, and Wollongong as well as the Sissano tsunami in Papua New Guinea. We probably need to consider the sort of organisation and multi-disciplinary membership of survey teams utilised by the New Zealand National Society for Earthquake Engineering.

Damage and disaster management

In the terms presented at the beginning of this report, disaster management is an exercise in risk management. Risk management is a process that begins with *risk identification*, proceeds through *risk analysis* and *risk reduction* to *risk transfer*, whereby the intractable risks are passed on to someone else. Unless risk management proceeds through these steps in an orderly and sequential fashion it is difficult to be sure that one is passing on the right risks.

	Domestic household non-farm	Farm and domestic & commercial	Commercial	Motor	Total no. of claims
Katherine flood, *January 1998*	40.5	0.7	42.4	16.5	2747
Townsville cyclone and flood, *January 1998*	42.7	0.6	47.2	9.5	9643
Coffs Harbour storm, *November 1996*	21.3	1.4	63.9	13.4	2203
Armidale hailstorm, *September 1996*	55.7	7.3	20.1	17.0	10 364
Singleton hailstorm, *December 1996*	55.4	2.0	18.7	23.8	4692

Table 3: Insured damage in selected categories (%) (Source: ICA statistics)

	Brick %	Timber %	Fibro %	Other %
Policies	80.6	5.8	10.8	3.8
Claims	89.0	4.8	4.9	1.3
Total sums insured	86.2	4.6	7.2	2.0
Sum of claims	90.4	5.5	2.9	1.3

Table 4: Summary data household damage–21 January 1991 Sydney thunderstorm (after Blong, 1997)

Item	% of total cost
Structure	**20.8**
Contents	
Floor coverings	21.3
Furniture	8.0
Bedding and bedrooms	8.2
Lounge	4.9
Kitchen	2.5
Refrigerator	4.2
Stove	1.5
Washing machine	3.9
Clothes/personal	9.7
Other	6.2
Contingencies	8.8
Total	**100.0**

Table 5: Average residential damage components – 1985 Toongabbie floods (after Smith et al., 1990)

The 1998 Wollongong rainfalls, floods and landslides have demonstrated the ability of politicians at all levels of government to sidestep the first three stages of the risk management process. To be even-handed, the 1996 Coffs Harbour and the 1998 Katherine floods allowed some insurers to implement a process of risk acceptance (the reverse of risk transfer!) even when their policies quite clearly stated that the flood damage was not covered.

The above analysis suggests that we should not be complacent about the damage statistics that we have available as equipment to focus disaster management on risk reduction or risk transfer. We have not progressed very far along the risk management chain; it can be argued that there is considerable room for improvement in risk identification and risk analysis.

How would disaster management be improved if we had better information about damage? There are probably a lot of answers to this question but I will focus on just four.

Warnings

At 0215 on Tuesday 29 January 1974 the Brisbane River peaked at 6.60 metres on the Port Office gauge. Twelve and a half hours earlier the Bureau of Meteorology issued a flood warning that predicted the flood height to within 11 cm and the timing of the flood crest to within 15 minutes (Heatherwick, 1974). Despite the accuracy and timeliness of this warning, significant damage occurred to house contents and vehicles. While there were undoubtedly a variety of reasons that the *actual* damage was close to the *potential* damage (cf Smith, 1994), one of the key factors was that few people understood how a flood height on the Port Office gauge related to their local situation. Technically the flood warning was as good as it could get; in practice, too many of those at risk failed to respond in an appropriate fashion.

Some of the data in *Tables 3* and *5* suggest that moveable objects such as motor vehicles and a range of small, valuable household contents are still damaged unnecessarily. Detailed surveys indicate frequencies and values of items that are damaged in disaster impacts. The challenge for disaster management is to focus warnings and responses to warnings so that the gap between actual and potential damage is increased.

Building codes and building advice

Australian building codes seem to make a pretty good job of providing design requirements for small buildings in many situations. The earthquake code (AS1170.4 –1993), for example, has provisions for domestic structures and specifies earthquake coefficients for a range of architectural components such as parapets, connectors for wall attachments storage shelves etc. The New Zealand Standard, *Seismic restraint of building contents*, (NZS 4104–1994) provides many more details, although the contents domestic dwellings are excluded unless specifically requested by an owner or occupier. A new standard has also been released with details for the upgrading of existing buildings (AS3826–1998 *Strengthening existing buildings for earthquake*).

The language of most standards is hardly transparent, being designed for specialist engineering audiences. However, Standards Australia Committee BD/64 on *Construction in bushfire-prone areas* was unable to reach agreement, resulting in the publication by Standards Australia and CSIRO of the excellent volume *Building in bushfire-prone areas—information and advice* (SAA HB 36–1993), intended for general consumption. It is noteworthy that so much of the advice in this volume stems from detailed CSIRO damage surveys in the aftermath of the 1983 Ash Wednesday bushfires.

Obviously, the substantial costs of building damage are borne by insurers, individuals, or communities. The starting point for improved building codes and appropriate building advice must be carefully-thought-out damage surveys.

Hazards that have been neglected in Australia in terms of both building codes and specific user-friendly advice include hailstorms and floods. This neglect is surprising given the importance of these hazards. For the Singleton (1996), Armidale (1996) and Sydney (1990) hailstorms the average domestic insurance claim for (predominantly) hail damage ranged from $5500–10900. Similarly, 1986 Sydney flood damage averaged $4800–6250 for houses flooded to overfloor depths (Smith *et al*, 1990).

The average insured damage claim for domestic structures from the Newcastle earthquake was about $8430. There were almost 64,000 household (buildings or contents) claims (Blong, 1995). There were about 30,000 household insurance claims from the 18 March 1990 Sydney hailstorm. The recurrence interval of this hailstorm is in the range 20–25 years (Andrews and Blong, 1997). The return period of the Newcastle earthquake is certainly less than once in several hundred years and may well be in the range of once in thousands to even tens of thousands of years. If all these values are roughly correct, for a reasonably long record the total household damage bill from hailstorms will be at least an order of magnitude greater than that from earthquakes.

Data presented earlier suggested that floods may be more important than hailstorms from the point of view of damage to small buildings. Perhaps our efforts with building codes and building advice require an additional focus?

Land use planning

Dr John Tomblin, until recently a senior member of the UNDHR team, once observed that successful mitigation is a succession of non-events. If all houses located on bushfire-prone slopes and aspects were designed appropriately and built of the most resistant materials, would bushfire vulnerability be reduced? If the soft soil site factor for domestic structures under earthquake loads was enforced (instead of being waived when the soil profile is not known), would we eventually see a reduction in damage to houses on soft clays, loose sands and uncontrolled fill? Do the topography and terrain factors in the wind code adequately reflect the associated risks? Presumably, the answer to all of these questions is 'yes', and rigorous application of these land-use planning principles has increased or would increase the number of non-events.

Hailstorms and floods lie at opposite extremes in relation to the value of land use planning. Despite assertions to the contrary, it is difficult to find evidence in cities like Sydney that some areas are more hail-prone than others. However, it must be conceded that not nearly enough effort has gone into the task.

On the other hand, for floods it is reasonably easy to identify the floodplain areas that are prone to riverine floods. It may be a reasonably straightforward task to delineate areas at risk from flash floods. New South Wales seems to have made a reasonable job of delimiting the 1:100 year flood on major rivers and in controlling building development below this level, at least in the last 15 years. Other states have been much less focussed on reducing flood damage.

My assessment is that the broad pattern of building codes and land use planning provides an invaluable start to risk reduction but that much more can be done with the detail. Integrated approaches to land use planning from the point of view of natural hazards and risk reduction seem to have a long way to go. For example, for most parts of eastern Australia, the return period for a Newcastle-size earthquake (M_L 5.6) is quite low—for Melbourne an M_L 5 to 6 earthquake has an estimated recurrence interval of 16,000 to 84,000 years per 1000 km^2 (Berryman *et al*, 1995).

On the other hand the 1:100 year flood has a 67% chance (on average) of occurring in a 100-year period. If the earthquake return periods for Melbourne are roughly correct (and it would be difficult to argue that they are much better than a guess), we can expect a Probable Maximum Flood in about the same time period.

Why are there such apparent discrepancies in our approach to land use planning?

Modelling damage in future disasters

Improved computer models of future disasters have several practical applications. For the moment assume that we have a good understanding of the physics of ground motion in earthquakes, wind gusts in the boundary layer, and the return periods for earthquakes, tropical cyclones, and thunderstorms. The additional data we require to build worthwhile damage models includes some form of loss curve which synthesises hazard intensity, building damage, building value, construction type and age. Damage models are much improved if each structure at risk can be located in terms of latitude and longitude. *Figure 4* (see page 8) provides an example of loss curves that take account of some of these factors.

The amount of detail required to build reasonably sophisticated models far exceeds the data available. Analysis of the building damage produced by the Newcastle earthquake (*Figure 4*) suggests that the most important single piece of information required about domestic houses is whether they are of double brick construction or some other construction (brick veneer, timber, fibro etc). At a more detailed level, it appears that the presence of heavy tile roofs adds to inertial forces and building damage.

Information, which allows distinctions between double brick and brick veneer construction to be made routinely, is collected by few local governments. Few insurers are able to make such differentiations for their entire portfolios. While we might have quite a deal of information about building vulnerability at a generic level, disaster management requires such information at the individual house level. Except for a selected few areas in North Queensland, we don't have enough information to manage damage.

The three examples below illustrate ways in which damage models could be used in Australia, possibly in the near future as all the technology is available. At least the first two disaster reduction strategies are used more or less routinely in North America.

Scenario 1: The damaging M 6.0 earthquake on the other side of the continent reminds our disaster managers that it makes sense to identify the dwellings in their city made most vulnerable to earthquake ground shaking by reasons of geological substrate, location, construction type, building age, quality of maintenance etc.

Scenario 2: After several losses from tropical cyclones insurer A, dismayed by the new reinsurance premiums, withdraws from the Queensland market. Insurer B, on the other hand, adopts a strategy that identifies insureds most at risk using a combination of building, terrain and topographical factors. Insureds will be charged premiums that reflect the contribution of each of these factors to the risks of damage in tropical cyclones.

Scenario 3: As the intense multi-cell thunderstorm that has just tracked across the city's northern suburbs passes out to sea, the disaster management call centre automatically dials the telephone numbers of the most vulnerable residents in the least resilient dwellings, offering practical assistance, reassurance and a prioritised response.

Conclusions

- In this study the focus on damage has been rather narrow with the concern only with small buildings. However, damage to buildings is significant; insurance data averaged over 32 years suggest average annual damage costs of more than $250 million, and total direct damage >$300 million. The latter figure is much larger if uninsured hazards are included, though there is too little information to allow sensible estimates of total damage to be made.
- It is difficult to determine which are the most important perils in terms of total direct damage because existing databases are of insufficient quality. If we take insured losses for individual disasters, the big 4 in descending order of importance are: *earthquake, tropical cyclone, hailstorm, flood*. In terms of events with insured losses >$100 million the big 4 are: *hail, tropical cyclone, flood, bushfire*. For the total number of events with insured losses the order is: *storms, tropical cyclones, floods, hailstorms*. Total insured losses for the 31-year period are in the order: *tropical cyclone, hailstorms, earthquakes, floods*.
- It may be that it is more difficult to determine the most important hazard, in terms of building damage, in Australia than it is elsewhere.
- Further analysis of losses are required to define insured to total damage ratios. However, there can be little doubt that the greatest uninsured losses to small buildings are produced by floods.
- For many natural hazards, we have a reasonable, but far from perfect, understanding of the types of small buildings that get damaged. For many hazards our understanding of the building elements that are damaged preferentially is inadequate. Improved understanding requires that undamaged as well as damaged buildings are surveyed—otherwise it is not possible to determine risk rates and the task of improving building codes and advice is made less efficient.
- Detailed damage surveys are required for all disasters where small buildings are damaged. There is considerable merit in establishing and co-ordinating appropriate response teams at a national level. If such teams existed we would not have missed the opportunities for long-term risk assessment and damage reduction presented by recent events such as the floods in Queensland, the Northern Territory, NSW and Victoria, and the tsunami in Papua New Guinea.
- Land-use planning for natural hazards is at best haphazard. It should include integrated assessments and be risk-based.
- The damage management half of the disaster management industry is in its infancy. The lack of focus on damage issues by the relevant disaster management agencies results from the lack of funds and skills, and the absence of the political will to focus on anything but the short term. In the private sector, insurers too infrequently charge premiums that reflect the real risks of damage to small buildings from natural hazards.

Damage management seems to me to be in crisis—if only for the reason that there isn't nearly enough of it. We have missed numerous opportunities to understand damage and to begin damage risk management. But there will be plenty of future opportunities.

Acknowledgements

Together with other staff in the Natural Hazards Research Centre, I have benefited enormously from the freedom to pursue a range of academic interests as a result of the core funding provided to the Centre by Swiss Re Australia, Guy Carpenter, QBE Insurance Group and Benfield Greig Australia. I would like to thank Chris Henri (Insurance Council of Australia) for providing data and background.

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Bushfire '99 Conference

The next national bushfire conference
Bushfire '99
is to be held from
6–9 July 1999
in Albury, NSW

The theme is
'Flammable Australia:
the fire regimes and biodiversity of a continent'

Co-convenors:
School of Environmental and Information Sciences,
Charles Sturt University, CSIRO and NSW NPWS

The organising committee is anticipating that well over 200 delegates will attend, with several excellent speakers including Dr James Clark, an eminent paleaoecologist from Duke University, North Carolina, USA

Convenor: Mr Brian Lord

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Correction

In the last issue of the *Australian Journal of Emergency Management* an article on page 46 by John Pisaniello and Jennifer McKay, entitled 'The need for private dam safety—a demonstrative case study' contained some small inaccuracies.

A corrected version of the paper is available from the EMA website at http://www.ema.gov.au/pdffiles/vol13/Pisaniello.pdf Note: This article is in Adobe Acrobat format.

The mistake was made when the wrong version was sent for typesetting.

We apologise for the error.

Developing an understanding of urban geohazard risk

by Ken Granger,
Director, AGSO *Cities Project*

Presented at AGSO Cities Project Workshop,
Townsville, 8 July 1998

Introduction

This paper provides an overview of the geohazards risk assessment philosophy and practice that has evolved through the experience gained over the first two years of the Australian Geological Survey Organisation's (AGSO) *Cities Project*. It is offered as a contribution to the ongoing development of a national approach to the adaptation of *AS/NZS 4360:1995 Risk management* (Standards Australia, 1995) to the specific realm of emergency management.

The approach reported here is still somewhat provisional because we are still developing the information, techniques and tools needed to undertake a task as complex as assessing community risk to a multitude of hazards. There are several reasons for this 'provisional' status, not least of which is the need for our approach to be tested in the final step of the risk management process, namely the development of risk mitigation strategies and emergency response options at the community level. The first such application is currently being planned.

The Cities Project

The *Cities Project* was established in 1996 to undertake applied research directed towards the mitigation of the risks that are posed by a range of geohazards and faced by Australian urban communities. The ultimate objective of the project is to facilitate safe, sustainable and prosperous communities. To provide a realistic focus to this research, and to achieve early practical outcomes, the *Cities Project* is using a series of case studies based on Queensland centres to develop and test its science and techniques. Cairns is the first of these case studies, and the results of this study are used here to illustrate our approach.

Our view of geohazards is deliberately very broad and includes *all earth surface processes with the potential to cause loss or harm to the community or the environment.* Whilst our focus is mainly on the potentially fatal acute geohazards such as earthquake, landslide and inundation, the importance of chronic, but economically significant, geohazards such as acid sulphate soil, coastal erosion, reactive clay and dry land salinity, is also recognised.

Such a broadly based program of research obviously demands a multi-disciplinary approach. To enable AGSO, which is a highly focused earth science research agency, to achieve the objectives set for the *Cities Project*, a network of operational, research and supporting partners has been developed. We have been most fortunate in attracting the support of partners of great quality and enthusiasm. They span a very broad range of scientific disciplines, administrative responsibilities and industry sectors.

Of particular value has been the close collaboration with researchers involved in the *Tropical Cyclone Coastal Impacts Program* (*TCCIP*), a multi-agency and multi-disciplinary research program coordinated by the Bureau of Meteorology. The risk assessment approaches adopted under both the *Cities Project* and *TCCIP* are essentially identical, in spite of the different hazard phenomena being addressed.

Risk management

The concept of risk, and the practice of risk management, received a significant boost in Australia with publication of *AS/NZS 4360:1995*. This generic guide provides the philosophical framework within which *Cities Project* studies are developed. That process is outlined in *Figure 1*.

This paper deals largely with the risk identification, risk analysis and risk assessment stages of the process. The tasks of risk prioritisation and risk treatment are left to other stakeholders such as the Cairns City Council and the Queensland Government agencies that have that statutory responsibility.

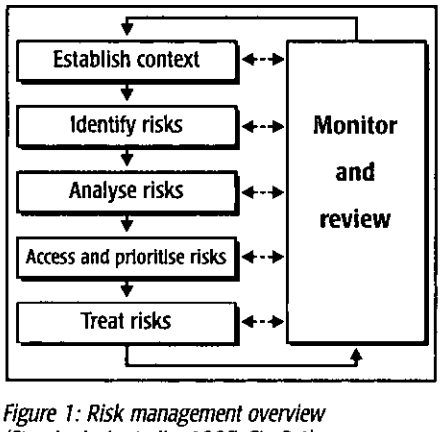

Figure 1: Risk management overview (Standards Australia, 1995, Fig 3.1)

What is Risk?

AS/NZS 4360:1995 (page 5) defines 'risk' as:

'the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood'.

This definition is really too general for our purposes, consequently we have chosen to follow the conceptual basis developed under the Office of the United Nations Disaster Relief Coordinator (UNDRO) in 1979 and cited by Fournier d'Albe (1986) as follows:

- *Natural hazard* means the probability of occurrence, within a specified period of time in a given area, of a potentially damaging natural phenomenon.
- *Vulnerability* means the degree of loss to a given element at risk or set of such elements resulting from the occurrence of a natural phenomenon of a given magnitude.
- *Elements at risk* means the population, buildings and civil engineering works, economic activities, public services, utilities and infrastructure, etc., at risk in a given area.
- *Specific risk* means the expected degree of loss due to a particular natural phenomenon: it is a function of both natural hazard and vulnerability.
- *Risk* (i.e. 'total risk') means the expected number of lives lost, persons injured, damage to property and disruption of economic activity due to a particular natural phenomenon, and consequently the product of specific risk and elements at risk.

Total risk can thus be expressed simply in the following form:

$Risk_{(Total)}$ = Hazard x Vulnerability x Elements at Risk

This approach is not only elegant, it is also very practical. Given the complexity of urban communities and the degree to which the various elements at risk are interdependent, the 'total risk' approach is considered mandatory. Further, it also lends itself equally well to quantitative, qualitative and composite analytical approaches.

Risk mitigation (i.e. moderating the severity of a hazard impact) is the principal objective of risk management. In this

context, risk mitigation might be seen as *the process by which the uncertainties that exist in potentially hazardous situations can be minimised and public (and environmental) safety maximised. The objective is to limit the human, material, economic and environmental cost of an emergency or disaster, and is achieved through a range of strategies from hazard monitoring to the speedy restoration of the affected community after a disaster event.*

It is clear that uncertainty is a key factor, indeed it can be argued that the effectiveness of risk mitigation strategies is inversely proportional to the level of uncertainty that exists. The risk management process, particularly the risk analysis and risk assessment stages is, therefore, clearly aimed at developing the best and most appropriate information with which to reduce that uncertainty.

Risk identification

A detailed understanding of what events have occurred in the past (including paleo events) and their effects provides the basis for understanding what could or will happen in the future, ie it is the key step in the risk identification process. To this end, AGSO has developed catalogues on historic earthquakes, landslides and tsunami events, whilst the Bureau of Meteorology maintains comprehensive collections on severe weather events such as cyclones. The insurance industry maintains some data on the loss associated with such events. The material accumulated by the Newcastle Region Public Library on the 1989 earthquake in that city stands out as an exemplar of the type of comprehensive historical information resource that is needed to underpin community risk assessments. Whilst there is no comparable collection yet available for Cairns, *Figure 2* provides an overview of the 'risk history' of that city.

It is important to note that the earthquake of record occurred in 1896 (felt intensity of MMI 5+), the flood of record occurred in 1911 (15.39 metres gauge height) and the most significant cyclone impact on record was that of 1927 which put a storm tide of about 1 metre above high tide level through the town. In 1927 the population of Cairns was only 10% of its current level! The list does not include Australia's first BLEVE (boiling liquid expanding vapour explosion) accident that occurred in Cairns in 1987 or the numerous bushfires that have occurred in the area.

It is perhaps of little wonder that today there is a widespread belief in Cairns that they face little, if any, risk, from severe natural hazards. The myth of the 'glass wall'

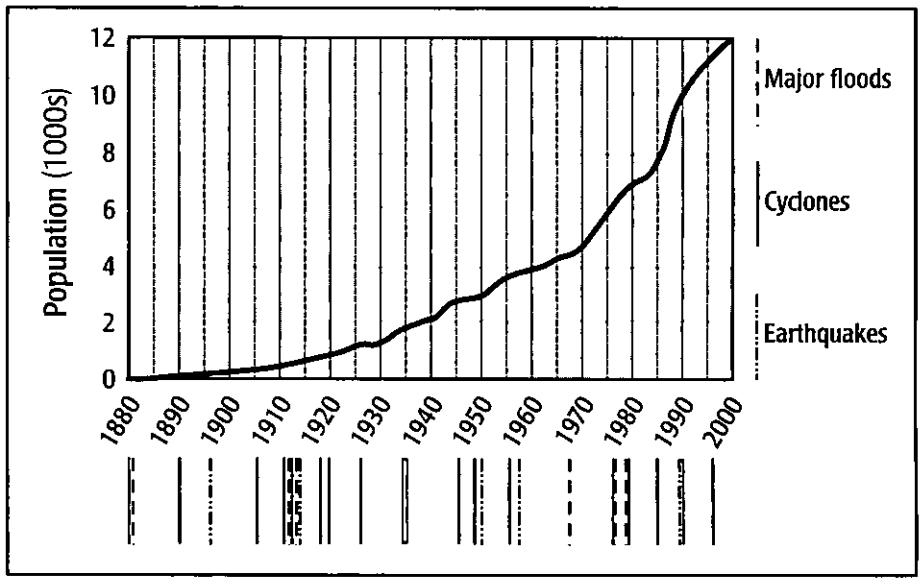

Figure 2: Cairns Risk History

protection provided by the Great 'Barrier' Reef and the hinterland mountains unfortunately has great currency in Cairns.

Risk analysis

Phenomenon process knowledge. The focus of hazard science research is on the mechanisms that cause, create, generate or drive the hazard phenomena e.g. what causes earthquakes and what influences the transmission of their energy through different strata. This is underpinned by information relating to the background climatic, environmental, terrain, ecological and geological aspects of the site that are relevant to hazard studies, e.g. the depth and nature of the sediments and their microtremor response. Whilst there is little that can be done to eliminate or reduce the severity or frequency of these phenomena, a good understanding of what drives them enhances our ability to forecast or predict their behaviour. It is also fundamental to establishing an understanding of event probabilities.

Elements at risk and their vulnerability. This is a relatively new area of study and is focused on developing an understanding of the vulnerability of a wide range of the elements that are at risk within the community e.g. the buildings, infrastructures and people. It draws on disciplines as diverse as geography, engineering, demography, economics and psychology. It is in this aspect that the synergy between the *Cities Project* and *TCCIP* has been most effective, given that the elements at risk are common, regardless of the hazard involved.

A very significant effort has been made to develop very detailed data on the principal elements at risk in the built environment of Cairns, whilst comprehensive statistics of good resolution are available from the quinquennial national census to provide at least basic measures of human vulnerability. The broad groups of elements at risk for which data have been collected in Cairns include:

The Setting. Basic regional data has been accumulated from a very wide range of custodians for themes including the physical environment (climate, vegetation, geology, soils, land use, topography, etc), access (external links by major road, rail, air, marine and telecommunications infrastructures) and administrative arrangements (local government, suburb and other administrative boundaries).

Shelter. The buildings that provide shelter to the community at home, at work and at play vary considerably in their vulnerability to different hazards. A range of information relating to their construction, including materials of the walls and roof, the shape of the roof, the height of the floor above the surrounding ground, the number of stories and the age of the building, is required. These building characteristics contribute to the relative degree of vulnerability associated with exposure to a range of hazards, as shown in *Figure 3*. A database containing such details on more than 33,000[1] individual buildings in Cairns has been developed.

Access to shelter is also significant, so information on mobility within the community is needed. Details of the capacity and vulnerability of the road network and the availability of vehicles, for example, have been acquired, as has the location and status of designated emergency shelters or safe havens. The detailed street network is held in topological form so that the neces-

[1] Collection of this data was made possible by a grant from the Australian Coordinating Committee for the International Decade for Natural Disaster Reduction in 1995.

sary route modelling analysis can be undertaken.

Sustenance. Modern urban communities are highly reliant on their utility and service infrastructures such as water supply, sewerage, power supply and telecommunications. These so-called *lifelines* are significantly dependent on each other and on other logistic resources such as fuel supply (see, for example, Granger, 1997).

The community is also dependent on the availability of food supplies, clothing, medical supplies and other personal items. Information is being accumulated on all of these, as well as on the enterprises that wholesale, distribute and service these sectors (such as transport, material handling equipment and storage). All of the key facilities in Cairns have been identified in the building database and basic data on power and water supply infrastructure are available.

Security. The security of the community can be measured in terms of its health and wealth and by the forms of protection that are provided. Physically, these may be assessed by the availability of facilities such as hospitals, nursing homes, industries, commercial premises, agricultural land use, ambulance stations, fire stations, police stations and works such as levees. Also important are socio-demographic and economic issues related to the elderly, the very young, the disabled, household income, unemployment, home ownership and the resources available at the fire and police stations. Emergency plans are also a key component of community security.

Society. Here we find most of the 'warm and fuzzy' measures such as language, ethnicity, religion, nationality, community and welfare groups, education, awareness, meeting places, cultural activities and so on. Some of these may be measured in terms of the facilities that they use, such as churches, meeting halls, sporting clubs and so on; however, the more meaningful measures relate specifically to the individuals, families and households that make up the community. Extensive use is being made of the detailed data from the 1996 National Census to flesh out our understanding of the socio-demographic and economic dimensions of vulnerability under both the 'security' and 'society' components.

Whilst other approaches to comprehensive risk assessment, such as *HAZUS* (NIBS, 1997), may segment the elements at risk differently, there is very close accord on their overall and individual significance.

Synthesis and modelling. Clearly, the range and variety of information needed to fuel a comprehensive risk analysis is enormous. Whilst there are many sources now available from which such information can be captured or derived, much of it with the essential spatial and temporal attributes needed, there remain important gaps. Our knowledge of hazard phenomena and the processes that drive them, for example, are far from perfect. It is necessary, therefore, to develop appropriate models (process, spatial and temporal) to fill the knowledge gaps. The behaviour of some hazards, such as bushfires and floods, have an established body of modelling research behind them, whilst others, such as cyclones and earthquakes, especially in intraplate areas such as Australia, are as yet, less well served.

Characteristic	Flood	Wind	Hail	Fire	Quake
Building age	•••	•••••	••	•••••	•••••
Floor height or vertical regularity	•••••	•		••••	•••••
Wall material	•••	•••	•••••	••••	••••
Roof material		••••	•••••	••••	•••
Roof pitch		••••	•••	•	
Large unprotected windows	••	•••••	••••	•••••	••
Unlined eaves		•••		•••••	
Number of stories	••••	••		•	•••••
Plan regularity	••	••		•••	•••••
Topography	•••••	••••		••••	•••

Figure 3: Relative contribution of building characteristics to vulnerability

A key aspect of these models is an understanding of the probability of recurrence of events of particular severity and the levels of uncertainty that exist in both the data employed and the models themselves. Given these uncertainties we remain cautious about presenting most of our findings as *predictions* of risk; rather we prefer to caveat them as providing nothing more than *indications* of what the future may hold.

The synthesis of data and the essential mapping of the spatial relationships between the hazard phenomena and the elements at risk requires the use of tools such as geographic information systems (GIS). In the work undertaken in the Cairns case study 85 to 90% of the information used has some form of spatial content. Similarly, the relationships that are most significant in risk analysis and risk assessment are largely spatial. To accommodate this spatial emphasis, the *Cities Project* makes extensive use of GIS tools and technologies.

Whilst GIS have been used over the past decade as tools to address specific aspects of the risk management problem, especially in hazard mapping and the spatial modelling of phenomena such as bushfires, or flood and storm tide inundation, there are few examples of integrated risk management applications. There are obvious advantages in developing a fusion between a philosophy of risk management and the power of GIS as a decision support tool, hence *Risk-GIS* as it has been christened in the *Cities Project*. As such *Risk-GIS* provides the analytical 'engine' which drives the *Cities Project's* urban geohazard risk assessment process. *Risk-GIS* also provides a most potent form of risk communication (an aspect about which *AS/NZS 4360:1995* is unfortunately silent) through its capacity to provide a visual representation of risk situations.

Risk assessment and prioritisation

Scenario analysis. This is an emerging technique that contributes to 'future memory', an understanding of 'what will happen when ...'. The output embraces forecasts or estimates of community risk including economic loss and potential casualties, or assessments of the impact of secondary or consequential hazards, such as the spread of fire or the release of hazardous materials following an earthquake. It also provides essential input to both the development of risk treatment strategies and to framing long-term forecasts or estimates.

In an effort to address the diverse range of applications to which the output from risk scenarios may be put, we have adopted the practice of running a range of scenarios, typically extending from the relatively small and more frequently occurring events to those in the 'maximum probable' or 'maximum credible' range. *Figure 4*, for example, illustrates the cumulative range of risk associated with storm tide inundation scenarios for Cairns. This figure is similar to the 'risk curves' employed by the insurance industry and, indeed, the x-axis could be scaled to dollars of loss or potential fatalities, whilst the y-axis could be scaled (perhaps logarithmically) to event probability.

Acceptability. In the approach to risk assessment set out in *AS/NZS 4360:1995*, it

is the practice to compare the level of risk found during the assessment process with previously established risk criteria, so that it can be judged whether the risk is 'acceptable' or not. At first glance this may seem to be something of a 'chicken-and-egg' process—if you do not know what the level of risk posed by earthquake is in Cairns, for example, how can you realistically determine what level of risk is acceptable?

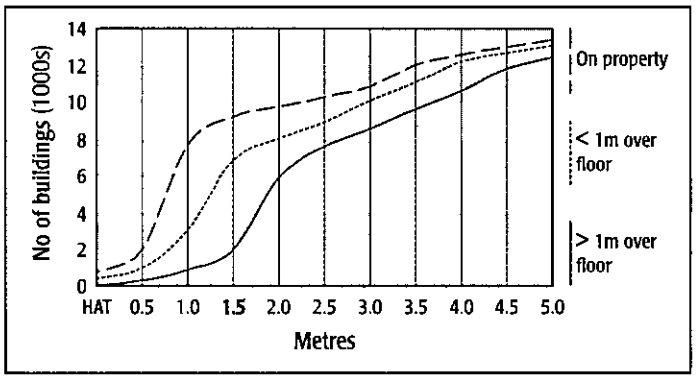

Figure 4: Number of buildings affected by different storm tide scenarios in Cairns with heights above highest astronomical tide (HAT).

Levels of acceptability are, however, 'built in' to such things as urban planning design constraints and the Building Code, where criteria are based on 'design' levels. For example, under the earthquake loading code *AS1170.4–1993 Earthquake Loads* (Standards Australia, 1993), the 'design level of earthquake shaking' is one in which there is an estimated 10% probability of the ground motions being exceeded in a 50 year period i.e. the acceptability criterion is set at a 10% chance of exceedence over the nominal lifetime of a 'typical' building.

Not all acceptability criteria can be expressed as categorically as this because they deal with human nature and the political 'outrage' dimension of risk management. They also vary considerably over time—the threshold of acceptance is typically much lower immediately after a hazard impact than it was immediately before the impact, hence the need for a strong feedback mechanism between establishing acceptability and the formulation of risk mitigation and response strategies.

Perhaps the risk 'formula' could be better expressed as:

Risk $_{(Total)}$ = (Hazard x Vulnerability x Elements at Risk)^{Acceptability}

to reflect the strong modifying influence of acceptability. Clearly, a key element in determining limits of acceptability rests with effective risk communication and public policy development.

The 'acceptability' factor is central to the process of risk prioritisation which is the first step in the allocation of resources to risk mitigation, especially if considered in a multi-hazard context. We are beginning to address the complex issue of comparing the risks posed by hazards with greatly different impact potential. In Cairns, for example, there is a strong spatial correlation between the areas that are most at risk from major inundation hazards (river flooding, storm tide and tsunami) and those in which deep soft sediments are most likely to maximise earthquake impact. Conversely they are the areas that are at least risk from landslide impact and, to some degree, from severe wind impact. Additionally, the impact on the Cairns community of cyclone hazard with a 150-year return period is likely to be more severe than the impact of the shaking associated with a 150-year return period earthquake; but the maximum credible earthquake event may have a greater potential for catastrophe, than the maximum credible cyclone.

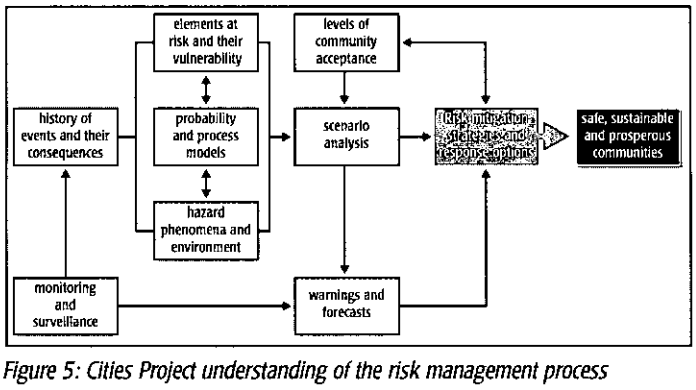

Figure 5: Cities Project understanding of the risk management process

Risk mitigation strategies

Whilst the *Cities Project* is concerned primarily with risk identification, analysis and assessment, it does have some linkage with elements of the risk mitigation process.

Monitoring and surveillance: One of the principal sources of historical hazard event information and hazard phenomenon knowledge is the extensive network of monitoring stations and remote sensing resources that have been established across Australia. For example, the Bureau of Meteorology maintains some 45 weather radar sites, 246 automatic weather stations and 3,029 stream gauging stations, whilst AGSO has access to more than 150 seismographs across the country. The Bureau also takes data from the Japanese Geostationary Meteorological Satellite 26 times a day in addition to data taken from the polar orbiting US NOAA. Whilst weather monitoring of Cairns is comprehensive and has reasonable historical depth, seismic monitoring coverage has until recently been relatively poor, with only the larger (and less frequent) events being measured by distant instruments.

Warnings and forecasts. An effective warning and forecasting system, combined with a high level of community awareness and risk appreciation, is clearly one of the most potent mechanisms by which to achieve risk mitigation. Whilst these warnings are typically taken to mean short-term warnings such as those issued by the Bureau of Meteorology for the hazards that can literally be seen coming, such as cyclones, floods and severe storms, they may also embrace the longer-term estimates of the 'hazardousness' of areas such as those contained in the earthquake hazard (acceleration coefficient) maps that accompany *AS1170.4-1993* or by hazard maps specifically prepared for a city. They can both be significantly enhanced through the scenario analysis process.

Mitigation strategies and response options. Risk assessments are made so that strategies may be developed that ultimately will lead to the elimination, reduction, transfer or acceptance of the risks, and to ensure that the community is prepared to cope with a hazard impact. Whilst the development and implementation of these strategies lie essentially outside the remit of the *Cities Project*, our experience in working with emergency managers and others to date suggests that amongst the most effective strategies are:

- well maintained and appropriate information that is fundamental to risk assessment
- risk-based planning of settlement, development and key facilities (such as hospitals)
- protection plans for key facilities and lifelines
- cost-effective engineered defences such as levees and retrofit programs
- appropriate and enforced building and planning codes
- emergency management plans, resources and training based on risk assessments
- wide-spread and ongoing community awareness programs based on risk history, scenario analysis and an effective risk communication capability.

These components of the *Cities Project's* understanding of the risk management process are illustrated in *Figure 5*.

The bottom line is that if we get all of this right, the outcome will be safer, more sustainable and more prosperous communities.

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Disaster events calendar

❖ 10–13 May 1999, Osaka, Japan

11th Congress of World Association for Disaster and Emergency Medicine (WADEM)

Contact: Secretariat of 11th Congress of WADEM, 1-1, Tsukumodai, Suita City, Osaka, Japan 565-0862; Tel: 81-6-6834-7364) Fax: 81-6-6872-1846
e-mail: wadem11@osk3.3wab.ne.jp

● 10–21 May 1999, Bangkok, Thailand

Third Regional Training Course on 'Community Based Approaches to Disaster Management" (CBDM-3). Offered by: the Asian Disaster Preparedness Center (ADPC)

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ADPC
Asian Institute of Technology
P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand
Tel: (66-2) 524-5378/5354; Fax: (66-2) 524-5360
e-mail: adpc@ait.ac.th
www: http://www.adpc.ait.ac.th/Default.html

❖ 11–13 May 1999, Chicago, Illinois.

PROMIT 98 International Expo: 'Solutions for Natural and Man-Made Disasters' and National Mitigation Summit.

Contact:
National Building Protection Council
6300 Park of Commerce Boulevard
P.O. Box 3051, Boca Raton, FL 33487-82291
Tel: (561) 988-0932; Fax: (561) 241-1247
e-mail: nbpc@nbpc.org
www: http://www.promit.com

● 19–21 May 1999, Cape Town, South Africa

Emergency Services Africa '99

Contact:
Conference Secretary
Suite 157, Postnet X3036, Paarl
Republic of South Africa 7620
Tel: +27 21 590 1702; fax: +27 21 872 1404
e-mail: zacks@mweb.co.za

❖ 24–25 May, Sydney, Landmark Parkroyal

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Developing and implementing detailed plans to ensure provision of essential services over key Y2K impact dates.

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International Quality and Productivity Centre
Level 9, 70 Pitt Street, NSW 2000
Tel: 02 9223 2700; fax: 02 9223 2622
e-mail: michelle@iqpc.com.au

● 25–27 May 1999, Honolulu, Hawaii

Tsunami Symposium

Sponsor: Tsunami Society.

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Tsunami Society
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or call the symposium chairperson
George Curtis (808) 963-6670

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Hemispheric International Decade for Natural Disaster Reduction (IDNDR) Meeting for the Americas: Towards a Reduction in the Impact of Disasters in the 21st Century

Contact:
Helena Molin Valdes
IDNDR Regional Office for Latin America and the Caribbean
c/o Pan American Health Organization
P.O. Box 3745-1000, San Jose, Costa Rica
Tel: (506) 257-3141; fax: (506) 257-2139
e-mail: undpcos.nu.or.cr

❖ 8–11 June 1999 Delft, The Netherlands

Sixth Annual Conference of the International Emergency Management Society – TIEMS '99: 'Contingencies, Emergency, Crisis, and Disaster Management: Defining the Agenda for the Third Millennium'

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TU Delft, P.O. Box 5015, 2600 GA Delft
The Netherlands
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Tel: +31 15 278 34 08; Fax: +31 15 278 34 22
e-mail: tiems@sepa.tudelft.nl
WWW: http://www.sepa.tudelft.nl/ tiems.htm

● 14–16 June 1999 Amsterdam, The Netherlands

International Conference on Disaster Management and Medical Relief (DMMR)

Contact:
DMMR Conference Secretariat
Steven Lohman
Netherlands Ministry of the Interior and Kingdom Relations
Tel: +31 70 302 7011; fax: +31 70 302 1444
e-mail: dmmr@minbiza.nl

❖ 20–23 June 1999 Hamilton, Ontario, Canada

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e-mail: hyd99@im.com.au

❖ 27 July–26 August 1999 Swindon, Wiltshire

12th International Disaster Management Course

Cranfield Disaster Management Centre

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The Administrator, Disaster Management Centre
Cranfield University, RMCS, Shrivenham,
Swindon, Wiltshire, SN6 8LA
Tel: 01793 785287

continued on page 20

Social links and communication actions: Let's think over the communication principles to be adopted in emergency situations

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Presented at the Research Committee on Disasters, World Congress of Sociology, Montreal, Canada, July 1998

Introduction: the need for a social concept

The theory maintained in this paper arose from a certain discomfort and a questioning on the application of emergency measures—specifically the lack of importance given to the voice of the victim and the democratic loss. Is it possible to get people to adopt a social behaviour with no reference to a social concept?

The return to normality often requires a shared in-depth social study that should provide a communication concept much broader than the transmission of authoritarian directives. The large number of disasters the world has encountered in recent years gives us a good opportunity to explore new directions in emergency situation communication.

The shocks are so important that we need to consider more than just the technical aspect. We have to go back to the basic concept. The social destabilisation created by emergencies stresses the importance of thinking over the social link and what it is made of. Because of its dramatisation process, emergencies may make apparent some fundamental mechanisms of society.

Two important concepts: 'social link' and 'communication action'

The *social link* concept came a long way from notorious ancestors. Viviane Chatel (1997) relates this tradition in *Le lien social et l'inachèvement de la modernité*. On his part, Durkheim mainly studied the link between individuals and society. For Durkheim, social belonging follows a triad made of the individual, the group and morals. It is exactly with a will to share these morals that the sociability process is carried on. The individual moves from ***I*** to ***we***. For Durkheim, belonging to a society is the result of a wilful and well-informed agreement to rational collective morals. Max Weber, another notorious ancestor, looked at the social link concept from a very different angle. The individual is a *decoder* of meanings within the society and the integration process is realised according to the principle of social action coherence. It is from the meaning that individuals give to their action that the social concept and the social link may be materialised. We must remember these elements when facing a period of social vulnerability, particularly while examining the role of the media.

However, the author who established a direct relation between social link and communication activities is Jürgen Habermas. His works (1987) on communication action give us a clear and precise study. For Habermas, the communication action is at the centre of the social link. Refusing the principle of instrumental reasoning, he does not accept the theory of a society based on technical parameters but suggests a society made up of individuals who are actors in their own story—informed individuals, subjects able to participate in a public discussion held according to the argumentation rules. This view carries a democracy ideal that suggests that political decisions must be submitted to all members of the society. This action, resulting from a consensus process, will lead to social emancipation. It is impossible to summarise these monumental writings but I will try to isolate some key elements suggested by Habermas.

- Individuals are the essence of society. These individuals are subjects. They can take part in public discussions. These discussions must be held under argumentation rules.
  This vision of society includes a democracy ideal that postulates that political decisions have to be discussed by all members of the society. The action resulting from this consensus will then have a social emancipation capacity.
- For Habermas, the first step is the shared decision. The consensus is the base of social action and of the social link. Communication action is opposed to strategy action.
  This type of action is not only shared in the discussion process but in the consequences as well. This theory maintains that communication action is at the heart of social action in total cohesion with society by sharing the meanings freed from instrumental logic. Communication action requires that an inter-subject agreement be shared. An action, taken up in its decision process as well as in its consequences, must be defined from a common exchange between elements socially concerned and aimed at an agreement. Performance is not the subject here but a just process in expressing ideas—*inter-comprehensiveness*.

Obviously, inter-comprehensiveness requires the setting up of a number of prerequisites. The process of expressing ideas can only take place in conditions of shared knowledge where the *actor* is either a speaker, addressee or observer. Inter-comprehensiveness objects to any unidirectional or linear principles in the exchange process.

Another author, Putnam (1996) refers to *Social Capital* of a society just like others refer to GDP (Gross Domestic Product). The author refers to standards and networks of a civil society that make communication actions possible among citizens for mutual benefits, optimising the efficiency of political, social and institutional actions. We consider this to be a must condition. In modern liberal societies, whether we adopt, like Habermas, the *live world* concept or the *discours social commun* (from Fossaert) there are enough possibilities to provide the references needed for communication actions. The communication action concept must, however, be based on the *world's live actors* like social institutions, culture and individuals.

The democracy ideal brought up by communication action is made up of more than must conditions. It is bond to establishing ethics, validity requirements of the various categories of *social actors*. The learned world must bear a desire for truth; the community world must aim for a normative universe based on precision and individuals must show intentions to be authentic. Then, the communication action concept emerges from a program that sets

up the limits, determines the contents, the normative process of interpretation, conciliation and behaviours.

A few words about methodology

In scientific literature (Weinberg, 1996) four integration locations of the social link are generally identified as *the family*, *the community*, *the work place* and *the state*.

From these integration locations we can study communication action in emergency situations. It is impossible to review all that has been done in this field in recent years. However, the most significant points can be underlined. This inference process is based on the analysis of emergency situations, the consulting of large scale simulation as well as on experiences in management, planning and intervention in exceptional situations. For the analysis, various types of emergencies (natural, technological and psycho social disasters) have been selected. In certain cases, access is available to first-hand information. For other cases, where the disaster was very important (e.g. an extremely severe flood in Saguenay, a region of Québec, Canada), data is used from other sources. Every integration area of the social link can be studied from the vulnerability level as well as the capacity to re-create the social link. An inductive and a deductive reading of these two inter-related logic axis will help us make difficult reports and identify tracks for our reflection.

Integration locations of the social link in exceptional situations

The family

The family, as it is in our modern times (divorce, parental role etc.) may not really an ideal integration location of the social link. Let us state clearly that the family does not help the development of a culture of civil protection. The notion of personal scenario does not flourish and information on potential risks is not integrated into family life. It is easy to imagine the consequences of this situation. The *enlarged family* alone is given a function. It is then confined to act as additional help leaving behind prevention action and united actions in emergency situations. State contribution is to be later examined in another article; multi-risks information campaigns are not found in our country as they are in the Netherlands, thus reinforcing our observation.

We have a tendency to identify the lack of information related to potential hazards as one of the main reasons for that situation with many consequences. It is difficult to justify a personal scenario without having the right preliminary information. Without adequate preliminary information, it is difficult to justify the creation of a personal scenario. Prevention, without foreseeable priorities could not establish the appropriate links to a credible and possible reality. Individual motivation development is also lacking a key element, the association process that can make the citizen directly concerned. The information on potential hazards is an essential element to the setting up of a valuable personal scenario, allowing for the relative sharing of personal and social benefits of the action. We are not convinced that municipal authorities and the business and administrative world are doing what they should in that field. There are many responsibilities and a good co-ordination is needed.

We believe the culture of civil protection could not exist without a significant change of attitude from these key actors of emergency situations. The family could not become a social cohesion location without the information needed to do so. We are now facing an essential notion, the theory of communication action that has to be brought up in place of the strategic action. The communication action requires a sharing of the information and, as a result, a sharing of power that comes with it. This notion cannot be set apart from the basic principle of our society, that is the upholding of a level of information that makes it possible for the citizen to be the judge of his life, his family and of his co-ordinated social actions.

We are now in the centre of the democracy process. For that principle to be respected in emergency situations, it is necessary to come to inter-subject agreements, prior to disturbances. These agreements can, of course, only be related to potential hazards. We agree with other researchers that a good number of persons have a socially coherent judgement in emergency situations. Even if it is impossible to foresee every hazard, it is quite possible to democratically anticipate protection and self-protection measures for individuals and their community. For these reasons, we disagree with the municipal authorities that doubt whether emergency planning is important or necessary.

The personal scenario is important to minimise the vulnerability of the family. To measure this importance, we need only to take a look at the amount of work that came to the community health centre in the case of the Saguenay flood. Too often, because of the will to maintain institutional and inter-organisation cohesion or in the rush for deadlines, we forget that the notion of emergency must take its meaning right here. For the physical and emotional vulnerability of individuals within the family, we can feel the real sense of emergency. Apart from these parameters, there are only technical problems.

The duration of the emergency situation can be very hard on the family. This length of time can modify, in many ways, the conceptual diagram of the emergency action. For individuals and for the family, a crisis period may go on much longer than the recovering time accepted by administrators. We have observed that, at the moment the Government comes to the end of its emergency actions and while the media was reporting that things were going better, a family living a profound sadness while looking at its home burning because the damage where too severe. Family members also have been seriously disturbed by the delays involved in insurance claims. Emergency actions can become totally asynchronous with social time as lived by the family. This time difference makes it impossible to create or restore the social link. In such cases, communication, far from supporting social integration, may become an element that will separate and make more distant the expressed positions.

Other points, not often raised, that are also related to the duration and to the gravity of the emergency situation, are the actions undertaken during the recovery period. Emergency recovery measures can be felt like a crisis by a family that had not been touched at all by the disaster. After the flood in Saguenay, the rebuilding of some industries, with trucks and heavy equipment operating 24 hours a day, created an unliveable situation of noise and dust for some parts of the town. Public health and safety were also endangered by the large number of trucks loaded with dangerous chemicals going through. Because of the many damaged railroad tracks, hundreds of trailer trucks had to be driven in residential areas on roads that are not suitable for this kind of transportation. Apart from spill hazards in urban areas, this truck traffic was a real danger for young children used to a quieter area.

As it can be seen, the social link concept goes beyond all of the normal parameters of communication and calls for a reconsideration of the usual temporality of emergency situations, while redefining the actors. Known emergency phases may become asynchronous or even contradictory. Upholding the social link with communication puts the protagonists in diametrically opposed positions, their validity criteria being different. Although these problems are difficult, preliminary discussions may seriously reduce

consequences and help put up corrective or extenuating measures. Gregory Bateson taught us that coherence may only survive in paradoxical situations with recalling and sharing the logic order. The setting up of an authentic communication action needs to be well prepared and it takes some time. A consensus must be reached on the definitions of the reasons for the action, the representatives must be previously identified and the exchange conditions have to be accepted and shared by all.

The structuring of the social link in the family would be impossible without a cohesion with the other integration locations of the social link. Family is closely related to the State. As for the relation with the business and administrative world, we noted several problems in that sense.

For now, we are looking at the close relation between the family and the community during exceptional situations. Often considered as the *enlarged family*, mainly in rural areas, the community is the expression of the social link as well as a dimension of its materialisation measure. The integration of family activities in the community activities, during emergency situations, may become an expression of solidarity, an extenuation of the anxiety caused by the event because of the security feeling that the participating action can produce.

The State can also minimise the level of stress in the family by setting up some administrative or legal programs—compensation, unemployment insurance, lease cancellation etc. The relation between the family and the community has always been organic but the relation with the State is quite different. One of the many reasons for this seems to be that the convention is not shared by all participants. When a citizen does not know the advantages of an emergency measure, if they do not know its adjacent parts and if they have never been consulted on its validity, it is quite possible that they do not understand it and they would not help put it up or accept it.

Communication in emergency situations is important. Making it possible is a ***must***. Some people told us that the crisis had been negotiated between media and the decision makers. This statement illustrates well that the social link integration location set up in the family is not seen (or perceive) by individuals as a priority for the emergency situation actors.

However, it is very difficult to set up an authentic communication process. Perception of necessity is a problem, the level of authority could be another one e.g. the municipal level does not always share our view, nor does it have the time, money or knowledge to set up an adequate communication process.

As we said before, sharing information is also sharing power. However, it is imposssible to imagine the culture of civil protection without the principle of the communication action.

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Raymond Corriveau holds a PhD from Mc Gill University in Montréal. He is a professor and member of the executive committee of the Social Communication Department at the Université du Québec in Trois-Rivières. He has been acting in the communication world since 1974, and worked as a communication specialist for television and radio in Canada and France. A member of national commissions (Council of Press, University programs in communication), he also has been a consultant for the private and the public sectors.

He is presently involved in Emergency Situation Communication, including a number of communication projects against dengue fever in Viet Nam, Martinique and Cuba. He has published many articles in specialised magazines, two books (*Social Discourse* and *Community Network*) and a third one is in progress (*Communication and Emergency Situations*). He is also a member of the Union for Democratic Communication, the Canadian Communication Association, the *Association canadienne des sociologues et anthropologues de langue française* and *l'Union des écrivaines et écrivains du Québec., Association québécoise de communication.*

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Disaster events calendar (cont.)

❖ 12–14 August 1999
Seattle, Washington

Fifth US Conference on Lifeline Earthquake Engineering

Sponsor: American Society of Civil Engineers Technical Council on Lifeline Earthquake Engineering

For program information, contact:
Don Ballantyne
EQE International,
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e-mail: dbballan@eqe.com
or
Tom O'Rourke
School of Civil and Environmental Engineering
Cornell University
273 Hollister Hall
Ithaca, NY, 14853-3501
Tel: (607) 255-6470; fax: (607) 255-9004
e-mail: tdo1@cornell.edu

For conference registration and logistics, contact:
Andrea Dargush
Multi-disciplinary Center for Earthquake Engineering Research (MCEER)
Red Jacket Quadrangle
State University of New York at Buffalo, Buffalo, NY 14261-0025
Tel: (716) 645-3391; fax: (716) 645-3399
e-mail: dargush@acsu.buffalo.edu

❖ 22–26 August 1999
Sydney, Australia

The International Congress on Local Government Engineering and Public Works incorporating the 10th National Local Government Engineering Conference

Co-hosted by the Institute of Municipal Engineering Australia, The Institution of Engineers, Australia and the International Public Works Federation.

Contact:
IMEA Congress Secretariat,
GPO Box 2609, Sydney, NSW 2001, Australia

❖ 30 August–5 September 1999
Melbourne, Australia

'Rescue Down Under' International Road Accident Rescue Symposium and Expo

Sponsors: Victoria State Emergency Service and the Australian National Road Accident Rescue Association.

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❖ 20–22 September 1999
Pretoria, South Africa

International Conference on Integrated Drought Management: Lessons for Sub Saharan Africa

Sponsor: UNESCO International Hydrological Program

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PO Box 82, Irene 0062, South Africa
Tel: +27 12 667 3681; fax: +27 12 667 3680
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www: http://www.wrc.org.za/events/drought

Re-defining community and vulnerability in the context of emergency management

Risk management is progressively being applied to emergency management and is a useful development. It has notions of 'community' and 'vulnerability' as key elements. These concepts are not well drawn out in the risk assessment process. If we examine these issues in functional terms and move away from a dependence on arbitrary administrative boundaries for emergency management, we can make progress towards targeting services more effectively and achieving greater community involvement in emergency management.

by Philip Buckle
Manager, State Emergency Recovery Unit,
Department of Human Services

Presented at Disaster Management: Crisis and Opportunity: Hazard Management and Disaster Preparedness in Australasia and the Pacific Region Conference, James Cook University, Centre for Disaster Studies, Nov 1–4, 1998, Cairns, Queensland.

Introduction

The goal of emergency management is the effective delivery of services to a target population. This applies to prevention and response activities as well as it does to recovery activities where defined programs and recipient groups are often easier to identify.

For services to be effective, delivered efficiently and in a timely manner and through appropriate systems they must be must be planned and designed to meet a particular need, that is they must be targetted as precisely as practicable. Once needs and recipients have been identified they may be aggregated into a community for which a service delivery structure can be developed that directly links services and needs.

A key issue therefore, for emergency managers is to define the most appropriate catchment for delivering services to meet needs.

To achieve effective services emergency managers therefore need a clear understanding of the phenomena with which they have to deal. These include the hazards (such as fire and flood) in themselves and they also include the social phenomena at risk from the hazards.

Communities, meaning in its broadest sense local populations, are now accepted by emergency managers as an integral and fundamental part of the emergency management structure.

Having a better understanding of the phenomena with which we have to deal, whether they are of bio-physical, social, economic or psychological origin, will enable us to develop strategies and actions across prevention, response and recovery that better achieve their goals and maximise public safety.

There are alternative perspectives that can be applied to planning services for emergency management and these perspectives may lead us to modify the basis on which some services are currently planned and delivered. At least, these alternative perspectives will allow us to more effectively target services by a more precise definition of needs and target groups.

I do not want to suggest that existing administrative areas are, necessarily, inappropriate but I do believe that in the interests of better program management and more effective service delivery we need to constantly review the basis of our planning and operational arrangements. This applies increasingly in a world subject to change (such as municipal amalgamations and agency restructures) where we need to work from the most stable and constant elements in a changing environment.

Until recently the paradigm of understanding that applied to emergency management concerned itself largely with the hazard agent itself. As a result, describing, measuring and controlling hazards, and in turn preventing or suppressing them, were the priority activities of emergency management.

This approach made good sense in the early years of systematic emergency management, given that protecting life, property and well being must be the initial concerns of emergency managers. The understanding we have gained of hazard dynamics enabled us to develop effective and professional response systems.

However, this approach makes less sense in prevention and recovery activities where social activity, and the interaction between the community and the hazard, is at least of equal importance to effective program delivery as an understanding of the hazard itself.

Hazards are important only in so far as they threaten or harm human activities or assets or those (such as the environment) on which we place some value.

Despite the need to understand communities and affected populations so that services can be targetted and priorities for programs established there is virtually no assessment of need or vulnerability analysis currently undertaken.

VICSES are promoting the need to carry out vulnerability studies as part of the risk assessment process and DHS undertakes locally-based needs analysis after disasters. But neither agency approaches these assessment processes with consistency across the State, with rigour or with an understanding of the theory and methodology required by studies that will yield useful outcomes in terms of offering direction to planning and program development. Both agencies are developing their capability in this area but are constrained, in my view, by the limits of the risk management documentation.

In its strategic sense emergency management is not just about understanding hazard causation; it includes understanding the full range of consequences of hazard impact, and it is about understanding the relationships of environmental, political, social and economic forces that influence shape the frequency, nature and location of emergencies.

Unless we understand these issues we will not be able to develop effective prevention and preparedness programs and we will not be able to develop systems and programs that effectively mitigate impacts or sustain communities in recovering from impacts.

Most importantly however, if we are to base emergency management on the community, if we are to engage the community in planning and self-protection then we require a clear and accurate sense of what we mean by community. Our current, simplistic notion of community as all the people in a given area (ignoring internal diversity and external links and relationships) is not adequate to meet the needs either of emergency managers or of local people themselves.

Risk management

In recent years the emergency management community has acknowledged the need to improve planning theory and capability and in response to this a risk management approach is being adopted by many agencies. This is a significant step towards achieving a clearer understanding of issues and priorities in achieving higher levels of public safety.

The risk management approach moves away from a single focus on the hazard agent and gives more attention to:

- the social, political and environmental contexts in which hazards occur
- the values and principles that guide decision making
- the risk (potential consequences for identified populations)
- the range of options to deal with the risk
- the process for selecting, implementing and monitoring risk treatments.

In Victoria a risk management approach to emergency management is being progressively adopted and promises significant advances in management and operations. Both the Victoria State Emergency Service and the Country Fire Authority are making notable progress in integrating risk management with their planning, prevention and response operations.

The risk management approach relies in part, but significantly, on the key concepts of community and vulnerability. In operational terms a risk management approach involves the community in the planning process and uses the concept of vulnerability as a criterion in assessing risk and then allocating resources.

However, 'community' and 'vulnerability' are undeveloped concepts that are applied bluntly. As a result they have less utility than if their elements were elicited and expressed with greater clarity and understanding. They could then be applied with precision in evaluating the functional requirements of emergency management programs.

A particular difficulty with the risk management standard AS/NZS 4360 and its derived processes is that it does not indicate how to identify communities, vulnerabilities and resilience. Given that these concepts are central to risk assessment the methodologies to achieve evaluate these elements of the process are not well understood by the emergency management community. Even outside this professional group the application of these issues to emergency management has not been explored in any depth.

I would like to explore the notions of community and vulnerability and to show how they can be developed in a more useful manner than they are currently in most risk management activities.

First, let me give my own definitions. By community I mean any grouping of people that have something in common, something shared (and believing that they have something in common and having only that as a communal attribute may be sufficient to define a community).

By vulnerability I mean a propensity to loss. However, implicit in my understanding of vulnerability is the notion of differential vulnerability (that is, different people or groups may be exposed to different magnitudes of loss or may be exposed to different types of loss). As a constant, albeit often silent, partner of vulnerability I include the notion of resilience, which I take to be the capacity to withstand damage or to recover from a loss.

The risk management approach relies in part, but significantly, on the key concepts of community and vulnerability. In operational terms a risk management approach involves the community in the planning process and uses the concept of vulnerability as a criterion in assessing risk and then allocating resources.

I want to indicate some key aspects of these concepts, which will allow us to more clearly articulate relevant issues, and in turn to develop and apply better services more effectively.

Let me reiterate my acknowledgement of the progress we have made in moving from a simplistic hazard-centric view of emergency management to a risk management approach. But while we have the impetus of change with us we have an opportunity to move further ahead.

I would like to draw out some of the issues in understanding community and vulnerability and to then illustrate these by reference to some recent emergencies in Victoria.

Let me say that the ideas expressed in this paper are my own. The work I describe is clearly 'work in progress' and we have a long way to go before we can be confident that these notions can be applied successfully in a practical sense, especially since Victoria's emergency management arrangements are demonstrably effective in planning and action and are responsive to local needs and issues. However, we are continuing to explore these issues in the context of recent events in East Gippsland. We hope that our understanding of community, vulnerability and resilience and social needs analysis will be applicable across the rest of Victoria. We also expect to develop planning and evaluative methodologies that will further improve our capacity to plan for effective emergency management.

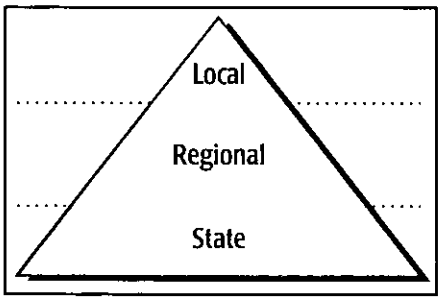

Figure 1: Community based on area or administrative unit (there is little or no differentiation of subgroups or particular needs or service requirements)

Community

In practice, it seems to me, community is often taken to be synonymous with the people living within a defined administrative unit—typically a local government area. Otherwise, community is most often used to either refer to all the people within a defined cultural unit (almost always a town or locality) or to refer to the population of a more or less identifiable spatial area —such as East Gippsland or north-east Victoria.

These definitions are useful in two ways. First, Government and non-government services are often provided on the basis of local government area, or town or locality. Service delivery administration therefore defines a community (even if the community includes people who are not significant recipients of services). Second, by identifying a community with a geographic area we may be thereby creating a commonality of interest that can be used for emergency management purposes.

But this argument is double-edged. Many agencies, including local government, State and Commonwealth public sector, private sector and non-government organisations do not have co-terminous boundaries. This in turn requires considerable effort to co-ordinate planning and operational activities over jurisdictions with dissimilar spatial boundaries.

But these are very blunt characterisations of community and we have to ask how they actually advance us in providing better services. In many ways the added benefit is not substantial.

This coarse grained approach may also confuse planning and operational issues with which we are required to deal by encouraging us to overlook the complexity of the groups (communities) and relationships between the groups within the relevant units of operation.

We need a more trenchant analysis of community if we are to respond to complex events such as emergencies and disasters. The complexity of disasters is central to our need to better understand communities. Disasters are events that by their nature may affect all sectors of the population and may impact on all aspects of economic and social activity. There may be differential impacts on different groups and the needs generated by the impacts and consequences may persist for long periods, while other needs may arise or diminish as time elapses.

Another type of community is that based in a hazard prone area—such as a flood plain or an airport flight path, a slope or a vegetation type shares exposure to a particular hazard—but which may share little else. The common element is a risk and a need for mitigation services and, if an event occurs, assistance measures.

We can also have communities that are based on economic enterprise, such as farming and tourist activities. Often different economic activities will co-exist within the one area and the business owners may share more than one common characteristic. Nonetheless, when disasters impact very extensive areas, the most significant common attribute for the entire area may be the economic activity.

Communities based on age are relevant to need and therefore to the provision of disaster services. Age may be especially relevant in terms of the extremes, youth and old age, or in terms of particular periods of crucial development, such as adolescence. Gender-based losses and needs can often be easily discerned and these form another basis for delineating a community, women and men may have particular requirements for services and support, especially after disasters.

Other commonly occurring causes of need after disasters include low income, disability, ethnicity and isolation.

This notional matrix (*Figure 2*) suggests that a person may belong to a number of different communities that will overlap but not necessarily be co-terminous. Mapping communities will therefore give a set of complex relationships, networks, hierarchies and nested groups and 'Venn diagrams' much different to the flat, homogenous geography implied by an approach based simply on administrative unit.

The range of categories of need that may be generated by a disaster is extensive, including health and wellbeing, food and sustenance, medical, shelter, income maintenance, transport, communications, psychological and social support as well as restoration of damaged bio-physical environments. Needs may occur at any system level of individual, family, group, organisation and government and may occur across levels to include one or more of these levels in the required support and recovery process.

Any affected community is likely to cross some defined administrative boundaries on which much of our planning and service provision is based. Therefore to ensure service effectiveness and to ensure equity and appropriateness in programs, we may have to make efforts to ensure at a very minimum that there is effective ***co-ordination*** between administrative units.

Another type of community is that based in a hazard prone area—such as a flood plain or an airport flight path, a slope or a vegetation type shares exposure to a particular hazard—but which may share little else. The common element is a risk and a need for mitigation services and, if an event occurs, assistance measures.

Given that any one administrative unit or geographic area may not be relevant to all, or even many, disaster generated needs it may make sense to plan on the basis of need (or common interest or community) instead of on the basis of administrative unit. In this sense ***co-operative planning*** and activity is preferable to co-ordinated action.

The point of this approach is it is not based on a broad-brush approach that conceals through its generality essential issues that need to be addressed as part of the emergency management process. Rather, it identifies with precision the communities that will require assistance, support and services.

It is not based on the (at least partial) artificiality of administrative boundaries. It is based on a functional assessment of needs that allows services to be specifically targetted.

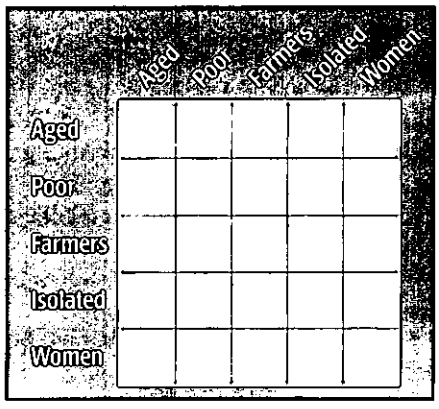

Figure 2: example of a matrix to identify communities of need (notional only)

This functional approach has been adopted by the Shire of East Gippsland in assessing and planning for social needs over the next decade. They approached their population's needs not from the standpoint of the various demographic groups per se but from the basis of the needs people have and the services that are required to meet those needs. So community needs are assessed as health, education, youth services, housing, recreation, cultural development and special needs, rather than the needs of the aged, young etc.

The proposed approach to planning addresses the substantive issue, which is *need*, rather than being driven by the administrative basis on which services are provided.

Vulnerability and resilience

This discussion of identifying communities by function requirement (services derived from needs) brings us to the point where we need to consider vulnerability and resilience. Most of the work that has been carried out on vulnerability has focussed on groups that are, prima facie, exposed to a risk.

However, assumptions implicit in this approach have not been critically examined and a proper assessment of the basis of vulnerability and resilience has not been made.

As I indicated above most of the literature on vulnerability identifies the aged, the very young, the poor, the socially and physically isolated, the disabled and ethnic groups as being particularly vulnerable.

This approach does not drill down into the subject to try to ascertain why these groups may be vulnerable and nor does it address attributes which these groups may have which reduce vulnerability and which enhance resilience.

Importantly also it ignores the issues of differential vulnerability. This I take to embrace two concepts. Different groups may be exposed to different types of losses. Within groups individuals may be exposed to different magnitudes of loss. Vulner-

ability, like risk, is not homogeneous across social and geographic landscapes.

Most risk assessments also ignore the issue of resilience. That is the capacity that people or groups may possess to withstand or recovery from emergencies and which can stand as a counterbalance to vulnerability.

If we accept the notion of resilience then we may consider directing some resources away from repairing loss to enhancing skills and other attributes to minimise loss in the first place or to strengthen capacity to recover.

More importantly these categories of vulnerability are not obviously relevant to vulnerability and therefore disaster generated need and therefore protective and support services.

Emergency managers can do nothing about age, they cannot make the old young, or the very young more mature. They cannot modify the values and behaviours of ethnic groups. They can do nothing about teaching the illiterate to read and write.

People are not vulnerable because they are old, but because they lack resources, because they have reduced mobility. Ethnic groups may be vulnerable not because they are not indigenous but because they have reduced access to services and information because of language (and therefore communication) difficulties.

So, categorisation of vulnerability has to be on the basis of an issue relevant to the matter of a particular event or type of emergency. Further, we know that all groups of people, men and women, young and old, rich and poor, may be vulnerable in different ways. We are all vulnerable to some loss. So we need a method of more finely assessing and assigning a priority to vulnerabilities.

Equally we need to look at resilience. While the aged have reduced mobility, for arguments sake, so they may have more substantial life experience that enables them to withstand the stresses of emergency impact and the requirements of recovering. The young may not have a fully developed capacity to integrate and work through the stresses of disasters. However being young they may have additional supports (such as parents and teachers) they may possess a natural adaptiveness and they may have a longer period (compared say with the aged) to overcome loss.

What I propose is that there are certain meta-categories of vulnerability, which include but are not limited to:

- Management capacity (for example, the capacity to deal with one's own affairs and to meet ones own needs, physical or mental disability)
- Resource availability (e.g. wealth, income, insurance)
- Cultural attitudes and values (e.g. different expectations of help, religious or ethnic attributes that may require special attention or which may separate a person from the broader supportive community)
- Access to services (e.g. language barriers, literacy, geographical distance)
- Social isolation (e.g. having poor social networks, being marginalised in society)
- Significant change over a short time span (e.g. change in industry structure)
- Pre-existing stressors (e.g. previous exposure to a disaster)

People who match these categories positively may be said to have a degree of resilience.

These are types of categories with which we can deal and which we can assess in a practical and determined manner to achieve a very definite outcome. We cannot assess vulnerability on the basis of, say, age. This is meaningless in the disaster context and at best draws us to include large numbers of people, with many different characteristics, into the one broad pool.

The question arises as to how we can identify these characteristics. There is no definitive answer to this yet. Currently we have to use proxy data in many cases, which can force us to revert to the old categories of age, gender an0d the like to identify the need and vulnerability.

We are working to improve our capacity in this area. The significant progress we have made is in conception vulnerability in functional terms that we can address in practical ways rather than in terms that are surrogates for other needs and which cannot be addressed substantially.

This approach or way of thinking about needs gives us a tool for assessing vulnerability and applying it to a particular area, population group or situation.

Consonant with this meta-structure it may be possible to identify more specific dimensions. People exposed to the following losses need to be assessed in terms of the meta-categories to assess their vulnerability.

These dimensions of loss may include:

- death and injury
- trauma
- damage to homes
- damage to social networks
- damage to expectations, values and beliefs
- damage to the environment
- damage to business (capital, trade, cash flow and income)
- community disruption and dislocation of social networks
- damage to infrastructure

As part of the planning process we should try to match anticipated damage, such as house loss, psychological trauma and income loss, with the meta categories. In turn, this will allow us to derive a hierarchy or index of vulnerability.

It will also indicate functional needs and will show how they may extend across administrative boundaries. In turn, this may suggest a more appropriate basis for planning than on the simple and single local government administrative unit.

After an event when we monitor impacts on individuals, groups and communities we can consider indicators which measure change over time or deviation from average or expected levels, such as:

- death rates
- morbidity
- suicide rates
- mental illness
- accidents rates
- property sales
- divorce
- bankruptcies/enterprise closures

These indicators are still being developed, and they require base line data for any given area or population to maximise their utility, but we are progressing in our development of criteria which will indicate community well-being and how the status of individuals, groups and communities changes over time.

These indicators are easier to assess at the individual level. At increasing levels of aggregation it becomes more difficult to identify relevant and key factors and to measure the impact of any specific event.

Drawing out the impact of a 'spike' such as a disaster from structural long term changes, such as the change in the economic base of a community, can be difficult. In many situations disasters may accelerate negative trends and be neutral or selectively beneficial for positive trends.

Case example: East Gippsland floods, June 1998

Floods occurred in the East Gippsland Shire, in the eastern part of Victoria on 23 June 1998. There was minor flooding in the adjacent Shire of Wellington but it was of a minor and localised nature.

The floods occurred over an area of approximately 200 km by 200 km and affected urban centres such as Bairnsdale and Lakes Entrance, the coastal strip which houses where 30,000 people live as well as extensive areas of the hinterland where another 10,000 people reside.

For 2 years prior to the floods the area had experienced the worst drought recorded and this had impacted significantly on farm viability, local economic capacity, the

emotional wellbeing and strength of the local communities and the economies of the local urban centres.

The flood occurred within the one local government area and the municipality used its municipal emergency management plan for the to direct its response. The municipality worked collaboratively with the Department of Human Services and agencies such as the Department of Natural Resources and Environment (with responsibilities for agriculture, natural resource management and some infrastructure) as well as the Victorian Council of Churches, the Red Cross, Salvation Army and the Society of St Vincent de Paul, local community health centres and other local groups as well as major utility providers.

It soon became clear that the needs of the population of East Gippsland were not homogenous.

An initial issue with which we had to deal was that the municipality had been formed a few years previously from the amalgamation of four smaller local government areas. Many residents who still related, or retained a loyalty to the old areas had not welcomed this amalgamation. For the people these areas were more local, local government had been closer, more familiar and more responsive. Equally, for some people there was if not hostility then resentment to change and the amalgamated, larger local government area. This meant that, for some purposes, we were dealing with an actual municipality and four virtual (ghost) municipalities, which existed in a practical way as an outcome of local people's history, traditions, hopes and expectations of local representation.

In Bairnsdale, Lakes Entrance and Paynesville the major damage was confined to houses and to small business, and assistance was required to repair homes and to provide some financial support and financial services to these groups.

Behind the coast there are four major valleys running approximately north to south from the Great Dividing range to the coastal plain, cutting through rugged mountain terrain. Land communication east to west in East Gippsland is therefore possible only along the coastal strip and these valleys are effectively separated from each other.

Bairnsdale, the largest town, is at the western end of the municipality. Some affected areas are up to 4 hours drive from Bairnsdale and are therefore remote from services. Access to services was therefore an issue for some people. In fact for day to day services they rely on urban centres such as Delegate in New South Wales. This required recovery managers to put in place special communication and information arrangements.

Other areas had particular social and physical infrastructure needs. In the first case, for example, childcare or hospital care were issues in some areas but not others. In the second case some areas had special requirements for roads and bridges.

Within each of the valleys drought and flood affected farmers had similar requirements for assistance in disposing of dead stock, repairing farm assets and replacing stock. But given their geographic separation different logistical arrangements had to be applied.

Within each valley there was also a group of people who had chosen an alternative lifestyle and were often referred to as 'ferals' by local farmers. These people ran small subsistence properties and had less need for farm support.

There were clear cultural differences (and at times antagonisms) between farmers and alternative lifestylers. Also each valley had small numbers of small businesses, such as local stores, motels and services stations, that required different sorts of financial assistance to the farmers.

So we have five distinct geographic areas divided by different occupational groups. Other significant divisions occurred along age lines and family lines. The average age of farmers in East Gippsland is in the low sixties and this reduced their capacity to manage their own recovery. At the same time, given the remoteness of the area families with young children often had difficulties (which were becoming apparent during the drought) of ensuring that adequate services and social contact was available for young children. The flood impact heightened these needs and made them more urgent.

At the same time there are longer term social processes occurring in East Gippsland, such as environmental degradation of farming areas, population loss from towns and the movement into debt of the farming community that all reduced local capacity to manage recovery.

The recovery process also encountered cultural values that initially restricted recovery services. There was a clearly articulated belief that East Gippsland had experienced flood and drought before and had survived these events and would therefore survive the current drought and floods. This culture of independence and self-reliance was an asset (a display of potential resilience) but it also led some community leaders to be very suspicious of assistance measures from outside the local area.

The response to this of recovery agencies was to engage the local community in dialogue to identify needs and to learn from local people what sorts of assistance measures and delivery processes would be appropriate.

Local people were employed as community development officers and local services received supplementary funding to ensure that existing services could meet new demands and where necessary, new programs could be put into place.

The Department of Human Services, in conjunction with other social service agencies, engaged in a process of needs and service mapping which it did through a process of engaging local communities, interest groups and service providers in discussion as well as formally surveying all relevant service providers in the area.

This allowed the development of assistance measures that were targetted to particular needs and areas. The special needs of families in remote areas have been recognised and the requirements of farmers for innovative financial support to manage the future of their farms have been acknowledged by the government.

Victorian gas disruption, October 1998

The gas shortage occurred across the greater part of Victoria and was managed centrally out to DHS regions and then to local government.

Initial impressions were of an homogenous population affected by the event. However, as time elapsed the general population resolved itself into a number of distinct groups.

- people who were simply inconvenienced by the shortage
- people who had to buy additional appliances and who were without financial resources (such as the poor), people who were laid off or whose businesses were forced to close)
- those who required heating for health and safety issues (such as the frail elderly)
- those who required hot water washing facilities (such as some people with skin disorders)
- those who required a 'hospital in the home' e.g. premature babies, paraplegics)

This event was managed not on the basis of geography or of administrative unit (though local government did co-operate in delivering and co-ordinating services locally) but on the basis of need.

The response to the event was characterised by an ongoing needs assessment that examined and monitored the impact of the gas shortage and through professional knowledge, community input and direct

public enquiry, identified needs groups. From this assessment it was relatively easily in organisational terms (though made difficult by the scarcity of gas) to develop systems and services to meet the needs.

Without an ongoing needs assessment, however, existing structures and programs would have been inappropriate to support people significantly affected by the event.

The response was characterised by a high degree of initiative and adaptiveness in assessing the situation, identifying personal and social requirements, establishing criteria to allocate scarce resources and putting systems into place to deliver the resource or assistance measure.

Conclusion

We need to recognise that community and vulnerability are not simple concepts and first questions we need to ask are who is vulnerable to what, what strengths and resilience do they possess and where are people with similar characteristics located - and to continuously monitor and assess.

The essential point is that we need to recognise that community is not based just on administrative unit, and that it may make good sense in emergency management terms for communities to be recognised as often crossing administrative and political boundaries. Of course these boundaries have utility in terms of day to day delivery of services but their usefulness to emergency management needs to be reassessed.

In particular we must ask whether many units of administration are now so large, geographically and in population that they do not conform in any sensible way to notions of community or local.

From an analysis of common interests or needs we can develop a more appropriate basis for our concepts of who constitutes a community and what the vulnerabilities are and from this we can move to a more effective basis for developing services.

At the moment emergency management services are often developed in a broad-brush fashion with little regard for local difference, whether this is based on geography, occupation or some other relevant social factor. This means that services—particular in recovery—have to be developed on the run, after an event has occurred. At best this can lead to delays in service provision.

We must also accept that much of emergency management has been responsive to the issue of damage or potential damage, and has directed its efforts to stop damage occurring through structural means, protective services or recovery programs. This approach (preserving life and safety) is obviously understandable and necessary. These programs have usually been provided to local people rather than drawing on local capacity to develop local strengths.

However, by a more careful analysis of community we should be able to identify assets and characteristics that can be used to support resilience. If we identify and strengthen these we can improve the capacity of individuals, families and communities to prevent or reduce impacts in the first place.

Identifying vulnerabilities and resilience will also allow us to identify social issues or trends that are not necessarily part of the narrow area of emergency management. Nevertheless we may be able to deal with these—for emergency management purposes—through the application of other policies initiatives and programs.

Identifying vulnerabilities and resilience will also allow us to identify social issues or trends that are not necessarily part of the narrow area of emergency management. Nevertheless we may be able to deal with these –for emergency management purposes–through the application of other policies initiatives and programs.

Where, for example, vulnerability to a hazard is a matter of poverty then we may be able to mitigate impacts through the financial redistribution programs (local tax regimes, regulatory costs, buy back schemes and so on).

The approach proposed in this paper already has some precedents. Catchment Management Authorities in Victoria manage water-related activities on the basis of a catchment and watersheds defined by function rather than by administrative or arbitrary boundary.

And efforts to achieve co-ordination across different administrative units are being improved constantly as improvements in communications improve our capacity to communicate and to exchange information in real time in diverse ways (fax, video and audio conferencing, virtual conferences), using various media (internet, email, mobile phones, telemetry, radio, satellite phones).

Further Geographic Information Systems give us the capacity to map demographic and cultural phenomena more quickly and more intelligently, and to display the results in more easily understood ways than was imaginable even a decade ago.

A crucial issue is how we identify proxies for the meta-categories of vulnerability. We have some understanding of proxy relationships with the meta-category where it cannot be identified immediately. However, we need to be creative in our thinking to develop new ways of identifying the substantial issues that need to be addressed.

Methodologies such as social planning, social audits needs analysis and social impact analysis already exist. We can refine and develop these as tools that will enable us to more efficiently understand the groups that make up the communities that we seek to work with in emergency management.

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Participatory planning for flood mitigation: models and approaches

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The paper critically examines the dominance of top-down, scientific and technical modes of analysis in decision making structures for flood hazard mitigation. It explores the possibilities of incorporating more diverse and contextual knowledges — emphasising social and cultural, as well as scientific and technical, dimensions— and creating more democratic forms of decision making.

Introduction

This paper discusses a range of approaches, successful and otherwise, that have been developed to deal with different flood conditions, institutional arrangements and cultural practices. Examples are drawn from a developed world context in the UK, USA and Portugal, but with a particular focus on the UK. In all three countries there are organised institutional structures to plan for and manage floods and a range of approaches has been adopted. These are dependent upon local factors, both physical and, more importantly in the context of this chapter, human. The paper examines flood management decision making and the role of the flood defence engineer in the construction and alteration of floodplain landscapes, primarily through the provision of structural flood defences, and discusses how the engineer's vision can conflict with the values of some local residents. It draws on both quantitative and qualitative research with river engineers, floodplain residents and others involved in flood hazard mitigation (Fordham, 1992) and includes some of the findings from two major research projects: the Public Perception of Rivers and Flood Defence Project and the European Union-funded EUROflood Project. What unites these otherwise diverse cases is the preponderance of top-down, expert, masculine models of decision making that, while slowly changing, still find difficulty in relinquishing control and acknowledging different voices and values.

Planning for floods is a complex endeavour even when, as is often the case, the decision-making parameters are restricted to the scientific and technical dimensions. However, the reality is more complex than this and even the most technically competent proposals can fail to win the support of the communities at risk if other, social and cultural, dimensions have been excluded or included too late. In recent years the need for public consultation and participation has become more widely recognised and further stimulated through, for example, Local Agenda 21 initiatives. Yet, far from being consensus-building, these activities can be conflict-generating and can expose major disparities between those in professional decision making roles and the lay public about what constitutes both the problem and its solution.

The structural bias in flood hazard management

Floodplain management is a multidimensional problem which has been ill-served in the past by a uni-dimensional, technical-engineering approach resulting in a bias towards structural 'solutions' to flood hazards. This approach has been based on an 'objectivist' (Cvetkovich and Earle, 1992) view of flood risk, which assumes there is an objectively measurable, 'true' level of risk, rather than a 'constructivist' view of risk which explicitly recognises that environmental hazards are social issues, involving subjective judgements about what is valued:

> *Risk is not an inherent quality of the physical world but represents an interaction between physical and psychosocial characteristics* (Cvetkovich and Earle, 1992: 6).

However, the concept of multiple adjustments to flooding is not new. Gilbert White (1945) discussed this concept in some detail over a half-century ago. Nevertheless, structural approaches generally became the norm in those countries that could afford them, and even some that, arguably, could not.

Many agencies with a responsibility for flood management have traditionally had a significant proportion of (male) engineers on their staff (as opposed to planners, for example) who have a bias towards the construction of physical structures to control and limit flood damage. This structural bias has meant that non-structural approaches (such as flood warning systems and land use planning) have fulfilled a secondary role, complementing physical structures or replacing them only when there is some overriding obstacle to their development. However, during the 1980s particularly, the increasing costs of structural solutions and, more particularly, the growing environmental concern at their impact, meant that the structural bias slowly began to be eroded.

> *This national commitment to the taming of rivers and coastal waters ranks among the foremost undertakings of mankind, equivalent to the pyramids of Egypt, the Great Wall of China, and the moon program. It is now in the process of joining them as past history* (Platt, 1986:29–31).

This was perhaps a rather optimistic assessment of the demise of physical flood programmes, even in the US, but certainly more non-structural measures came to be used and multi-functional approaches developed throughout the 1980s and 1990s.

Tulsa, Oklahoma

Tulsa, on the Arkansas River, has a long history of floods, which became increasingly frequent and damaging as floodplain development intensified. Flood control measures were piecemeal and reactive for many years and Tulsa is typical of many flood-prone areas locked into the damaging spiral of the 'levee effect', with floods occurring every two to four years throughout the 1960s and 1970s as billions of federal dollars were spent in structural flood control projects to protect and, ironically, encourage the increasing development of the floodplain (Patton 1993). In the 1980s Tulsa experienced more Federal disaster declarations for flooding than any other community in America (FEMA 1998).

Policies were geared towards re-establishment of the *status quo* and the 'system' worked against proactive initiatives to mitigate damage. Government funding supported rebuilding *in situ* and locked people into a cycle of repetitive flooding. Local people petitioned and lobbied over many years and eventually were successful in stimulating an official response which incorporated a multi-functional approach. This approach included *inter alia* acquisition and relocation of high-risk floodplain properties and a change of land use to less damaging recreational purposes (City of

Tulsa 1994). The aesthetic, ecological and recreational properties of river environments were incorporated into future planning in addition to the more usual hydrological aspects. Tulsa is one of 50 US communities to become Project Impact Disaster Resistant Communities: this is a community-based, partnership effort initiated by the US Federal Emergency Management Agency (FEMA) to help individuals, businesses and communities reduce their risks and future disaster costs (FEMA 1998). Tulsa is an early example of this kind of broader approach to floodplain management which goes beyond the structural to incorporate non-structural approaches, environmental enhancement, and community-government partnerships.

One of the major stimuli for changing flood planning practices has been the increasingly hostile reaction of the public to large scale, 'hard' engineering structures (straightened, deepened, concrete-lined river channels etc.) in what are often scenic and valued environments. This has been generally (but not exclusively) on aesthetic rather than (scientific) ecological grounds: the general public often having a somewhat limited knowledge of ecological principles but a strongly held sympathy for the conditions of wildlife; and a strong landscape sensibility.

The next stage in this developmental process was the emergence of river restoration projects (Holmes and Nielsen 1998; Vivash et al 1998; Tunstall et al 1997; RRP 1993, 1994) which seek to return river environments to their pre-disturbance state. Their overall strategy to 're-naturalise' previously over-engineered rivers is dependent upon an ecologically sensitive rationale and a stated aim of public participation and partnership. Nevertheless they are still primarily engineering projects.

Although the provision of flood defences to populations at risk of flooding is the responsibility of both statutory agencies and individual riparian owners, individual responsibility is less significant in the UK context because of the considerable scale and financial cost of flood protection, and its conceptualization as a public good (it is difficult to provide major defences, such as flood relief channels and embankments, for one person without also benefiting or impacting upon others). Such flood defence projects are widely perceived to be 'for the public good' and thus would appear to be uncontentious. However, this is not always the case and conflict between flood engineer and floodplain resident can (and frequently does) arise (Fordham, 1993). The reasons for conflict are various but include, often fundamental, differences in what river landscapes and environments symbolise and in the way environmental decision making is organised institutionally.

River landscapes

River landscapes have different meanings for different groups of people. For many people who have chosen to live by rivers, river landscapes have strong symbolic meanings. In the suburban context they often mark the separation of the working, or outside, environment from that of the home: they can represent a ribbon of rustic escape, the repository of a pastoral aesthetic and the last bastion of unchanging values. It is less often the case now in the industrialised North, that people living by rivers also gain their livelihood from them. Few river engineers live close to rivers because this would be deemed an irrational act due to the flood risk they present. For many engineers the river is their place of work; a flood control mechanism and the raw material of the engineering craft: synonymous with, and dependent upon, change, development and control. Cosgrove has argued (1990) that control of the river goes beyond curbing the negative effects of free-flowing rivers on homes and livelihoods: water represents power—machine power (mills and turbines) and political power (the so-called hydraulic civilisations are the most obvious example).

Many riverside dwellers minimise the separation between home and river and view the river as an extension of their property and so the construction of floodbanks and floodwalls between them and the river represents a direct assault (Fordham, 1992); firstly, on what is perceived as their most valuable asset, their home, and, secondly, on their aesthetic sensibilities. It is easy to underestimate the effect that environmental schemes—whether for urban renewal or flood defence—can have on some people. The affect can be similar to bereavement:

> *'We never thought in our lifetime that we'd be able to afford something like this, with that view and of course then we lost it ... The thing is, it's gone forever. That view is never ever going to come back and it's gone.'* [Riverside resident, southern England].

This transcript extract, from an interviewee whose previously uninterrupted view of the river had been interrupted by a three metre high flood embankment, cannot convey the intonation and facial expression which would better support the comparison with bereavement. Links can be made to research examining the attitudes of former inhabitants of an American urban renewal scheme in Boston (Marris 1974) where the description has been found to be apt for some strongly affected floodplain residents:

> *For the majority it seems quite precise to speak of their reactions as expressions of grief. These are manifest in the feelings of painful loss, the continued longing, the general depressive tone, frequent symptoms of psychological or social or somatic distress, the active work required in adapting to the altered situation, the sense of helplessness, the occasional expressions of both direct and displaced anger, and the tendencies to idealise the lost place.* (Marris 1974:43).

The Thames Perception and Attitude Survey

In the Thames Perception and Attitude Survey (Tunstall and Fordham 1994), which examined attitudes to flood defence and the environment in the River Thames floodplain, strong attachments to place were demonstrated. The findings showed the importance of proximity to the river in affecting responses to flood risk. Interviewees expressed their preparedness to live with range of flood risks *(see Figure 1 and Table 1)*, from a 1:200 risk to a 1:5 risk. Those that lived closest to the river ('riverside' dwellers) were consistently more likely to accept the risk because of the environmental advantages that the river afforded them. For many of these interviewees, they had chosen to live there because they loved the river: they had made a trade-off between risk and environment (Fordham 1993, Fordham et al 1991).

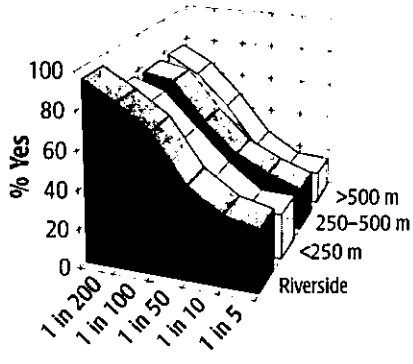

Figure 1: Preparedness to live with various flood risks

There is, of course, great spatial and experiential differentiation (between those flooded and those not; those who live close to the river and those who do not; those who have chosen to live by a river and those who have not; those who live in scenic river environments and those who live in degraded river environments; those for whom the river represents beauty and asset, and those for whom it represents risk and

Would you be prepared to live in this same area if the risk of flooding were as follows:	
1	a 1 in 200 risk, each and every year, that your house would be flooded;
2	a 1 in 100 risk, each and every year, that your house would be flooded;
3	a 1 in 50 risk, each and every year, that your house would be flooded;
4	a 1 in 25 risk, each and every year, that your house would be flooded;
5	a 1 in 10 risk, each and every year, that your house would be flooded;
6	a 1 in 5 risk, each and every year, that your house would be flooded?"

	% Agreeing					
	1:200	1:100	1:50	1:25	1:10	1:5
Riverside	94	84	72	48	36	32
<250 *metres*	78	72	54	37	24	24
250–500 *metres*	77	74	53	37	28	22
>500 *metres*	77	68	50	29	18	17

Table 1: Preparedness to live with varying levels of flood risk (n = 494) (Tunstall and Fordham, 1994)

threat) that can create major divisions in communities. The differences can be complex but even those who have been seriously flooded can be opposed to flood defences which may be unacceptable on aesthetic grounds:

'You must be careful about engineers, they don't care about the look of a thing.'

These are the words of a woman on the south coast of England who had recently experienced flooding in which several tons of gravel and sea water had broken through the windows of her home (Fordham 1991b). She still objected to proposals for flood defences, comprising a gravel embankment, which would block her view of the sea. This was generally regarded as an irrational and even selfish position by some of the proposing engineers. Other examples of risk-environment trade-offs can be seen in both the US and, perhaps surprisingly, Bangladesh.

Big Thompson Canyon

Something of the tension between local residents and officials with decision making power is apparent in Colorado where a flash flood in 1976 killed 146 people (although seven bodies were never found) in the Big Thompson Canyon (Gruntfest 1977; 1987). This is one of the most scenic areas in the Rocky Mountain region. Some of its residents have also made a risk-environment trade-off; trading the risk of flash flood (although the level of risk of the 1976 event has been put as high as 1:10,000 (Gruntfest 1997)) against the considerable beauty of the location. But for local people there are many factors which keep them there which may not easily be quantified or rationalised. Therefore, it can seem perverse to professional emergency managers that they continue to put themselves and, some would argue, others at risk (two emergency responders also died during the flood disaster) through their continued presence in the canyon. The residents' own voices were heard at the Symposium held in 1996 to discuss what had been learned in the intervening 20 years (Gruntfest 1997) but, interestingly, they had not been on the original list of invited participants (Wamsley 1996 pers. comm.). While this oversight was redressed, it is indicative of the way 'experts' can assume their own appropriateness in making decisions for absent others.

The Big Thompson example is also notable for the subsequent emphasis on a simple but effective non-structural response. As you travel along the canyon you are faced with several road signs warning you to climb to safety in case of a flash flood *(Figure 2)*. it remains a problem to get people to abandon their cars in times of flash floods and accept that they are 'better wet than dead' (Gruntfest 1997).

Figure 2: A simple but effective warning for flash floods in Colorado

Bangladesh

Even in Bangladesh, a country hugely vulnerable to floods, attitudes to floods and flood-prone areas are not as simple as some experts and 'outsiders' often believe. Research among the char-dwellers of Bangladesh (Schmuck-Widmann 1996; 1998 pers. comm.) has shown the strong sense of place (Relph, 1976) that (among other things) binds people to hazardous environments. Chars are river islands created, and often destroyed again, by silt transport. The chars may be washed away in a year or may last for decades. They clearly represent a high level of risk to their resident population who are acutely vulnerable and yet these islands are not entirely defined by the risk they represent:

'On the chars we are free as birds. Sometimes we live here, sometimes there. We are not bound to one place like the 'mainlanders'. On the mainland we would feel like in a cage.' (Schmuck-Widmann 1996: 68).

Even during the major floods to hit Bangladesh in the summer of 1998, risk and environmental benefit were seen to be in some kind of balance:

'An old man standing up to the neck in the floods said indeed it was a tough time, "but despite [this] I love to live here on the chars in the middle of this river, because here I get peace"' (Schmuck-Widmann 1998, pers. comm.)

It is important to approach flood planning from diverse perspectives in which local knowledge and preferences have equal weight to those of visiting experts.

The river engineer

There has been a shift in attitude and practice in recent years among engineers working in river and coastal management, from the former, dominant paradigm of working to control nature, to the more recent model that espouses working with nature. There is evidence, however, from the research discussed here, that many engineers have not complied willingly with this change; that rather than jumping freely into this new environment they have had to be pushed into it by public opposition and subsequent legislation. Some engineers would challenge the view that they have been forced into adopting these changes (Fordham 1992):

'Most of us tend to be drawn towards countryside and nature and that sort of thing. So I don't really think there is a great conflict. Nowadays I think people tend to want conservation, things that look nice, and that is what they're given but I think that the general attitude of engineers is that that is what we should be providing anyway ... because this is why most of us tend to come towards this sort of job.' [River engineer].

'Where we can do things to enhance, we do. You know, we're not forced into it, we do it quite happily.' [River engineer].

However, the perceptions and attitudes of engineers have been found to have the characteristics of a closed system (Sewell

Rungs on the ladder of citizen participation	Nature of involvement	Degree of power sharing
8 Citizen control		
7 Delegated power	*Citizens are given management power for selected or all parts of programmes*	degrees of citizen power
6 Partnership	*Trade-offs are negotiated*	
5 Placation	*Advice is received from citizens but not acted upon*	degrees of
4 Consultation	*Citizens are heard but not necessarily heeded*	tokenism
3 Informing	*Citizens' rights and options are identified*	
2 Therapy	*Powerholders educate or cure citizens*	non-participatory
1 Manipulation	*Rubber-stamp committees*	

Table 2: Arnstein's 'Ladder of Citizen Participation' (source: Arnstein, 1969).

1974): their attitudes appear strongly conditioned by training, and to be closely allied to the standards and practices of their profession. They believe themselves to be highly qualified to do their job and to be acting in the public interest (Sewell 1974:120, Fordham 1992). Sewell concluded that 'experts are not in favour of institutional change, especially if it means that their own role will be altered' (1974:129). This is characteristic of social systems generally and can be conceptualised as a state of 'dynamic conservatism' or a tendency to fight to remain the same (Schon, 1971). In the case of institutional structures for flood defence, environmental factors have already forced a degree of institutional change to accommodate them (i.e. in the provision of conservation and landscape officer posts and the imperatives of environmental legislation). In recent years the need for public consultation and participation has become more widely recognised and further stimulated through Earth Summit and Local Agenda 21 initiatives.

Consultation or participation?

Increasingly it is considered necessary to involve the public in the decision-making process in order to attempt to achieve consensus on what can be controversial issues. The 1992 United Nations Conference on Environment and Development (UNCED)—*The Earth Summit*—also made a major focus on public participation in environmental issues. The subsequent documentation, *The Rio Declaration and Agenda 21: Programme of Action for Sustainable Development*, encouraged the development of local level, popular participatory techniques (UNEP 1993).

The European Community Directive 85/337/EEC made public participation a legal requirement in European member states. There is, however, some discretion in interpretation and implementation. In the UK this directive was implemented in 1988 through Statutory Instrument 1217 (in respect of proposals for land drainage improvement works). This requires an environmental statement to be produced for projects likely to have a significant effect on the environment. The agency proposing to carry out works must decide whether the proposed works are significant and to announce in the local press either that they propose not to produce such a statement or that they have produced one. If the latter, copies must be produced for interested parties. The public involvement in this process tends to be at the end stage—consultation after production of the statement or assessment—and not necessarily in a pro-active way at the early stages of decision-making.

The full integration of participatory opportunities and techniques in public decision making is likely to take some time to become a widespread reality due, in large part, to inherent secrecy within institutions. Many public participation efforts have been limited to top-down consultation (Fordham et al, 1990) whereby a chosen option is promoted to the public who have little opportunity but to accept or reject. This can lead to an unacceptable polarisation of views (Fordham, 1992).

The terms 'participation' and 'consultation' are frequently used interchangeably but they are in fact discrete. Participation invariably implies consultation at some stage but the converse is not necessarily the case. Consultation can occur without any real participation in the decision-making process: views can be sought but disregarded. Involvement through consultation may not effectively influence the outcome. Resource managers rarely have the communication or group problem solving skills necessary for effective participation (Sewell and O'Riordan, 1976:19-20). National Rivers Authority (now Environment Agency) engineers interviewed in the early 1990s (Fordham, 1992) reported a major growth in consultative aspects of their work and a lack of any formal training at any point in their engineering career

A classic analysis of participation is presented in the form of Sherry Arnstein's 'Ladder of Citizen Participation' (Arnstein, 1969). The eight rungs of the ladder *(see Table 2)* represent varying levels of citizen control. According to this typology, consultation can be mere tokenism which simply reinforces the *status quo* and provides a means for informed consent rather than an expansion of democratic choice (Nelkin, 1984:36). Just how far up the ladder it is possible to go, and how far any decision-maker would want to go (given the largely voluntary nature of much consultation in the area of flood management) is debatable.

Whom to involve

Differences in perception between professionals in various fields and the public have been recognised for some time (White, 1966a, 1966b; Craik, 1970; Sewell, 1971, 1974; Sewell and Little, 1973; Cotgrove, 1982). Early work by Sewell (1974) provides an introductory framework of some of the key issues. He notes the reliance on expert opinion (notably engineers among others) in decisions relating to environmental quality which, he suggests, results from the complexity of the problems involved, from the uncertainty of individual decision-makers in the adequacy of their judgements and also partly from the promotional abilities of the professionals themselves.

A consequence of this has been the development of a technical elite which has assumed responsibility for the identification of problems and their solutions and whose advisory role has been institutionalised within administrative structures. A further consequence has been 'the alienation of the public in the policy-making process' (1974:111). Engineers, for example, not only define the problem to be solved, they also determine the options for a solution and frequently select the strategy to be adopted. This process inevitably gives expression to their views of what society wants (1974:112) or needs.

Sewell found scepticism on the part of professionals (particularly in the sciences) about the involvement of the public in

policy making because the latter were perceived as not sufficiently well informed and liable to produce a profusion of opinions which would make policy making impossible. However, while the presentation to the public of a few discrete alternatives has the advantage of simplifying the process of choice, unless the values of the public—rather than those of the professionals—are reflected in the alternatives, they may all be rejected (1974:129).

> *When practical decisions are needed open debate can rapidly yield place to authoritarian rule. In this respect the link between water management and power remains unbroken.* (Cosgrove, 1990:11).

The dominant masculine engineering values and culture favour the rational over the emotional and can lead to the exclusion of subordinated groups and values. Even the language used in science and engineering is indicative of this androcentric dominance: masculine/objective, feminine/subjective; masculine science is 'hard' science while feminine knowledge is subjective and 'soft' (Keller 1985). Feminist sciences and epistemologies attempt to transform partial, distorted, androcentric, mainstream representations, theories and practices (Harding 1990) but to date there has been minimal impact on the engineering culture. What is sought here is not necessarily a replacement of a masculine science and practice with a feminine paradigm but to acknowledge the legitimacy of alternative discourses:

> *Feminist inquiry can aim to produce less partial and perverse representations without having to assert the absolute, complete, universal, or eternal adequacy of these representations.* Harding 1990: 100).

Identities are contradictory, partial and strategic (Haraway 1990:197) and this becomes apparent in environmental disputes, of which flood defence scheme proposals are one. The selection of who 'gets to sit round the table' and make their voice heard is a strategic decision.

While it is accepted practice (and often a statutory duty) for agencies to consult official government bodies and selected groups, it is perceived to be more difficult to deal with a diffuse and heterogeneous public. Professionals prefer to deal with representatives unless members of the public involved are very few in number. This was the model adopted for the earliest stages of the Maidenhead scheme which subsequently proved problematic. Although, in order to achieve the best possible (at the time) environmental option, the Thames Region of the National Rivers Authority (NRA, now EA) had moved forward considerably in terms of a more inclusive and wide-ranging decision making process (see Gardiner 1988), the public opposed its plans to route the flood relief channel across an area selected as suitable by the 'experts' and not officially designated as of great wildlife importance (Tunstall, Fordham and Glen 1994; Fordham et al 1990). While 'officially' un-designated, the area was valued nevertheless by local people. These findings showed up in social surveys carried out after the formal consultation period in which local people's views had been presumed to have been canvassed through representatives. Those interviewed in surveys have expressed a preference for consultation with both the general public *and* their representatives *(see Figure 3* and *Table 3)* in order to ensure their own voices are heard.

When to involve the public

Evidence supports the view that participation should occur early within the decision-making process, before major choices have been made and options foreclosed (Kasperson 1986:276; Bruton 1980:440). However, many arguments against early participation have also been advanced; such as that information collection (possibly of a technical or scientific nature) may not yet be complete and the opportunity exists therefore for confusion when further assessment is carried out at a later date; that there is likely to be a profusion of interested and possibly competing parties requiring information; and that early consultation can increase the opportunities for opposition (McNab 1997; Kasperson 1986:277). However, once the problem area is defined, inertia on the part of decision-makers can make a fundamental re-examination of policy issues extremely difficult and costly: technical and policy issues are rarely clearly delineated (Krimsky, 1984: 50).

A series of social surveys (Tunstall, Tapsell and Fordham 1994; Tunstall and Fordham, 1994) carried out between 1987 and 1993 in several areas of England for the National Rivers Authority as part of the Public Perception of Rivers and Flood Defence Project, asked floodplain residents for their views on public consultation processes. The findings showed a strong preference for early consultation, either before the Authority/Agency starts studying and choosing options or at the stage when several options have been selected for them to choose between *(see Figure 4* and *Table 4).*

This preference of the public was at odds with the usual timing of consultation where

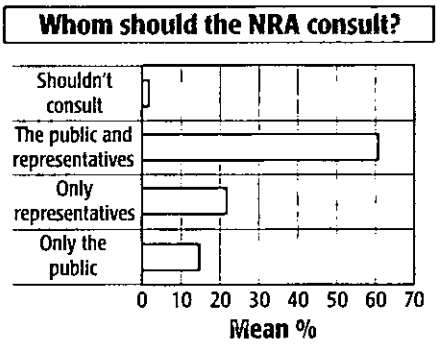

Figure 3: Whom should the NRA consult?

'In your view, should the National Rivers Authority ...

1 only consult the general public directly?
2 only consult through representatives such as parish councils, residents' committees, wildlife and amenity groups etc.?
3 consult both the public directly and through representatives?
4 Shouldn't consult?'*

** These questions varied slightly between surveys and areas. In all, over 1800 interviews were carried out.*

		Mean %
1	Only the public	15
2	Only representatives	22
3	The public and representatives	61
4	Shouldn't consult	2

Table 3: Whom to consult (Source: Tunstall, Tapsell and Fordham 1994; Tunstall and Fordham 1994)

river engineers favoured consultation at the preferred option stage or when they had selected several preferred options for the public to choose between. A major flood defence scheme for the Maidenhead area in southeast England, which involves the construction of a flood relief channel (a second 'River Thames'), met with early controversy through its decision to consult at the later stage when a preferred option had been selected (Fordham et al 1990).

The NRA/EA has since learned from these public relations failures and now opts for a somewhat different model. It began, when it was still the NRA, with Catchment Management Plans (Gardiner 1992) which examined the whole catchment area rather than focusing on a project-by-project approach and used wide-ranging consultative exercises. It now develops Local Environment Agency Plans (e.g. EA 1997) which again take a catchment-based approach but also propose an integrated plan of action, combining flood defence with water resources, pollution control and development issues. This again places emphasis on early and wide consultation with the public and even devolves organisational control of many meetings to local groups. Thus a wider public can have access to the decision making arena. There remains a danger however that subsequent,

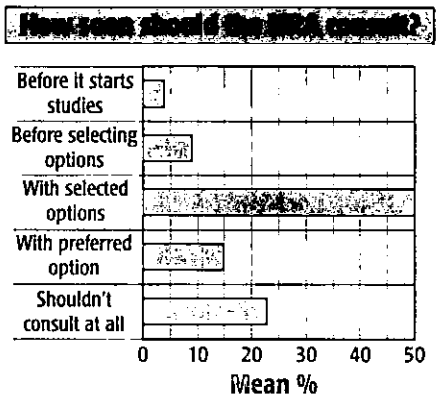

Figure 4: How soon should the NRA consult?

"If the National Rivers Authority were to propose a flood-relief scheme for this area, how soon do you think it should consult the public? Should it consult them ..."

1 Before it starts studying the flood problem?

2 Before it selects any options for the design or route?

3 When it has selected a number of possible options for the public to choose between them?

4 When it has chosen a preferred option for the design or route for the public to comment on?

5 The NRA should not consult at all but should go ahead with whatever it thinks best."*

** These questions varied slightly between surveys and areas. In all, over 1800 interviews were carried out.*

		Mean %
1	Before it starts studies	23
2	Before selecting options	15
3	With selected options	50
4	With preferred option	9
5	Shouldn't consult at all	4

Table 4: When to consult the public (Tunstall, Tapsell and Fordham 1994; Tunstall and Fordham 1994)

individual, flood defence schemes may not adhere to such 'open' forms of management.

Techniques used in public consultation exercises

Professionals involved in flood planning and management employ a range of techniques but typically favour a limited number, such as public meetings with slide and video displays, and written information or newsletters. These clearly favour one-way communication—from the expert to the public—and leave the professionals largely in control (although public meetings can, of course, be highly adversarial and threatening to those 'at the front').

The Portuguese case study for the European Union-funded 'EUROflood Project' (Correia et al 1996) was focused on the town of Setubal in the metropolitan area of Lisbon. This is a town with 90,000 inhabitants, located 35 km south of Lisbon, in the estuary of the River Sado. It is under considerable development pressure and was one of the most seriously affected areas during severe floods in 1967 and 1983.

The main focus of this particular element in the EUROflood Project was to design a Geographical Information System (GIS) for Setubal (Correia et al 1996) with an emphasis on its use as a public information tool. Thus, a GIS was proposed which would allow, *inter alia*, the involvement of the public in the different stages of the planning process of risk alleviation; the simulation of different scenarios such as different flood levels; the opportunity of seeing and understanding some of the technical aspects of the flood problem; and the possibility of active participation in the decision process, in a user-friendly environment, using innovative methods such as multi-media and the incorporation of oral histories etc. Thus, a large database could be constructed incorporating anecdotal, qualitative material as well as the more usual quantitative and 'scientific' data.

The use of a GIS was seen to be an advance in flood hazard communications strategies, particularly in a country without a culture of public participation in such decision making areas. The graphical display properties of a GIS were regarded as a positive element in the conveyance of complex human-environment interactions. However (perhaps somewhat typically) the technical aspects of data gathering and inputting absorbed the available resources and this final stage of public involvement was not completed.

While this was an innovative development in flood hazard information management, it remains one modelled largely on Irwin's (1995) 'deficit model' i.e. providing the public with (technical) information which they lack and have difficulty in understanding or accessing. The extent to which it could be used more proactively by the public remains untested.

Conclusion

It has been argued (Sewell and O'Riordan, 1976) that the ultimate aim of participation is 'community participatory design', through an integration of the latent planning potential of the public and the expertise of the elite; this being most possible at the small scale, community level where interest is high. A contributory aim in flood hazard mitigation is often the achievement of consensus; a notion based on social homogeneity. However, inevitably, distributional consequences occur, with costs and benefits being unevenly distributed (Lowe and Goyder, 1983:98–105); and, in non-homogeneous communities, increased participation is likely to highlight differences and increase conflict. Therefore, it is important to examine whether a condition for consensus exists: if so, participation may further its realisation; if not, (if a condition of diversity exists) then participation is likely to contribute little to conflict resolution and may increase conflict by creating conditions for confrontation and polarisation (Wengert 1976:27). This would make imperative the setting up of parallel agencies, departments, or processes for conflict resolution in, the more usual, heterogeneous social configurations.

But the perceived need for, and form of, consultation and participation can be different depending on whether one is communicating (official/engineer) or receiving (floodplain resident) information. A differentiation can be made between the public official's perception of the role of public participation—as a means to accomplish ends (characterised by such goals as: correcting misperception; educating the public; reducing conflict; easing implementation; and increasing legitimacy)—and the public's approach to public participation which tends to concentrate on ends rather than means and is characterised by conflicts over fundamental ethical issues such as: appropriate or tolerable levels of risk; who is to decide such levels; and, in terms of scheme or project development, whether it should go ahead at all; and for the benefit of whom? (Kasperson, 1986).

Despite recent developments in floodplain management which favour a broader agenda and more inclusive consultative policy, decision making is still dominated by an androcentric engineering culture which privileges a top-down, technocentric approach, a relationship to the public based on a 'deficit model', and a focus on the means to accomplish ends. Although the importance of ecological principles in river works is now generally acknowledged, these are founded upon a scientific/technical/rational discourse to which a more emotional ('feminine') sensibility is subordinated. Thus concerns about 'ordinary' landscapes and the 'look' of flood defence schemes can be relegated to the lowest level of priority and consideration. Engineers and planners can underestimate the importance of residents' attachment to their local areas and how it comprises a vital component of their social identity. 'A threat to their physical environment thus becomes a threat to the self.' (Hillier 1997: 19).

Alternative approaches, such as those informed by qualitative methodology and feminist theory for example, offer the possibility of a more inclusive form of

EMA UPDATE

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Edited by Rob Fleming

EMA news

The Hon John Moore is the Minister for Defence in the second-term Howard Ministry, replacing the Hon Ian McLachlan who retired from Federal Parliament. Mr Moore has government-wide responsibility for emergency management, including the approval of Federal assistance to States and Territories during times of disaster.

His early years were spent on a cattle property west of Bowen in North Queensland. He has a Bachelor of Economics from the University of Queensland. Before entering Federal Parliament in 1975, Mr Moore was a successful businessman and stockbroker. He is an enthusiastic sportsman, an active supporter of community organisations and has held senior positions on both the Queensland State Executive and Federal Executive of the Liberal Party.

In 1980-82 he served as Federal Minister for Business and Consumer Affairs and in 1996 he was appointed Minister for Industry, Science and Tourism.

Mr Moore is married and has two sons and a daughter.

Mitigation

In July 1998, the Minister for Finance and Administration agreed Mitigation Guidelines for the Natural Disaster Relief Arrangements (NDRA) which make mitigation a pre-requisite for disaster relief funding for recurrent disasters. In August, the Minister announced that the Commonwealth is prepared to provide $3 million on a dollar-for-dollar basis with State and Local Governments to enable risk management and mitigation studies to be conducted.

In 1998 the Local Government Association of Queensland conducted an inquiry into the NDRA. As a result, the National General Assembly of Local Government carried the following motion at its annual meeting:

'That the Australian Local Government Association welcomes the financial assistance announced by the Federal Government for risk assessments and the development of disaster mitigation plans but calls on the Federal Government not to fully activate the recently released NDRA Determination on mitigation requirements until agreement is reached between all three spheres of government as to what is an acceptable level of disaster mitigation; and funds are provided to not only support the development of risk assessments and disaster mitigation plans at the local level but also the implementation of key capital works to put into effect the mitigation plans.'

The Coalition also made the following election commitments: $10m for Rural and Regional Floodplain Management Program for flood plain management/flood mitigation projects in rural towns and regional centres. $10 over two years for flood prevention works in major regional centres – for new infrastructure (including levees) and repair of existing infrastructure. Removal of restrictions in the Natural Heritage Trust which limited flood mitigation assistance to towns with populations less then 40,000.

Further details on criteria and the implementation of these initiatives are unavailable at this stage. EMA is working with other Commonwealth agencies and State and local governments on the implementation of these measures and will keep stakeholders informed on progress.

For further information contact Jonathan Abrahams, phone (02) 6266 5219, fax (02) 6257 7665 or e-mail: jabrahams@ema.gov.au.

Urban search and rescue

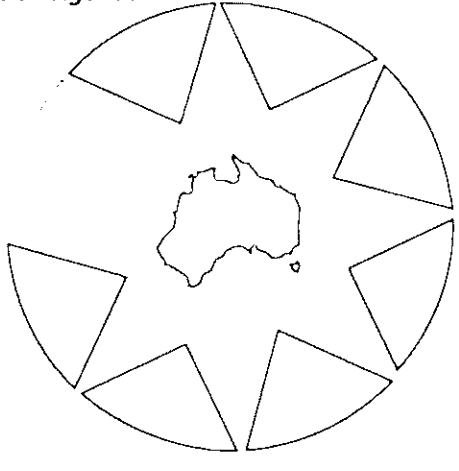
In November 1998, the National Urban Search and Rescue (USAR) Steering Committee met to continue development of a national capability. During the meeting, the Committee commenced work on the development on an Australian Emergency Manual (AEM) on Urban Search and Rescue.

For further information contact Trevor Haines, tel: (02) 6266 5169 or e-mail: <thaines@ema.gov.au>

Review of PNG Disaster Management Project

AusAID recently commissioned a team to redesign the 1995 PNG Disaster Management Project which had languished for a number of reasons. The team, which included Mr Phil Stenchion from EMA, visited PNG during October 1998. Following meetings in Port Moresby and a number of provinces, a workshop with key national-level stakeholders reached agreement on a revised design for the project. The revised design is essentially a scaled-back version of the more ambitious 1995 project and, given the recent disasters in PNG, appears certain to proceed.

For further information contact Phil Stenchion, phone (02) 6266 5441, fax (02) 6257 7665 or e-mail pstenchion@ema.gov.au.



Response to NBC terrorism course

In the event of a chemical, biological or radiological attack on Australian territory, emergency response agencies would be faced with managing the consequences of the incident. To ensure that response agencies are better prepared to deal with such a situation, EMA is currently developing a Response to NBC Terrorism course. It is planned to conduct the pilot course in late 1999/early 2000.

For further information contact Don Patterson, phone (02) 6266 5165, fax (02) 6257 7665 or e-mail dpatterson@ema.gov.au.

Y2K

In December 1998, a workshop was held at the Australian Emergency Management Institute to exchange information on the management of the consequences of Y2K remediation failures. All States and Territories and the Australian Defence Force were represented. The outcomes of the workshop are being used in contingency planning being undertaken by EMA and State and Territory Emergency Management organisations to address public safety issues.

For further information contact Rod McKinnon, phone (02) 6266 5328, fax (02) 6257 7665 or e-mail rmckinnon@ema.gov.au.

World Disaster Reduction Campaign 1998: Disaster prevention and the media (NSW Media forum and national launch of SEWS)

The theme for United Nations' 1998 World Disaster Reduction Campaign was 'Disaster Prevention Begins with Information'. The media were a special focus for the campaign, due to their critical role in spreading information about disaster prevention and providing early warning systems to a wide audience.

Activities in Australia focused on a forum held in Sydney on 7 October 1998 and the launch in most States and Territories of the Standard Emergency Warning Signal (SEWS). SEWS is a distinctive siren sound to be played on radio and television to attract attention before urgent safety messages. The signal has been used very successfully for many years in northern Australia for cyclone warnings but now may be used for any serious emergency anywhere in Australia.

At the NSW forum, over 70 invited emergency managers and media representatives met at the Australian Museum, Sydney, to discuss "Public Information, Media and Disaster Mitigation". The forum was hosted by the New South Wales State Emergency Management Committee and funded by the Australian IDNDR Coordination Committee. A summary of discussion is on the EMA homepage, based on the following sessions:

- Accuracy, Timeliness and Consistency of Information - Facilitating the Flow of Public Information and Preventing Public Panic.
- Joint Media Information Centre: Our Joint Responsibility During Emergencies.
- Public Education and Information to Reduce Natural Disasters: an On-going Role for all Emergency Managers and the Media.
- Victims: Treatment in Emergencies and Disasters.
- Media and Community Services: Appeals and Tributes.

International activities in support of the campaign included seminars and round tables in a number of other countries and a free international Internet Conference run by the UN IDNDR Secretariat, QUIPUNET (a Peruvian distance education provider), and San Francisco State University from 28 September–18 October 1998. The conference encouraged emergency managers, the media and the community to consider how they can cooperate in disaster prevention. The agenda focused on: Media and Disaster Prevention; Public Information: How to get the message out? and What is the Disaster Prevention Message? Conference papers are available at the following web site: http://www.quipu.net:1998/.

The UN IDNDR Secretariat also released a press kit containing information about media and disaster prevention which is available at: http://156.106.192.130/dha_ol/programs/idndr/presskit/.

For more information about Australia's involvement in the 1998 World Disaster Reduction Campaign, visit the EMA web site at http://www.ema.gov.au (under main menu, IDNDR) or contact Pip Marks, Australian IDNDR Secretariat, by phone +61 (0)2 6266 5408, fax +61 (0)2 6266 5029 or e-mail: idndr@ema.gov.au.

Seventh IDNDR Pacific Regional Disaster Management Meeting held in Nadi, September 1998

The Seventh IDNDR Pacific Regional Disaster Management Meeting was held in Nadi, Fiji on 24-26 September 1998. The theme for the 7th IDNDR Meeting was 'Partnership in National Disaster Management Programming.' Since disaster management cuts across all sectors, new partnerships have to be formed and old ones strengthened to promote the right environment for successful disaster management in each country. Partnerships help to build cooperation, to consolidate achievements, to sustain project efforts, and to establish operational platforms for attracting continued support from donors.

Senior disaster managers from fourteen Pacific Island Countries were invited to participate in the meeting, along with representatives from a range of Non-Government Organisations from the Region and observers from various regional organisations and the United Nations. The meeting was held back-to-back with the Joint Meteorologists and National Disaster Managers Meeting in Nadi, and the South Pacific Applied Geoscience Commission (SOPAC) STAR session and Governing Council meeting in Suva.

A report of the meeting has been drafted and will be placed on the EMA Homepage once it is finalised. For printed copies of this or earlier meetings, contact the Australian IDNDR Secretariat, phone +61 (0)2 6266 5408, fax +61 (0)2 6266 5029 or e-mail: idndr@ ema.gov.au.

Sasakawa Award for Disaster Reduction

The Australian International Decade for Natural Disaster Reduction (IDNDR) Coordination Committee was presented with a Sasakawa certificate of distinction for its work in Australia on disaster prevention, preparedness and mitigation, and its wider role in the Pacific.

The United Nations Under Secretary General for Humanitarian Affairs, Sergio Vieira de Mello, presented the award at a ceremony at the United Nations in Geneva on 14 October last, the 1998 UN World Disaster Reduction Day.

Alan Hodges, Director General, Emergency Management Australia, accepted the award as current Chair of the Australian IDNDR Committee.

The Australian committee was established in 1989, and is acknowledged internationally as an example of effective disaster prevention and preparation, in particular its education and awareness training and disaster preparedness and mitigation programs. It comprises representatives from Commonwealth and State/Territory governments, emergency management agencies, research institutions, the insurance industry and non-government organisations.

The Australian IDNDR Committee works closely with the small island states of the South West Pacific and provides assistance for a number of information projects, especially those directed at the community level.

The Sasakawa award is funded by the Japanese philanthropist, Mr Ryoichi Sasakawa, and is designed to help minimise damage and loss of life in the case of natural disasters and other emergencies and recognises outstanding work in these fields.

For further information contact, Alan Hodges, Director General, EMA, phone +61 (0)2 6266 5183 (w), fax +61 (0)2 6257 7665, or e-mail ahodges@ema.gov.au.

Workshop highlights holes in emergency response system

At a recent workshop at the Australian Emergency Management Institute addressing existing arrangements for countering emergency animal disease outbreaks, Australia's vulnerability and a lack of adequate preparation was identified.

Dr Geoff Neumann, veterinary consultant, said after the workshop, that emergency service agencies, the animal industries and the animal health community had developed high-level skills and had all made careful preparations. However, the integration of the three groups had been run down over time and there was a pressing need to re-establish better working relationships at every level.

Senior representatives from emergency services, State and Federal governments and peak animal industry bodies met to review how they could better link together to quickly stamp out an outbreak of infectious disease in the nation's herds and flocks.

Dr Neumann said that all sectors were alarmed that in recent years there had been little day-to-day contact between the various agencies.

'Apathy, increased workloads and other, more immediate, issues combined to cause the topic of integration to be put on the back-burner" Dr Neumann said. "While everyone recognises the need, the workshop concluded that immediate action was needed to address the deficiencies'.

The outbreak of the poultry affliction, Newcastle disease, near Sydney in 1998 was a further demonstration that these events will happen and cannot be ignored.

'Fortunately, Australia is free of most of the world's serious animal diseases and Australia's animal health status is the envy of most countries. "We need to keep it that way.' said Dr Neumann.

An outbreak of the most serious of all threats, foot and mouth disease, if not eliminated quickly, could lead to significant damage to the Australian economy.

'Not only would the farmers suffer, but the damage would flow through to affect all Australians'.

The workshop was organised and conducted by a partnership of Australian Animal Health Council Limited and Emergency Management Australia as part of the latter organisation's 'National Studies Program'.

Further details are available from Dr Geoff Neumann Australian Animal Health Council. phone +61 (0)8 8377 2022 or Colin Fiford, Australain Emergency Management Institute, phone +61 (0)3 5421 5100, fax +6 (0)3 5421 5272, or e-mail cfiford@ema.gov.au

Publications news

New and revised publications now available from EMA:

- **Hazard Action Guides.**
  (One-third A4 magnetic cards).

  Six of the seven in the set have been revised and facelifted. They are Flood, Severe Storm, Lightning Protection, Cyclone, Heatwave and Earthquake and give practical advice on what to do before, during and after. (Copies available through State/Territory Emergency Services.)
- **Surviving Cyclones**
  (A5 fold-out colour pamphlet).

  This joint EMA/Bureau of Meteorology publication has been revised and features new photographs and updated information on the formation and dangers of tropical cyclones and storm surges. It also covers the warning system and information on preparedness and safety precautions. (Copies available through State/Territory Emergency Services in Qld, NT, WA and northern NSW.)
- **Sixth IDNDR Pacific Regional Disaster Management Workshop Report**
  (New B5, 104-page book covering proceedings of the IDNDR-sponsored 1997 workshop in Brisbane).

  Available from Australian IDNDR Secretariat, phone +61 (0)2 6266 5408, fax +61 (0)2 6266 5029 or e-mail: idndr@ema.gov.au. The Executive Summary for this publication can be viewed on the EMA homepage.

- **Australian Emergency Manual Series: Part I — The Fundamentals**
  - Manual 3: **Australian Emergency Management Glossary**
  - Manual 4: **Australian Emergency Management Terms Thesaurus**

  (Copies available through your State/Territory emergency management organisation secretariats.)
- **Mt Macedon Papers Series**
  - **Mt Macedon Paper Number 7/1997**: Record of the *'Putting Community into Emergency Management Workshop'*.
  - **Mt Macedon Paper Number 8/1997**: Record of the *'Legal Issues Workshop'*.

  (Mt Macedon papers are available from EMA Canberra or EMA Mt Macedon.)

EMA addresses for publications orders (check above for appropriate EMA Office or State/Territory authority):

Emergency Management Australia
PO Box 1020
Dickson, ACT 2602
Australia

Australian Institute of Emergency Management
Main Rd
Mt Macedon, Victoria 3441
Australia

What's on at AEMI

Landslide Management Workshop

14–18 June 1999

This workshop will consider all aspects of managing landslides. Key considerations will include planning, public education and risk management. The major outcome will be a best practice guide for the management of landslide.

On-line subscription available to AEMI's Publications and Information

The Australia Emergency Management Institute (AEMI) Information Centre is pleased to announce a listserve facility for four of its services: the 'Australian Journal of Emergency Management,' 'INFOrecent,' 'Journal Abstracts,' and Seminars and Conferences updates. At present all services are available on the EMA World Wide Web home page http://www.ema.gov.au.

Instead of sending an e-mail message to initiate these services, subscribers should go to:

http://www.ema.gov.au/seminarsframe.htm. There they will find a subscription form in which they should indicate their full name, location and e-mail address.

The journal and INFOrecent are distributed quarterly and the other material on a monthly basis.

The Australian Journal of Emergency Management will be distributed in PDF format. The journal provides an information-sharing forum for everyone involved in emergency management. It has a large and steadily-growing national and international audience.

INFOrecent is a bulletin produced quarterly by the centre to provide clients with current information on new material received. It provides a subject listing with a short description of each item. INFOrecent is a vital tool for people wishing to keep abreast of the current disaster management literature. The material included in it is only a selection of some of the matter received by centre staff in the previous three months.

Journal Abstracts is an annotated list of a selection of journals received and abstracted by the centre. It is produced monthly and assists researchers and practitioners in keeping up-to-date with the most current literature. These abstracts are not included in INFOrecent.

The Australian Journal of Emergency Management and INFOrecent will continue to be distributed in hard copy.

The updates of emergency management seminars and conferences are produced monthly and incorporated into the larger database located on the AEMI home page, which includes a search engine.

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decision making in which no dimensions are barred from consideration, and in which reflexive and democratic processes are uppermost. 'Traditional forms of planning decision-making have tended to convey a message of place as identified and controlled by outsiders (the planners).' (Hillier 1997: 19) but sustainable environmental management, of which flood planning and management is a part, must include full integration of insiders' and outsiders' views. Andrew Maskrey has argued this case albeit largely within a 'Third World' context but it is a model which can be transposed to, so-called, 'developed' world initiatives:

The participation of people in the analysis of problems and the development of proposals is a vital characteristic of community based mitigation. The starting point is always the specific problems a community faces and people's perceptions of how to solve them. Proposals must be developed gradually, step-by-step. While this is a long process, in which each element has to be discussed and approved laboriously in meetings, it avoids the difficulties which can arise when proposals are generated outside, do not coincide with local needs and demands and overlook conflicting interests and objectives within the community. The long process of achieving consensus is worthwhile as it results in better proposals and a stronger community organisation (Maskrey 1989: 94).

The incorporation of such, seemingly, radical models and approaches into traditional engineering practice may appear utopian to some but a more achievable target is to ensure flood hazard mitigation is far more multi-disciplinary and end the separation of the technical and socio-cultural dimensions. There are signs that this process is beginning in some places but it is, as yet, at the earliest stage of transformation.

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Strengthening community participation in disaster management by strengthening governmental and non-governmental organisations and networks

A case study from Dinar and Bursa (Turkey)

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This paper focuses on issues and weaknesses related to disaster management in the 1995 Dinar (Turkey) earthquake, and subsequent attempts to apply the lessons learned from this earthquake into a study of strengthening community participation in Bursa, a province of Turkey which is located in the first-degree seismic zone, specifically focusing on earthquake disaster. The study in Bursa is a pilot one included in a general project for strengthening Turkey's disaster management system. The first step involved the study of a disaster-stricken community following the 1 October, 1995 Dinar (Turkey) earthquake. The findings related to attitudes and evaluations of the Dinar community and local and central authorities on some aspects of disaster management will be presented. Subsequently, the initial stages of the pilot study in Bursa, partly employing the findings from the Dinar study will be described. The paper will focus on important dimensions of disaster management, the facilitating and hindering aspects of disaster management in Turkey and will provide a discussion of the findings in relation to the sustainability of disaster management.

Introduction

Disaster management is a multi-faceted process that entails various stages. These stages are commonly conceptualised as the disaster impact phase, relief and rehabilitation, reconstruction, mitigation and preparedness phases. Effective planning and action for disaster reduction involves various social units such as central and local governmental agencies, NGOs, local communities and international agencies. The importance of strengthening the capacity of local communities in disaster reduction has been repeatedly stressed (Dynes, 1993; World Conference on Natural Disaster Reduction, 1994). Therefore, it is crucial to understand the attitudes, expectations and resources of the local community in order to develop plans that can be integrated into the ongoing social life of the communities living in disaster prone areas.

Natural disasters, like earthquakes have extensive psycho-social impacts on the affected populations (Durkin & Thiel, 1993). Survivors of natural disasters have to adapt to drastically altered physical environments, economic losses, disruption of activities and homelessness. They also have to cope with the emotional trauma of witnessing loss of lives, injury and property loss (Baum *et al*, 1983; Karanci and Rustemli, 1995; Rubonis and Bickman, 1991). Adversities following the disaster, such as lack of housing and break-up or displacement of families, were found to be related to the continuation of psychological distress (Goenjian, 1993). For effective disaster management it is very important to have plans for mitigation and to create a community awareness for the risks of future disasters and to empower local communities and authorities by giving information on how to mitigate future disasters For the sustainability of disaster management plans it is essential to institute community participation. In order to create awareness of future risks and to motivate preparedness it is fundamental to understand the attitudes, expectations, political, economical and socio-cultural contexts of the communities living in risk areas. (Habitat International Coalition, 1996; Bates *et al*, 1991 ; Karanci, Aksit & Sucuoðlu, 1996).

This paper will focus briefly on the legislation concerning disasters in Turkey and will report findings related to some aspects of disaster management from the 1995 Dinar earthquake. Subsequently, the preliminary stages of an ongoing project aiming to strengthen community participation in disaster management in Bursa, which is a metropolitan city located in the first degree seismic zone, but which has not yet experienced a recent earthquake will be presented.

The Turkish Disaster Law and institutional framework

In Turkey, the first law concerning disasters was enacted in 1944 and solely focused on earthquakes. The reason for this being that the major type of natural disaster affecting Turkey is earthquakes. This law was a response to the 1939 Erzincan earthquake and several similar subsequent earthquakes and it was the first law to stress the need for plans for rescue, material aid and temporary shelter prior to the occurrence of earthquakes. The law also had a clause that emphasised compensation for the loss of property. The formation and the funding of provincial rescue and emergency aid committees was also introduced (Severn, 1995). In 1959, the 1944 law was replaced by a new more extensive law covering disasters other than earthquakes, like fires, floods, landslides and similar disasters. The responsibility for the execution was given to the Ministry of Public Works .This law established the duties and the responsibilities of the 'Provincial Rescue and Aid Committees'. The main emphasis is to make and keep the plans for provincial rescue and aid updated and to clearly delineate the personnel involved in such plans. In 1983, in order to ensure the coordination between the central and provincial administration an 'Extraordinary Status Co-ordination Council' has been developed which is established if the need arises by the government.

The development of earthquake zonation maps in Turkey started in 1944 and with numerous revisions the most recent one was developed in 1996. Similarly, construction specifications were revised several times and the most recent one was published in 1997.

As can be seen, although detailed responsibilities are given to the provincial and central governmental institutions, the non-governmental organisations and the private sector are not involved in the system. Furthermore, measures on mitigation are not included.

The October 1, 1995 Dinar earthquake

The aim of this study was to examine the attitudes and expectations of the survivors of the Dinar 1995 earthquake, about different phases of disaster management. More specifically the aims were to examine the impact of the earthquake on social-economical dimensions, to explore the attitudes about the houses constructed

after the earthquake by the state, beliefs in the possibility of hazard mitigation and who is regarded as responsible for such action and future risk perceptions.

Dinar city is located at the juncture of the Aegean, Central Anatolian and Mediterranean regions in Turkey. The estimated population before the earthquake was around 40,000. Agriculture and trading and small crafts were the dominant activities. An earthquake of magnitude 5.9 struck Dinar on October 1, 1995 at 17.57 p.m. The mainshock of the earthquake was preceded with foreshocks for four days, the largest one having a magnitude of 4.7. These foreshocks initiated structural damage in many buildings which were then severely aggravated by the mainshock. Numerous aftershocks were recorded in the following days, which continued for more than three months. The mainshock having a duration of 20 seconds was immediately followed by a strong aftershock two hours later with a magnitude of 5.0. The Dinar earthquake caused a death toll of 90, and more than 200 injuries. The economical losses were estimated at US$250 million.

The total population affected by the earthquake in the region is 100,000 and the number of residential units is about 24,000. The damage observed in the city is beyond the expectation when it is considered that the Dinar earthquake is not a severe one. According to the damage survey conducted in the affected region after the earthquake, out of 24,000 residential units, 4340 (18%) were heavily damaged, 3712 (15%) were moderately damaged, 6104 (25%) were lightly damaged and the remaining 9844 (41%) were undamaged. Since 4340 units were either collapsed or severely damaged, a death toll of 90 might be considered as less than expected. The foreshocks in the preceding four days of the main shock considerably reduced the death toll because many residents had already left their houses or the city before October 1 by fear and expectation of a big quake.

Building stock in the city mainly consisted of one- and two-storey adobe, brick and stone masonry buildings, and 3–6 storey reinforced concrete-framed buildings. There are also 3-4 storey masonry buildings that were originally constructed as single or two-storey buildings, with upper stories added by permission from the municipal administration, which is strictly against the Turkish Seismic Design Code .

Examination of the disaster management aspects of the Dinar Earthquake

Our study of the Dinar earthquake took place in two stages. The main findings related to disaster management from the two phases of the study will be presented separately.

Stage 1

This part of the study took place within the six months following the Dinar earthquake. The main objectives were the assessment of the mitigation and preparedness, relief, rehabilitation and reconstruction phases of the disaster management cycle in Dinar and to formulate the weaknesses and the strengths of the existing disaster management system.

The data sources for this stage were in-depth and focus group interviews with Dinar residents, experts and officials in Dinar and surrounding cities and in Ankara, the capital of Turkey, observations during the field trip to Dinar and the examination of written documents related to the Dinar earthquake.

Previously prepared disaster management plans could not be implemented. 'The plans just stayed in written documents kept in dusty shelves.' Furthermore, the community was not adequately informed about rescue and relief operations.

Mitigation and preparedness

Dinar had its first urban planning in 1971 and subsequently two revisions were made on the first plan. The final plan before the 1995 earthquake was prepared in 1990. The fact that there had been three urban planning experiences since 1971 is an indication of movement towards rational planning. However, the results of the 1995 earthquake showed that the enforcement of the urban plan and the building codes were evaded, monitoring and evaluation of these enforcement activities were not carried out. Our analysis revealed that a number of actors , such as the owner, the project engineer, the contractor and the controller, the municipality, and the community members , share responsibility in this state of affairs.

Rescue and relief

The majority of officials and community members pointed out that rescue and relief activities were poorly coordinated and that the local administrators were inefficient because *a.* they were victims themselves and *b.* they were inexperienced in disaster management. Adequate national and international aid (tents, food etc.) was available, however its distribution was unsystematic and aid was delivered for a very lengthy period (6 months).

Previously prepared disaster management plans could not be implemented. 'The plans just stayed in written documents kept in dusty shelves.' Furthermore, the community was not adequately informed about rescue and relief operations.

Thus, it can be suggested that the formation of regional civil defense teams and professionalism and specialisation in relief and rescue work is necessary. It also seems essential to establish the involvement of the local community. Aid should be distributed systematically and the community needs to be informed regularly about the activities.

Temporary settlement

The General Directorate of Disaster Affairs conducted a survey with earthquake victims just a few days after the quake. Four choices were given. Ninety-eight per cent of the respondents chose 'receiving rent allowance'. All victims with heavy or moderate damaged houses (7166 families) were provided with rent allowance which was delivered for 12 months. However, this decision was afterwards criticised because:

- the survey was conducted when the victims were still in shock
- it led to the desertion of Dinar by its residents and paralysed economic activities
- it created a substantial increase in rents in neighboring provinces
- it forced the most needy segment and some of the civil servants to stay in Dinar in spite of receiving the rent allowance and live in tents
- it compelled children to separate from their families, friends and their schools.

The majority of community members and officials stated that prefabricated disaster housing situated in Dinar would have been a better option. Thus, care should be given to settle the community in their own neighborhoods.

Reconstruction

The preferences of the Dinar community and the local officials were mainly one-or two storey buildings without soft stories, the separation of shops and residences, and the supervision of construction by honest and technically-expert engineers. It was also stressed that the final approval should be given by the state and not the muni-

cipality. Another main point was the need to educate engineers and skilled workers on earthquake resistant construction.

What is constructed by the State

The new settlement plan for Dinar suggested three- and four-storey buildings and also contained buildings with shops in the basement. As a result of damage surveys 1480 new units were constructed and 1300 units were strengthened. The new residential units were distributed to the right holders with long term loans in October 1996 (one year after the earthquake).

As can be seen, the preferences of the community on one- or two-storey houses was not taken into account, with the new houses being three- or four-storey buildings with shops in the basements. The attitudes of the right holders towards the newly-constructed disaster housing were assessed in the second stage of the study.

Stage 2

This part of the study involved the administration of an extensive questionnaire in order to examine attitudes related to different aspects of disaster management and some psychological variables like distress, coping and social support. Only some of the findings related to disaster management will be presented here.

The questionnaires were administered to 315 adult residents [165 (52.4%) females and 150 (47.6%) males] of Dinar. The female sample was selected from the twenty-six neighborhoods in Dinar on the basis of the type of current housing (disaster housing, built after the earthquake; houses that had moderate, light and no damage from the 1995 earthquake) and some of the female but the majority of the male sample was selected on the basis of status at work (self-employed; State employee and wage workers). 31.7% of the respondents were living in government-built disaster houses, 22.5% in houses that had no damage from the 1995 earthquake, 27% in lightly damaged, and 15.9% in moderately damaged and repaired houses. The mean age of the respondents was 34.3 (sd = 11.48) and the mean number of years of education was 8.3 (sd = 3.73). The mean household size was 4 persons. 90% of the respondents stated that they were in Dinar during the 1995 earthquake. 70.8% of the sample were born in Dinar and 72.4% were married.

The questionnaires were administered by 11 trained undergraduate and graduate students from the Departments of Psychology and Sociology of the Middle East Technical University, Ankara, Turkey in February, 1997, sixteen months after the earthquake. The interviewers went either to the houses or work places of the respondents and individually administered the questionnaires as structured interviews with a few open ended questions and recorded the replies themselves. The administration of each questionnaire took about approximately 45 minutes. Data was analysed by using the SPSS program.

Attitudes and evaluations related to housing

The questionnaire contained 19 items tapping views on current houses, neighborhoods, relationship with neighbors and services provided by the municipality and the availability of social institutions. Each item was rated on a 4-point Likert type scale by the respondents (1= Completely disagree; 4= Completely Agree). The factor analysis of the responses (varimax orthogonal rotation) yielded five factors explaining 50.2% of the total variance. These factors were labeled as 'satisfaction with the current house', 'satisfaction with the relationships with neighbors', 'satisfaction with the neighborhood', 'satisfaction with the currently inhabited building' and finally 'satisfaction with social services'. Mean factor scores for each respondent for the five factors were calculated by summing the scores on the items that had above .35 loadings on each factor and dividing them by the number of factors. An analysis of variance was conducted examining gender by type of current house (disaster; no damage; lightly damaged; moderately damages) by the five satisfaction factors as the repeated measure. The results yielded only a significant interaction effect for type of house by satisfaction factors ($F=3.52$, $p<0001$).

The (reconstruction) preferences of the Dinar community and the local officials were mainly one- or two storey buildings without soft stories, the separation of shops and residences, and the supervision of construction by honest and technically-expert engineers.

As shown in *Table 1*, the most pronounced differences on satisfaction seems to be between those living in disaster houses and those living in moderately damaged houses. For the house and the social services satisfaction, those living in the disaster houses are significantly more satisfied than those living in moderately damaged and repaired houses. For those living in the moderately-damaged houses, although there is governmental aid to strengthen their houses, the owners need to pay for the non-structural repairs and at the time of the study these houses were not strengthened. Thus, this state of affairs might have caused the relatively negative evaluations of this sample. The disaster houses were distributed to their owners one year after the earthquake, and the occupants were very recently settled in their houses. Thus, they were quite satisfied with the speed of reconstruction and seemed to be satisfied with their houses and the social services. However, since the disaster houses are distributed randomly to the right holders, they had no choice in determining their neighbors. This lack of control over choosing neighbors seems to be reflected in their lower satisfaction with their neighbors compared to the other groups, especially to the no damage group. However, considering the fact that four is the maximum satisfaction score, their mean satisfaction rating of three still reflects quite a favorable attitude towards their neighbors.

Mean satisfaction scores of the sample living in different types of houses

	Disaster housing	No damage	Lightly damaged	Moderately damaged	F
House Satisfaction 1, 2	3.20 a	3.10 a	2.98 a	2.60 b	10.19 ***
Neighbor Satisfaction	3.09 a	3.42 b	3.28 a b	3.27 a b	5.51 **
Neighborhood Satisfaction	2.50	2.57	2.48	2.47	0.31 NS
Building Satisfaction	2.85	2.70	2.97	2.62	0.34 NS
Social Services Satisfaction	2.67 a	2.50 a b	2.48 a b	2.24 b	3.15 *

*$p<.05$; **$p<.001$; ***$p<.0001$, N.S $p>.05$.

1 Means with different subscripts are significantly different from each other.

2 The range for the scale scores is 1–4, higher scores reflecting more satisfaction.

Table 1: Presents the mean satisfaction scores on the five factors of the sample living in four different types of houses.

Beliefs on mitigation and hazard perceptions

For the planning of disaster reduction measures it is important to explore the beliefs of the community on the possibility of mitigation and their perceptions of future risk. In order to examine these dimensions six questions related to mitigation, future earthquake expectations and evaluations of the current house on its resistance to future earthquakes were used. All of these questions were rated on four point Likert type scales. The responses to these questions were factor analysed in order to reduce them into appropriate dimensions. The varimax orthogonal rotation yielded three factors explaining 74.2 % of the total variance. The factors were labeled as 'doubt about the resistance of the house', 'belief in mitigation', and 'perceived risk'. Mean factor scores were computed for the three factors. A Multivariate Analysis of variance using gender by type of present house (Disaster; No damage; Light Damage; Moderate Damage) by the three earthquake-related cognitive factors was conducted. This analysis showed that the type of house (Wilks =.94, p<.03) and gender (Wilks= .95 p<.002) effects were significant.

As shown in *Table 2*, the only significant difference was about the evaluation of the safety of the houses. There was a systematic increase in doubt as we moved from the disaster housing and houses with no damage from the 1995 earthquake to houses which suffered light damage. The inhabitants of the moderately damaged houses were least confident about the safety of their houses.

These results point out that the evaluation of the disaster housing is quite favorable and may reflect trust in state supervised construction practices. For the moderately damaged houses the decision was repairing and strengthening the buildings. However, this doesn't seem to be a satisfactory solution for the inhabitants. Thus, it may be valuable to inform them of the strengthening procedure and give details on how strengthening will improve the resistance of their houses.

When the earthquake related cognitions were examined according to gender, it was seen that the only significant difference was on beliefs in mitigation. Women tended to believe less in mitigation (M=2.33; s.d=.81) as compared to men (M=2.62; s.d=.73; F= 10.76; p<.001). Further analysis revealed that education is positively related to beliefs in mitigation for both females and males. However, for females being employed was also related to beliefs in mitigation. Employment may enable women to have access to more information in regards to what is being done and what can possibly be done, and thereby may increase their beliefs in the possibility of doing something for disaster reduction. This finding implies that for community participation it may be important to built networks that can also reach housewives.

Mean factor scores of earthquake cognitions for the subjects living in four different types of houses 1

	Disaster housing	No damage	Light damage	Moderate damage	F
Doubt about the safety of the house	2.23 a	2.29 a	2.75 b	3.32 c	34.36 *
Belief in mitigation	2.59	2.48	2.41	2.23	2.46 NS
Perception of risk	3.13	2.29	2.75	3.32	0.41 NS

* p< .001; N.S : p> .05
1 Means with different subscripts are significantly different from each other.

Table 2: Mean factor scores on the three earthquake cognition factors for the four types of houses.

The evaluations of the state-built disaster houses were very positive. The inhabitants seemed to be satisfied with the houses, the social services and had trust in the seismic safety of their houses. This is a very favorable picture and seems to reflect the appropriateness of the decisions about where and how these houses were built.

The present results seems to point out that the Dinar community is perceiving the risks of a future earthquake and that they believe to some extent in mitigation. However, to the question 'have you done something as a preparation for a future earthquake?' only 14% replied affirmatively. Thus, it seems that although the social base is cognitively ready for mitigation they have not turned this into action. The answers to the question on assigning responsibility for mitigation ('Who should take actions for mitigation?') seems to solve this puzzling finding. The respondents believed that mitigation measures should be taken by the state (41%), the municipality (38%), the major (15%), Civil Defense Units (6%). Only 26% stated that it is their own duty. Thus, although they believed in mitigation, they placed the responsibility for mitigation on external, mostly governmental agencies. Thus, for future action plans on disaster reduction it seems important to shift this externalised and centralised responsibility locus to internal and local sources.

Conclusions and suggestions

The evaluations of the state-built disaster houses were very positive. The inhabitants seemed to be satisfied with the houses, the social services and had trust in the seismic safety of their houses. This is a very favorable picture and seems to reflect the appropriateness of the decisions about where and how these houses were built. The fact that the construction was completed within one year may have also contributed to these favorable attitudes. However, the same picture was not true for the occupants of the moderately damaged houses. Sixteen months after the earthquake the strengthening process was still not completed and the inhabitants anyway did not seem to trust the safety of the strengthened buildings. Therefore, it may be necessary to hold workshops using participatory adult learning principles, in order to understand the reasons for their distrust and dissatisfaction and modify their beliefs on the strengthening process.

Although the respondents perceived risks for future earthquakes and believed in the possibility of mitigation, very few engaged in preparatory activities. Furthermore, they believed that taking measures for mitigation is the responsibility of agents outside themselves. Thus, it seems important to investigate ways of initiating and maintaining community participation. Women tended to believe less in the possibility of mitigation. Therefore, in the plans for community participation it seems important to give special emphasis to integrating women.

Project to strengthen community participation in a province not recently struck by an earthquake: Bursa as a metropolitan city located in the first-degree seismic zone

Bursa has been chosen as a pilot city to identify existing and prospective local institutions and networks and strengthen

or empower them so that local people will be able to better prepare for a future disaster when it strikes or have greater welfare if disaster does not strike.

Bursa is one of the seven metropolitan centers with a population of 500,000 and over. These metropolitan centers have main municipalities consisting of city portions of more than one district, each of which has its own municipality (SIS, 1993). Bursa metropolitan center with a population of more than one million has three district municipalities. All of these three municipalities, but especially two, have received a massive influx of migration. According to recent calculations in the period between 1980–85 Bursa received 15,600 migrants every year. In 1985–90, yearly migration inflow increased to 25,000. Among seven metropolitan centers in Turkey, Istanbul, Bursa and Gaziantep are the only three cities where yearly migration rate has increased from one period to the next.

In 1990, the city population of main or metropolitan Bursa was 834,576. However, the urban population in Bursa province as a whole was 1,157,805. Over the last 70 years a complete reversal has taken place. In 1927, 28.6% of population in Bursa Province was living in city centers in the province, while 71.4% was living in the villages. In 1990, 72.2% of population was living in the cities, while the percentage living in the villages was only 27.8%. These figures indicate mass migration from the villages of the province as well as from the villages and cities of other provinces in Turkey, including immigrants from South-Eastern European (Balkan) countries, Such as Bulgaria.

Bursa is in first degree earthquake zone and last major earthquake took place in 1855. Close to one and a half century elapsed and according to earthquake engineers and geologists it is very likely that a major earthquake will take place in the region.

Our aim is to see how local organisations can be set up so that the local populations will be ready for such a disaster before it strikes. Our interviews in Bursa have shown that it is possible to bring together central government agencies, main or metropolitan municipality and district municipalities and Non Governmental organisations to establish community networks in the neighborhoods. We have observed that this local need has already some beginnings in the establishment of ***Local Agenda 21*** in Bursa, which is a global initiative set up in 1994 during the Rio Summit Meeting of United Nations. It is a global initiative to organise local communities.

Dinar city was not prepared for a disaster. Existing zoning and housing regulations were not enforced by the municipality. Building construction was carried out to maximise urban rent. But this was not combined with minimising losses in a disaster such as an earthquake. As we have shown in the previous sections households and the community are not still organised for a better mitigation and preparedness for earthquakes.

We are hoping that Bursa will be more prepared for a disaster through the local organisations that will involve men and women as individuals and households as groups into community networks. We have already noted that *Local Agenda 21* has already been set up in Bursa. A pilot Local Consultation Center in one of the neighborhoods within the boundaries of Nilüfer district municipality of Bursa Metropolitan Municipality has already been established. However they admitted that they do not know how to involve local people into such networks. Community participation in these new forms are not readily forthcoming. Old forms of community participation should be unearthed and new forms should be devised and implemented. Some NGOs such as Chamber of Civil Engineers, Chamber of Commerce and Industry, Rotary Club and so on needs to be involved. The problem is to get it going. One of the ways to start it rolling will be to have a large meeting with the already existing Urban Council by inclusion of new partners or stake holders. If smaller groups are established in such a large meeting it will be possible to carry out training workshops in community participation. These workshops and committee organisations should be carried from metropolitan municipality level to district municipality levels. Then these should be repeated in neighborhoods.

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The tyranny and triumph of distance: Disaster response planning for decentralised mental health services

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Presented at the Disaster Management: Crisis and opportunity: Hazard Management and Disaster Preparedness in Australasia and the Pacific Region Conference, James Cook University, Centre for Disaster Studies, November 1–4, 1998, Cairns, Queensland.

Factors such as distance, population distribution and cultural differences contribute to Queensland being considered Australia's most decentralised state. Queensland is Australia's second largest state, with an area of 1.7 million square kilometres, or approximately one quarter of the nation's total land area. Less than half of Queensland's 3.4 million people live in the capital city, Brisbane (Australian Bureau of Statistics (Queensland Office), 1998). As a result, many government and non-government services are increasingly decentralised, and agencies involved in responding to disasters are no exception.

Decentralisation and the resultant high degree of local control over services may be seen to have a number of advantages. These include improved effectiveness, sensitivity to local issues, faster response times, and greater commitment to service provision (Hodges, 1997). However, there are also disadvantages inherent in decentralisation, which present significant challenges to service planning. These include difficulty ensuring consistency between local areas, coordination of services between local areas, and difficulty providing the full range of services in areas where the local population is not sufficient to support these. Queensland Health has recently undertaken a project to implement effective disaster response planning by mental health services, which is both consistent and coordinated across the State. This experience has provided an excellent opportunity to examine the tensions between locally-based and centralised organisation, in addition to a review of effective strategies for meeting the community's specialist mental health needs in the circumstances of a disaster.

Disaster response arrangements and mental health services in Queensland

The provision of health services in Queensland is the responsibility of 39 district health services. The Mental Health Sub-Plan forms part of the Queensland Health Disaster Plan, which in turn is a functional plan of the State Disaster Plan (*Figure 1*).

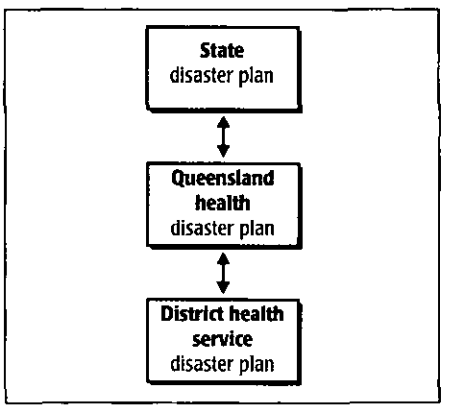

Figure 1: Queensland Health Disaster Planning

The Queensland Health Disaster Plan broadly outlines a strategy for activating a mental health service response. District health services are expected to have developed local procedures which correspond with the objectives set out in the Queensland Health Disaster Plan. Additionally, involvement of mental health services in the recovery phase of a disaster are activated and coordinated by the Department of Families, Youth and Community Care according to the Community Recovery Functional Plan.

Development of mental health disaster planning in Queensland has followed an interrupted course and the emphasis on particular roles to be adopted by mental health services in the disaster circumstances has shifted over time. This course reflects development and debate in the research literature, and variable commitment by stakeholders. In the early 1990's efforts to ensure implementation of appropriate disaster response planning included the distribution of a resource manual to mental health services, who were then responsible for preparing their own plans (Queensland Health, 1990). Subsequently, a review of mental health disaster response plans was conducted in 1995. The review found that mental health services' participation in disaster planning, their ability to respond effectively, and the currency of plans was found to be widely variable across the State. Moreover, there was little coordination between district health services.

The full range of mental health services, with both community-based and inpatient services (*Figure 2*), is not available in all Queensland Health districts. This applies to most remote or predominantly rural districts with small populations. However, satellite mental health services have been developed in a number of key rural centres, which employ at least one mental health professional. These satellite services are

Key components of Queensland Mental Health Services:

1 Referral, intake and assessment, including extended hours capacity.
2 Continuing treatment, using a case management approach, including:
- community treatment services
- outreach services
- acute inpatient treatment
- mobile intensive treatment for identified 'at risk' individuals
- extended inpatient treatment and rehabilitation services for special needs groups.

3 Mainstreamed, integrated services to promote continuity of care across service components.
4 Prioritised services to those most in need.

Targeted to people with mental disorders and serious mental health problems, including people suffering from acute and persistent psychoses, mood, anxiety, or eating disorders, and those with situational crises that may lead to self-harm or inappropriate behaviour directed towards others.

Figure 2: Ten-year Mental Health Strategy for Queensland 1996

each linked to, and supported by a principal mental health service centre, located in a major district health service (Queensland Health, 1996). There are currently 15 principal mental health service centres, with two more planned within the next two years. Eight of these are linked to a network of satellite services, based in the remaining 22 Queensland Health districts.

Models for service delivery in disaster planning literature

Since World War II, and in particular, since the 1970s, the involvement of mental health professionals in responding to disasters has been argued strongly (Pawsey, 1983, Raphael 1986, National Health and Medical Research Council, 1992). Contrary arguments are much less compelling, and have been based largely on the manner in which mental health services are provided; for example, stigmatisation of service recipients, over-diagnosis of pathology, etc (Pawsey, 1983). While most individuals affected by a disaster will experience a psychological response which may seen as being part of a spectrum of 'normal' responses, a significant proportion may experience more clearly pathological responses (National Health and Medical Research Council, 1992, Bromet & Dew, 1995, Krug et al., 1998). The number of people affected psychologically is generally greater than the numbers physically affected, the effects may be less obvious, and they may easily become chronic conditions (New South Wales Health Department, 1996). A number of adverse psychological sequelae of disasters have been identified. In the immediate aftermath, acute stress reactions, organic disorders, acute anxiety and panic disorders, precipitation of psychotic states, fugue and other dissociative states, acute decompensation, sleep disturbance and inappropriate or suicidal behaviour have all been described. The longer term sequelae can include post traumatic stress disorder, depression, anxiety disorders, drug and alcohol abuse, psychological problems in those physically injured, complicated bereavement, and more generalised problems such as relationship and work difficulties, anger towards those perceived as responsible and survivor guilt (National Health and Medical Research Council, 1992, Bromet & Dew, 1995, Erikson & Lundin, 1996, Krug *et al*, 1998).

The literature provides less consistent guidance about what particular approaches mental health services should adopt in responding to disasters. The efficacy of some high profile mental health approaches, such as Critical Incident Stress Debriefing, has recently been questioned (Deahl & Bisson, 1995, Raphael, Meldrum & McFarlane, 1995, Carr et al., 1997, Gist & Woodall, 1998), which has lead to increasing awareness of the importance of well designed research. It has also resulted in much more cautious planning in the deployment of resources. Having said this, there is general support in the literature for the following elements (Raphael, 1986, McFarlane, 1989, Aptekar & Boore, 1990, National Health and Medical Research Council, 1992, McDonnell *et al*, 1995).

- The focus of the mental health service response should be ensuring continued access to mental health services for new and existing service recipients
- Involvement of mental health services at the earliest phase to assist in informing and coordinating the response
- Emphasis on healthy responses to disaster
- Utilising pre-existing relationships and roles as much as possible, to maximise continuity and community trust
- The site at which a mental health response is required is not necessarily the actual major incident or disaster site
- Education and information are provided to disaster workers and the general community prior to, and following a disaster
- Those in need of more specialist mental health assistance are identified
- Specialist mental health intervention is provided to the small proportion who are severely affected, or are at high risk of developing a disorder
- The presentation and needs of children and young people are different to adults (in location, timing and character), and specific child and youth mental health services need to be provided in addition to adult services
- Collaboration should occur with other services involved in a disaster response and the community recovery process.

Planning process

A 12-month project has been undertaken by the Mental Health Unit, Queensland Health in order to address these issues in a coordinated fashion across the State. The project is supervised by the Chief Psychiatrist, and employs a senior project officer. Importantly, the project has utilised a consultative framework in order to maintain an emphasis on localised arrangements, and to ensure ownership by key stakeholders. Membership of the steering committee has comprised officers with State-wide responsibilities and representatives of district health services. The committee determined that an effective strategy for ensuring consistency in disaster response planning was to develop detailed guidelines which district health services were to adopt. However, the guidelines needed to reflect the wide variability in mental health service arrangements, interagency agreements, culture, and population distribution and size between districts. Therefore, a process of drafting and wide consultation was conducted, which utilised the experience of the district health services, in addition to other key agencies; some of whom had recent experience of a disaster.

Disaster planning guidelines for mental health services

The finalised disaster planning guidelines were endorsed at the Departmental level on 5 August 1998, as a benchmark for disaster planning for mental health services. The guidelines reflect the basic requirements deemed essential for an efficient and effective disaster response by mental health services, and were designed to be used in one of two ways:

- where mental health services already had sophisticated plans, the guidelines were intended to assist in reviewing the suitability of the existing disaster plans.
- Alternatively, the guidelines were structured in such a way as to allow for use as a template, onto which locally relevant information could be added.

Provision was made for the document's inclusion as a sub-plan of each district health service's disaster plan. In addition to the district health services, copies of the disaster planning guidelines were distributed to other key disaster response agencies at a State level, and to Emergency Management Australia.

The disaster planning guidelines for mental health services describe the activation, philosophy, provision, and review of mental health services in the circumstances of a disaster. The document was prepared in accordance with Section F (Mental Health Plan) of the Queensland Health Disaster Plan and the Queensland Disaster Management Principles. At the district level, the guidelines additionally form a supporting plan of the District Community Recovery Plan. Appointment, activities and responsibilities are outlined for the State Director of Mental Health, Mental Health Controller (who has responsibility for activation and oversight of the disaster response locally), Mental Health Response Coordinator, and Mental Health Response Team members. The guidelines additionally describe training and support requirements for staff.

The focus of the mental health service planning and response to a disaster will be

ensuring continued access to mental health services for new and existing service recipients. This may include:

- providing home-based services or transport to mental health services where appropriate
- ensuring necessary treatment is continued, including medications
- providing information to other emergency or recovery services and the general community about healthy responses to disasters, and coping strategies
- providing information to other emergency or recovery services and the general community about signs of mental illness, and referral and assessment resources and processes.

The mental health service will be represented at the local Community Recovery Committee and is responsible for negotiating and coordinating the provision of mental health services in conjunction with the other recovery agencies. Generally, the role of the mental health service in the community recovery process includes:

- education of recovery workers and the general community in the mental health aspects of disasters
- consultation and assistance to primary health care providers and crisis counselling services, and support for disaster affected persons
- consultation and assistance to existing organizational structures in psychological support of recovery workers.

Inter-district arrangements

Clearly, in those districts with small, low density populations, and those without the full range of mental health services, all of the roles outlined by the disaster planning guidelines could not be provided by that district's services alone. In order to solve this problem, the guidelines were designed such that the response could be coordinated between district health services, in a manner corresponding with mental health service network arrangements. That is, disaster response planning is designed to occur, not only in conjunction with other local agencies, but also with neighbouring district health services. Collaboration in staff support and training, and hand-over of coordinating roles are outlined.

An additional factor identified as a significant challenge to providing consistent disaster response planning is the very definition of disaster. What might be considered a distressing incident in a large community, might be seen as a disaster in a small community. For example, the traumatic death of a number of people in a small community might represent a significant proportion of the population. As a result, the definition provided by the Queensland Health Disaster Plan, as any event of such magnitude that it overwhelms the resources available to combat it, was adopted. In addition, disasters are understood to affect the whole community, in addition to individuals alone; to require a total community response; and to produce chronic difficulties, rather than acute difficulties alone.

Implementation

The implementation of disaster response planning by the district health services has been lent a great deal of assistance by the involvement of key stakeholders throughout the development of the disaster planning guidelines. A sense of ownership has been fostered, which in turn has set a high priority on disaster response planning, and facilitated the process of adoption of the guidelines at the district level. From an early stage of this process, staff were identified in each district to coordinate activities and distribute information locally. A three-month deadline for implementation was set, during which time the project officer worked closely with these identified staff members, as well as other key district staff. The task was to ensure that essential activities were undertaken, and that local disaster response planning met the benchmarks set by the disaster planning guidelines. Staff awareness of the document was enhanced through a series of workshops and inservices, which provided an opportunity to discuss and problem-solve local challenges to effective implementation. The document is also accessible to Queensland Health staff via the Statewide electronic network, known as *QHiN*.

Review and continuous improvement of the implementation of appropriate disaster response planning by mental health services has been designed to occur at district, State and service network levels. A Statewide review was conducted following the initial implementation phase. Subsequent reviews are planned on a yearly basis, and following activation of the disaster plan.

Conclusion

Whilst the State Disaster Planning documents in Queensland contain broad guidelines for the provision of a disaster response by mental health services, the corresponding plans at the local level have historically lacked consistency, and in some cases were inappropriate, or inadequate. Factors which have presented a significant challenge to the implementation of consistent, and comprehensive plans included the distribution and coverage of mental health services across the State, the debate in the literature about effective approaches, local expectations of mental health services, resource implications and the required continuation of services to priority groups. The strategy adopted by Queensland Health to overcome these challenges has sought to capitalise on the benefits of decentralised service structures. These include efficient mobilisation of resources, significant local expertise, and strong pre-existing local networks. The strategy was then incorporated into existing inter-district support arrangements to maximise understanding of roles and responsibilities.

Consistent with the approach outlined above, a further task to be undertaken by this project will be to develop standardised printed material that might be provided by mental health services to other disaster response agencies and the general community in the circumstances of a disaster. Once again, such a resource must contain locally relevant information, such as advice about available services. Additionally, a training package for mental health workers will be developed to augment local expertise in disaster response planning.

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The Auckland electricity supply disruption 1998: emergency management aspects

By Gareth Davis, Deputy Director, Victoria State Emergency Service, Melbourne

As with most agencies involved with emergency management planning, the Victoria State Emergency Service (VICSES) has participated in discussion and planning on 'lifelines'. When the power crisis occurred in Auckland it appeared to VICSES to be an opportunity to observe a lifeline failure and possibly identify some 'downstream effects' which may not have been anticipated in the planning process. In the same vein, it was an ideal opportunity to confirm the effects that had been identified in theory, and assess their impact on the community. Due to the excellent relationship between VICSES and the New Zealand Ministry of Civil Defence, permission was received for Deputy Director Gareth Davis to travel immediately to Auckland and join the Civil Defence office in that city. He subsequently reported on his trip to the peak emergency management body in Victoria, the Victorian Emergency Management Council (VEMC). Some time after the crisis, the New Zealand government directed that two inquiries take place:

- A ministerial inquiry instigated by the Minister of Energy and with terms of reference concerning why the failure occurred etc.
- A 'low-key debrief and review of the response activities', instigated by the Ministry of Civil Defence (MoCD), with terms of reference concentrating on the emergency management aspects of the event.

As one of the aims of the latter review was to analyse the performance of the MoCD, it was considered desirable to have 'an outsider' involved, and Gareth Davis was asked to participate. The report of the review was issued in June 1998 and was in a form dictated by the terms of reference: answers to five key questions. This article is Gareth's initial report supplemented by some information from the Ministerial review.

The scene

The city of Auckland, on the North Island of New Zealand, has a population of 350,000. Its central business district, a block of some three square kilometres, contains a residential population of approximately 5,000, mainly in high-rise apartments, and a business sector of 7,000 businesses, employing approximately 68,000 people, most of whom commute daily. Some of these business are large corporate bodies but there is a significant number of small businesses of a variety of types. Many of these involve food preparation and storage ranging from small sandwich shops to super markets.

The night population of the CBD can increase to approximately 7,000 because of the number of entertainment and accommodation premises. Two education institutions, Auckland University and the Auckland Institute of Technology, have a significant effect on the day population figures with combined student numbers of 35,000.

In employment terms, the CBD involves 28% of the city's employment, over 13% of Auckland regional employment and 5% of New Zealand's employment.

In summary, the city block under discussion is small in area but extremely significant in Auckland and New Zealand terms.

The problem

Electric power in Auckland is reticulated and sold by Mercury Energy.

In the main CBD, power is supplied via four main 110Kv feeder lines and a fifth 22Kv auxiliary line. Two of the main lines are gas filled and have capacities of 50 MW each and two are oil filled with a capacity of 60 MW each. The fifth line is able to carry approximately 40 MW loads and all the lines, combined with 'transfer power' have the ability to provide power to the level of 285MW. As the total CBD load is normally around 140 Megawatts it is obvious that when the load is evenly divided between the feeders, they are operating on a load approximately one half peak capacity.

The 40 Megawatts provided by the auxiliary line may appear insignificant. In the context of this event the ability to provide this power proved to be extremely important.

The first indication of any problems was a request by Mercury Energy, on Thursday 19th February 1998, for their CBD customers to conserve power 'otherwise drastic measures will have to be taken.' What was not explained was that three of the four main feeders had failed. On Friday afternoon, for whatever reason, the fourth feeder failed and left the power available to the CBD, at the maximum, 40 MW. This resulted in loss of power to most commercial premises and a significant number of residential premises during the day, and supplementary effects such as loss of some traffic lights and street lighting. The losses to various sectors was intermittent, random and unpredictable.

The direct effects

The physical effects where power was lost were many and varied, and in the main, predictable.

- ***Multi-story office blocks***
  - lost main lighting, computer systems, air conditioning and lifts
  - automatic doors locked open or closed depending on the system and affected by fire and burglar alarm systems. With no 240V power, those systems went to battery operation
  - staff were trapped either in lifts, or in the building where doors were closed. Some office blocks had emergency (generator) power which provided limited facilities throughout the offices. It became apparent that connection to emergency power in some buildings was a matter of choice by the tenant and would be reflected in the monthly lease payment.
- ***Residential apartments***
  - lost main lighting, and unlike office blocks, most did not have emergency lighting
  - had some residents trapped in lifts or access to apartments was compromised because of automatic door opening which was not battery backed up
  - had no emergency (generator) power, and
  - as would be expected, had no refrigeration which would result in the spoiling of food.
- ***Retail businesses***
  - had very little emergency (generator) power
  - lost lighting which included advertising signs and the like
  - lost computers, including all modern cash registers

- lost refrigeration and the ability to safely store certain food, and
- lost electrical cooking facilities.

- ***Police and Emergency Services***
  - received a significant number of calls for assistance
  - initially had difficulty handling calls because the '111 system' failed due to power surges. The equipment for the whole of New Zealand is located at Auckland and calls were diverted to Wellington and Christchurch.

The secondary effects

- Most of the government departments and corporations in the high rise office blocks re-located to suburban or regional offices if available. Others hired temporary premises outside the affected area. Many had difficulties in re-location because of inflexible computer systems which required the network wiring in the building. It would appear that business continuity plans did not exist.
- The University of Auckland and the Auckland Institute of Technology cancelled 'enrollment day' and advised all students not to attend. This had a dramatic effect on a number of businesses that rely on students as their customer base.
- Tourists to Auckland, particularly those arriving by sea, were significantly affected as many of the main tourist facilities are within the area in question. One large tourist ship cancelled a three day visit and moved on to the next port of call.
- Virtually no commuters to the CBD from offices and other businesses, removing the day time lifeblood of some retail businesses.
- Virtually no customers, day and night, for the retailing, hospitality and entertainment industry.
- Fire department received unusual number of fire and rescue calls all related to generators. The calls ranged from people being overcome by fumes because they had generators running in areas without ventilation, to fires with people refuelling generators whilst they are still running, through to generators catching on fire because of running for periods far above that for which they were designed.
- The Health Department was concerned at attempts by a minority of food outlets to retain food which is suspect due to intermittent refrigeration.
- Some government departments were unable to carry out normal business which has downstream effects. The Lands Title Office, for example, had thousands of transactions that are unable to be processed. The Auckland District Court was forced to relocate to temporary premises. The New Zealand Reserve Bank was affected.
- Traffic control was extremely difficult due to intermittent operation of traffic lights. Because they were not on the one separate circuit, they were unable to be continually provided with emergency power and operated intermittently as power was provided to the geographic sector in which they were located.

The initial actions

- Mercury Power requested all relevant authorities and agencies assemble for a briefing.
- City of Auckland issued release that included 'keep out of CBD area because of safety' statement by Mayor.
- City of Auckland activated municipal Civil Defence (CD) organisation, despite not declaring a CD emergency.

The University of Auckland and the Auckland Institute of Technology cancelled 'enrollment day' and advised all students not to attend. This had a dramatic effect on a number of businesses that rely on students as their customer base.

- Ambulance, Police, Fire Authority and Civil Defence consulted and drew up a priority list of installations and buildings that should receive either a constant share of the power available, or emergency generators.
- Health authorities consulted with City of Auckland on refuse disposal, food storage etc.
- Using Supermap software and data from the last census, the demographics of the area in question were defined precisely and distributed to all agencies.

Next actions

- Mercury Power arrange for morning and afternoon briefings at their offices, including all the agencies involved. Progress on the power situation is reported, other actions discussed, emergency power priorities reviewed and media releases formulated. An updated street map of the affected area is distributed.
- The Auckland City Council CD organisation arranges an afternoon briefing for all interested at which they report types of assistance requested and that which has been provided. They table an 'Auckland CBD Energy Crisis Emergency Management Plan'
- The fire authorities arrange a meeting with companies that specialise in building lift maintenance and arrange for them to keep a check on their customers and 'rescue' anyone trapped in the lifts. This reduces the load on the fire department for direct checking of all lifts.
- In a similar vein, the fire department calls a meeting of companies dealing with fire and burglar alarm systems and requests they contact all their customers and check the condition of system backup batteries.
- The fire authorities locate a manned educational caravan within the CBD to emphasise the need for fire safety with generators and candles etc.
- The 40MW power available from the fifth line is rotated around various sectors during the day and the whole area of the CBD at nighttime, which allows batteries to re-charge, high rise water pumps fill header tanks and sewerage pumps to operate.
- The health and fire authorities combine their resources for checking premises, with fire inspectors and health inspectors travelling together to check the various safety aspects.
- Extra refuse pickups are organised and skip bins for food disposal are provided. Some food from commercial premises is seized by health inspectors after being found suspect.
- Mercury Energy compile a list of locations of emergency generators and import large generators from other parts of New Zealand and Australia. Many commercial premises buy or lease generators and Mercury Energy facilitates connection of same.
- Regulations are 'relaxed' to allow generators and extension cords on foot paths etc.
- Auckland City Council compiles a list of building managers and includes them on distributed information bulletins.
- Because 109 accommodation units owned by the Auckland City Council and capable of housing 400 people were vacant, emergency accommodation was offered to all residents within the affected area. Despite many people temporarily moving out of the affected area, only two families accepted the Council offer. Most people moved to friends and families.

Subsequent actions

- Mayor of Auckland calls a public meeting to address concerns of residents and businesses. Mercury Energy decides not to attend. Majority of attendance and

discussion from business sector and main concerns focus on lack of customers and uncertainty of power supply. Some business people express the view that if they knew when the power was going to be available during a 24 hour period, they could plan their business around it.

- As it appeared that the repair of one main cable was imminent, authorities were faced with the dilemma of how that limited power would be shared equitably. A meeting is arranged between Auckland City Council, Mercury Energy and representatives of business and resident groups. The meeting determined to divide the CBD into four zones with two of the zones receiving power between 7 am and 12 midday and the other two between 12.30 pm and 6 pm. All zones would receive power during the night.

The expected repair did not materalise on time, but the zone system was implemented anyway. It was advertised in the local media and used by businesses to plan their return to work for staff.

Points to ponder

Emergency management systems

In the New Zealand Civil Defence system, 'declarations' play a significant part when an emergency occurs. Emergencies can be 'declared' at local government, Commissioner and Director level. Whether a particular event is declared or not has many ramifications for funding, control etc., and it is important to note that the Auckland power crisis was not 'declared' at any level. In other words, in the context of their traditional emergency management, it was not considered an emergency.

The 'declaration or not' question was one of those addressed by the Ministerial review, with the conclusion that

'In view of the requirements of the Civil Defence Act, the decision not to declare was the correct one.'

The conclusion was the only one that could be reached, *because of the Act*, but one must ask the question as to whether the New Zealand Civil Defence Act is properly structured to deal with this type of event? The review also identified as requiring improvement

'Response agencies' understanding of each others' roles and limitations in events requiring a multi-agency response, but not warranting a declaration of emergency, and a mechanism by which leadership is established and promulgated in such cases;"

Not that New Zealand is isolated in having an emergency management system that may not address properly lifelines events. How many of us have? We (emergency managers) are continually faced with the dilemma of 'when is an emergency an emergency?' As we follow the risk management path we continually debate 'how far do we go?' when discussing threats to the community. If people are not dying or being injured and property not being destroyed or damaged; is it our business? I would suggest that the Auckland situation, and others like it, have confirmed that emergency managers can no longer confine themselves in a comfortable box. They can not isolate themselves from the event which has none of the normally associated emergency dramatics, but because of economic or sociological effects, is disastrous for the community or the nation.

In a similar vein it is too much to expect that every organisation and business has comprehensive continuity plans. However, some simple contingency planning can make a huge difference when the event occurs and can mean the difference of business continuing or not.

Lifelines planning

Many emergency management planners believe that inadequate attention and resources have been devoted to a study of the integrity of those lifelines on which the community is so dependent. The failure of one or more lifelines at any one time can be catastrophic to the community in terms of social, economic and personal hardship and loss. The Y2K issue creates another dimension to the possibility of lifelines failures.

New Zealand has been ahead of most in putting lifelines planning on the agenda. The lifelines studies on Wellington and Christchurch are documented proof of that. And yet, in Auckland, where stage one report of the Auckland Engineering Lifelines Project was printed in July 1997 there has been difficulty in completing the next phase because of lack of commitment by some of the participants. One of those? Mercury Energy!

Tasmania has shown, with their lifelines projects on Launceston, Hobart and the North West Region, that different techniques in a 'horses for courses' strategy, can produce a worthwhile result.

It is obvious that lifelines considerations have to be included in local government emergency management planning, and if the risk management path is followed, they will. What is not so obvious is the coordination required when significant urban areas transcend local government areas.

Special cases

What was obvious in the Auckland situation, and in other events where critical supplies have been lost, is the need to have decided *before the event* those installations, institutions etc. that will receive special treatment during a lifelines crisis. Not that it can be expected to precisely list building by building. However, if people are aware beforehand, and have been able to plan for such an event, the response is more effective and, importantly, the community aggravation is minimised.

Resource lists

Although resource lists are generally part of local emergency management plans, there needs to be a broader approach when considering lifelines aspects. A registry of building managers, for example, would not normally be one of the lists recorded, and yet will be invaluable in a lifelines crisis in urban areas.

In most cases, the lists in question need not be kept per se, but the plan should identify where they can be accessed. professional associations, trade groups, institutes etc. can be the source of essential information when a category of person is required.

Preparedness and continuity planning

Organisations, public and private, need to carry out some preparedness activities with lifelines losses in mind. With electricity supply, for example, it is not practical to expect all agencies to have emergency generators for all facilities, but it could be expected that at the least they have:

- worked out what of their equipment, systems etc. are essential for business to continue
- calculated the load of those essential items
- had facilities pre-wired to plug in a suitable generator.

In a similar vein it is too much to expect that every organisation and business has comprehensive continuity plans. However, some simple contingency planning can make a huge difference when the event occurs and can mean the difference of business continuing or not.

Gareth Davis has been with the Victorian State Emergency Service since 1974 and has extensive experience in the operational and planning sides of emergency management. He has a particular interest in 'lifelines'.

UK emergency planning – the integrated approach

By Sarah Paul, Head of the Home Office, Emergency Planning Division

Background

The Home Office is responsible for local civil protection in England and Wales, whilst Scotland and Northern Ireland make their own arrangements. The Home Secretary is, however, ultimately answerable for civil protection throughout the UK.

The lead response to a major incident is normally taken by the police. Government departments take a central role during a civil emergency according to their day-to-day responsibilities. So the Department of Environment, Transport and the Regions, for example, gives the central response to a coastal chemical spill. The Home Office is in the lead on wind storms and the uncontrolled return to earth of satellites (during which times it may play an operational role, described below.) It also shapes the general approach to civil protection by providing guidance on and promotion of risk assessment, prevention, preparedness and response at the national, local and international levels.

Legal framework

Emergency planning in England and Wales developed to take advantage of the infrastructure built over many years by central and local government during the Cold War. The Civil Defence Act 1948 requires that central government has in place arrangements to deal with the protection of the population in event of a hostile attack by a foreign power.

Regulations made in 1953 under Section 3 of that Act provide for the payment of grant to county level local authorities as a contribution towards their expenses for Civil Defence functions[1]. This led to the setting up of dedicated emergency planning units in those local councils throughout England and Wales. Each local authority has such a unit staffed with between one and ten emergency planning officers.

The Civil Protection in Peacetime Act 1986 allows local authorities to use civil defence resources to avert, alleviate or eradicate the effects of any disaster whatever its cause, hostile attack or not. Following two reviews in the early 1990s, the Home Office decided to scale down the preparations for war in the light of a diminished threat and to encourage local authorities to adopt the strategy of Integrated Emergency Management (IEM) which is outlined in this article.

Civil protection in England and Wales has now developed into a broad function, providing safety and security for the public across the full spectrum of disasters. The Emergency Planning Division works today to enhance the quality of national civil protection at the central, local and international levels.

The central, local and international interface

The Division is part of the Home Office Fire and Emergency Planning Directorate, and is composed of eight groups, each of which feeds into the overall UK picture.

The Central and Local Government Group amongst other things, pays grant to local authority emergency planning units which it monitors, assessing work methods and disseminating best practice. There was recent wide consultation on National Standards for civil protection through workshops across Britain and an internet bulletin board. The results of this consultation should be announced early in 1999 with the aim of standardising the quality of civil protection.

Their introduction should help develop the profile of the function within local authorities. A review, currently underway, of the distribution of Home Office funding will seek to introduce a more equitable system of allocation, which should be in place by 2000–2001.

The Central and Local Government section maintains the Division's Emergency Operations Suite in readiness to fulfil the Home Office's operational role as lead department in the event of severe storms and satellite incidents[2]. The department also has major responsibilities in the event of international crisis and war.

The group's head is the Principal Warning Officer (PWO) for the UK. In wartime he or she would activate attack warning broadcasts to the public. To assist in this, 30 volunteers, known as Home Office Warning Liaison Officers, work closely with the Royal Air Force and in the event of war would have a key role in transmitting up-to-date information back to the PWO.

The Telecommunications Group manages the Emergency Communications Network (ECN), a resilient telephone system that links central government, local authorities, police and fire services during a civil emergency. The network is protected from the possible effects of electro-magnetic pulse which can compromise communications and other electronic equipment. The group is also developing a telephone preference scheme for essential users when the public network is overloaded. It advises the NATO Civil Communications Planning Committee, the Home Office and other government departments on telecoms in an emergency.

The Research Group carries out a wide mix of work including research on the technical aspects of a national attack warning system and assessment of the economic consequences of disasters. A member of the Research Group recently chaired the NATO Group of Experts and the National Steering Committee on Warning and Informing the public. Its current projects include the development of hazard models, and a sophisticated computer based hazard and consequence modelling environment for hazard scenario assessment.

The International and Home Defence Group deals with the cross-national-boundary dimension of civil protection. The Chernobyl incident in 1986 heightened awareness that the effect of disasters can travel far beyond an incident site. And lessons learned from incidents such as the Montreal ice-storms and the Auckland power cut in New Zealand are informing work on preparedness for any infrastructure failures resulting from the Millennium Bug.

The group works closely with NATO, the United Nations and the European Commission, harmonising UK crisis management arrangements with international treaty obligations, planning and playing exercises and providing civil advice and support to military home defence planners.

The Finance and Business Group provides the Division with strategic and

Notes

1. In 1998 the Home Office paid £13m (approx. A$33.54m) in Civil Defence Grants to the 178 local authorities that have a statutory responsibility

2. Details of how the UK delegates responsibilities across government departments see the Home Office publication *Dealing with Disaster* (see footnote 4).

financial advice and draws together contributions to the Directorate Plan, which sets the strategic framework for the Division.

It manages the contract for storage and maintenance of the Emergency Fire Service Stockpile, known affectionately in the UK as the Green Goddesses. These fire appliances are mobilised across the country during major incidents. They are also deployed for Army use during industrial action by firefighters.

The Home Office Emergency Planning College is a venue with expert speakers and course directors offering training on all subjects of relevance to emergency managers, journalists, senior executives, paramedics etc. from the UK and abroad. The College library is the European designated centre for emergency planning documentation.

Many professional bodies recognise the courses as contributing towards their Continuing Professional Development (CDP) requirement. The College is a 'moveable feast', providing distance learning and roadshows for those who can't attend in-house seminars and workshops.

The Central Government Preparedness Group is responsible for policy on central government emergency planning, ensuring readiness to manage civil contingencies and operational duties as required. This includes managing projects aimed at minimising the potential impact of the Millennium Bug on public safety. It encourages the exchange of information and experiences on these matters among the civil protection community.

Local and central authorities are being encouraged to take Y2K considerations into account in future exercises. Such work complements a range of activity across government[3]. The Integrated Emergency Management (IEM) approach advocated by the Division and described below demands that emergency arrangements are able to cope with any eventuality, making them ideally suited to handle an unknown quantity such as consequences of the Millennium Bug problem.

Principles of the integrated approach

General guidance is produced in the form of *Dealing with Disaster*, an internet and 'paper' document which is updated to build on lessons learned from exercises and major incidents. This covers everything from command and control to the combined response at major incidents. It is something of an emergency manager's 'bible', so all responders to a major emergency in the UK work from the same protocol[4].

Co-ordinated arrangements naturally lie at the heart of emergency planning and local authorities are expected to produce them, based on the risks in their communities. The Home Office develops and promotes the principles of Integrated Emergency Management (IEM) to encourage local emergency planners to involve all organisations that may respond during an emergency. Consultation is vital, and this 'inter-agency' work involves the police, the fire and ambulance services, healthcare providers, the utilities, managers of large dangerous sites in the area (such as nuclear plants or chemical plants), other local authority officers such as surveyors, social workers and so on.

Through IEM, emergency planners are encouraged to facilitate these arrangements rather than just write them. And whilst no-one would deny the significance of the arrangement itself, it is the planning process which provides the chance to involve and inform all those who might be respond to a disaster. Responders are more likely to remember and understand the logic and detail of plans to which they have contributed.

Integrated Emergency Management covers five areas:

- risk assessment
- prevention
- preparedness
- response
- recovery.

Arrangements should be non-specific and flexible on all the above levels, making them fit to deal with any disaster. The Home Office encourages their regular exercising and provides guidance over the internet[5], through its magazine *Civil Protection*[6] (which goes to 20,000 emergency planners worldwide) and through a guide to planners, the latest of which will be published in the New Year.

The exercise guide gives a checklist for exercise designers to follow, making sure that health and safety threats are envisaged and all goals achieved.

The Division participates in major local authority exercises, giving government input and showing how emergency planning units would liaise with central government during a civil emergency. This also tests the Emergency Operations Suite and keeps the Division up-to-speed in its operational role.

Contact with local authority contingency planners is two way and involves consultation and liaison with bodies representing the profession, such as the Local Government Association, Emergency Planning Society (EPS) and individual emergency planners. In preparation for the introduction of National Standards an internet bulletin board allowed them to contribute. To the same end, Home Office workshops took place throughout the UK.

A Millennium Bug internet bulletin board currently encourages interested parties to share information on their contingency work in this area[7]. And workshops organised by the EPS across the UK are helping to determine the best way forward.

The Y2K challenge

The Millennium Bug threat is being taken extremely seriously in the UK. All government departments are looking at it in terms of both compliancy and contingency planning. The Government is providing free training for companies through a specially set-up company, Action 2000[8], which has also launched a massive national publicity campaign to raise awareness of the problems, particularly amongst small to medium businesses.

Action 2000 has a remit to ensure there is no material disruption to essential public services as we go through the millennium date change. It is working with the Home Office Emergency Planning Division and the Emergency Planning Society to encourage local authority emergency planning units to bring together the key utilities, emergency service providers and businesses in their areas to assess what risks to safety systems may be posed by non-compliance or poor business continuity planning. Such inter-agency work relies on honesty and openness, which is why the Government has asked organisations across the country to sign a Pledge to avoid litigious action where possible, so suppliers can admit their shortcomings, address them or make contingency plans.

Conclusion

Local authority emergency planning units will be executing the good practice supplied by the Home Office Emergency

Notes

3. Issue 45 of the Home Office magazine *Civil Protection* details this activity. To obtain a copy refer to footnote 6.

4. You can download *Dealing with Disaster* at http://www.homeoffice.gov.uk/epd or order a copy from Brodie Publishing, 110-114 Duke Street, Liverpool LI5 AG, Tel: 0151 707 2323, Fax: 0151 707 2424, E-mail: brodie.publishing@virgin.net

5. You can download the advice *Why Exercise Your Response to Disaster* at *www.homeoffice.gov.uk/epd*

6. To obtain a copy of *Civil Protection* or go on the mailing list contact Civil Protection, Room 658, The Home Office, 50 Queen Anne's Gate, London SW1H 9AT or e-mail: civilprot@btinternet.com

7. The Millennium Bulletin Board: http://www.homeoffice.gov.uk/epd

8. Action 2000's website is http://www.open.gov.uk/bug2000.htm

Planning Division and the Government, particularly when preparing for the mass celebrations and possible IT failures in the Year 2000. That's why we're consulting them, and other interested parties, on their experiences and expertise in the field.

This mirrors the Integrated Emergency Management approach, so the Home Office doesn't impose good practice on the planning community, but builds it in partnership with its 'external stakeholders'. The introduction of National Standards in 1999 will further cement this relationship, when UK emergency planners, at the central and local levels, implement the standardised aims they have conceived together.

Sarah Paul is Head of the Home Office Emergency Planning Division, which has responsibility for civil protection in England and Wales. Her main tasks are to devise policy on civil contingency planning including emergency communications, research, war emergency legislation, civil defence grant, guidance and support to local authorities, police service and voluntary organisations with an emergency planning role.

She transferred to the Home Office in 1989 following work in the Cabinet Office as an occupational psychologist. As a Home Office administrator she has worked in civil defence, police current expenditure on establishment, assessment of senior officers in the operational services (police, fire and prison). She has also served in one of the Home Office agencies, the Prison Service Directorate of Healthcare, from which she took up her current post in 1996.

The 1999-2000 Australian Disaster Research Grants

The Program

The Australian Disaster Research Grants program provides limited financial support for researchers to go to a disaster site in Australia to gather valuable data that might otherwise be lost.

Research is to be undertaken in the immediate post-impact period (within a few days or weeks after the event) and should include short qualitative and quantitative field investigations of disasters.

Eligibility

The program is open to Australian academics, scholars and practitioners in any area of emergency management. The applicant will need to demonstrate the ability to undertake the type of research intended and to draw conclusions for application to similar events or to other types of disasters.

Type of research

No restrictions are placed on the type of research that might be undertaken. Natural and technological disasters are included and areas of investigation can include either scientific, social or management areas.

While it is expected that physical scientists will specify the type of hazard to be investigated, social scientists might select a topic area that could be studied regardless of disaster type or location.

Funding

The total annual funding for the total program is limited to $25,000 and the maximum for a grant is $5000. It is expected, however, that the average individual grants will be about half that level.

The funds can be used to meet travel, accommodation and modest data collection costs. Salaries, overheads, data analysis costs and incidentals are not covered.

Applications

Application forms must include the following information:

- the research problem to be studied
- background research on the identified problem
- the research design to be followed
- the plan to move to the field and access the data needed
- the theoretical and/or applied benefits anticipated
- a tentative budget based on team size, time in the field and data collection costs
- contact details.

A curriculum vitae is to be attached to the proposal. Additionally, a letter from your institute or organisation supporting your bid to undertake the research is required.

Selection criteria

Selection will be undertaken by EMA from the most meritorious applications submitted against the following criteria:

- the requirement that the data be collected in the immediate post-impact period
- the potential value of the research to enhance emergency management capabilities
- the need to focus on major risks having an impact on public safety
- the research investigates management in a multi-agency environment
- the practicability of the method proposed for collection of data, particularly during the on-site investigation
- demonstrated research ability and qualifications of personnel involved in the project.

Report requirements

You are required to submit a one-page progress report to EMA within three weeks of the commencement of the field work is required.

Your final report is to be of five pages or more and is required within four months of the commencement of field work. This report is to describe the research area, methods used, conclusions and their theoretical or applied significance and, if appropriate, is to be include recommendations.

Additionally you are required to supply a three-page summary of the research undertaken in a form suitable for publication in the Australian Journal of Emergency Management.

The final report is required in hard copy (12 copies) and on disk (Microsoft Word or WordPerfect). On receipt of the research report, EMA will provide a copy to the affected state or territory for consideration (eg, sub judice aspects). The report will subsequently be distributed by EMA to state and territory emergency management committees and will be placed on the EMA homepage on the World Wide Web.

Site access

If you have been selected for this program, when an event occurs which you consider appropriate to your area of study, you will be required to advise EMA:

- why the event is suitable for the research proposal which you previously submitted
- what on-site investigation you required (if different from the original proposal)
- when the on-site investigations should commence
- a budget estimate.

A condition of the program is that satisfactory arrangements are made for the research to be conducted. These will be undertaken by EMA staff who will contact the relevant state or territory emergency management committee to:

- advise details of the proposed research and on-site investigation
- seek agreement for the conduct of the on-site investigation; and
- confirm operational and administrative arrangements to apply including:
  - to whom you report and where
  - limitations applying to your movement while in the vicinity of the event
  - arrangements for seeking approval to vary the agreed on-site investigation
  - limitations on the type of material you can collect at the site (e.g. photographs).

EMA will advise you of any such conditions and, on receipt of your written assurance that these will be met, will authorise funds to facilitate the on-site investigation.

Notwithstanding arrangements made, there may be operational circumstances which require the research to be terminated or varied without notice.

It is your responsibility to make all travel and accommodation arrangements. You must advise both EMA and the relevant state or territory authority of all travel and accommodation details.

Program timings

Your application is required by the Director of the Australian Emergency Management Institute by April 30, 1999. Those applications, which are approved in principle, will remain current for the immediately-following financial year.

Submission

The address for applications is:

Director
Australian Emergency Management Institute
Mt Macedon Rd
Mt Macedon
Victoria, 3441

Application forms can also be obtained from the EMA web site at www.ema.gov.au/ausgrants.htm

Enquires should be directed to:

Mr Rob Fleming
Tel: (03) 5421 5100
Fax: (03) 5421 5273
E-mail: rfleming@ema.gov.au

Public Safety Risk Management: assessing the latest national guidelines

John Salter, EMA
Delivered at the IIR 3rd Annual Emergency Services Forum, Sydney, August 12–13, 1998

The need for a national Emergency Risk Management guideline

My underlying assumption is that for any service provision, national guidelines meet a need to provide the basis of a consistent approach. Further, Australians have a reasonable expectation if not a right to consistency in service provisions that relate to public safety.

Two basic rules of life (1. change is inevitable, 2. change is resisted) have provided an interesting context for the development of the national Emergency Risk Management guidelines over the last three years.

Machiavelli aside, the range of conservative reactions to the development of national Emergency Risk Management guidelines has varied from the 'dismissal' position (same wine, different bottle), to the 'entrenched' position (when it is not necessary to change, it is necessary not to change).

The risk management approach is not just business as usual, nor does it merely provide a tool (for analysis/assessment). The approach provides a framework for the systematic application of management policies, procedures and practices to the tasks of identifying, analysing, evaluating, treating and monitoring risk (AS/NZS 4360 Australia/New Zealand Risk Management Standard:1995).

Advantages of adopting a risk management framework (as identified and agreed by the National Emergency Management Committee, 1996) included:

- it is a formalised, systematic analysis and decision-making process
- it is being widely used, thereby providing a common language and process across all organisations, facilitating both promotion and integration.

An outcome of that 1996 meeting was the agreement to develop national Emergency Risk Management guidelines, and to incorporate the risk management approach into other emergency management products.

The guidelines are derived from a standard (AS/NZS 4360 Australia/New Zealand Risk Management Standard:1995) and therefore outline expectations related to processes and outcomes. Emergency management lacked clear guidance in the past and was often marred by approaches characterised by working in isolation (from the community at risk). [Process] features in the guidelines emphasise involving all stakeholders in decision making and the [outcomes] focus is on risks to communities, not just hazard agents.

Overall, a positive view (reflecting a commitment to continuous improvement) has prevailed in line with Benjamin Franklin's philosophy 'when you're finished changing, you're finished'.

Public safety has long been dogged by the unhelpful distinction between 'emergency managers' and 'emergency management'. The guidelines are at a level of generalisation with the flexibility to provide sufficient advice to accommodate all emergency risk management contexts—from local governments to multi-national corporations.

Other influences that have contributed to the 'need' for a national Emergency Risk Management guideline include externalities associated with more general philosophies on service provisions, such as accountability and economic rationalism.

Overall, a positive view (reflecting a commitment to continuous improvement) has prevailed in line with Benjamin Franklin's philosophy 'when you're finished changing, you're finished'.

Exploring the evolution of the final product

The guidelines were developed by the process outlined in *Figure 1*.

Assessing the guidelines – what do they mean to you?

Assessment is an interesting word—one that causes the risk management industry some angst. Internationally there is disagreement—some see it as a broad and general term that captures 'analysis and evaluation'; others use the term in a very specific way related to 'scientific analysis'. It is a term the current risk management standard still treats inconsistenly. Within the emergency management guidelines, it is used in the broad and general sense.

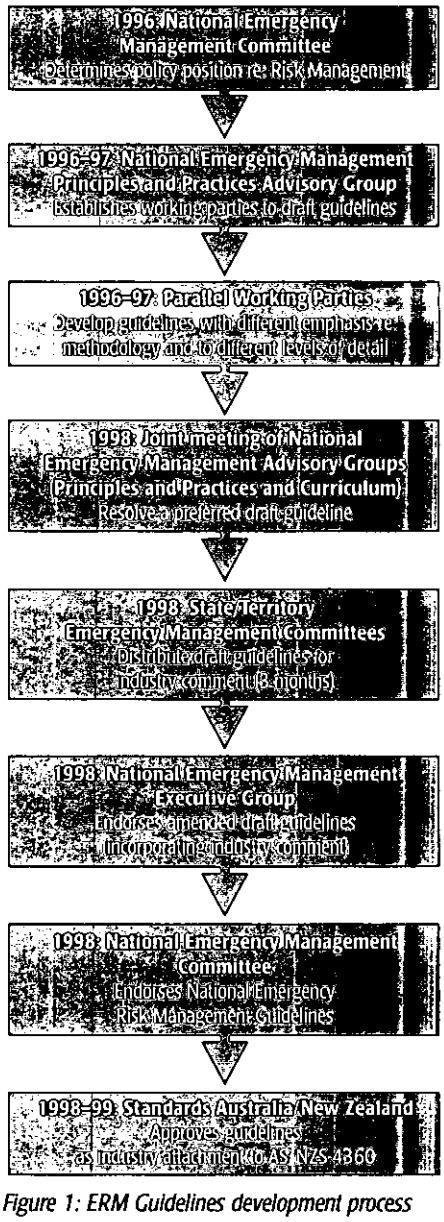

Figure 1: ERM Guidelines development process

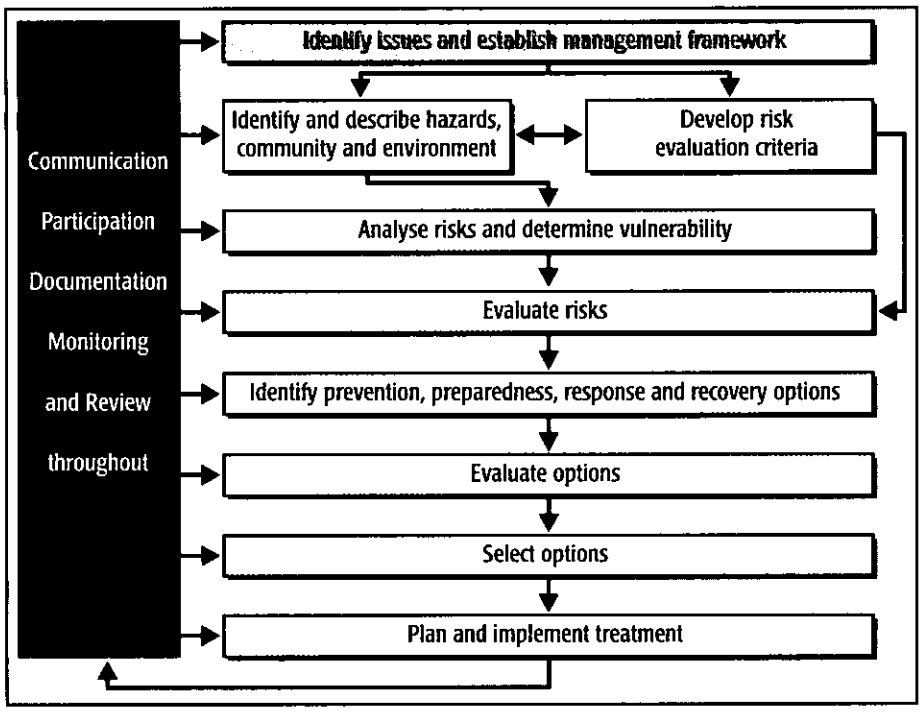

Figure 2: main elements of the Emergency Risk Management framework.

The specific meanings attributed to words are not what is most important in the guidelines. Nevertheless, some terms within the 'emergency management community' are terms that have a specific particular use, special meaning or emphasis. Indeed these context sensitive terms, and the concepts and principles they reflect, differentiate the emergency risk management guidelines from the general risk management standard. These terms provide a basis for identifying some of the key features of the guidelines in terms of 'what they mean to you'.

As outlined in *Figure 2*, the Emergency Risk Management Guidelines provide a contextually-enhanced framework that parallels the Risk Management Standard (AS/NZS 4360).

The crucial role of Communication and Participation

Underpinning the emergency risk management process is a requirement for communication, consultation and participation. The basis for this philosophy is that where all stakeholders contribute to the decision making process, there is a much larger pool of information and expertise to enable valid solutions to be developed. Further, for any decision making process to be successfully implemented, it must engender ownership and commitment from all parties influenced by it.

The resolution of issues related to risk management is not so much technical as it is political. It is about power and negotiation. If risk is recognised as a socially-constructed attribute, risk communication becomes pivotal, and focuses on the development of procedures for structuring dialogue; to develop shared understandings about risk and its acceptability. This raises issues about the use of communication and participation to facilitate a transfer of risk management to the community without incorporating sufficient enabling provisions.

If risk communication, as something fundamental to the design and implementation of treatments, is about facilitating meaningful dialogue that addresses any concern (information, attitudes, opinions), it becomes essential to recognise risk communication is a political process. Implications include the need to provide open, democratic processes that are underpinned by enabling provisions. Risk as a social construct in this context will also highlight the quality and performance of organisations within the emergency management community. Report cards will feature institutional values related to things such as bureaucratic access, caring, competence, trust and credibility. These social processes will be significant factors in the alignment of risk management towards vulnerability as any indicators of vulnerability must be chosen by reference to assumptions about underlying processes.

The core information – hazard, community and environment

As noted by Phillipe Boullé, Director of the International Decade for Natural Disaster Reduction, 'information, such as that necessary for understanding hazards and assessing the nature of prevailing vulnerabilities is essential for the determination of risk'.

The general Risk Management standard applies a method that views risk as arising from the interaction between 'sources of risk' and 'elements at risk'. This method is especially appropriate for closed systems and clearly bound problems, however it is considered inadequate for use in the emergency management context.

'Identify and describe hazards, community and environment' involves a detailed investigation of the characteristics of the hazards, the community, and the environment that form the basis of the problem to be solved.

'Hazard'

A hazard is a situation or condition with potential for loss or harm to the community or environment. Hazards may include:

Natural Hazards. These include bushfire, storm, flood, cyclone, storm tide, earthquake, and extreme heat or cold.

Technological Hazards. Technological hazards are caused by the failure of socio-technical systems. These include dam and levee failure and systems failures related to agriculture (e.g. drought), food contamination, industrial sites, infrastructure and transportation.

Biological hazards. These include the spread of disease *or pests* among plants, animals or people.

Civil and political hazards. These include terrorism, sabotage, civil unrest, hostage situations and enemy attack.

Organisational hazards. These include poor organisation, low resourcing, low staff competence, lack of awareness of responsibilities, and the potential of these to cause harm to the community or environment.

Most hazardous situations are rarely simple, and the situation studied in emergency risk management processes may involve a combination of a number of the types of hazard above.

Characteristics

The process of hazard identification and description involves determining information about significant fields including likelihood, spatial distribution, intensity, speed of onset, duration and the concern that the hazard arouses in the community. Information about a range of possibilities within each of the fields should be considered (e.g. in flood hazards variability in fields such as river height, duration of flood event and rate of river rise may be considered).

'Community'

In terms of 'community', a group may be identified by:

Geographically-based groupings of people such as households, neighbourhood, suburbs, towns, local government areas, cities, regions, states and the nation.

Shared-experience groupings of people such as particular-interest groups, ethnic groups, professional groups, language groups, age groupings, those exposed to a particular hazard.

Sector-based groupings such as agricultural, manufacturing, commercial, mining, education sectors. It may be necessary to consider groups within these sectors (e.g. the food processing group within the manufacturing sector).

Functionally-based groupings such as service providers responsible for systems or networks that provide for the movement of people, goods, services and information on which health, safety, comfort and economic activity depends (lifelines).

Most communities are rarely simple, as individuals are generally members of more than one community. The situation studied in emergency risk management processes may involve a combination of a number of different types of communities.

Characteristics

The process of identifying and describing a community involves determining information about significant fields including: size, spatial distribution, remoteness, prior experience or perception of the hazard, degree of exposure to the hazard, capacity to affect the environment or the hazard, access to resources, susceptibility or resilience to the hazard(s). Information about a range of possibilities within each of the fields should be considered (e.g. for geographically-based communities, variability in fields such as degree of exposure and ability to cope may be considered).

'Environment'

The 'environment' is a set of conditions or influences that surround or interact with a community and the hazards. Concepts of environment include:

Built environment. Elements such as buildings and infrastructure that provide for the movement of people, goods and services.

Physical environment. Elements from the natural environment such as topographical features, water bodies, vegetation communities, and ecosystems.

Social environment. Elements such as politics, economics, commerce, culture and public safety service provisions that relate to how the community functions.

These environments have complex interactions with the community and hazards. The situation studied in emergency risk management processes may involve a combination of a number of different aspects of the environment.

Characteristics

The process of identifying and describing the environment involves determining information about significant fields including the degree of mitigation effected on the hazard, the degree of protection afforded to the community, susceptibility or resilience to the hazard(s). Information about a range of possibilities within each of the fields should be considered (e.g. for an earthquake hazard and the built environment, a range of building types that provide differing degrees of protection may be considered; for a fire hazard and the social environment, variability in mitigation measures may be considered).

The centrality of vulnerability

Central to emergency management is a focus on determining vulnerability by establishing the capability of communities, the environment and systems to anticipate, cope with and recover from hazards. In order to profile the vulnerability of a community, the environment, or systems it is necessary to identify appropriate vulnerability indicators. Studies of vulnerability involve both quantitative and qualitative methods. Vulnerability indicators should be capable of measurement and meet tests for necessity and sufficiency.

Some vulnerability indicators will apply across all hazards. For example the proximity of any community, system, environment or asset will be a key consideration in relation to all hazards. However some vulnerability indicators are peculiar to each element of a community, the environment, or systems and will vary in relation to specific hazards. For example different buildings are vulnerable to different hazards; and hence characteristics such as the age of a component, its design, the construction materials used, location and prevailing ground conditions become considerations in determining vulnerability indicators.

The nature of vulnerability varies according to the study area and its proneness to specific hazards. Elements should be analysed at an appropriate level of geographic resolution for the problem at hand (e.g. for a community the resolution may range from individual household, collector's district, local government level, region, State or nation). Methods used for vulnerability analysis may be different for a small community as opposed to a big city, different for an area prone to a single hazard from one prone to multiple hazards.

Geographic Information Systems are useful in vulnerability assessment because of their power for exploring qualitative and quantitative relationships between communities, the environment, systems and hazards, by visualising situations, analysis, and modelling. Modelling is a simulation of processes associated with the problem being studied. Emergency risk modelling is used to estimate risk for a given scenario. Modelling facilitates the progression from a known situation to a prediction, based on expected behaviour. Modelling can be:

- *Physical.* A scaled replica is used for prediction;
- *Mathematical.* A mathematical relationship between cause and effect is used
- *Intuitive.* Intuitive understanding of the behaviour (based on experience or an understanding of the processes) is used.

Modelling of the processes that give rise to the risk is fundamental to the processes of emergency risk management.

Modelling scenarios accommodates uncertainty by examining how results vary as specific assumptions are changed. The output from modelling provides information that can be used to determine effective treatments.

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The changing nature of service provision

The shift toward risk management has significant implications for emergency management service provision, especially in terms of implementation and organisational change. As reported by Smith *et al* these include:

- increased service provision diversity (including a shift to prevention)
- community empowerment and responsibility
- increased inter-agency cooperation.

Under the broad public policy umbrella of 'risk management for safer communities', we are moving into the domain of client

focused service provision. Several new skill sets will be required of the emergency management community, for example:

- risk communication processes (based on planning with, not for) to negotiate appropriate levels and types of emergency management service provision will require facilitation skills to conduct service reviews and agree service level definition with clients
- contract specifications associated with outsourcing emergency management service provision will need a thorough understanding of and sensitivity to implications in order to achieve appropriate outcomes and performance indicators.

Predictions for further development of the guidelines

The material outlined above reflects the draft guidelines as they are about to go to the National Emergency Management Executive Group (AUG 98). As such two caveats apply—first, the material is only in part and draft and should therefore not be applied in the field; second, the draft must go through amendment, endorsement and forwarding to the National Emergency Management Committee.

The guidelines are only that (guidelines), and require substantively detailed supporting documentation to facilitate implementation. This 'how to' manual will be an Emergency Management Australia priority over the next twelve months. That there are already several attempts at 'implementation manuals' that are inadequate in various ways is testimony to the market need for a quality, detailed product.

There is a gap within the required detail at the level of 'vulnerability indicators'. Significant work will be required to identify appropriate indicators and associated research methodologies. Further, modelling tools need to better integrate the appropriate information factors and layers (hazard, community and environment characteristics) to analyse risk and determine vulnerability.

The guidelines could be developed into a flexible 'capability audit' framework that could be applied in any context. Such a product would have significant potential for applications in the private sector (e.g. infrastructure and asset management) and in the public sector in relation to the quality of public safety protection measures.

Closing reflections

The management priority is how to reduce community exposure to major risks. Hazards and strategies of prevention, preparedness, response and recovery are necessary elements of emergency management; however they are not sufficient. We have adopted, and are grappling with, the implications of the internationally promulgated construct that R ¦ H & V (where R = Risk, H = Hazard and V = Vulnerability). Indeed, the only reason for emergency managers to analyse hazards and assess vulnerability is to enhance their capability to manage risk.

A risk management approach, centred on considerations of vulnerability and processes of communication and participation, provides a flexible and holistic framework to better advise emergency management. Analyses focused on vulnerability will by identifying processes that bring about risk, highlight management options that address the key underpinning social features, structures or processes.

A risk management approach, centred on considerations of vulnerability and processes of communication and participation, provides a flexible and holistic framework to better advise emergency management.

In sum, in an era of increasing accountability, the guidelines provide a framework which, by focusing on managing community exposure to major risks, will facilitate the identification and implementation of intervention options that address the socially significant problems.

Slumber not in the tents of your fathers

For those of you who feel discomfort with the heralded changes, I suggest at a minimum the words of Washington Irving: 'There is a certain relief in change ... As I have often found in travelling in a stagecoach, that it is often a comfort to shift one's position, and be bruised in a new place'. However, I would urge you to consider the more positive view that develops from a recognition that you can not do today's job with yesterday's methods and be in business tomorrow.

Draft definitions

Definitions went to the NEMEG meeting (August 98) for amendment and endorsement.

For the purpose of the guidelines, the agreed definitions derived from those below will apply.

Community. A group with a commonality of association and generally defined by location, shared experience, or function.

Consequence. The outcome of an event or situation expressed qualitatively or quantitatively. In the emergency risk management context, consequences are generally described as the effects on persons, society, the environment and the economy.

Emergency Risk Management. A systematic process that produces a range of measures that contribute to the well-being of communities and the environment.

Environment. Conditions or influences comprising social, physical, *biological* and built elements, that surround or interact with a community.

Hazard. A situation, substance or condition with potential for loss or harm to the community or environment.

Lifelines. Systems or networks that provide services on which the well-being of the community depends.

Likelihood. A qualitative description of probability and frequency.

Preparedness. Measures to ensure that, should an emergency occur, communities and other-resources and services are capable of coping with the effects.

Prevention. Measures to eliminate or reduce the incidence or severity of emergencies.

Recovery. Measures that support disaster-affected individuals and communities in the reconstruction of the physical infrastructure and restoration of emotional, economic and physical well-being.

Response. Measures taken in anticipation of, during and immediately after an emergency to ensure its effects are minimised.

Risk. A concept used to describe the likelihood of harmful consequences, which is a function of hazards and the vulnerability of a community and environment.

Risk Analysis. The systematic use of available information to study risk.

Risk Evaluation. The process used to prioritise risks.

Treatment Options. Measures that modify the characteristics of hazards, communities and environments.

Vulnerability. The susceptibility and resilience of the community and environment to hazards.

Cyclone surge and community preparedness

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Natural hazards with lead times

This paper considers community flood and cyclone surge preparedness. In relative terms, cyclone surges have a warning time of wavering probability likely to extend over some days, with the erratic behaviour of cyclones (Commonwealth of Australia 1997) making final course and severity difficult to judge until about 12 hours before landfall. Last minute evacuation is likely to be compromised by road flooding. Although likely cyclone strikes provide clear warning, issues of timely evacuation are complicated by infrequent surge strikes in Australian centres, high population turnover in many tropical towns and cities, and the rapid growth of coastal populations and infrastructure.

For these reasons, this paper looks at community-wide involvement in preparation for a precautionary response to a cyclone surge threat. Recent post-flood social research in North Queensland is synthesised with Cairns transport network and elevation modelling as case studies to consider details of community preparedness, as required by the Commonwealth (EMA 1993). To help achieve preparedness, it is necessary to be clear about allocation of responsibility.

State and territory governments carry responsibility for the '... protection and preservation of the lives and property of their citizens' (EMA 1993), with Queensland Department of Emergency Services as state coordinators. Because it is already established that emergency management includes prevention, preparedness (Cronan 1998), response and recovery (EMA 1993), post-flood research indicated a need to strengthen community involvement in preparedness. For instance, SES was on full alert before the floods struck Cloncurry, but the community was poorly prepared, informed or warned. To help understand underlying physical and social issues connected to flood threats, the Centre for Disaster Studies at JCU, North Queensland has developed a research approach.

Flood threat research approach

After establishing the nature of the potential hazard, including the likely maximum flood or surge height, public vulnerability and awareness is surveyed. The great restrictions to evacuation caused by land based flooding is fully factored in to the detail of preferred evacuation timing and destination of the vulnerable. Preferred movement sequence of the vulnerable is developed in discussion with emergency managers, and how the preferred movement can be implemented. Finally, we take the stance that effective implementation of recommendations is all that matters. This approach was used in the synthesis of the following three case studies, considering the event, the response and the lessons learned, leading to recommendations to increase commitment for community preparedness.

Cloncurry, March 1997

Because of the steep, unmonitored upper catchment and the confluence of two major atmospheric depressions (including ex-cyclone Justin), waters in Cloncurry rose 2m higher than any flood in a hundred years, explaining the general inertia against precautionary response. Although there was official preparedness, people 'knew' how high the floodwaters would peak. Research showed overwhelming levels of disbelief during and after the event (King and Goudie 1998). Along with disbelief, research found that support from neighbours was rapid and selfless. A better warning systems was widely called for, and that there was a clear need for more public awareness and involvement.

Townsville, January 1998

There was major flooding in the Townsville area in January 1998 (associated with ex-cyclone Sid). Along with a 1,000 household telephone survey within days of the event, two researchers conducted interviews and local observation on Magnetic Island, a suburb of Townsville, 8 kilometres from the mainland. Those geographers set out to establish impacts of the flooding on the local community and infrastructure, and assess planning issues of evacuation when that level of flooding precedes a significant cyclone surge. They interviewed 24 flood affected householders and business proprietors. Police and the local SES leader were also interviewed at length.

Magnetic Island flood impacts

The four settlements on Magnetic Island (pop. 3000, ABS 1996) are connected by a narrow sealed road, vulnerable to landslides at each intervening headland. The January 1998 deluge caused landslides that obstructed the main road between Picnic and Nelly Bay, Nelly Bay and Arcadia, and Arcadia and Horseshoe Bay (see *Map 1*). The main road network was also severed temporarily in five places by stream flows in three of the settlements. These upslope drainage lines were all temporarily impassable, and will present severe restrictions to any needed evacuation ahead of a cyclone surge. The Townsville and Magnetic Island floods of January 10 clarify the dangers created by swollen off-slope 'mini catchment' streams cutting crucial routes to shelters (see *Photos 1, 2* and *Map 1*).

From interviews and observation it became clear that the official response was brave and swift, but it was also clear that, like Cloncurry, many residents were unaware of the danger. This core issue: lack of community preparedness or knowledge is made stark by results of the 1000 household survey conducted in Townsville, which showed the reality predicted by the extensive research carried out in Cairns by the Tropical Cyclone Coastal Impact Program (TCCIP). The TCCIP included development of the Granger Digital Elevation Model. Extensive mapping with this and other existing databases was used to predict what might happen to Cairns in the event of various storm surge scenarios. *Table 1* summarises Cairns City Council data and identifies the buildings that would be affected by a 3 metre storm surge. This is defined as the height above Australian Height Datum (AHD). Granger used AHD as the basis for the ground height data of each building. Cairns tide tables indicate that AHD is approximately a metre below the highest tide level. Granger states that Cairns AHD is 1.78 metres below the Highest Astronomical Tide (HAT). The following table shows the vulnerability of many building types in Cairns to a moderate storm surge of about 1.2 metres above HAT.

Table 1 predicts the impact from a moderate storm surge that would completely

Type of building	Number of buildings	Number of buildings below 3 metres and above AHD	Percentage of buildings below 3 metres and above AHD *
Accommodation – motels, hotels etc	267	162	61
Houses – private Dwellings	28 041	5093	18
Flats, townhouses and apartments	2488	1071	43
Sub total housing	*30 796*	*6326*	*20*
Business and commercial premises	1533	1259	82
Industry – factories etc	79	68	86
Sheds and warehouses	76	43	57
Miscellaneous – business related	19	19	100
Sub total business and industry	*1707*	*1389*	*81*
Recreational facilities	87	41	47
Community facilities – churches, halls, libraries etc.	210	111	53
Sub total community buildings	*297*	*152*	*51*
Emergency services– police, fire, SES, defence etc.	40	25	62
Logistics - bulk gas, fuel, storage and transport	395	322	82
Health Services	151	98	65
Power Utilities	25	22	88
Water supply	34	11	32
Telecommunications	32	14	44
Educational Facilities	219	113	52
Government Facilities & depots	54	37	69
Sub total service facilities	*950*	*642*	*68*
Total all buildings	33 750	8509	25

Source: Queensland Department of Emergency Services/ Cairns City Council; 1995 survey by Granger et al. AHD – Australian Height Datum (mean sea level: at Cairns this is approximately 1 metre below the highest tide level such that 3 metres above AHD is only 2 metres above the high tide level. The Highest Astronomical Tide is 1.78 metres above AHD).

Table 1: Cairns buildings and flood vulnerability.

cripple the city and probably wipe out its economic base. Of course, considerable wind damage will have occurred in conjunction with the extensive flooding. While only 20% of the residential housing stock will be inside such a flood zone, 81% of all business and industry will be inundated and 68% of all service facilities. It is this latter impact that will cause the greatest problems during and immediately after the event. The emergency services will probably be crippled with 62% of facilities flooded, and health services at 65% will be inaccessible and probably out of action for a considerable time. Power utilities will probably sustain major long term damage aside from the extensive wind damage to power poles and lines.

In comparison, the actual impact of the January 1998 floods in Townsville shows a similar kind of scenario. A far greater impact fell on the emergency services and infrastructure than on residential buildings. While table 2 records the impact on a whole range of services, the ambulance, police and fire stations experienced a much higher rate of disruption, with 75% probably unable to respond during the height of the floods. Although only 15% of households were inundated, this may represent 7,500 households. In fact 6,955 insurance claims had been lodged by domestic householders by the end of April. The size of the disaster, coupled with the intensified impact on services and infrastructure, meant that most of the impacted people were on their own. This is probably the most critical issue in a natural hazard. The whole population has to understand precisely what to do in a disaster situation because the services and infrastructure of the community will inevitably be overwhelmed.

Because the Centre for Disaster Studies is conducting long term, outcome oriented research, the actual state of residents prior to and during an extreme weather event in Townsville sets the scene for the large amount of work needed to inform and involve the public in precautionary evacuation in highly vulnerable centres like Cairns.

Cairns cyclone surge and the road network

A three year study in Cairns set out to define the role and implications of the road network weak points ahead of a cyclone surge, aiming to produce recommendations to minimise loss of life. This scoping study is near completion.

Findings

There are many flood points in the Cairns road network (*Map 2* and *3*), including twelve that are likely to block major evacuation routes, and at least six areas in the main Cairns floodplain. Along with likely landslides on exit routes to the relative safety of the interior Tablelands, these low points in the road network are the most obvious weakness in the Cairns road network.

This paper next considers these issues of road network flooding in some detail, then explores strategies to help achieve an early and precautionary evacuation. These strategies, as detailed below, include local inundation maps, definition of a maximum total flood contour, billet brokers, flood spotters and mobile sirens.

General outcomes from TCCIP road network research in Cairns since 1995

Following meetings with road engineers from Cairns City Council and Department of Main Roads, it became clear that the road network will impose severe restrictions on last minute evacuations. Flood

Statement of inundation impact	Yes affected %	No not affected %	Not applicable %
Inaccessible all or part Saturday to Monday	54	46	0
Operations were disrupted	59	41	0
Disruption from water inside building	35	60	5
Disruption from water around buildings	35	54	11
Disruption from dependency on other disrupted facilities	49	46	5
Staff unable to reach premises or leave	57	35	8
Customers/users unable to reach or leave premises or service – Saturday night	41	19	40
Loss of stock, equipment and plant	35	65	0
Damage and loss to storage capacity	22	70	8
Restoration of normal operations delayed	57	41	3

Source: Centre for Disaster Studies Survey of Business and Infrastructure

Table 2 (left): Townsville Flood 1998, impact on Ambulance, Police and Fire Stations, Infrastructure, Government, Council and Transport and Medical Facilities

Table 3 (below): Townsville Floods 1998, summary statistics of inundation levels and utility loss

Summary of inundation levels	Number affected	% affected	Mean depth – minor % covered
Water inside house	149	15	239.0 mm
Flood water on property	609	60	76.0 %
Depth of water on property	609	60	314.0 mm
Depth of water on road	679	67	453.0 mm
Loss of Utilities			Mean time – hours
Loss of water supply	168	17	14.7
Loss of power supply	476	48	11.4

Source: Survey of 1000 households

waters may cut evacuation routes long before a cyclone strike (see *Photo 3*). An evacuation to safe local shelter spread over many hours will minimise traffic congestion if there is increasing probability of an impacting surge. Also, reflection showed that vehicles accumulating on the 'threatened' side of floodwaters will make transferring to 'high-clearance' vehicles increasingly chaotic. Hence the need for early departures, and marshalling points on highest ground within the vulnerable communities.

Also, because the evacuation procedures developed will form the basis of response for many years to come, planning needs to include the likelihood that the enhanced greenhouse effect will increase the frequency and severity of cyclones (Minnery and Smith 1994). Further, sustainable urban development should include explicit cyclone preparation, including vegetation buffering, response infrastructure and strategies in all areas of ongoing urban growth.

The magnitude of the problem

Prior to a surge, about 6,000 vehicles and 25,000 people (ABS 1991 census) will be located in the main Cairns floodplain. Under ordinary road conditions at 60kph, one road lane can carry about 800 cars per hour (Turton 1992). Although not yet confirmed, it is reasonable that vehicles travelling at about 15kph through flood water of less than 250 mm, with double the distance between vehicles (observation during Townsville floods), each flooded lane could only move 100-200 vehicles per hour. Moving traffic through flood waters is very slow, barring breakdowns. Further, about 2,000 households in the main flood plain do not own cars. Transport planning will be successful if no-one is trapped and drowned. Transport planning is fully dependant on an informed public undertaking early and voluntary responses. Map two shows that the only exit routes from Machans Beach, Yorkeys Knob, Holloways Beach and Trinity Beach may be cut days before the cyclone path is clear. The following *Map 3* shows how constricted vehicle movement is likely to be in the main flood plain of central Cairns, with essentially only three exit routes servicing about 6,000 vehicles, evacuating at perhaps 600 per hour, barring any failures.

Map 3 has three 'time' layers.

- *Local land-based flood areas.* The stars in Map 3 show the local flood areas in central Cairns. This flooding may occur days before the cyclone and surge.
- *The three 'dry' exit routes.* The dark continuous lines show the three 'dry' exit routes around the flooded areas (traffic lights will be adjusted to help exit flow).
- *Approximate temporary coast line levels at 1, 2 and 5m.* After flooding and evacuation, the heavy dotted lines show the 'temporary coast line' at 1, 2 and 5m surge above HAT.

The temporary coast lines and the following information are all based on a digital elevation model (DEM) developed by the Granger team, with a general accuracy of about 250mm for elevations for every building in Cairns. The methods developed through this Tropical Cyclone Coastal Impact Program process have relied heavily on the Granger DEM. This accurate elevation data has allowed mapping of ground contours at half-metre intervals. The closeness of some Cairns real estate to the level of the HAT is emphasised by photograph 4, showing floor levels in Central Cairns just centimetres above a calm 'king' tide.

Three evacuation layers

Part of the initial TCCIP brief was to identify three logical layers of inundation, for planning and public education. Generation and study of hundreds of elevation maps shows three 'natural' levels of sea flooding at 1, 2 and 5m (extreme surge height, see *Map 3*). There is a highly vulnerable coastal edge and low points to 1m, then the broad coastal plain of inner Cairns and lowest parts of each northern beach suburb, including Trinity Park from 1–2 metres. A third layer, likely to need mobilising only ahead of the most severe cyclones, occurs above the 2m surge (over HAT). This layer contains progressively more of the beach suburbs, and a relatively narrow upper edge at the beginning of the mountainous base of the Cairns flood plain (from 2 to 5m).

Further specialised hydrological studies are needed to factor in funnelling of surge waters into narrowing valleys, and the additional temporary flooding as the depth of surge combines with the depth of land-based flood waters. This is particularly relevant for the Barron Delta area.

There are three response layers: the obvious and known 'coast-edge' low points to 1 metre; a general surge to 2 metres; and an 'upper edge' from 2–5 metre surge.

'Folding over' from low to higher shelter

An evacuation to minimise loss prior to or during a significant surge should necessarily begin with early and widespread precautionary 'self evacuation' to relatively safe public or domestic shelter on higher ground. Precautionary evacuation is recommended because cyclones have erratic paths (Loudness 1977), and their effects are not fully predictable (Trollope 1972).

Exit roads are likely to be blocked by land-based floodwaters or landslides. The primary objective is for vulnerable people to 'fold over' from low, threatened areas to designated shelters, friends, relatives or networked contacts living on higher ground. Destination shelter would ideally be strong, and away from large trees and major debris sources, with socially similar households. Hosts will be providing a great service to the evacuees in their care. It would be preferable if the hosts felt comfortable with the kind of people sharing their home, especially in the extremes of this natural disaster.

The bulk of the community should be involved in surge preparation. Early public involvement will help clarify community needs and encourage co-operative behaviour. This will minimise direct and formal demands on the disaster response when the next major cyclone threatens Cairns.

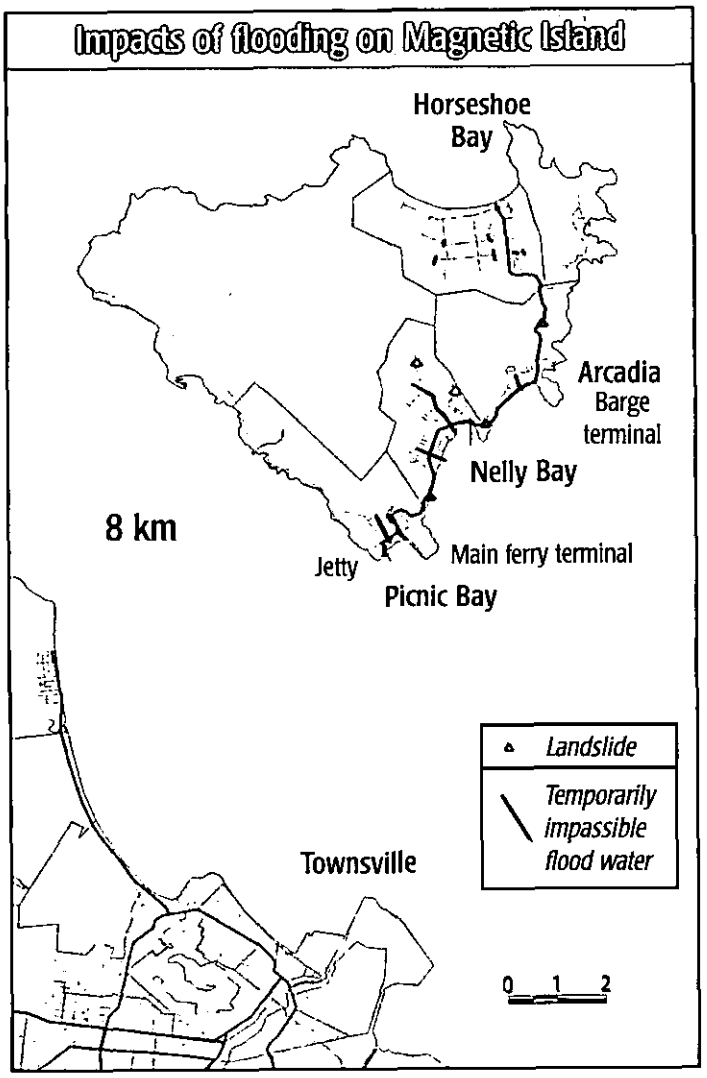
Maximising successful pre-surge road use

Goal: to minimise loss of life and portable valuables through early movement.

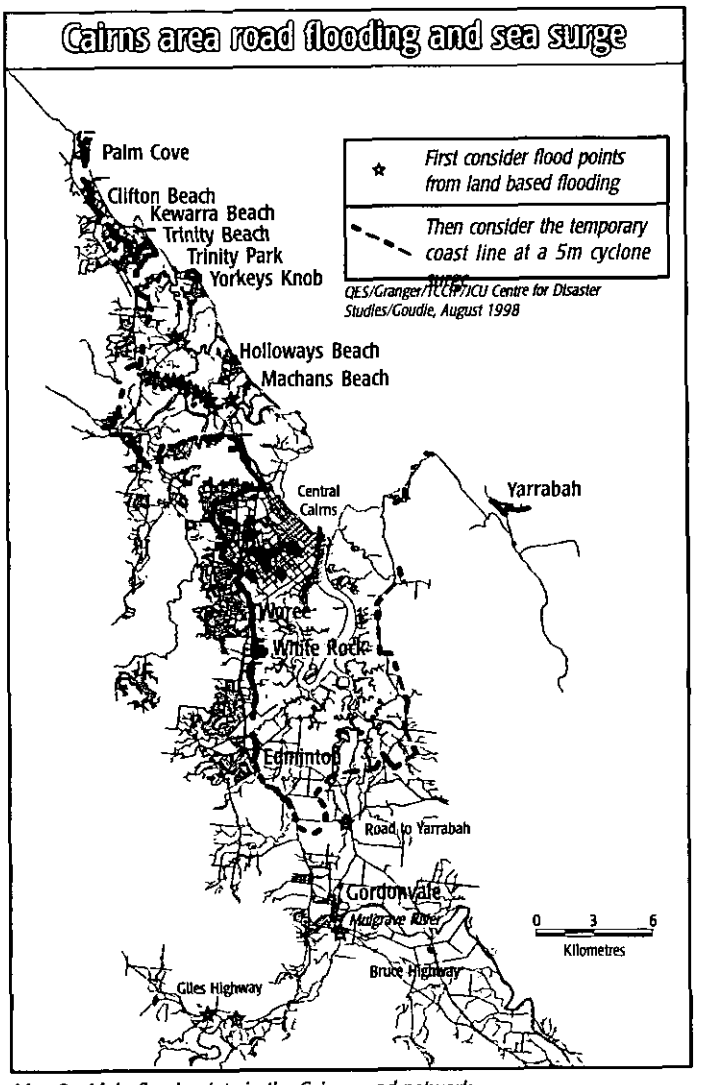
Political support and community preparation can be combined with a commitment to precautionary evacuation. By knowing the flood areas in the road network, and ensuring that evacuation zones are well known, there is the potential for deep community involvement to ensure the vulnerable 'fold over' to fully pre-arranged private billets ('lodgings').

Along with work being done by the Cairns Counter Disaster Committee, the goal may be achieved with clear, strong political support (personalised publicity and generous staffing and funding), public education and involvement, a clear on-ground indication of the extreme edge of flooding vulnerability and local sponsorship. Providing local storm surge maps at 1, 2 and 5 metres in local shops and mail-outs will inform people with the localised information they need for their future safety. The tourism industry can develop detailed plans to relocate all vulnerable tourists booked in to formal accommodation.

A further problem exists for people without contacts on higher ground to arrange safe shelter in the home of a suitable and obliging household. There is need to provide links between vulnerable people without social networks and residents on higher ground who wish to offer pre-arranged shelter. These linking agents are referred to as 'billet brokers' (a 'billet' is a private, usually unpaid temporary lodging).



Map 1: Magnetic Island, 19°S – January 10, 1998 floods



Map 2: Main flood points in the Cairns road network

Finally, use of emergency service and police sirens should ensure everyone knows there is an imminent, locally destructive hazard developing or about to impact.

Developing planning consensus

The strategies of early, *ad hoc* evacuation and much greater political involvement were clearly supported when put to about 50 TCCIP conference members in November 1996 (CDS 1996). During 1997 and 1998, the early *ad hoc* evacuation approach was further developed in consultation with Cairns authorities, and combined with on-ground experiences with flood victims in Cloncurry and Townsville. This led to the development of eight primary recommendations, which were put to a national workshop of experts in planning, natural disasters and emergency management.

The workshop, held in Townsville in July 1998, was convened by the Australian Geological Survey Organisation. The AGSO *Cities Project* applies research to mitigate geohazard impacts on urban Australia. To date, AGSO research has focused on Cairns, Mackay and Gladstone, representing urban centres faced with increased geohazard risks. Of the eight recommendations discussed at this national workshop to achieve early, *ad hoc* precautionary evacuation ahead of a possible cyclone surge, three were strongly supported by the group as a whole, three were supported in principle, and two caused prolonged discussion.

Recommendations for a 'safe' surge

There was clear and near unanimous support for the key recommendation:

- Strong political support for public education.
- Seasonal use of maximum urban flood contour signs was actively supported. Modelling of a Category 5 surge of 5 metres, with funnelling (McDonald Wagner 1988), wave reach and added flood height from land-based flooding should be used to define a 'local contour of safety'—the local maximum flood height, which could be prominently indicated where it crosses major roads. We can then encourage people to negotiate their own billets with friends, relatives, work-mates or other contacts above that line, but within their own general urban sector, minimising cross-town and last minute movements.
- Local 'spotters' placed at known flood points to report as waters rise. When a large cyclone is in the vicinity, radio or mobile phone information from spotters should trigger evacuations before routes are severed as a severe cyclone approaches (see *Photo 4*).

Photo 1: Base of major landslide, Gustav Creek, Magnetic Island, January 1998

Photo 2: Barton St. bridge, breached by flood waters, Nelly Bay.

- Sponsorship and public involvement were clearly accepted by the workshop.
- Local inundation maps in retail outlets was tentatively accepted by the group, but it was asked if people would take any notice of local flood maps. It is essentially an issue of personal, family and 'portable property' survival, so it is likely to be studied with interest each year from October to March, while people are shopping at their local convenience store or mall. Organised by sponsors, larger displays and maps can be established in each shopping complex in the Cairns area. These detailed maps will be specific to the usual 'catchment' of each store.

It was suggested during workshop discussions that mailouts could be prepared for each vulnerable area and sent out to all relevant households and organisations at the first cyclone watch. Legal and liability issues appear to need strengthening in favour of precautionary evacuation. In the context of a 'right to know', there is perhaps also a duty of care involved.

There was *support in principle* for self-organisation in the tourism industry for their staff and guests. This needs more discussion and development. All accommodation providers in the tourism industry are best placed to know of individual tourists in the district, and most likely to know where most of them are during their Cairns stay. Logically, the tourism industry should take full responsibility for the safe relocation of their own staff and guests under Emergency Services direction (Drabek 1994). The industry has many buses, 'adequate' up-slope shelters, and an accurate record of visitors in the area at any given time. It was suggested that a representative of the peak tourism body be drafted onto Counter disaster committees.

There was much energetic discussion over 'local billet brokers' and local siren warnings. These recommendations are discussed in detail below.

'Billet brokers'

For the many low-lying residents in Cairns who do not have their own informal networks to arrange overnight billeting, there is a clear need to have 'billet brokers' (Goudie 1996). This role could be fulfilled by interested and active members of various community groups in Cairns.

To clear the Central Cairns flood plain, about 25,000 people will need relatively safe shelter. Many of these people have not developed social networks in Cairns because many people have not lived in Cairns for long. Developing effective procedures to link the vulnerable with like households on higher ground is crucial to early evacuation efforts, and may be relatively easily achieved by involving community service groups to develop a 'billet link' phone service and data base.

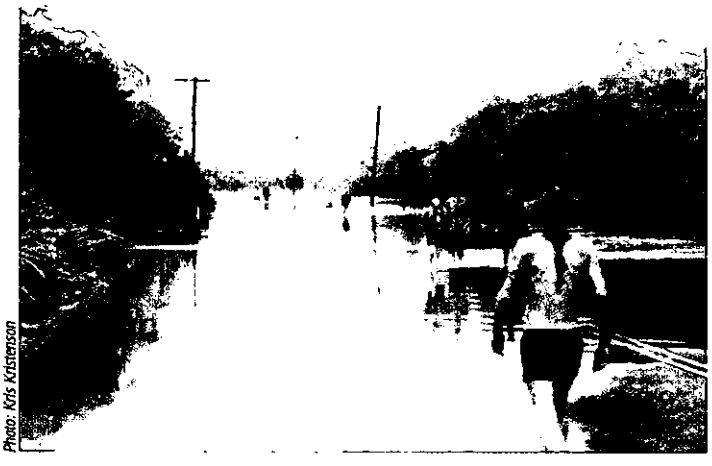


Photo: Kris Kristenson

Photo 3: Machans Road, the only exit from one of the vulnerable North Cairns beach suburbs, soon after Category 2 Cyclone Justin, March 1997

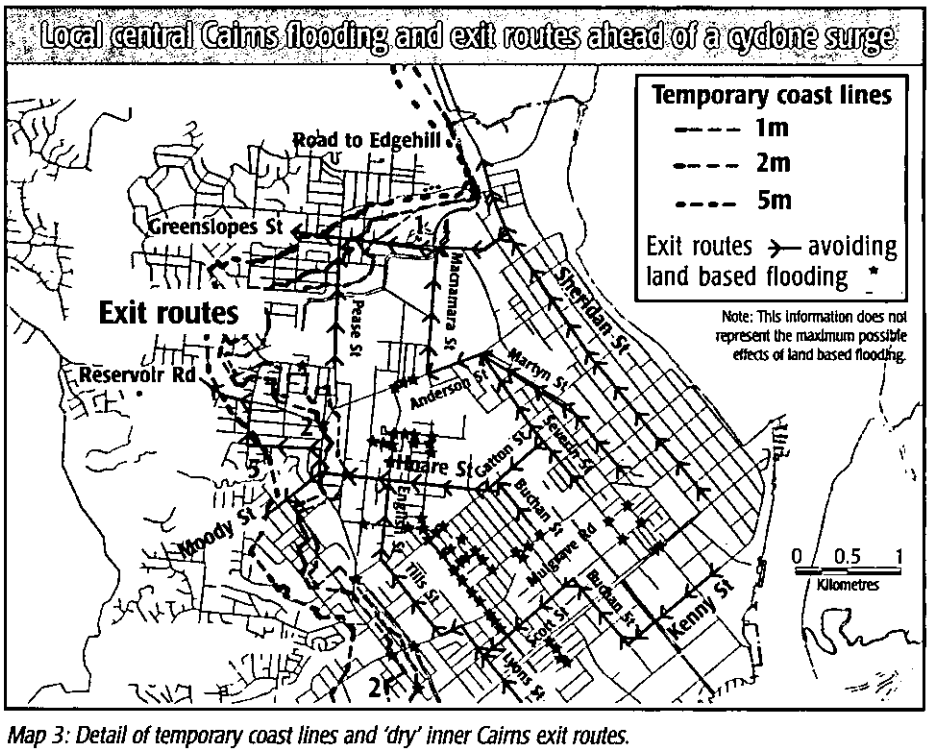
Such activities would need seeding funds to set up the data base framework, and to cover phone, newsletter printing and mailing costs, plus, perhaps, a little support for the parent groups involved. In this way, people in the vulnerable, low-lying areas would be facilitated to form a contact with a welcoming household on higher ground, well before land-based flooding or gale-force winds prevent safe passage from lower to higher ground. A major cyclone threat would trigger an early, ad hoc response, engendering an attitude of a 'practice', an overnight 'picnic', rather than a 'false alarm'.

Mobile sirens

Research in Cloncurry and Magnetic Island found that not enough people listen to the radio, and the TV information is just not localised or specific enough. Development and implementation of an effective siren based public warning system is recommended to avoid ignorance of life-threatening danger. It was luck alone that four people on Magnetic Island did not drown. The use of a mobile siren system could be piloted in a small population like north central Cairns, and developed for all areas of Queensland which are flood or fire prone.

The workshop group was told that a siren warning would be given by the Bureau of Meteorology for severe storms, similar to cyclone warnings. Unfortunately, these warnings are not out in the street, a need indicated by recently studied flood experiences. In the study of the Cloncurry floods of March 1997 it was found that about 70% of the 40 flood or near-flood affected households gained 'no warning at all', a further 15% had 'very little warning'. Seventy percent of interviewees got their flood information from their 'own observation' or 'no-one'.

It may be attractive to assume that people are glued to the electronic media ahead of a major cyclone and surge, but research



Map 3: Detail of temporary coast lines and 'dry' inner Cairns exit routes.

following extreme weather events carried out by the Centre for Disaster studies indicate otherwise. More recently, 53% in a 1000-household Townsville survey (King 1998) did not stay tuned to radio or TV during the Townsville 1998 flood, 53% had heard no warning, and many stated that they wanted a better warning system. This study of 1000 randomly selected households highlights the actual need for on-ground warning systems. The 'unique' floods of Cloncurry and Townsville showed how reliance on the media does not work effectively. Because of the trial nature of this recommendation, it is perhaps best funded through TCCIP, and first tested by a local council at a small scale of about two hundred households.

For sirens to be effective, there would need to be widespread information about the signals, their meaning, and what individual responses should be. Radio and local talks, along with local letter drops, political, SES and police public involvement would help prepare residents and managers for the practice runs. It is suggested that the siren signals (see below) are sounded at 11 a.m. on the first Sundays of October, November and December, to familiarise people with the sound, and the preferred response. Further, *mobile sirens already exist in the community* on police and emergency vehicles. Thus the infrastructure costs should be modest.

The sirens could have three alarm levels:

- *danger looming*, stand by, or respond in a precautionary way (perhaps three short blasts, repeated periodically)
- *respond to danger* (equivalent to an order to evacuate, perhaps one short and two long blasts)
- *danger imminent*, prepare for impact (perhaps three long blasts).

A fourth signal, 'all clear', may also be useful (perhaps short, well spaced blasts).

A pilot to refine understanding

To properly achieve *ad hoc* early self-evacuation, the recommendations detailed above have been developed during the 3-year TCCIP study, discussed and modified to the level documented here. These recommendations address core issues implicit in road network restrictions. If evacuation is delayed until a surge is almost certain, land-based flooding is likely to causes panic, especially in the northern beach suburbs. The recommendations (or others addressing identified problems) should be refined, publicly tested and implemented.

For a pilot test of the recommendations to be worthwhile, the primary requirement of active, funded, near-aggressive and public political support is needed. This view was vigorously supported by the July 1998 AGSO-convened group—strong, active political support is mandatory for widespread precautionary responses. This means effective full time staff, adequate funding and maybe sponsorship, and clear messages from the political arena that each level of government acknowledges the danger and are properly funding likely ways to minimise loss of life through drowning.

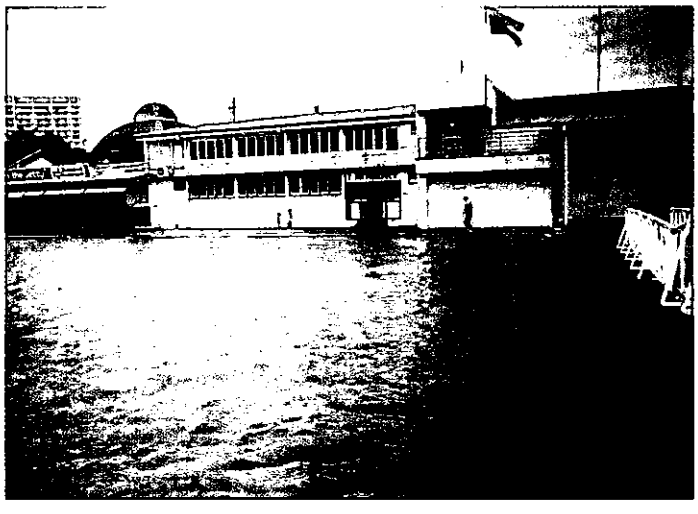


Photo 4: Water front central Cairns on a calm Highest Astronomical Tide, January 1997

Secondary recommendations

Seeding funds should be provided to form and support the operations of Community Surge Groups and Billet Brokers.

Staggered evacuation procedures should be developed for all vulnerable people requiring an ambulance. Various health authorities could provide a mapped (Mapinfo or Latitude) database of people in their care who may need special attention (updated each October). If they live in the low areas of beach suburbs, they will need to be moved before exit routes are compromised.

Most vulnerable people (elderly, infirm, disabled, tourists and those without cars or rides with friends or neighbours in the lowest areas) should be moved first.

A strong police anti-looting presence may reassure people to leave sooner rather than later.

A signal that a residence is vacated. As people evacuate a building, they could tie a pillow case near their front door, so emergency workers know the residence was unoccupied.

Evacuees without use of cars should board evacuation buses at specified marshalling points within vulnerable communities as soon as a *recommendation to evacuate* is given.

Signs to identify 'dry' routes should be developed to help guide people from low to high ground, avoiding areas likely to be flooded.

Vertical evacuation (sound high-rise commercial buildings) could be designated as 'shelters of last resort' for people trapped in the inner city area (Smith 1995).

Other recommendations

There is a need for effective communications for SES personnel. Many had difficulty contacting each other on Magnetic Island to co-ordinate effective responses.

More detailed public education should be provided about the dynamics of flooding specific to each 'mini' catchment, and off-slope flooding across roads leading from low to high shelter.

In line with current government policy (ESD 1992, IPA 1997), the community in 'urban segments' should be fully involved to ensure 'safe' upslope shelter. For example, what extra items are needed? Who will help the infirm?

In Cairns, there is an agreed procedure in place between Council and the Main Roads Department to achieve best removal of debris and repair of weak points in the road network immediately after any cyclone flooding, aiming to allow the maximum number of people to return to their properties as soon as possible.

Community Service TV announcements and footage of Cairns road flood-points may help encourage early self-evacuation of the vulnerable to 'safe' shelters.

Use the roads early

A committed combination of political support to the approaches outlined, education, public involvement, billet brokers, mobile sirens and *ad hoc* precautionary evacuation is likely to minimise the social impacts of major cyclone surges in vulnerable coastal centres. This paper has shown that a geography research method that combines computer modelling, interviews, a planning team, literature search and principles of sustainability is useful in disaster impact minimisation. If the above is agreed to, the next step is pilot implementation in one of the vulnerable areas, perhaps in the north of central Cairns.

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Refereed

Digital Elevation Modelling for natural hazard risk assessment

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Introduction

The application of geographic information systems (GISs) to natural hazard risk management is a relatively new and emerging science. Coppock (1995) notes that GIS has made a contribution to various facets of natural hazard risk management since risk is a multi-dimensional and multi-disciplinary phenomenon, which have a spatial component, whatever their initial focus. Hence, the success of GIS implementation for natural hazard risk reduction can be contingent upon the availability of spatial data. The digital elevation model (DEM) is a key form of spatial data . A DEM is a spatially referenced continuous surface representing the topography of an area. A DEM surface may be represented by a grid, where each cell in the grid indicates a ground elevation. DEMs are usually stored as computer files and are key to most GIS spatial databases.

Ground elevations modelled by DEMs are important for a number of natural hazard risk management applications including flood inundation modelling (storm tide and riverine), landslide susceptibility modelling and bushfire risk mapping. Risk management personnel may not be directly responsible for DEM creation but may need to be familiar with the general concepts and key terms. Concepts include DEM *accuracy*, *resolution*, *spatial extent*, *currency* and *fitness-of-use*. Presenting the basic theory of DEM creation, and DEM characteristics may help risk managers understand and better utilise this important, and increasingly common, model of spatial data.

Spatial data issues associated with DEMs including error, accuracy, resolution and scale are also critical to other spatial data used in GIS-based natural hazard risk management. Data themes can include physical hazard zonations, building and lifeline databases, and census data. Examining these issues should also be a first step when organisations integrate GIS with risk management processes such as AS/NZS 4360 (1995). For example, the first stage of AS/NZS 4360 is titled 'Establishing the Context' and focuses on institutional issues surrounding the implementation of the standard. This stage is important since it identifies the aims, objectives and GIS modelling limitations of the project. Similarly, issues of error, accuracy, resolution, scale and spatial extent should be considered. DEMs are examined as a case-study of these issues.

Cairns in Far North Queensland is the study site, and reference is made to storm tide inundation modelling. Issues associated with riverine flooding are similar, and the general concepts are applicable to other natural hazard risk assessments. In Queensland, DEMs have recently been used for developing inundation evacuation plans, and therefore, issues of accuracy and error are critical for decision making. Issues to be discussed also include, DEM availability in Australia, surface interpolation procedures and DEM input data sources. Since risk results derived from DEMs are as accurate as the input data used to derive them, attention is given to DEM error assessment. End-users of DEMs perceive levels of accuracy in the elevation data that are optimistic. Exploratory spatial data error analysis is shown to be a critical aspect of DEM creation, and for determining the *fitness-of-use* of spatial data.

DEM components

A DEM is described by three components: the DEM resolution (grid cell), DEM accuracy, and DEM spatial extent (Figure 1). The spatial extent is a relatively simple concept describing the area on the ground that the DEM covers. The spatial extent is determined by the area of interest, and by the availability of input data sources such as contours or spot elevations. Grid resolution and grid error are the more complex components of a DEM. The grid resolution is similar to the minimum mapping unit concept common in cartography, and is the areal size of each grid cell in the DEM. Selecting an appropriate DEM cell resolution is a choice between adequate surface representation, the availability of input data, and the allowable DEM file size. Priority is given to maximising the DEMs ability to represent terrain variation for a modelling application since computing issues can be overcome with faster processors, and larger storage capacities.

DEM cell sizes range from 250 metres (where each cell represents an area of 250 x 250 metres on the ground) for continental/regional scale mapping, to 20 metres for more local mapping. Where the terrain is less homogenous, a smaller cell size is chosen. One guide for selecting a suitable DEM cell size is the desired level of modelling detail required. However, the areal density of the input topographic can also determine suitable cell sizes. A DEM is a model of a real world phenomenon and hence will contain inherent errors. Error is defined as the deviation of the modelled attribute from the true value. By definition, DEMs will always contain horizontal and vertical errors and this can undermine the results obtained from hazard risk models. For example, the vertical error in the DEM may be greater than a predicted inundation level. DEM vertical error is discussed in further detail as it has important implications for natural hazard risk modelling.

Commercially available DEMs

In Australia, DEMs that cover the entire country are rare. Such continental scale DEMs have accuracy's which make them unsuitable for many local scale hazard risk assessment projects. Of note is the Australian Surveying and Land Information Group (AUSLIG) 1:250,000 scale DEM (1/40 degree, 250 metre grid resolution) for all of Australia. The suitability of small to

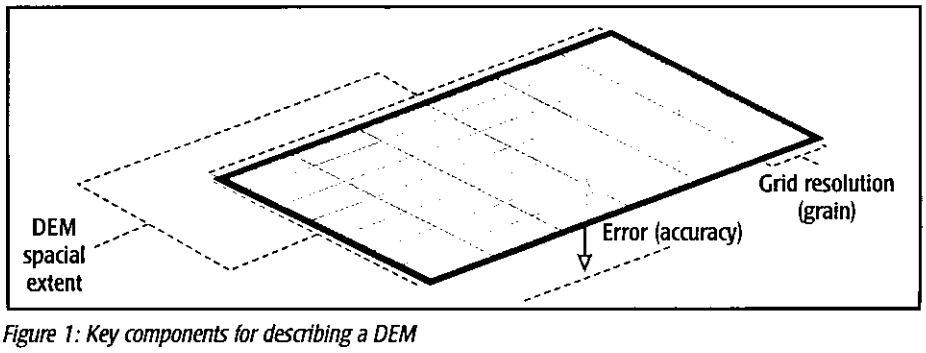

Figure 1: Key components for describing a DEM

medium continental scale DEMs (1:250,000) for storm tide risk management is discussed later in the paper. Since high vertical accuracy continental scale DEMs are not available, it is more common for DEMs to be created from local topographic data including topographic maps, spot elevations from survey control points, spot elevations from global positioning systems (GPS), levelling data from utilities including sewerage networks or road networks, spot elevations from orthophoto maps, existing digital elevation models and satellite image pairs that allow for elevation data extraction (e.g. SPOT images).

Digital contour and spot elevation data are commonly available from mapping agencies, such as AUSLIG, for most of Australia. The national coverage at larger scales (1:25,000) is far from complete. Other potential sources of elevation data include local government engineering departments; State geodesy, surveying or mapping agencies; State land management agencies; State utility management agencies; and private engineering consulting and surveying companies.

As GIS and spatial analysis becomes more common, it is likely that large scale DEMs will become available from private and public agencies. Risk managers can then avoid the costs and effort associated with primary elevation data capture by purchasing existing DEMs. A recent development that is useful for risk managers is the establishment of the Australian Spatial Data Directory, which provides a web-based interface to search for spatial data, including DEMs, in Australia.

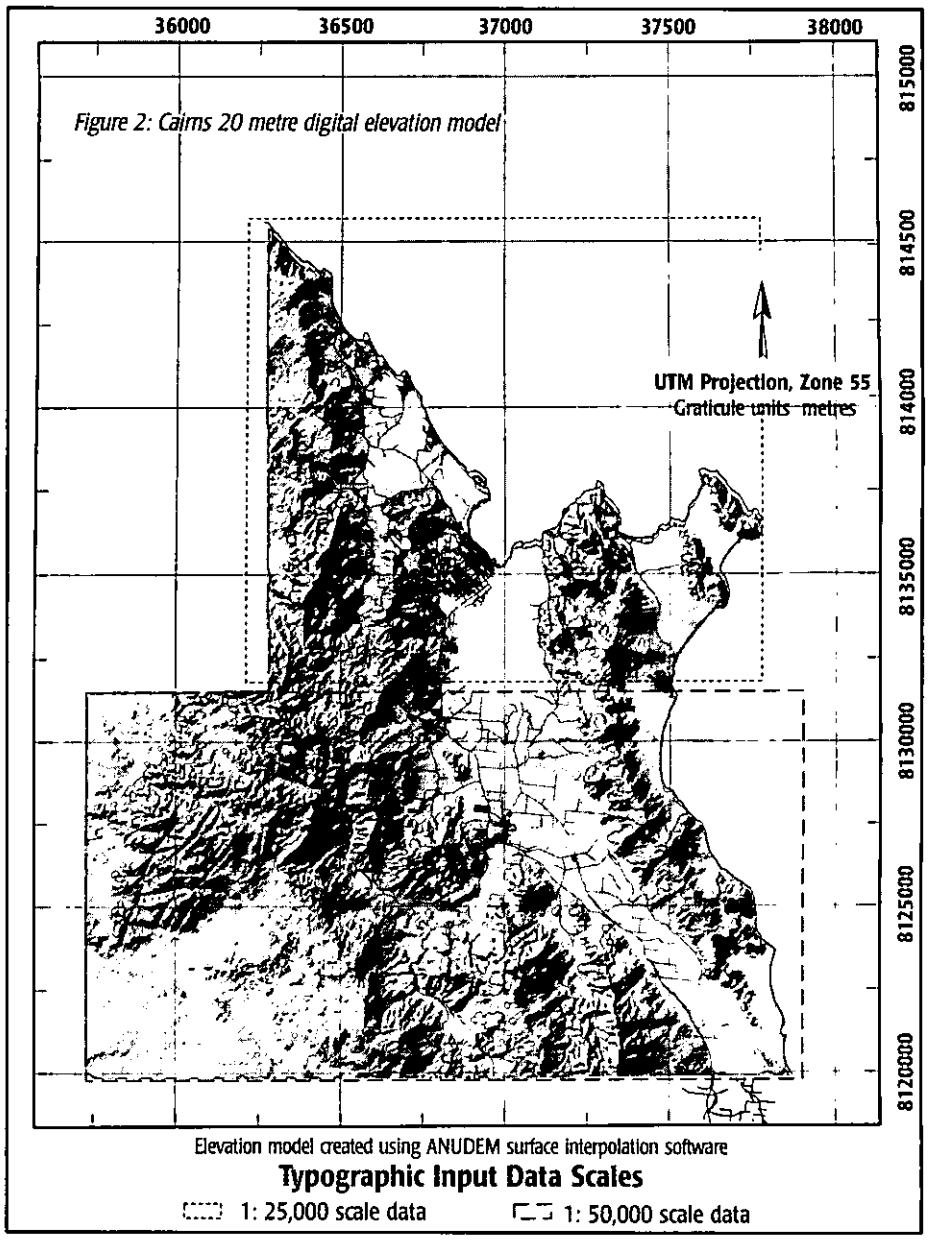

Figure 2: Cairns 20 metre digital elevation model

Creating DEMs from sparse elevation data

Since elevation data usually consist of discrete sample points such as contour lines or spot elevations, a DEM is created by interpolating these to regions without elevation data. A range of surface interpolation algorithms exist for transforming discrete elevation data (contours and spot elevations) to a continuous DEM surface. Algorithms include techniques such as weighted moving averages, bi-cubic splines, kriging, and finite elements (Carrara et al. 1997). More commonly, DEMs have been generated using Triangular Irregular Networks (TINs) from contour data within a commercial GIS such as ARC/INFO or Intergraph MGE.

Recently, commercial software designed specifically for elevation modelling, such as ANUDEM (Hutchinson 1996), has become available. The DEM creation process will be highly iterative, with a number of intermediate DEMs created before the final product is complete. For each successive DEM realisation, error assessment should verify DEM quality. Error assessment includes examining the number and location of data 'sink points', creating three dimensional plots to identify anomalous peaks or troughs, and comparison against known high accuracy control elevations. Since the process of DEM creation is fundamentally a technical issue, a detailed discussion is omitted here. Further discussion of DEM creation algorithms and procedures is available in Gao (1997). Of greater concern are the broader issues associated with DEM creation, use, and consequences for natural hazard risk management.

Input Elevation Data	Scale	Source
Contours (20 metre interval)	1:50,000	Dept. of Natural Resources
Contours (5m interval, 2.5m in low relief)	1:25,000	Dept. of Natural Resources
Spot elevations	1:50,000	Dept. of Natural Resources
Spot elevations	1:25,000	Dept. of Natural Resources
Stream networks	1:50,000	Dept. of Natural Resources
Stream networks	1:25,000	Dept. of Natural Resources
560 Permanent Survey Markers (PSM)	n/a	Cairns City Council

Table 1: Input data, scales, and data sources for the Cairns DEM

Cairns case study

Input data sources: DEM modelling

To illustrate the issues associated with DEMs, the objective was to develop the highest accuracy DEM possible for Cairns from existing elevation data. The DEM will be used for storm tide and riverine flood inundation modelling, and building damage assessment. Contour and spot elevation data was obtained from the Queensland Department of Natural Resources (DNR) in GIS format at two scales: 1:25,000 and 1:50,000. Commercial elevation data should always come with a data accuracy statement. The accuracy standard for the 1:25,000 scale data states that 90 % of the elevations are correct to within 5 metres. For the 1:50,000 scale data, 90 % of the

elevations are correct to within 10 metres (i.e. half the contour interval).

These statistics are termed root mean square errors (RMSEs), and represent the average deviation from the true ground elevation. Stream networks were also included in the ANUDEM DEM interpolation since they provide a more accurate representation of hydrologic features. Both datasets were combined and the smaller scale (1:50,000) was treated as the minimum mapping scale for the entire region. Since DEM input data for Cairns was derived from common commercially available contour data, results and conclusions are applicable for other natural hazard risk management projects in Australia.

Elevation data pre-processing

Pre-processing included identifying spurious contour and spot elevations. Spurious elevations occur as a relic of the data capture process, including the digital conversion of paper maps to digital format. For instance, the misplacement of a decimal point on an elevation contour during manual digitising can introduce gross errors to the final DEM. Another example is the case of a Permanent Survey Marker (PSM) in Cairns located atop a five story building providing an elevation 20 metres greater than ground height. And finally, the presence of decimetre contours in the source contour data can cause problems. These elevations appeared as 25 metres in the final DEM resulting in incorrect elevations along the coast. Errors are visible when the DEM is plotted in the GIS. Errors are indicated as exaggerated 'peaks' and 'troughs' in the study domain.

DEM surface interpolation

ANUDEM surface interpolation software was used to create the final DEM from topographic data (*Table 1*). Further details of ANUDEM based elevation modelling are available in Hutchinson (1988, 1996). The final Cairns DEM is shown in *Figure 2*, shaded using analytical hill shading with 256 grey levels to accentuate the relief. 560 permanent survey mark (PSM) elevations were obtained from the Cairns City Council and were withheld from the DEM interpolation, to be used for DEM error assessment. *Figure 3* shows the elevation frequency histogram for the Cairns study area.

Map scale	Contour interval	Vertical accuracy	Provider
1:25 000	10 metre	5 metres	State Mapping Agencies
1:50 000	20 metre	10 metres	State Mapping Agencies
1:100 000	20 metre	10 metres	AUSLIG
1:250 000	50 metre	25 metres	AUSLIG

Table 2: Scale, contour interval, and accuracy for selected topographic maps
Vertical accuracy is valid for 90% of the area in areas of light to medium vegetation. Where dense vegetation is found the accuracy is less. These values are representative of most maps in each map series although some variation exists where limited data are available, in areas of low relief, and other special cases which are noted on each map.

DEM error – background

Although DEMs are critical to many natural hazard risk modelling applications, they contain inherent *source* and *processing* errors. Source errors are present in the input data, including the horizontal and vertical accuracy of contours or spot elevations. Processing errors are introduced at the interpolation stage where a continuous elevation surface is derived from discrete data (ANUDEM modelling for instance). DEM *accuracy* is the amount of error present in a DEM. Topographic maps commonly contain accuracy measures that vary depending on the scale of data capture (*Table 2*). Accuracy measures commonly used for spatial data include root mean square errors (RMSE) (Sasowsky et al. 1992), epsilon bands (Dunn et al. 1990), probability surfaces (Lowell 1992), and classification error matrices (Walsh et al. 1987; Veregin 1995).

RMSE statistics are the most common measures of vertical accuracy in topographic data. An RMSE statistic is a summary for the average vertical error in the entire DEM. Sub-centimetre accuracy PSM points are used to obtain RMSE statistics for the Cairns DEM. The elevation at each PSM is compared against the elevation found at the same location in the DEM, absolute differences are obtained, and frequency histograms, and cumulative frequency histograms plotted to show the *global* error for a DEM. The mean of these values is the RMSE estimate or *standard error* for the DEM. The cumulative frequency histogram provides a *confidence interval* for DEM error. The term *global* means that the error measure is for the entire DEM. This is critical because DEM error may vary throughout the study area. For example, vertical errors are usually greater in mountainous terrain. DEM accuracies such as those shown in *Table 2* are conservative estimates, and may be of limited use to risk managers. Therefore a detailed error assessment as presented below should be used.

DEM error results

Figure 4 shows the error frequency histogram, and cumulative frequency histogram, for the vertical difference between the PSM elevations and the final 20 metre grid cell resolution Cairns DEM based on 1:25,000 scale contour and spot elevations. The RMSE statistic states that elevations in the DEM are correct on average to within 1.98 metres. At the 90% confidence interval the elevations are correct to within 4.5 metres 90 % of the time. This is a 0.5 metre improvement over the published accuracy standard of 5 metres accuracy, 90 % of the time. RMSE statistics indicate that interpolated DEM elevations deviate from the 'truth', indicating that source errors exist as a relic of the scale of data capture. A closer approximation of the PSM elevations would be impossible with topographic data captured at this scale (1:25,000). Risk managers need to ask 'what implications does this have for risk modelling?'

Risk managers should consider the study domain closely. In Cairns, the elevation range of occupied buildings has important implications for DEM error assessment, and hence for inundation modelling. For example, global error estimates (RMSE statistics) and confidence interval errors based on the entire DEM may not be relevant since occupied buildings are distributed in the lower elevations. The following section examines the variation of elevation error within the Cairns study site.

Spatial variation of error

The Cairns DEM was partitioned into three elevation zones in the ranges 0 to 2.5, 2.5 to 5, and 5 to 10 metres, and RMSE statis-

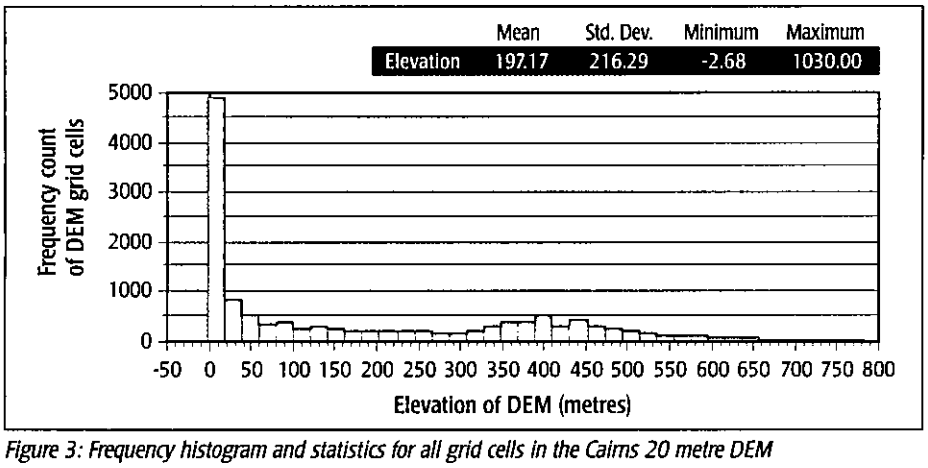

Figure 3: Frequency histogram and statistics for all grid cells in the Cairns 20 metre DEM

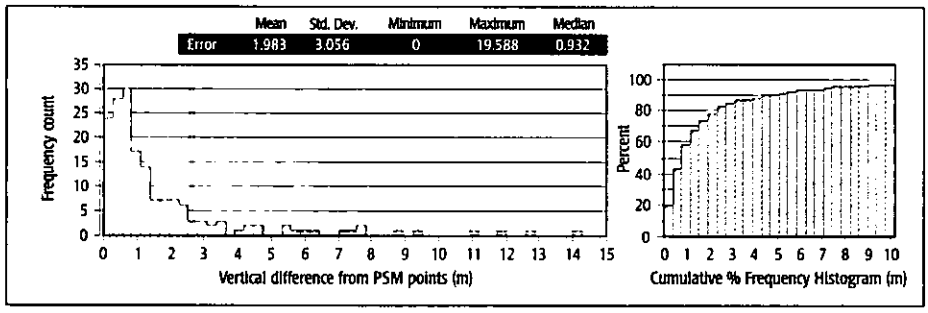

Figure 4: Error frequency histograms and cumulative frequency histogram for 20 metre Cairns DEM. Histograms show the difference between observed elevations in the DEM and elevations from PSM points.

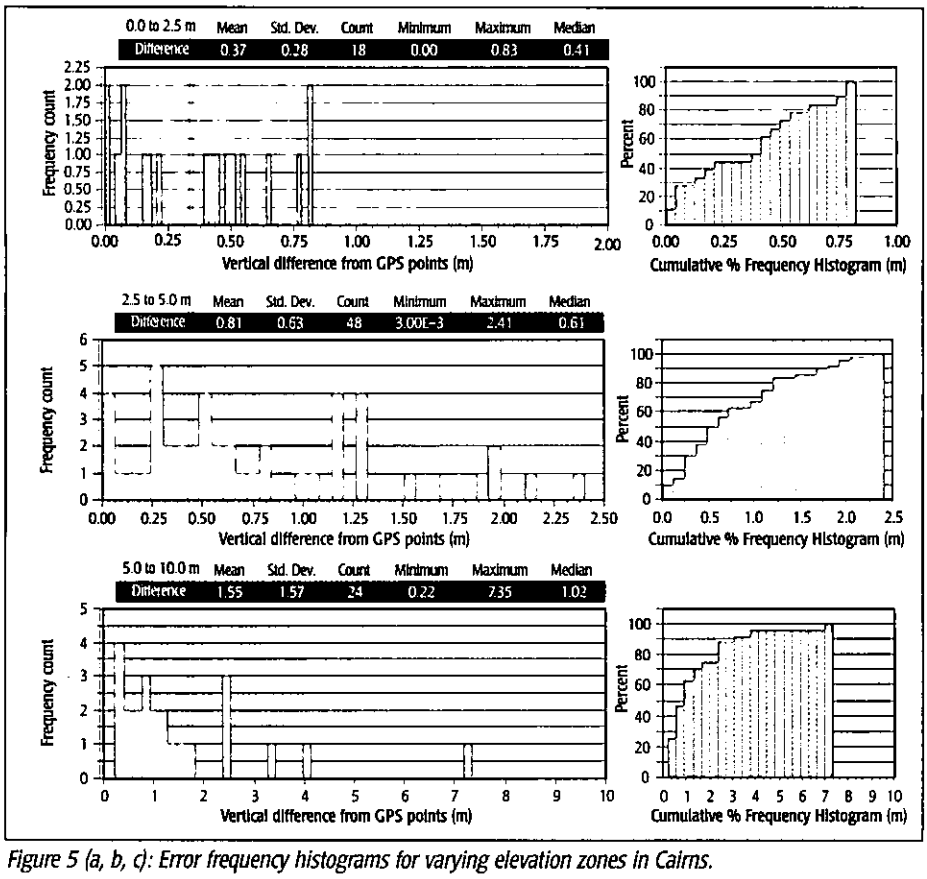

Figure 5 (a, b, c): Error frequency histograms for varying elevation zones in Cairns.

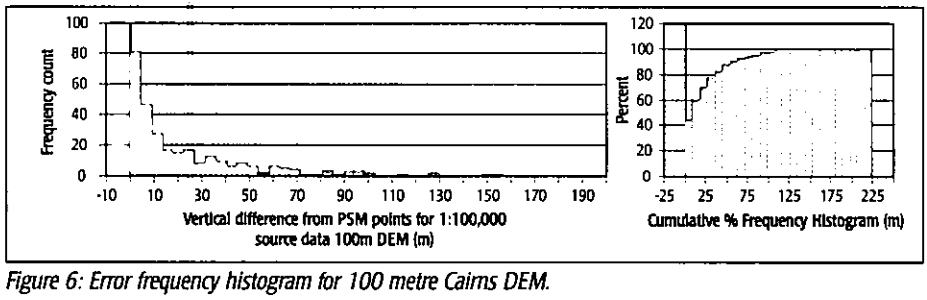

Figure 6: Error frequency histogram for 100 metre Cairns DEM.

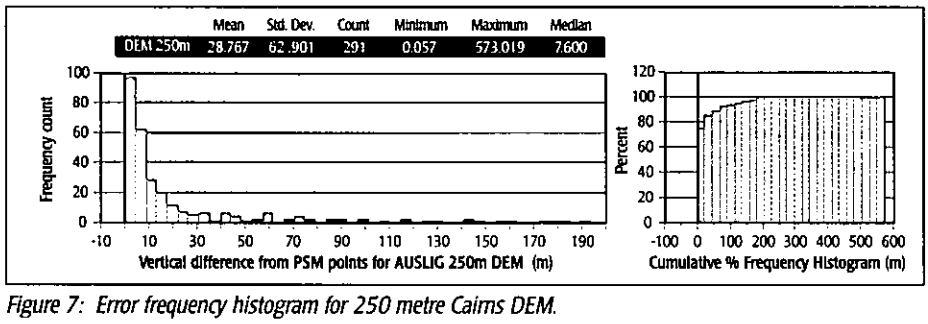

Figure 7: Error frequency histogram for 250 metre Cairns DEM.

tics calculated for each zone. This is significant for Cairns since most buildings are located on elevations less than 5 metres, and hence global RMSE statistics may be irrelevant for a hazard risk assessment such, as storm tide inundation. *Figure 5* shows error histograms for these three elevation zones. The RMSE is 0.37 metres, 0.81 metres, and 1.55 metres for each elevation zone, respectively. An approximate doubling of error is observed as the elevations become higher. Therefore, the DEM is more accurate in flat terrain and less accurate in higher relief regions which has important implications when urbanisation patterns are considered in Australia.

For flood inundation risk assessment, the spatial pattern of DEM error has important implications for evacuation planning. The concern is that DEM RMSE may vary through the study domain, making evacuation zones difficult to define. Results have shown that DEM error does vary spatially but within the areas of interest, or where people live, it remains relatively constant. Evacuation zones based on elevation can be used to prioritise regions to be evacuated. Therefore the Cairns DEM is suitable for developing flood inundation 'relative risk' zones.

Cumulative frequency histograms and summary statistics showing the variation in DEM error for varying elevation zones for the 20 metre Cairns DEM are also shown. Error results are shown for 3 elevation zones: *0–2.5, 2.5–5.0 and 5.0–10.0 metres (GPS points = PSM points).*

Alternate topographic data for elevation modelling.

The objective of elevation modelling is to create the highest accuracy DEM possible, from existing contour and spot elevation data. The previous discussion examined the error associated with elevation data in Cairns and the implications for risk modelling. For other areas in Australia, topographic data may not be commercially available, and existing smaller scale, and less vertically accurate data may provide a solution. This section examines the error associated with applying smaller scale, commercially available, topographic data for risk modelling. Two small scale, and less vertically accurate, topographic data sources are compared against existing fine scale, high accuracy DEMs. These data are representative of the scale and accuracy of commercially available topographic data in Australia. The first is a 100 metre grid resolution DEM developed using ANUDEM from spot elevations and stream networks derived from AUSLIG 1:100,000 scale topographic maps. The second is a continental wide, 250 metre grid resolution DEM which is commercially available through AUSLIG. The 250 metre Australian continental wide DEM has been developed from input date listed below.

- Bureau of Mineral Resources ground survey points (7 metre RMSE).
- Trigonometric Points (1 metre RMSE).
- 1:2,500,00 and 1:250,000 scale stream networks.
- 1:250,000 scale sink points (10 metre RMSE).

The methodology applied in Section 5.5 was used to quantify the error in these DEMs for Cairns. Figure 6 & 7 show error histograms for both small scale DEMs for Cairns. The 100 metre grid cell resolution DEM is accurate to within 75 metres, 90% of the time. The 250 metre grid cell resolution DEM is accurate to within 100 metres 90 % of the time. The RMSE for the 100 metre grid cell DEM is 24.6 metres, and a higher 28.7 metres for the 250 metre DEM. Results also show that there is difference between standard error accuracy measures (RMSEs) and accuracy's based on confidence intervals. Hence, risk managers should be aware of these differences. The final error estimate for the 20 metre Cairns DEM found that 90 % of the elevations are correct to within 4.5 metres. Large RMSEs for the small scale DEMs make them unsuitable for local scale natural hazard inundation modelling. 1:50,000 scale topographic data are the minimum scale required, but preferably 1:25,000 scale data, or larger, should be used. This rule may vary in areas of high relief, or where less input data is available.

Conclusion

The exploratory spatial data analysis has identified the error that can be expected from commercially available elevation data in Australia. If resources allow, high accuracy DEMs can be built from high vertical accuracy spot elevations and contours. The latest generation of commercial satellite imagery can be obtained as overlapping pairs which can be used for elevation modelling, although costs can be prohibitive. For natural hazard risk assessment, end-users should first determine the *fitness-of-use* of any DEM for their application. A bushfire risk mapping project may have a lesser need for high accuracy elevation data, than a flood mitigation cost-benefit analysis. Agencies charged with national risk management assessments such as climate modelling, may find continental scale DEMs adequate for risk assessment. Regardless of the risk modelling application, guidelines will be useful for any applications that utilise DEMs for natural hazard risk management. The guidelines are listed below.

- Risk managers should identify the level of accuracy required of the DEM before creating or purchasing them. A user needs assessment can detail the spatial extent of the required DEM and its other characteristics (cell size, accuracy).
- Where possible, risk managers should attempt to use existing DEMs that may be obtained from private companies, government agencies, or local councils.
- When DEMs are obtained, risk managers should receive detailed metadata. Metadata are information about data. The Australian New Zealand Land Information Council (ANZLIC) has recently drafted metadata guidelines for the use and transfer of spatial data. Metadata defines the features and lineage of spatial data, including the scale, accuracy and source of the input data, date of last update, and data custodianship. Some organisations have already implemented this standard for their spatial data management. Further information is available at http://www.anzlic.org.au/index.html. The guidelines are useful because they summarise the key issues risk managers should consider when purchasing and using spatial data.
- A DEM error statement should accompany any DEM. The error statement will provide a global estimate of vertical accuracy, commonly as an RMSE statistic. The error statement should note whether it is a standard error (RMSE) or an accuracy based on a confidence interval (i.e. 90 % of the time). This difference can result in different error statements. Error statements for DEMs are commonly omitted, and can lead end users to assumptions of elevation accuracy that are false.
- If global error estimates are inadequate —for example for a very large study site with large terrain variations—a detailed error assessment may be necessary. High accuracy PSM control points for the study site can be compared against the DEM. An error assessment can provide risk managers with an indication of the suitability of a DEM.
- DEM users are commonly concerned with DEM grid cell resolution. DEM vertical accuracy is a better indicator of DEM suitability, particularly in flat coastal areas where the terrain is relatively homogenous.

The limitations associated with DEMs are common to other spatial data in a GIS. The problems of accuracy, error and fitness-of-use, ultimately stem from the desire to adapt data which was designed originally for analogue cartography. Often, such data are adapted for modelling applications beyond the scope of their original purpose. This is a major reason for some of the limitations outlined, and risk managers need to be aware of these. Secondly, risk managers can influence the processes developing national, state, and local government spatial data specifications and standards so as to better accommodate natural hazard risk management, and risk modelling requirements.

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