07 November 2007

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Dear Mr File

PITT TOWN RESIDENTIAL DEVELOPMENT – DIRECTOR GENERAL'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

Thankyou for your letter dated 23 October 2007 requesting details of key issues and assessment requirements which may be included in the Director Generals Environmental Assessment Requirements for the Part 3A development application for Pitt Town.

The basic requirements of the SES for this proposal, consistent with the principles of the NSW Floodplain Development Manual 2005, is that the community of Pitt Town must be able to be warned and safely evacuated, using their own motor vehicles, in flood events that would result in the Pitt Town area becoming isolated by floodwater. This warning and evacuation requirement is not limited to the 1% Annual Exceedance Probability flood (1%AEP) but must deal with all credible flood events. The 1% AEP flood level is only relevant to protection of property and is not an appropriate standard for threats to life.

The warning and evacuation process can only be assessed against current levels of emergency services resources and there is clearly a finite limit to these resources. The SES in particular has no automatic capacity to increase its resource base to match the expanding scale of floodplain development in Pitt Town, or any other area for that matter.

Generically the SES's requirements can be expressed as follows:

- Assessment of the flood risk for the site should be conducted in accordance with the NSW Government's Flood Prone Land Policy as set out in the Floodplain Development Manual, 2005.

- Through the floodplain risk management process, the SES seeks an outcome in which:
  - There is no intolerable increase in risk to life and property on the site for existing development, and the remainder of the floodplain as a result of the proposal;

- Consideration has been given to the emergency management implications of the full range of flood events and not just the 1%AEP event. This should include large events such as the 1:500AEP, 1:1000AEP and extreme events such as the Probable Maximum Flood. Consideration should particularly have regard to effects on existing and future access/egress routes within and surrounding the development. This should also consider the impacts of localised overland flooding on evacuation routes;
- The development does not unreasonably increase the demand on SES and other emergency service resources;
- The evacuation of the proposed development and the existing community is achievable in terms of SES evacuation time line modelling and adequate shelter outside the flood affected area is available for all evacuees;
- The evacuation strategy for the development is consistent with that adopted by the SES in this area and does not conflict with strategies for existing developments; and
- Land uses and development types are compatible with the flood risk.

Some more detailed comment on the Pitt Town proposal is now provided.

Commencing as long ago as 2002, the SES has undertaken a significant amount of detail flood risk assessment work related to various proposals to undertake expanded residential development in the Pitt Town area. The main input to date was in 2002 when the SES produced a detailed report for Hawkesbury City Council. The report was part of the Local Environmental Study (LES) process in consideration of a revised LEP. The SES's 2002 report was also subsequently subjected to an independent review undertaken on behalf of Hawkesbury City Council by Molino Stewart Environmental Services.

By applying an evacuation modelling process developed by the SES, the Service was able to quantitatively demonstrate the constraints of this land in terms of credible flood evacuation scenarios. The modelling shows that there is a finite physical limit to the number of people that can be evacuated from Pitt Town in flood events. This means that it is possible to determine an absolute upper limit on the scale of residential development within Pitt Town. The constraint is effectively imposed due to the traffic carrying capacity of the only viable flood evacuation route. The entire assessment methodology, assessment process, and results were published in the 2002 LES report.

It is very important to point out that the SES's evacuation modelling is internationally recognised as ground breaking work. The modelling was developed during the State Government's Hawkesbury-Nepean Flood Management Strategy which commenced in 1997. At that time this work was apparently unprecedented and has been undergoing continual refinement and revision. This is why the results contained in the SES's 2002 report on Pitt Town are inconsistent with the results we would obtain today.

The 2002 SES report suggested that development yield in Pitt Town could be increased by raising the level (relative to flooding) of the evacuation route. For reasons too difficult to explain in this letter, we now know this is not correct and a subsequent SES assessment has demonstrated this fact.

As recently as January 2007 and at the request of Hawkesbury City Council, the SES again reviewed the 2002 report. The January 07 review (attached) demonstrated that it is not possible to evacuate Pitt Town if more than around 1,100 new lots are permitted. The proponent of this Part 3A proposal, the Johnson Property Group (JPG), has not accepted the results of the SES's recent work. In particular, JPG insists that the SES should be bound by the results of the original

2002 report despite our advice that those results are no longer valid. The JPG Part 3A proposal appears to be seeking approval for close to 1,400 lots and according to the work already undertaken by the Service, this scale of development is beyond the possible evacuation limit.

It is likely that a proposal could be put forward by JPG to avoid evacuation altogether by relying on a refuge area concept. The SES will not endorse any proposal to deliberately exceed the evacuation capacity with the intent of leaving residents trapped and isolated on the small area of high ground in Pitt Town that, according to theory, should be above the limit of even the largest probable flood. As the result of a recent Land and Environment Court hearing, the SES was required to investigate the risks associated with isolating people in floods. A multi-agency workshop was conducted and the resulting report (attached) clearly shows that deliberate isolation in floods is a high risk strategy.

The primary and legislated function of the SES is to prepare flood plans, community education strategies, and develop operational capability to deal with the flood risk already created by past development on floodplains in NSW. In that context the Service is obviously concerned about the fact that all new development on floodplains, no matter how well planned, creates additional flood risk. Such development also increases the demand on the SES to prepare additional flood response plans and supporting strategies and to try and find the human resources to implement these strategies. Unlike the situation for fire fighting resources, none of the increased demand is supported by any government or development-linked funding process.

This Part 3A process puts the SES in a very difficult position. We ask that the Department of Planning recognises that SES has no staff resources that have been established to deal specifically with floodplain development risk assessment. All such work is done by our planning staff at the expense of high priority work required of the Service to deal with the existing flood risk. The priorities and timeframes imposed on the Service to deal with what we know to be highly complex flood problems associated with new development assessment are in direct conflict with the need to focus on existing flood risk priorities.

Yours sincerely

S J (Steve) Opper ESM

Director, Emergency Risk Management

Attachments:

1. Pitt Town Rezoning – Review of Flood Evacuation Capacity, Jan 2007
2. A discussion paper on the issue of isolation risk in floods stemming from Land & Environment Court hearings, NSW SES 17 August 2007.

Attachment 1.

16 January 2007

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Dear Sir

Pitt Town Rezoning – Review of Flood Evacuation Capacity

The SES has been requested by Johnson Property Group (JPG) to review the flood evacuation capacity for Pitt Town with a view to seeking an increase in the scale of the proposed rezoning for new residential development. In addition JPG has sought advice from Molino Stewart Environmental Services (Molino) in respect of their proposal.

The SES has undertaken the revision and concludes that within the constraints of the Service's theoretical flood evacuation model no more than 1,100 new lots can be added to the existing residential capacity in Pitt Town.

The Molino report summarises the landuse planning history and the earlier SES evacuation assessment very well and so that information is not repeated here. The essence of the JPG position is that in its' earlier assessments the SES underestimated the extent to which many existing properties must be evacuated considerably earlier than our modelling assumed. If this assertion is correct then the number of dwellings to be evacuated later in the flood will be much less than assumed by the SES, resulting in a faster evacuation, and freeing up evacuation capacity for a larger scale of rezoning. The Molino report discusses the concept in detail and concludes that the logic of the argument is sound. Significantly, Molino was unable to test the validity of the JPG claim due to a lack of data about the spatial distribution of dwellings across the floodplain.

Revision of Data on Dwellings within SES's Pitt Town Sector

The SES has now completed a comprehensive data analysis of all available information about the number of and spatial distribution of existing dwellings and vacant lots in the Pitt Town area. The new SES data differs with previous data, including that provided by Council during the LES that preceded the adoption of the LEP allowing 631 new lots.

In earlier assessments the number existing dwellings assumed to be subject to the same flood evacuation requirement was adopted as 358 in the Pitt Town area. The difference between this figure and the new SES figure of 667 lots is almost certainly due to the problem of selecting common boundaries. Most importantly, and for the very first time in the history of this Pitt Town work, the SES has been able to align the data specifically to the SES's flood operations boundaries. This has eliminated the problem of discrepancies between different sources of data.

The total numbers now indicated by our work are summarised in the following table. The terms Level 1 and Level 2 refer to the evacuation operation levels in the SES flood plans. Level 1 operations are conducted by the local SES and involve partial evacuation whereas Level 2 operations assume evacuation of entire communities.

There is one Pitt Town Sector and six Sub-sectors that are identified on the attached map.

Table showing Pitt Town Sector & Sub-Sector Evacuation Data (Existing population)

Sub-Sector	Exist Dwellings	Occupiable Vacant Lots	Total	Evacuation Cut-Off	Level 1 Must Start	Level 2 Must Start
Pitt Town Central	430	46	476	16m	11m (4 Dw <11m)	11.5m
Pitt Town S/East	60	28	88	13.4m for some properties	10m(2 Dw <11m)	11.5m
Pitt Town North	5	0	5	7.3m	ASAP	N/A
Pitt Town East	25	4	29	Rising Grade	8m (Dw 8-25m)	Progressive
Pitt Town South	22	0	22	11m	7m (Dw 7-20m)	N/A
Pitt Town Bottoms	47	0	47	6.3m	ASAP (Dw 5-11m)	N/A
Sector Total	**589**	**78**	**667**	N/A	N/A	

Evacuation Time Line Analysis – Prediction Confidence Limit, Safety Factor, and Factor of Safety

The three terms; prediction confidence limit, safety factor, and factor of safety have specific and different definitions. These terms need to be understood to properly interpret the results of SES's evacuation time line modelling.

- Prediction Confidence Limit – This is the likelihood that a predicted flood height will be reached and reached at the time predicted.
- Safety Factor – this is a design concept and refers to a multiplier applied to a nominal base value (rated capacity) to ensure sufficient design capacity to cater for future uncertainty.

  E.g. Base value is 100 x safety factor of 3 = 300 design capacity

  The SES's evacuation time line model DOES NOT include a specific overall evacuation safety factor. The time needed to evacuate is not calculated and then multiplied by a specific safety factor to determine the ideal or design evacuation time requirement.

- Factor Of Safety – this is a concept related to the use of a designed system or product. The margin between the actual demand/load placed on a system/product and the rated capacity of the system/product is the safety margin or factor of safety.

  E.g. Rated capacity is 100, load is 60, safety margin is 40, factor of safety is 40/100 = 40%

These concepts are now discussed in the context of flood evacuation assessment.

Prediction Confidence Limit

The prediction confidence limit (PCL) is determined by the ability of the BoM to predict flood heights. Only by using measurements of rain that has already fallen in the catchment can the BoM be reasonably confident about a predicted height and time. The point in time at which such a prediction can be made, relative to a future height, is referred to in the SES's evacuation model as the Quantitative Precipitation Forecast Limit (QPF Limit). For Pitt Town the BoM advice is that the QPF Limit could realistically be as little as 9 hours. In other words, if the need to evacuate is indicated by a height of 16 metres being reached or exceeded then the BoM may only be able forecast that condition 9 hours ahead of time with confidence.

The SES is strongly of the view that those components of evacuation that directly involve the community in taking action (i.e. being warned, packing & preparing, and driving away) must be capable of fitting within the limits of the BoM to predict a flood within the bounds of the QPF Limit. If this prediction confidence limit is not applied then the chance of warning and evacuation being conducted for a flood that ultimately does not reach the originally forecast level requiring evacuation is significantly increased.

Safety Factor

As previously stated, above, there is no overall safety factor applied to SES evacuation modelling.

Factor Of Safety

The amount of time required to conduct an evacuation may be less than the actual time likely to be available within adopted confidence limits (QPF Limit). If this margin of extra time is considered as a percentage of the time required, it would be called an Evacuation Factor Of Safety (EFOS).

For example, if the time required is 6 hours and the available QPF Limit is 9 hours, then the safety margin is 3 hours and the EFOS is 50%.

Evacuation Factor Of Safety for Existing Residents of Pitt Town (16m route)

By SES's most recent assessment, evacuation of the existing lots for Pitt Town Central sub-sector would take around 5 hours within the 9 hour QPF Limit. This means there is a safety margin of just over 4 hours within the existing 9 hour QPF Limit for an evacuation route cut-off height of 16 metres. The existing Pitt Town Central Evacuation Factor Of Safety (EFOS) is therefore 80%.

Evacuation Capacity with a reduced EFOS for Pitt Town (16m route)

The community, not the SES, could decide that no EFOS is required and that the SES's time line model calculation within the QPF Limit is sufficient. If this were the case then the SES's time line model indicates that a maximum of 1,100 additional lots could be developed within the Pitt Town Sector. This will reduce the EFOS to zero. There are six sub-sectors in the Sector but only one of these – Pitt Town Central, is considered suitable for such development in terms of site elevation and access to the only evacuation route.

With 1100 new lots, a new total of 1576 lots, there is no safety margin using the SES's model and the EFOS will be zero with the route at 16m AHD.

Impact of Existing Development in Lower Areas on Evacuation Capacity (16m route)

In the submission from JPG it was suggested that much more of the existing Pitt Town population could be evacuated earlier than is currently allowed for in the SES evacuation assessment. Although the logic of this argument is sound, the SES's assessment shows that there is no significant impact on new development potential, particularly in the light of the higher base-line count of existing residential lots.

The SES has always known that the very low areas of Pitt Town must be evacuated early. Many areas are so low they need to be evacuated for heights of only 6 to 8 metres. The SES flood plans have always had this contingency included under what is defined as Level 1 flood operations, conducted by the local SES Unit volunteers. Of the six Pitt Town sub-sectors, three of these: Pitt Town North; Pitt Town Bottoms; and Pitt Town South must be fully evacuated before the BoM can provide a prediction that would trigger Level 2 flood operations in Pitt Town (prediction of a height exceeding 16 metres). These Level 1 evacuations account for only 74 of what we now know to be the total of 667 existing lots in the Pitt Town Sector.

Of the remaining three sub-sectors: Pitt Town South East; Pitt Town East; and Pitt Town Central, parts of Pitt Town South East will need to evacuated by 13 metres. Parts of the Pitt Town South East and Pitt Town East have rising routes which means people can leave progressively as water rises. These two sub-sectors account for a further 117 of the total 667 existing lots.

The evacuation of lower sub-sectors accounts for 191 of the total 667 lots. All of the remaining 476 existing Sector lots are within the Pitt Town Central sub-sector. The existing Level 2 flood operations trigger (for a QPF Limit of 16 metres) is around 11.5 metres. There are around 17 dwellings in Pitt Town Central that need to be moved earlier than this Level 2 trigger level of 11.5 metres.

Factor Of Safety from Raising Route to RL 17.3mAHD

When adopting the proposal in 2004 to make the new LEP to allow for an additional 631 new lots, the Council also decided to require the evacuation route to be raised to a new RL of 17.3m AHD. No explanation has been given for this condition. The SES assumes that the Council believed that raising the route would re-instate some of the evacuation safety margin eroded by the increased demand from the new development.

The obvious question is – does raising the route to RL 17.3mAHD re-instate the eroded safety margin for the existing community? The short answer is, in terms of a 9 hour QPF Limit (the Prediction Confidence Limit) for Pitt Town, it does not.

The most recent assessment by the SES indicates that the existing community has an EFOS of 80% (4 hour margin). With extra 631 lots added to the existing 476 lots, a new total of 1116 lots, the time needed for evacuation with the route at 16m AHD is 7.4 hours. The safety margin would be around 1.6 hours, a reduction of around 2.4 hours below the existing 4 hour safety margin. With a safety margin of 1.6 hours the new EFOS will be 22% (down from 80%).

The reason that raising the route to 17.3mAHD does not re-instate the eroded EFOS for the existing community is as follows. If the route is raised the BoM can no longer predict the height that triggers the need for Level 2 evacuation operations at the same point in time as when the route is at 16mAHD. Based on a 9 hour QPF Limit and if the route is at RL 17.3mAHD, the Level 2 trigger is 12.8m, or around 2.6 hours later than with the route at 16mAHD.

If evacuation capacity fully utilises the 9 hour QPF Limit confidence time (1576 lots) a margin only exists if the decision to evacuate is based on RL 16mAHD, which is 2.6 hours earlier than it needs to be made for the new route RL of 17.3mAHD. A prediction outside the QPF Limit must use forecast rainfall which is know to be in-accurate. The apparent safety margin only comes at the risk that later in the flood, if the Level 2 trigger predicted using forecast rain is not reached, the evacuation call may prove to have been un-necessary.

The emergency response strategy for Pitt Town is to evacuate the entire population if the evacuation route will be cut thus isolating the community. Raising the evacuation route to an RL of 17.3mAHD does have the effect of reducing the chance of the route being cut by floods. This means that a raised route has a net benefit of reducing the number of occasions on average that the entire island would need to evacuate. This benefits all residents above the current 16mAHD level, including around 250 existing lots and all of the possible 1,100 new lots.

Evacuation Capacity from raising Route to RL 17.3m AHD

The preceding discussion raises another question which is – what if some existing lots are so low that they cannot be delayed for the new starting time resulting from the 17.3m route? The existing starting time equivalent height is 11.5m and there are only 17 lots needing evacuation for this level in Pitt Town Central sub-sector. For a route at RL 17.3mAHD the new Level 2 starting time equivalent height will be 12.8m. In Pitt Town Central there are around 44 dwelling lots needing evacuation for a height up to 13m. This is an insignificant number in terms of landuse planning and in any case, the SES strongly recommends not relying on the evacuation model to work at this resolution.

Conclusion

In earlier work for Pitt Town the SES was applying a flood evacuation model for the first time. The results suggested that increasing the height of the existing evacuation route would increase evacuation capacity and hence permit a larger residential capacity. Since writing that report in 2002 the SES has continually revised and improved its' own flood evacuation modelling. It is now understood that raising evacuation routes does not, for all of the reasons discussed above, guarantee increased evacuation capacity. Raising a route will reduce the frequency of evacuations operations using the route.

As highlighted by the Molino report, the SES's flood evacuation modelling appears not to have been undertaken anywhere else in the world in this way. It is inevitable that breaking new ground will be process of frequent discovery. The impact of this revised understanding of the effect of route raising in terms of development expectation is regretted but continuous improvement in public safety is the only motivation for this work.

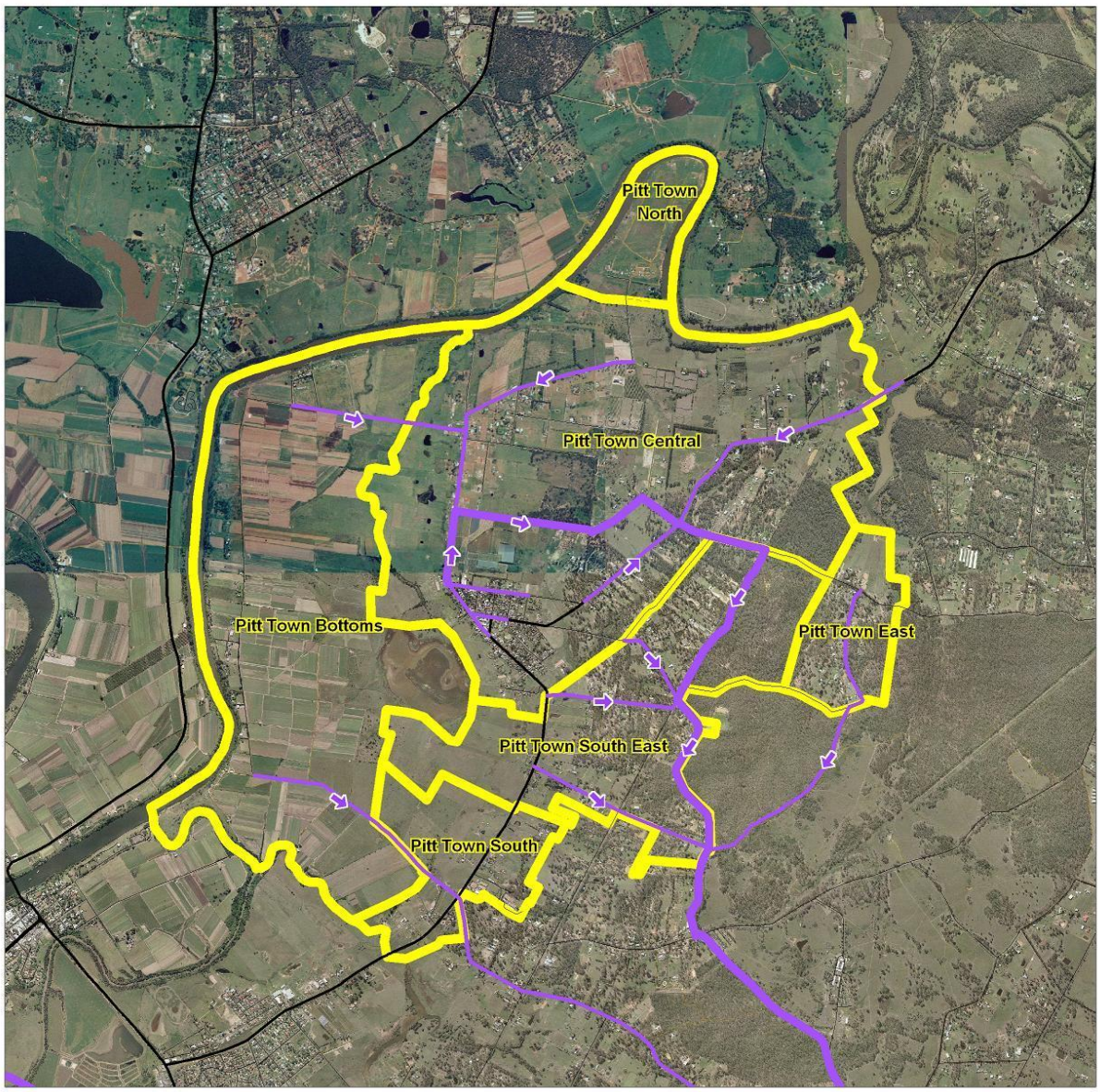
The SES has undertaken the revision and within the constraints of the Service's theoretical flood evacuation model no more than 1,100 new lots can be added to the existing residential capacity in Pitt Town. The route should be raised to 17.3mAHD if this is possible because of the net benefit of reducing flood evacuation frequency for around 250 existing lots and all possible new lots.

Yours sincerely

S J (Steve) Opper ESM
Director Emergency Risk Management

CC Johnson Property Group

Map of SES Sector and Sub-sector boundaries used for spatial analysis for Pitt Town



NSW SES 17 August 2007

A discussion paper on the issue of isolation risk in floods stemming from Land & Environment Court hearings.

Isolation during Floods

In the process of the Court reviewing the proposed flood warning and evacuation strategy for the proposed Seniors Living Development at Boronia Avenue Windang, the question as to what constitutes a tolerable (or intolerable) period of isolation by floodwater during a flood has arisen.

The applicant has devised a flood response strategy which attempts to define the circumstances in which either the evacuation of the site would be implemented or an alternative shelter in place option would be implemented. The evacuation option appears to be only considered applicable when two conditions are both satisfied.

To satisfy the first condition there must be sufficient flood prediction lead time to enable the evacuation process to be undertaken before the only road access route is potentially cut by rising floodwater from Lake Illawarra. The evacuation process is estimated by the applicant to be likely to take from around 8.5 hours (using resident vehicles) up to 12 hours (foot egress to buses). The SES does not disagree with this estimated time which has been determined using a general methodology developed by the SES.

For any flood scenario where the prediction lead time will be less than 8.5hours evacuation may not be able to be completed before the evacuation route is at risk of being flooded. On that basis the applicant proposes that the strategy option of sheltering in place during whatever period of isolation ensues is to be exercised. It must also be noted that despite a prediction indicating that sufficient time is available, evacuation could fail because localised drainage failure could prevent or interrupt evacuation.

The second condition test is related specifically to the expected duration of the period of isolation. In some scenarios, even where the prediction lead time would be 8.5hours or greater, evacuation is not proposed to be implemented because the period of isolation is considered likely to be too short to be worth the trouble of evacuating all 60 residential units.

During the hearing of 01 August, the Court attempted to assess the validity of the proposal for isolation but Mr Opper was unable to provide a definitive answer by way of a specified duration or threshold of tolerable isolation.

The Court formally directed Mr Opper to advise the applicant by 17 August 2007 whether or not the SES:

1. Considers it acceptable for residents of the proposed development to be isolated by flood waters for any period of time, and if it is acceptable, what is the maximum period of isolation; or
2. Is unable to set a period and therefore defers its decision to the applicant.

Although the SES is the designated lead agency Combat Agency for floods (DISPLAN 2006), there are a number of other significant players in the area of flood response. In recognition of this fact, the SES convened a half day workshop of the relevant parties at the SES State Headquarters in Wollongong on Monday 13 August. The agencies represented were:

NSW SES, as lead agency

State Emergency Operations Controller, represented by his delegate
NSW Police Force, Wollongong Local Area Command
NSW Ambulance Service Paramedics
NSW Fire Brigades, both Urban Fire and Rescue, and
NSW State Emergency Management Committee, District Emergency Management Officer.
In total there were twelve experts with different and specific experiences in emergency management present at the workshop.

Workshop Response

1. On the question of whether the SES considers it acceptable for residents of the proposed development to be isolated by flood waters for any period of time, and if it is acceptable, what is the maximum period of isolation?

   There is no safe period of isolation and isolation should always be avoided unless doing so introduces a risk to life higher than that of the anticipated isolation.
   Any individual who experiences a life threatening event while isolated is at significantly greater risk than a person who is not isolated and experiences the same condition.
   It was unanimously agreed that it was not possible to prescribe at what point during an event a period of expected isolation would transition from being tolerable to intolerable. Isolation is dangerous from the moment that it begins and the longer the period of isolation continues, the more opportunity there is for a life threatening incident to occur.
   It was noted that the validity of a decision as to whether to evacuate ahead of a predicted period of isolation, or to take the chance that nothing will go wrong and deliberately become isolated may only be known after the event. The person making the decision must be prepared to defend that decision.

2. On the proposition that if the SES is unable to set a period and then the decision therefore defers to the applicant.

   It was agreed that if the applicant proposes to rely upon isolation as a flood response strategy to justify the development, rather than an evacuation strategy, then the onus of proof that this is a safe strategy for a specific scenario must be on the applicant.

The argument that it would be too inconvenient to evacuate simply to avoid a few hours of isolation is not logical because risk to life and inconvenience are not comparable in a risk management assessment. As already stated in point 1 (above) taking the chance that isolation will not lead to an adverse outcome can only ever be validated after the isolation has ended without incident. In contrast, the act of evacuating in an orderly process is not considered to introduce additional risk.
This means that if the applicants' flood response strategy is risk based rather than convenience based, it should trigger evacuation in all scenarios in which the predicted flood could close the vehicular access route. Even in scenarios in which the entire site population may not be able to evacuate due to reduced time i.e. faster rising flood level, those residents assessed at the time as being most at risk should be moved from the site.
From the outset of this case the SES has maintained that the site must be able to be evacuated in floods. Evacuation must be the dominant strategy and isolation must be the alternate strategy. Probabilistically the isolation strategy must only apply to the least likely scenarios, not the more common scenarios.
The applicant's current so-called evacuation strategy indicates the exact opposite logic, with isolation appearing to be the default strategy in the majority of scenarios. Their

feasibility document in effect proves that evacuation is not achievable in the majority of circumstances. This is not a defensible risk management outcome for future residents unless the applicant can demonstrate that the isolation risk is capable of being managed without significant external input from emergency services.

Further Discussion

Following is some discussion of information collected from participants in the SES's isolation workshop.

Comment has been made by the applicant that the risks faced by the future residents of their development during isolation are no greater than that faced by the general community. This point of view is not accepted and does not stand up to an objective assessment.

It can be assumed that there is a background level of risks faced more or less equally by all members of society in respect to house fire, accident, crime, or life threatening medical emergency. The true risk profile is however both geographically and demographically variable and, for example, people who live on a floodplain are clearly exposed to an additional risk not shared by those people who do not. A proof of that fact is the current debate over flood insurance in which flood damage is not considered to be a common risk covered by general household insurance.

It is also reasonable to assume that the survival outcome for an individual who experiences the impact of a life threatening risk is directly related to their access to the external intervention of an appropriate emergency service such as a rescue service, fire brigade, ambulance, or police. An individual isolated from such services is clearly exposed to a risk much higher than that of the general community who are not isolated.

Emergency incidents occurring on the site whilst it is isolated

There is a likelihood that any one of a range of different emergencies requiring the response of the Ambulance Service, SES, Police Force, or Fire Brigades could occur on the site whilst it is isolated. These onsite emergencies may include the following types of incidents:

- Fire;
- Medical;
- Rescue; or
- Security (crime)

A basic principle of emergency management is to separate people from hazards. Given that it is rare to be able to move the hazard, the most widely accepted method of doing so is to implement evacuation. When the option for evacuation is denied and the hazard cannot be moved then a dangerous situation remains that requires the highest level of monitoring and intervention. This will be at a time when resources are in abnormally high demand. All emergency services at the SES's isolation workshop wanted to emphasise that this development and the demand that it will create during a flood cannot be viewed in isolation. Rather, the development must be seen as adding to an already high demand on limited emergency service resources.

As a result of the requirement to access the site through floodwater and the likely requirement to cope with a demand respond to other flood and storm related incidents, the response times of emergency services to respond to emergencies on the site is likely to be increased compared to normal standards.

As a consequence of having to travel through floodwater to reach people in difficulty, emergency services are exposed to greater risks than if flood-free access was available. Emergency service personnel have been exposed to flood situations which have lead to the injury or death of personnel. In recognition of this possibility, emergency services are

under an increasing demand to consider personnel safety. Each circumstance must be subject to an individual risk assessment at the time. If, after conducting a risk assessment of an incident, a controller or team leader is unsatisfied with the level of risk involved, the response will be delayed until the risk can be reduced or is no longer present. Following is a summary of key issues for Fire, Medical, and rescue.

Fire

Except in the very specific case of bushfire, the accepted response to a building fire is for people to evacuate to a safe distance away from the fire and toxic fumes. If a fire occurs within a building that is surrounded by floodwater it may not be possible to adopt that strategy. Especially for elderly people with reduced mobility that could present a very dangerous situation.

There are approximately 200 property fires per 100,000 people in NSW annually. It would be anticipated that the probability of a fire occurring on a site whilst it was isolated and surrounded by floodwaters would be greater due to power surges, electrical faults and the use of ad hoc heating and lighting measures such as candles (Personal Communication NSW Fire Bridges, 2007). Fire has caused deaths during floods, Joakman and Kelman (2005) conducted a study of 247 flood deaths which had occurred in Europe and the United States. Of the flood deaths analysed, 3.6% where attributed to the deaths of people within buildings due the occurrence of a fire.

In regards to the response to fire incidents, fires grow with time and cause progressively more damage. A critical point in their development is when a fire extends from the area of origin to effectively consume the whole room. This is called flashover. Research has shown that fire crews reaching an incident within 7 minutes of the start of a fire had a 90% chance of arriving before this critical stage had occurred (Personal Communication NSW Fire Brigade, 2007). This is the basis for the NSW Fire Brigades standard of fire cover. It follows that the likely delay in response times during floods would greatly exacerbate the chances of a fire spreading from its point of origin. In 2005/2006, fifty percent of NSW Fire Brigades response times where within 7.0 minutes and 90% where within 11.4 minutes. The number of fires contained to the room or object of origin was equal to 69.2% (NSW Fire Brigades, 2006).

The proposed development will not have to meet any specific provisions for fire suppression and will require only domestic smoke alarms. In addition, it was also questioned by the fire brigades how they could access the various parts of the complex and the necessary fire fighting infrastructure of hydrants etc. when the building and surrounding roads are affected by floodwater. The fact that the basement car park doors are likely to be closed in flood protection mode would further exacerbate the problem.

Medical

In regards to the response to medical incidents, the NSW Ambulance Service responded to 733,000 emergency life threatening incidents during 2005/2006 (Ambulance Service of NSW, 2006). This equates to 11,000 emergency responses per 100,000 people in NSW. People can regularly develop medical conditions during flooding and deaths can occur as a consequence. Joakman and Kelman (2005) concluded that 5.7% of flood deaths could be attributed to people having suffered a heart attack. It can be anticipated that the occurrence of medical incidents may increase during flooding due to stress, immersion in water, and unusual lifting or moving of possessions although the latter should not apply to the subject development.

Increasing age is related to long-term health conditions, higher rates of disability and poorer reported health status (Australian Bureau of Statistics, 2005). National 04/05 hospital admission statistics indicate that persons aged 55 years and over accounted for a

large proportion of admitted patients, accounting for 60.2% of total patient days (Australian Institute of Health and Welfare, 2006). The elderly are also considered to be especially vulnerable during occurrences of natural disasters since they are often frail and unable to respond without assistance. This is reflected in a study of 2213 flood deaths in Australia by Coates (1999) which observed an increase in the number of deaths per 100,000 people for persons over the age of 59.

Given the vulnerability of the elderly it is likely that their demand on emergency services during flooding will be greater than other age groups. This is what was reported by participants at the SES isolation workshop where it was noted that the elderly represented the major source of requests for help during floods, storms, and fires.

Ambulance response times are critical to ensuring the survival of a patient, for example a person who suffers a heart attack has double the chance of surviving if they get to a hospital within an hour of feeling the symptoms (National Heart, Stroke and Vascular Health Strategies Group, 2004). In regards to trauma injury it was shown during the Korean and Vietnam wars that rapid access to definitive surgical care reduces the rate of mortality from trauma (Department of Human Services, 1999). Therefore the likely delay in response times could result in a higher rate of mortality from medical incidents originating on the site. In 2005/2006 at least fifty percent of Ambulance Service of NSW emergency response time where within 9.53 minutes (Ambulance Service of NSW, 2006)

During the recent evacuation of a Wyong Nursing Home due isolation by floodwaters and the threat of further inundation, six ambulance crews supported by other emergency services where required for just this one facility.

The provision of an on-site medical room and some form of trained nurse at the proposed Boronia Avenue development was described by the Ambulance paramedic as largely irrelevant. Such a proposal should not be relied upon to eliminate or even to significantly reduce the risk to life during isolation. The Ambulance paramedic opinion is that an on site nurse could achieve little more than a competent trained first aider. On site first aid, including oxygen and basic resuscitation equipment, cannot deal with the underlying medical condition. Unless the victim is rapidly provided intensive life support by fully equipped paramedics and then transported to a hospital with the required treatment facilities, they will remain at serious risk and are likely to die.

Rescue

It is not correct to assume that the behaviour of people during flooding will be rational, with people often making decisions which place their lives and the lives of others in danger. The World Health Organisation estimates 40 percent of the health impacts of floods are directly related to wrong (irrational) behaviour (WHO, 2002).

Recent flooding in the Hunter Region provides further evidence of irrational behaviour during flooding. Of the eight flood deaths which occurred as a consequence of the June, 2007 storm in the Hunter, three can be directly related to wrong behaviour (i.e. driving a vehicle through floodwater). In Newcastle, during the peak of the flash flooding, residents where advised through broadcast emergency warnings by the SES to shelter within their homes. In the surrounding streets floodwater was of great depth and high velocity. Despite this advice many people still attempted to leave the relative safety of their homes and travel through floodwater. This resulted in the need to undertake numerous flood rescues.

The NSW Fire Brigades reported the rescue of 360 people over the course of the floods, sixty of which were reported to be rescued from life threatening circumstances. The flooding was so severe that there were also many people who ultimately required rescue from within buildings although the proportion is not known. This highlights that sheltering in place can only ever be seen a relative safety strategy after landuse planning has failed to create the proper separation between people and the flood hazard.

Post flood reviews after the June, 2005 and Grafton, 2001 floods have shown the reluctance of a large percentage of people to act in accordance with the advice from emergency services. In Lismore, 2005, 60 percent of the community after being warned to evacuate chose not to (Opper et al., 2006). In Grafton, 2001, 78 percent of the community after being warned to evacuate chose not to (Pfister, 2002). Further to these examples advice by the SES to residents of Eugowra in 2005 to evacuate, resulted in only 20 people out of a resident population of some 700, attending evacuation centres.

In summary, the isolation of any group of individuals by floodwater, but especially a group of aged and/or disabled people, must be seen as a high risk problem. Unless the risks describe above can be shown to be manageable by the on site management, evacuation must be the preferred risk management option.

References

Ambulance Service of NSW (2006). Ambulance Service of NSW Annual Report 2005/2006. Ambulance Service of NSW, Sydney

Australian Bureau of Statistics (2005). Health of Older People in Australia: A snapshot 2004-05. Australian Bureau of Statistics, Canberra.

Australian Institute of Health and Welfare (AIHW) 2006. Australian hospital statistics 2004–05. AIHW cat. no. HSE 41. Canberra: AIHW Health Services Series no. 26.

Coates, L (1999) Flood Fatalities in Australia 1788-1996. Australian Geographer 30(3), pp. 391-408.

Department of Human Services (1999). Review of Trauma and Emergency Services. Victorian Government, Melbourne.

Joakma, S. and Kelman, I. (2005). An analysis of the causes and circumstances of flood disaster deaths. Disasters, 2005, 29 (1), pp.73-97

National Heart, Stroke and Vascular Health Strategies Group (2004). National Strategy for Heart, Stroke and Vascular Health in Australia. Australian Government Department of Health and Ageing, Canberra

NSW Fire Bridges (2007). Personal Communication

NSW Fire Brigades (2006). NSW Fire Brigades Annual Report 2005/2006. NSW Fire Brigades, Sydney

Opper, S., Gissing, A., Molino, S. & Edwards, G. (2006). To flee or not to flee – an evaluation of warning and evacuation effectiveness. Presented at 2006 NSW Floodplain Management Authorities Conference, Lismore.

Pfister, N. (2002). Community response to flood warnings: the case of an evacuation from Grafton, March 2001. Australian Journal of Emergency Management, Vol. 17 No. 2, Canberra.

World Health Organisation (WHO) (2002). Floods: Climate Change and Adaptation Strategies for Human Health. World Health Organisation, Copenhagen.