Pitt Town
Flood Risk
Management Review

MOLINO STEWART

INTEGRATED SUSTAINABLE SOLUTIONS

Final Report

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FINAL REPORT

for

Johnson Property Group

by

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1 BACKGROUND

In 2001 Hawkesbury City Council (HCC) resolved to prepare a Local Environmental Study (LES) for additional residential development at Pitt Town. A draft LES was prepared in 2002 and finalised in 2003 after public comments were received.

An issue raised in the LES was that of flood evacuation. A report was prepared by the State Emergency Service (SES) estimating the number of residential properties which could be safely evacuated from Pitt Town in the context of the existing flood evacuation planning for the Hawkesbury Nepean Valley and using the existing road infrastructure.

This report was placed on exhibition with the LES and attracted much comment. HCC commissioned Molino Stewart Pty Ltd to independently review the SES report. The Molino Stewart review concluded that:

- The SES evacuation modelling was appropriate; and
- Its findings that up to 1,000 additional dwellings would be able to be safely evacuated if the circumstances assumed in the model were correct

Council resolved in December 2004 to adopt a new Local Environment Plan (LEP) and in November 2005 an accompanying Development Control Plan (DCP) which would permit an additional 631 residential properties.

Johnson Property Group, one of the owners of land rezoned for residential development, requested that the Minister for Planning assess the expansion of the Pitt Town residential precinct under Part 3A of the Environmental Planning and Assessment Act, 1979. The Minister has agreed to do so and accordingly the Director General of the Department of Planning issued Director General's requirements on 15th November, 2007 for a concept plan for the creation of additional residential and rural residential lots on land owned by Johnson Property Group and others.

Those requirements included the need to assess the proposal in relation to the NSW Government's Flood Prone Land Policy as set out in the Flood Plain Development Manual.

This report sets out the assessment of the proposal with regard to the Director General's requirements in respect of flooding.

2 DIRECTOR GENERAL'S REQUIREMENTS

The Director General's requirements includes, amongst other things, that:

"The Environmental Assessment must address the following key issues:

…

9. Flooding

(1) 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.

(2) Through the floodplain risk management process, an outcomes is to be sought in which:

- *There is no intolerable increase in risk to life and property on the site for the 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;*
- *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 areas 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.*

Each of the above is assessed in this report

3 EXISTING AND PROPOSED DEVELOPMENT

3.1 Existing Residential Development

According to the 2001 Census there were 250 dwellings in the Pitt Town Urban Centre collector district and another 197 in the larger collector district which surrounds it (ABS 2006a, 2006b). Of these 447 dwellings, only 425 were occupied.

According to the 2006 Census, there were 252 and 212 dwellings in the urban centre and surrounding area respectively of which 436 were occupied (ABS 2007). There was actually one less occupied dwelling in Pitt Town in 2006 with the increase all being within the surrounding collector district. There has been a 7.5% increase in the number of dwellings in the surrounding collector district over five years.

The SES has a Flood Emergency State Plan for the Hawkesbury Nepean River and in that there is a Pitt Town sector which is identified for evacuation (SES, 2006). This includes the Pitt Town Urban Centre but not all of the surrounding collector district. In its report to Hawkesbury City Council (HCC) on the evacuation of Pitt Town, the SES assumed that there would be 358 residential dwellings which would require evacuation from the Pitt Town Sector based on advice from HCC (SES, 2003).

Were the two additional dwellings in Pitt Town to be added to this number, and the 7.5% growth in dwellings applied to the surrounding area then there would now be 368 dwellings requiring evacuation.

3.2 Proposed Residential Development

HCC has approved the rezoning of parts of Pitt Town to allow an additional 631 residential lots. Some of this land is owned by Johnson Property Group.

Johnson Property Group is seeking approval of 659 lots on its land alone which, when combined with the approved lots on other land which has been rezoned would result in an increase of 915 lots over the existing residential develop in Pitt Town.

This report assesses the flood risks in relation to the total 915 additional lots.

4 FLOOD RISK ASSESSMENT

4.1 NSW Flood Prone Land Policy

The primary objective of the New South Wales Flood Prone Land Policy, as set out in the NSW Floodplain Development Manual (DIPNR, 2005) recognises the following two important facts:

- Flood prone land is a valuable resource that should not be sterilised by unnecessarily precluding its development; and
- if all development applications and proposals for rezoning of flood prone land are assessed according to rigid and prescriptive criteria, some appropriate proposals may be unreasonably disallowed or restricted, and equally, quite inappropriate proposals may be approved.

Without elaborating upon the details of the Policy and Manual here, suffice to say that the manual recommends that as a minimum the habitable floors of dwellings should be above the level of the 1 in 100 Average Exceedance Probability (AEP) flood with an allowance for freeboard (typically 300-500mm) . It also requires that consideration be given to the consequences of flooding up to the Probable Maximum Flood (PMF) particularly in relation to life safety.

4.2 Flood Hazards for Pitt Town

Pitt Town is affected by flooding from the Hawkesbury Nepean River. The levels of a range of floods are summarised in Table 1.

Table 1: Flood Levels and Probabilities at Pitt Town

Flood AEP*	**Level (m AHD)**
1 in 20	13.7
1 in 50	15.6
1 in 60	16.0
1 in 100	17.3
1 in 200	18.6
1 in 500	20.3
Probable Maximum Flood	26.4

*AEP is the chance in any year that a flood equal to or exceeding the nominated level will occur. A 1 in 100 AEP means the nominated level has a 1% chance in any year of being equalled or exceeded.

Many existing dwellings in Pitt Town are below 16m AHD and some on the outskirts of the town and in surrounding rural areas are below 14m AHD.

Many of the surrounding roads are cut by flooding at levels below 11m AHD and the highest of the roads leading out from Pitt Town would be cut when flooding exceeds 16m AHD, effectively isolating the town from road transport.

The largest flood recorded in the Hawkesbury Valley occurred in 1867 and reached about 19.5m AHD. There is also sedimentary evidence indicating that there have been one or more floods equal to or greater than the 1 in 500 flood level under current climatic conditions.

In a Probable Maximum flood all of the existing homes and most of the proposed homes will be inundated with only a small area at the northern end of town being above water.

The town is likely to be isolated for three or more days in these more extreme events.

4.3 Pitt Town Flood Risks to Property

All of the proposed building envelopes will be above the 1 in 100 year flood level which is generally regarded as an acceptable minimum level for residential development in the NSW Floodplain Development Manual. Nearly all of the development will be above 20m AHD and much of it will be higher than 24m AHD. This means that nearly all of the proposed residences will not only be above the 1867 historical flood level but also above the largest flood in the Valley for which there is evidence. The direct flood risks to property from the proposed development will therefore be tolerable.

There is no proposal to substantially fill areas to raise the proposed land above flood levels and, even if there were, the size of the development in relation to the surrounding floodplain is such that it would not increase flood levels on surrounding land. Nor is the construction of dwellings on the land likely to noticeably impact on flood levels upstream given the scale of the development in the floodplain once the river has risen sufficiently to impact on the new dwellings.

In summary, the risks to existing and proposed properties from flooding would be tolerable when the principles of the NSW Floodplain Development Manual are considered.

4.4 Pitt Town Flood Risks to People

The risks posed by flooding to the existing and proposed population of Pitt Town is more complicated because evacuation routes from the town can be cut in very frequent floods but most of the town can be overwhelmed by much larger floods.

The SES has determined that it is not acceptable to expect the people of Pitt Town to remain in town if it is forecast that flooding will reach heights which will flood most of the dwellings. The SES therefore has a plan for the timely evacuation of Pitt Town ahead of an extreme flood. It expects that any new development would not significantly compromise this plan for the existing population and evacuation of the additional population should be able to be integrated into the existing evacuation plan.

The following section assesses the implications of the proposed development on evacuation.

5 EVACUATION ASSESSMENT

The SES's plans for flood evacuation of Pitt Town are set out in its *Draft Hawkesbury/Nepean Flood Emergency State Plan* (SES 2006). This review was undertaken assuming that evacuations would be undertaken in accordance with that Plan.

The analyses of timings, resources and development in this report were carried out using the timeline analysis model which the SES has developed for evacuation planning in the Hawkesbury Nepean Valley (SES, 2003; Opper, 2004).

A summary of the Plan and Model and their application to Pitt Town follows.

5.1 Flood Evacuation Planning

The SES has defined two categories of flooding in the Hawkesbury Nepean Valley:

- Level 1 Floods – these are smaller floods in which the evacuation planning and co-ordination can be managed at a local level by SES controllers using local flood plans. Generally these require evacuation to local high ground.
- Level 2 Floods – are much larger floods where the scale and extent of flooding requires evacuation of entire communities across the floodplain. The scale of operations is such that they need to be planned and co-ordinated by State Headquarters through regional controllers.

Floods exceeding 15m AHD at Windsor Bridge have been classified by the SES as Level 2 floods. If it is forecast that a flood is going to exceed that height the Hawkesbury/Nepean Flood Emergency State Plan takes over from the local plans.

In Pitt Town the local plan requires farm equipment and stock to be moved to high ground above the forecast flood level. Where it is anticipated that homes will be isolated or inundated, residents are directed to make preparations to reduce flood damages and evacuate to higher ground. In practice this has generally meant that people move their stock, farm equipment, vehicles and themselves into Pitt Town (Steve Opper, NSW SES pers. comm. December 2006).

Although the State Plan comes into effect when it is forecast that flooding will exceed 15m AHD at Windsor Bridge, there is no imperative in Pitt Town to change the flood response until it is forecast that the town's evacuation route will be severed by floodwaters.

When there is a high degree of certainty that that is the case, the State Plan calls for the evacuation of the entire Pitt Town population to the M7 Motorway. This will include all of those evacuees who have evacuated to Pitt Town from lower lying areas during Level 1 Flood operations as well as during the early stages of Level 2 operations. Pitt Town does not share its evacuation route with any other population centres until the traffic reaches Windsor Road and then the M7.

Currently the trigger for the evacuation of the entire Pitt Town population is when the Bureau forecasts, using fallen rainfall records, that flooding will exceed 16m AHD at Pitt Town as this is the lowest level of the town's current evacuation route. However, before this occurs, the SES will have been progressively evacuating the lowest lying properties in Pitt Town to higher areas in the town.

In other words, some of the existing Pitt Town residents will be evacuated into Pitt Town early because their homes or local access routes will be flooded but once it is clear that flooding will exceed 16.0m AHD the remainder of the town and those who have been

evacuated into Pitt Town will be evacuated towards the M7 because the town is likely to become isolated by floodwaters.

It is entirely possible that rainfall intensities will be such that the Bureau of Meteorology will be able to forecast a Level 2 flood without the SES having yet implemented Level 1 evacuations. In other words, in some circumstances the entire Pitt Town and surrounding population will be told to evacuate to the M7 without some having first been told to evacuate to local high ground.

5.2 Flood Evacuation Modelling

The numbers of people and the rate of rise of floodwaters in floods less that 16m AHD are such that there is likely to be adequate time and road capacity for people to be warned personally and to evacuate to the higher ground of Pitt Town.

In floods which are anticipated to exceed 16m AHD there will be thousands of people to warn and evacuate and the floodwaters are likely to be rising at a much faster rate. This is why it is critical that modelling of the evacuation is carried out before hand so that adequate plans can be made for the safe evacuation of everyone.

A detailed Critique of the SES model and its assumptions can be found in *Pitt Town Local Environmental Study Flood Emergency Risk Management Review* (Molino Stewart, 2003). In summary the SES model and evacuation plans assume that:

- The flood will be rising at 0.5m per hour;
- The Bureau of Meteorology will be able to forecast flood heights at least nine hours in advance based on rainfall recordings in the catchment;
- The SES will require six hours to mobilise emergency service personnel but that this will be done using Bureau flood predictions based on forecast rainfall;
- Emergency service personnel will door knock every property which needs to evacuate;
- Doorknockers will work in teams of two and will notify an average of 12 properties per hour;
- There will be 21 doorknocking teams available for the Pitt Town sector which includes Pitt Town and surrounding rural properties (currently the plan allows for 10 but the SES has committed to increase this up to 21 should development proceed);
- People will take one hour to accept the warning message and respond;
- People will take a further hour to prepare to evacuate;
- People will evacuate in their own motor vehicles;
- There will be an average of 2.07 vehicles per dwelling evacuating from Pitt Town (this is based on 2001 Census data of total vehicles in collector districts divided by the number of occupied dwellings);
- There are 358 existing properties in the Pitt Town sector;
- The maximum rate of travel along the evacuation route will be the lesser of 600 vehicles per lane per hour or the number of evacuation vehicles generated per hour by door knocking; and
- A traffic safety factor needs to be allowed for delays caused by local flooding, fallen trees or power lines, vehicle breakdowns or accidents. The size of the traffic safety factor will vary from one to three and a half hours depending on the duration of travel.

The SES plans require the time needed for doorknocking, response and evacuation to be less than the nine hours warning given by the Bureau.

5.3 Ability to Evacuate

In this review the evacuation plans and SES model assumptions have been accepted and then used to test the implications of the proposed additional residential properties on Pitt Town's evacuations.

Table 2 shows the results of the modelling for the existing development of 358 dwellings. This provides three hours more warning time than is required to evacuate as reported in Molino Stewart (2003).

The second line in the table shows the implications of providing an additional 915 dwellings and increasing the number of doorknocking teams to 21. The existing and proposed population should be able to evacuate in the time available but the surplus evacuation time would be reduced from 3.0 to 0.4 hours.

The third line shows the results of the evacuation analysis should it be assumed there has been growth in the existing number of residences which need to be evacuated based on 2006 Census data. This growth would only decrease the surplus evacuation time by a couple of minutes.

The maximum average traffic flow rate in these scenarios would be 522 vehicles per hour which is well within the 600 vehicle per hour assumed capacity of the road under adverse travelling conditions.

The Pitt Town evacuation traffic would not have to merge with other Hawkesbury Nepean evacuation traffic until it reached Windsor Road which taking evacuation traffic from South Windsor, Windsor, Bligh Park and McGraths Hill. Windsor Road is a four lane road which should have sufficient capacity to take all of this traffic should it all be trying to use the road at the same time. Even if it cannot, there is ample space along the Pitt Town evacuation route for traffic to queue above the PMF level.

5.4 Temporary Accommodation

The SES plan is to only provide short-term temporary accommodation at evacuation centres which are to be managed by the Department of Community Services in accordance with its Recovery Support Plan. Generally, the evacuated population is expected to find its own temporary accommodation with friends and family or in paid accommodation. Although, there could be more than 60,000 people from the Hawkesbury Nepean needing temporary accommodation and other localities in the Sydney Metropolitan area also flooded, the size of the city is such that an additional 3,000 people from Pitt Town should be able to be accommodated.

5.5 Failure to Evacuate

The SES modelling is based on the premise that people will respond to a flood warning evacuation in a timely fashion and the timings of forecasts, flood rises and travel will be in accordance with, or better than, the model. Of course it is possible that evacuation will take longer than modelled or that the available warning time will be less despite the conservative assumptions about these in the model.

What is more likely, is that some residents will choose not to evacuate when advised to do so and will lose the opportunity to leave Pitt Town before their homes are flooded. These people will effectively be stranded on an island which will shrink in size as the

flood waters rise. Because there is an area in Pitt Town above the PMF level and it is within an easy walk of all of the proposed residential development, failure to evacuate does not pose a high risk to life.

Table 2: Existing and Proposed Development Evacuation Timings with Current Route Level

Scenario	Original Dwellings	Additional Dwellings	Total Dwellings	Total Vehicles	Door Knock Teams	Time to Door Knock (hrs)	Warning Acceptance Factor (WAF) (hrs)	Warning Lag Factor (WLF) (hrs)	Vehicles per Hour (hrs)	Travel Time (hrs)	Traffic Safety Factor (TSF) (hrs)	Total Evacuation Time (hrs)	Evacuation Trigger Level (mAHD)	Minimum Route Level (mAHD)	Available Time (hrs)	Time Surplus (hrs)
SES 2003	358	0	358	741	10	3.0	1	1	248	3.0	1.0	6.0	16.0	16.0	9	3.0
Proposed	358	915	1273	2635	21	5.1	1	1	522	5.1	1.5	8.6	16.0	16.0	9	0.4
Proposed plus existing growth	368	915	1283	2656	21	5.1	1	1	522	5.1	1.5	8.6	16.0	16.0	9	0.4

6 CONCLUSIONS

This assessment has shown that the proposed 915 lot residential development in Pitt Town:

- Is consistent with the NSW Government's Flood Prone Land Policy as set out in the NSW Floodplain Development Manual, 2005;
- Will be above the 1 in 100 flood level, mostly above historical flood levels and some will even be above the PMF which means that the risks of flooding to the proposed properties would be tolerable and in accordance with the principles set out in the NSW Floodplain Development Manual;
- Is a land use and development type which is consistent with the flood risk;
- Will not take up significant flood storage capacity or create significant obstructions to flood flows and so will not significantly increase flood risks for existing properties in Pitt Town or elsewhere on the floodplain;
- Can be safely evacuated along with the existing Pitt Town community in the available time for the full range of floods when modelled using the SES evacuation timeline modelling and the current evacuation elevations;
- Will reduce the surplus evacuation time available for Pitt Town from three hours to a little under half an hour;
- Can be evacuated in a manner which integrates with the existing SES evacuation strategy for the area;
- Will not interfere with the evacuation of existing developments elsewhere;
- Can easily evacuate to a high point within Pitt Town above the PMF should residents be unable or unwilling to evacuate before the evacuation route out of Pitt Town is cut;
- Will require temporary accommodation for its residents should they be evacuated but that the additional 3,000 persons should be able to find such accommodation somewhere in Sydney;
- Will not increase risk to life elsewhere on the floodplain;
- Will require an additional 22 emergency service personnel (11 door knocking teams) to undertake doorknocking in Pitt Town which the NSW SES has previously indicated can be provided.

7 REFERENCES

Australian Bureau of Statistics, 2006a *2001 Census QuickStats Collector District 1230308*

Australian Bureau of Statistics, 2006b *2001 Census QuickStats Pitt Town*

Department of Infrastructure, Planning and Natural Resources, 2005 *NSW Floodplain Development Manual*

Hawkesbury City Council, 2003 *Pitt Town Local Environmental Study*

Hawkesbury City Council, 2005a *Hawkesbury Development Control Plan*

Hawkesbury City Council, 2005b *Business Papers Ordinary Council Meeting 27 September, 2005*

Hawkesbury City Council, 2005c *Business Papers Ordinary Council Meeting 1 November, 2005*

Hawkesbury City Council, *2005d Business Papers Ordinary Council Meeting 15 November, 2005*

Opper S, 2004 *The Application of Timelines to Evacuation Planning*

Molino Stewart, 2003 *Pitt Town Local Environmental Study Flood Emergency Risk Management Review*

State Emergency Service NSW, 2003 *Pitt Town Local Environmental Study Flood Emergency Risk Management Revised Analysis of Urban Growth Impact*

State Emergency Service NSW, 2006 *Draft Hawkesbury/Nepean Flood Emergency State Plan, January 2006*