

## 7 FLOODPLAIN MANAGEMENT CONSIDERATIONS

### 7.1 SELECTION OF THE FLOOD PLANNING LEVELS

The flood planning levels are the flood levels selected for planning purposes, and will directly determine the area of land that should be subject to flood-related building and development controls.

Selection of the flood planning levels is one of the most critical decisions in floodplain management, and is not an easy one. It should be based on an understanding of the flood behaviour, together with the balancing of social, economic and environmental consequences of flooding, including the potential for property damage and the risk to human life. Traditionally, only one flood planning level has been selected for a particular area, but current thinking is to consider more than one level for different types of developments or locations within the floodplain.

The adoption of a singular flood planning level may be unduly restrictive for some types of land uses. For example, whilst it may be appropriate for some land uses, such as a hospital, to be located above a PMF flood, it could be argued that residential, industrial or recreational land uses do not require such restrictive control.

Also, the adoption of a single flood planning level causes misconceptions by the community regarding flood risk. Most importantly, residents within the floodplain (ie. the area below the PMF) but above the flood planning level, often mistakenly believe they are not at risk from flooding.

To overcome the shortcomings of a singular flood planning level, a graded set of controls that consider the variation of damage risk with flood frequency and land use, have been proposed for the Georges River study area. These are contained in the *Planning Matrix* approach, which is discussed further in **Volume 2** of the study.

The planning matrix approach does not rely on the definition of a singular flood planning level. In essence, the approach makes use of a range of flood planning levels for various land uses within the flood prone land below the PMF, in relation to different ameliorative controls (eg. floor levels, evacuation routes, flood compatible materials, etc.).

Within the planning matrix, the selection of the controls and the various flood conditions at which the controls apply, has been based on:

- ▶ procedures and philosophy espoused in the Government's 2001 Floodplain Management Manual;
- ▶ investigations carried out within the current study;
- ▶ community attitudes expressed during the current study;
- ▶ minimising Council's exposure to legal actions in relation to flooding;
- ▶ each Council's previous development policies; and
- ▶ experience gained from the development of planning controls and flood policies for various communities across NSW in recent years.

The 100 year flood level (plus freeboard) has been retained as the principal floor level control for residential land uses in the study area. This is an important component of the proposed planning controls. The decision was based on a consideration of:

- ▶ the unacceptable increase in flood risks and damages, should a lower level be adopted;
- ▶ an unacceptable impost on future development, if a higher level was adopted;
- ▶ inconsistencies with recent development approvals if a level different from the 100 year flood was adopted;
- ▶ recognition that the community views the residential floor level control as the principal component of the Council floodplain controls, and that changes to this control should not be made unless very strong arguments exist.

Liverpool, Fairfield and Bankstown Councils have been applying design flood levels from the Georges River Flood Study Report [PWD, 1991] for many years now. A review of flood behaviour undertaken as part of the current investigations, in particular the impact of changes that have occurred within the catchment since the previous flood study, has confirmed that the levels provided in that flood study are still appropriate and should continue to be applied.

## **7.2 TYPES OF FLOODPLAIN MANAGEMENT MEASURES**

Floodplain management measures can be divided into three general groups:

- (i) those that modify flood behaviour;
- (ii) those that modify property in order to minimise flood damage; and
- (iii) those that modify people's response to flooding.

Measures that modify flood behaviour usually include structural or engineering works that attempt to lower flood levels, or to divert floodwaters away from areas that would otherwise flood. Examples include dams, retarding basins, levee banks, bridge and culvert amplifications, dredging, and modifications to the watercourse to improve its ability to convey floodwaters. Many of these measures were favourably supported by the community, particularly dredging the river, the construction of upstream dams, and levee banks. Some of these measures have already been implemented within the Georges River study area, including the Kelso levee, finger levees and deflector levees at East Hills and Carinya Road, and channel amplification on Milperra Drain. However, the scope for additional structural measures is likely to be limited, due to cost and/or environmental issues.

Measures that modify property in order to minimise flood damage include voluntary purchase, house raising and controls on new development. Several voluntary purchase schemes and house raising schemes are already being implemented within the study area, and these are probably the largest schemes in Australia. The adoption of additional voluntary purchase and house raising schemes received mixed community support, whilst controls on new development were strongly supported. These controls can be implemented for minimal cost and will ensure that the potential for flood damage does not increase. Consistent controls on future

development are therefore seen to be a major component of the Georges River Floodplain Risk Management Plan.

Measures that modify people's response to flooding usually includes measures that provide additional warning of flooding, improved public awareness of the flood risk and improvements to emergency management measures during floods. All these measures were strongly supported by the community, and can be implemented at little cost. These catchment-wide measures have been largely overlooked in previous studies, which have tended to concentrate on solutions for specific areas. The measures can also be very effective in reducing flood risk and flood damage, and are considered to form a major component of the Georges River Floodplain Risk Management Plan.

### 7.3 SUMMARY OF FLOODPLAIN MANAGEMENT MEASURES CONSIDERED

There are a number of floodplain management measures that have previously been adopted in specific areas of the Georges River floodplain. Some of these measures have already been implemented, whilst other measures are currently in the process of being implemented. A review of these measures is appropriate as part of the current study. There will also be other measures that have not been considered or thoroughly assessed, particularly the catchment-wide measures.

Floodplain management measures that have been considered in this study are summarised in **Table 7.1**. These measures are further discussed in **Sections 8 & 9**. The recommended floodplain risk management plan is provided in **Section 10**.

**TABLE 7.1**  
**Potential Floodplain Management Measures**

Description	Report Section
<i>1. Review of Existing Measures</i>	
Liverpool Voluntary Purchase Scheme	8.1
Bankstown Voluntary Purchase Scheme	8.2
Milperra Drain Channel Augmentation	8.3
Kelso Levee	8.4
East Hills Finger Levees	8.5
Carinya Road Finger Levees	8.6
<i>2. Other Potential Floodplain Management Measures</i>	
Flood Mitigation Dam in the Upper Catchment	9.1
River Dredging	9.2
Levee at Milperra	9.3
Stormwater Considerations	9.4
Additional Investigations	9.5
Compensatory Development Measures	9.6
Planning and Development Controls	9.7
Flood Warning Enhancements	9.8
Emergency Management Operations	9.9
Public Awareness	9.10

## 8 EXISTING FLOODPLAIN MANAGEMENT MEASURES

### 8.1 LIVERPOOL VOLUNTARY PURCHASE SCHEME

*Findings: Investigation of self funding initiatives for remaining 71 properties*

Under a voluntary purchase scheme, Council offers to purchase properties that have been identified as severely flood affected if and when they became available for purchase, subject to the availability of funds at the time. Voluntary purchase is not compulsory acquisition and affected property owners can expect to receive market values, or higher than market values, for their properties (ie. valuations assume no voluntary acquisition scheme is in place and disregards development constraints that may apply on that land due to its flood prone nature).

A major voluntary purchase scheme was adopted by Liverpool City Council in 1984 for property located on the Milperra floodway. The Scheme originated from a study undertaken by the Public Works Department on the Moorebank-Milperra floodway in the early 1980s [PWD, 1983]. The study identified the area as one of the worst floodways in New South Wales and recommended the removal of all development from the floodway on both the Liverpool and Bankstown sides of the river.

A review of the Liverpool voluntary purchase scheme was recently undertaken [Bewsher Consulting, 2000]. This review includes:

- ▶ details concerning the origins of the scheme;
- ▶ the flood behaviour of the site;
- ▶ properties included in the scheme;
- ▶ administrative matters concerning the scheme;
- ▶ the basis of property valuations;
- ▶ the method of prioritising property purchases; and
- ▶ development controls that are appropriate for the remaining properties in the scheme.

The Liverpool Scheme originally included some 146 buildings, located in Rickard Road, Newbridge Road and Davy Robinson Drive. Later records refer to the inclusion of vacant properties within the scheme, with the total number of identified properties increasing to 174. However, four of the identified properties are believed to be reserved for County Open Space, and may not fall into the ambit of the voluntary purchase scheme [Bewsher Consulting, 2000]. Therefore, the total number of properties in the scheme is believed to total 170.

Liverpool Council, with the assistance of the State and Commonwealth Governments, has purchased 99 properties to date over the first 20 years of the scheme. This leaves 71 properties still to be purchased. The location of purchased properties and remaining properties still to be purchased are shown on **Figure 8.1**.

The cost of acquiring the 99 properties purchased to date has totalled some \$16M. However, with recent price rises in the property market, future property purchases



will be considerably higher. It is likely that the cost of acquiring the remaining 71 properties could be \$30M or higher (based on 2003 values). This increase in property values places a significant impediment to the completion of the voluntary purchase scheme. Another impediment to the Scheme is that the Commonwealth Government withdrew financial support for floodplain management programs in urban areas several years ago, placing increased financial burden on both Liverpool Council and the State Government to complete the Scheme.

The original Moorebank-Milperra Floodway Study investigated alternative floodplain management measures for this area, but concluded that removal of all development from the floodway, through a voluntary purchase scheme, provided the only complete solution to the flood problem. Also, as the scheme has progressed, it could be argued that the flood risk to the remaining properties has actually increased. This is largely due to anticipated increases in overbank velocities as more of the properties are gradually removed. There may also be increased evacuation concerns, as the remaining properties become more isolated.

Thus there appears to be little alternative but to complete the scheme, and to do this in as short a time frame as possible. However, the financial burden on Council and the State Government is high, and this objective may not be achievable under current practice. If house prices were to remain static, and the current level of funding (at about \$2M per annum) were to continue, the scheme is likely to take at least a further 15 years to complete. In reality, it is likely that there will be further property price rises, and there is no guarantee that the level of government funding will continue.

In view of the above, it is recommended that other self-funding initiatives to complete the scheme are investigated. This could include encouraging private-sector development in the area in order to provide a source of funds to acquire the remaining properties. Examples of development that might be considered include:

- ▶ sand extraction for commercial gain;
- ▶ flood compatible tourist developments, such as golf courses or marinas;
- ▶ commercial development on the fringe of the floodway; or
- ▶ a combination of the above.

Commercial development, such as a business park, could be considered on the western strip of the voluntary purchase area, adjoining Riverside Road. This would require compensatory excavation from elsewhere in the floodway to provide a strip of land that could be developed (say 150m in width by 600m in length) that is at or above the 100 year flood level. The remainder of the floodway would need to be dedicated to more flood compatible uses such as lakes, recreation areas, temporary parking, etc, all of which could be integrated with the business park, or could be part of separate facilities.

Land already acquired by Liverpool Council could be transferred to the development consortium at little or no cost, on the understanding that the consortium purchases the remaining properties in the Scheme (approximate cost \$30M). Therefore the value of the development project would need to be able to return a profit to the consortium of at least this amount.

It is beyond the scope of this study to determine development proposals within the voluntary purchase site. However, it is recommended that Liverpool Council further pursue the possibility of the potential for private-sector development of part or all of the site in order to fund the purchase of the remaining properties in the Liverpool Voluntary Purchase Scheme.

## 8.2 BANKSTOWN VOLUNTARY PURCHASE SCHEME

*Findings: Acquisition of remaining 4 properties pending agreements from owners*

The Bankstown voluntary purchase scheme originated from the same Moorebank-Milperra Floodway Study [PWD, 1983] as the Liverpool Scheme. The Floodway Study identified the area on the Bankstown side of the river, downstream of the Milperra Bridge, as an extremely hazardous area and recommended voluntary purchase as the only acceptable flood management strategy for the area.

The Scheme originally identified the purchase of 16 privately owned houses located along Auld Avenue and Henry Lawson Drive. It is understood that the scheme was subsequently expanded to also include vacant properties, as was the case for the Liverpool Scheme. It was further expanded in 1984 to also include two other properties south of the Flower Power Development on Henry Lawson Drive. The total number of properties included in the Scheme is now 25.

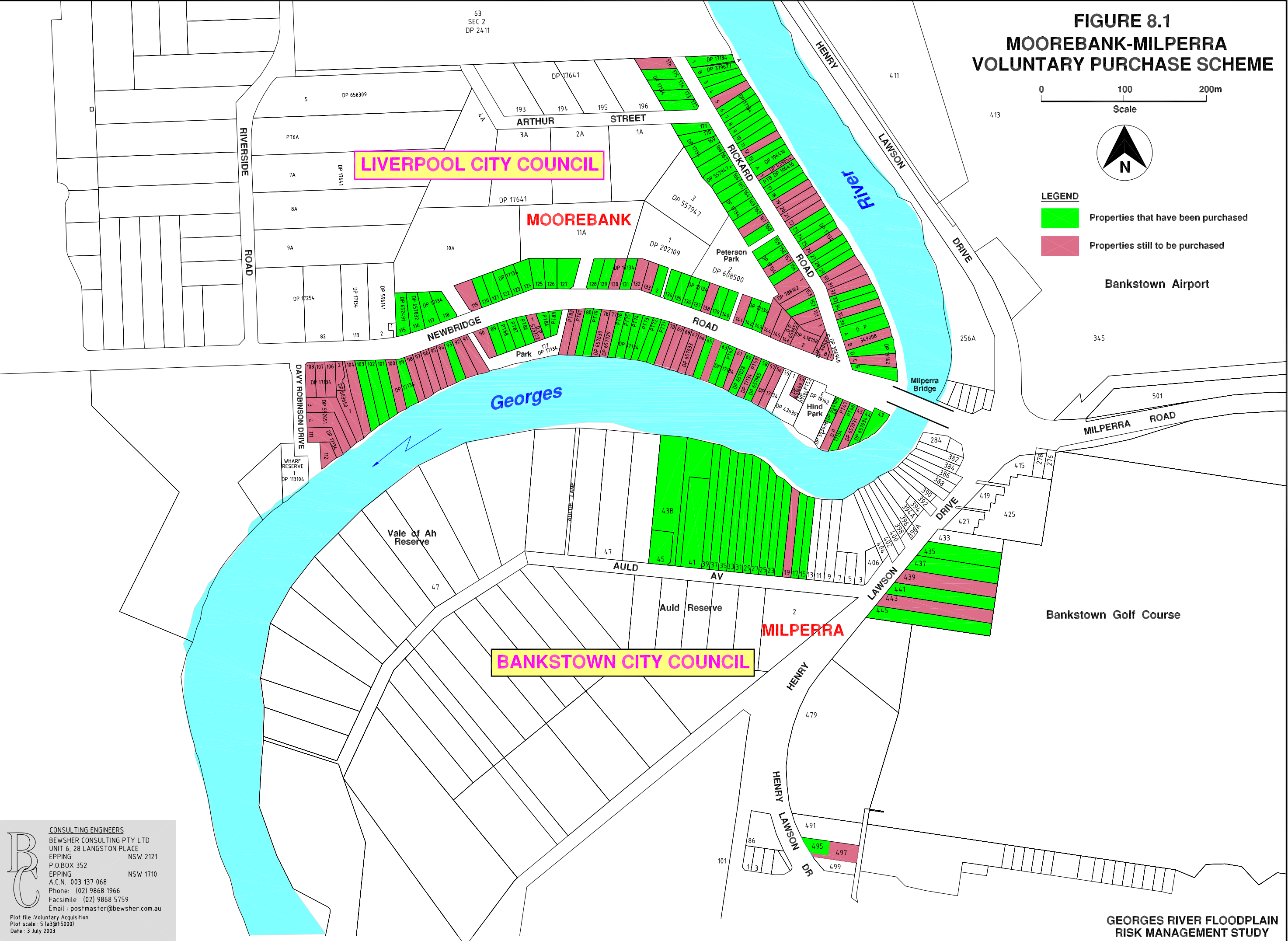
To date, Bankstown Council, with the assistance of the State and Commonwealth Government, has purchased 21 of the 25 properties. The location of properties purchased to date, and those remaining in the Scheme, is shown on **Figure 8.1**.

Each of the four remaining properties still to be acquired contains a house. The estimated completion cost of the Scheme (based on 2003 prices) is approximately \$2M.

Completion of the scheme has similar problems as the Liverpool Scheme. Increases in property costs and the withdrawal of Commonwealth funding to the scheme has placed increased burden on both Bankstown Council and the State Government. There has also been a reluctance of the four property owners to participate in the Scheme in recent years, although this may be largely due to diminishing awareness of both the voluntary purchase scheme and the flood risk of the area.

Fortunately, there are only four remaining properties still to be purchased, and the financial costs are not insurmountable. Nevertheless, Bankstown Council could pursue other self-funding initiatives to complete the Scheme. This could involve generating some form of income from those properties already purchased in order to acquire the remaining four properties (subject to agreements from the remaining property owners).

FIGURE 8.1  
MOOREBANK-MILPERRA  
VOLUNTARY PURCHASE SCHEME



### 8.3 MILPERRA DRAIN CHANNEL AUGMENTATION

*Findings: Local flood conditions to be reviewed as part of the Milperra Drain Drainage Study*

Milperra Drain is a tributary of the Georges River, which drains an industrial area adjacent to Milperra Road, in Bankstown. It is an area that is particularly susceptible to high flood damages, largely due to the type of industrial development located adjacent to the Drain.

Milperra Drain suffers both backwater flooding, when the Georges River is in flood, and local flooding from short duration floods over its local catchment area. A flood investigation for the Milperra Industrial Area was completed in 1990 [Willing & Partners, 1990]. The report noted that there was little scope to improve flood behaviour in a Georges River type flood, but improvements to Milperra Drain could alleviate inundation in local flood conditions.

Improvements to Milperra Drain commenced in 1990-1991. This involved channel widening, channel lining, and culvert amplification. The original channel improvement works have now been completed. More recently, further improvements have been identified as being desirable for the downstream reach of the Drain, which would involve widening the drain to increase its capacity in this area. It is understood that these works would impact on sensitive vegetation and other private land, and as such these works have been deferred.

The Milperra Drain channel improvement works are effective in local catchment flooding only. Bankstown Council recently commissioned drainage studies on a number of local catchments, including the Milperra Drain catchment. This study should review the effectiveness of drainage improvements to date and assess the need for further augmentation. The impact of earthworks and other drainage modifications within Bankstown Airport on local flood behaviour should also be considered as part of that investigation.

### 8.4 KELSO LEVEE

*Findings: Minor levee bank modifications and geotechnical review recommended*

The Kelso Park Levee provides protection for up to 275 residential homes in the Kelso Park and Panania areas from a Georges River flood.

A feasibility study for the levee was completed in 1984 [PWD, 1984], with construction commencing in 1986. Construction was still in progress when the August 1986 flood occurred. The first benefits of the levee were realised during the April 1988 flood.

Local drainage within the area protected by the levee is an important component of the levee scheme. Local runoff is drained to the river through four 1200mm diameter pipes under the levee bank. These pipes have manually operated floodgates that are usually left open to allow tidal exchange with Kelso Creek. The SES close the floodgates when flood warnings are issued by the Bureau of Meteorology.

There are a number of key issues associated with the Kelso Levee. These include:

- ▶ the level of internal ponding behind the levee when the flood gates are closed;
- ▶ the actual level of protection provided by the levee;
- ▶ behaviour under large floods that overtop the levee;
- ▶ reliance on the manual closure of the flood gates when potential flooding is likely; and
- ▶ development within the area protected by the levee bank.

The original feasibility study estimated an internal ponding level of RL 3.5m AHD during a 100 year flood when the flood gates are closed. This level approximately coincides with the lowest floor levels of existing residential homes within the protected area. Numerous investigations have since been undertaken to confirm or refine this estimate. The most recent Kelso Creek Floodplain Management Study [Bewsher Consulting, 2000] provided a revised 100 year flood level estimate of RL 3.75m AHD for the area “protected” by the levee. The 100 year Georges River flood level is RL 5.0m AHD. The effect of the levee is therefore to reduce flooding levels in the area upstream (east) of the levee by 1.25 metres in this flood event. The levee will overtop in larger floods, such as the PMF, and flood levels behind the levee will rapidly rise to the same level as the Georges River.

The feasibility study recommended that the levee be constructed at a level 0.5m above the 100 year Georges River flood level. This equates to a level of RL 5.5m AHD. The additional 0.5m is a freeboard allowance that caters for various uncertainties, including accuracy of computational methods; wave action; possible increases due to greenhouse effects; and construction tolerances. Many levees in New South Wales include a freeboard allowance of 1.0m.

A recent survey by Bankstown Council indicates that the crest of the levee is generally at a level of RL 6.0m AHD or slightly higher, although there are two low points where overtopping could commence at RL 5.8m AHD. The first low point is located about 40m north of the outlet structure, and extends over a distance of some 75m. The second low point is further north, where an access road has been constructed to the Australian Rules Oval and the Baseball fields, and also extends over a distance of about 75m. Thus the existing levee is providing a level of protection that is 0.8m above the 100 year flood. This increase in height above the 100 year flood is within the normal freeboard allowance (ie 0.5m to 1.0m) that would normally be applied to levee banks in New South Wales. The increase in height should therefore not be mistaken as providing an increased level of protection beyond the 100 year flood.

Given that two low points along the levee crest have been identified, at least 0.2m below the general crest height, consideration needs to be given to whether modifications to the levee to remove the low points are warranted. Whilst low points along the levee reduce the potential freeboard provided by the levee, there can be some advantages during large floods that overtop the levee. One advantage is being able to concentrate the point of overtopping to areas of the levee that are unlikely to fail when overtopped. This would prevent rapid inundation of the area behind the

levee, which would be a consequence of levee failure. Also, a controlled low point in the levee will allow some limited overtopping to occur prior to widespread overtopping, which will provide residents with some visual indication of the problem prior to the more hazardous conditions occurring.

The first low point, immediately north of the outlet structure, is not considered to be an appropriate location for overtopping to first occur. This is due to its proximity to the outlet structure and the height of the embankment at this location. Minor levee adjustments are therefore recommended at this location to increase the level of the crest by approximately 0.2m to a minimum height of RL6.0m AHD.

The second low point, where the access road crosses the levee to the sporting fields, is considered to be a more appropriate location for controlled overtopping. The crest level is generally wider at this location and the height of the embankment considerably reduced. Minor works are recommended to stabilise this low point for overtopping flows. Existing log barriers should be removed and replaced with more flood compatible and non-floating structures, such as bollards.

A final issue to be considered is the desirability of further development, or intensification of existing development, within the area that is “protected” by the levee. This should be considered carefully by Council for the following reasons:

- ▶ there may be some instances when the flood gates are not closed during a flood, either due to insufficient warning, absence of key personnel, or mechanical failure;
- ▶ the levee may fail at a level below the crest height of the levee;
- ▶ there is an increase in flood hazard during large floods that overtop the levee, due to the anticipated rapid rise in floodwaters that would occur; and
- ▶ any development or filling that reduces the available ponding storage volume will increase the internal ponding level behind the levee bank.

Apart from the minor works required to raise the low spot in the levee crest to the north of the outlet structure, a review of the structural integrity of the levee would be timely. The review and minor levee works is estimated to cost of the order of \$50,000.

## 8.5 EAST HILLS FINGER LEVEES

*Findings: Voluntary removal/relocation of 7 houses adjacent to the river*

There are up to 80 residential properties that are potentially affected by flooding in the 100 year flood on the banks of the Georges River at East Hills, between the East Hills Railway line and Bass Avenue. The combination of flood depths and high flood velocities presents potentially hazardous conditions to a number of these properties.

Various schemes to reduce the flood hazard were investigated by the Public Works Department in the mid 1980's, as part of the East Hills Floodway Model Investigation [PWD, 1987]. A number of options were considered, including:

- ▶ removal of development through a voluntary purchase scheme;

- ▶ construction of a ring levee enclosing all flood liable development;
- ▶ construction of a combination of deflector levees and finger levees across the floodplain to reduce flood velocities;
- ▶ relocation or removal of selected buildings; and
- ▶ improvements to property access conditions.

The preferred scheme, which was adopted by Bankstown Council in consultation with the community, essentially involved the construction of a number of finger levees and improvements to property access during floods. It is important to note that the scheme does not alleviate flooding to homes in the area – it only attempts to reduce the flood velocities and improve access conditions.

Implementation of the scheme commenced in 1995. The location of some of the finger levees was slightly amended during the construction phase, largely as a result of objections by some residents. In particular, agreement to the construction of the final levee wall could not be reached. Bankstown Council subsequently commissioned an investigation to review the performance of the constructed scheme [WBM, 2001] and to assess an alternative position for the final finger levee.

The review indicated that the constructed scheme had reduced high hazard conditions for up to 24 buildings, but 7 buildings within the area remained subject to a high flood hazard. Furthermore, it was determined that it was unlikely that further levee works, that would be aesthetically acceptable to residents, would reduce the level of hazard for these houses. The seven buildings that are still subject to a high flood hazard are those that are located close to the river bank (ie Nos 494, 502, 504, 536, 538, 544 and 552 Henry Lawson Drive). These same properties are among those that were previously identified for relocation or removal in the various schemes investigated by the Public Works Department in the mid 1980's.

It is understood that voluntary purchase was an unpopular option with residents in the area when this was first examined, and this will most likely still be the case today. However, there is an opportunity to relocate four of the seven buildings further up the property, away from the river, to reduce the high flood risk for these buildings. This could be undertaken as a special relocation program or alternatively it could be made a condition of any subsequent redevelopment that may be proposed within the property. There is less scope to relocate the other three buildings, which already have other buildings at the front of the property, and the removal of the buildings close to the river may need to be considered in conjunction with a voluntary acquisition scheme, if and when the property owners agree to participate.

The estimated cost of the relocation/removal of the 7 buildings is likely to be of the order of \$1.2M. However, there may be scope for this cost to be reduced should the objectives be achieved through future redevelopment.

Part of the access improvement works recently constructed at East Hills includes the construction of an embankment/wall between Henry Lawson Drive and the Slip Road. This embankment/wall would provide protection to up to 11 properties on the eastern side of Henry Lawson Drive in a 100 year flood, except for a gap that occurs at the intersection of Maclaurin Avenue and Henry Lawson Drive. The temporary

closure of this gap during major floods (by sand bagging or other means) may also be worthy of consideration by the State Emergency Service.

## 8.6 CARINYA ROAD FINGER LEVEES

*Findings: Detailed review of existing flood mitigation measures recommended*

The floodplain at Carinya Road, Picnic Point, is subject to similar flood conditions as experienced at East Hills. Similar flood mitigation schemes were investigated by the Public Works Department during the 1980's [PWD, 1983]. Options considered included:

- ▶ removal of development through a voluntary purchase scheme;
- ▶ construction of a ring levee enclosing all flood liable development; and
- ▶ construction of a combination of partial levees (known as finger levees) across the floodplain to reduce flood flow velocities.

The preferred option was the construction of an upstream deflector levee and several finger levees along property boundaries. The scheme, which was implemented some time ago, aims to reduce the flood hazard of the area by reducing flood velocities on the floodplain, much the same as the East Hills Scheme.

It was also intended to reduce the residual flood risk to existing dwellings by the application of building controls for any new development or redevelopment. The main objective of the controls is to encourage the gradual relocation of dwellings from the low-lying land on the river-side of the property to higher ground towards the back of the property. Opportunities to improve flood access conditions were also an objective.

Whilst the scheme was completed a number of years ago, it would be timely to undertake a detailed review of the constructed scheme, similar to the review that was recently undertaken for East Hills. This would include the establishment of a 2-dimensional hydraulic model to assess the reduction in flood hazard arising from the constructed scheme, and the identification of any residual high hazard areas where further measures should be considered. It would also be appropriate to include a review of flood-related planning provisions, such as the requirements for elevated walkways, in this assessment.

The estimated cost of the review is \$30,000.



## 9. OTHER POTENTIAL FLOODPLAIN MANAGEMENT MEASURES

### 9.1 FLOOD MITIGATION DAM IN THE UPPER CATCHMENT

*Findings: Not recommended due to high costs and environmental concerns*

Construction of a flood mitigation dam or detention basin in the upper catchment area was strongly supported in the community questionnaire. Some 62% of respondents favoured this option, whilst 18% of respondents were against the option. It also rated highly in the list of “top 5” measures suggested by the community.

These dams or basins act to temporarily store floodwater from the upper catchment areas during floods, releasing the water at a controlled rate. As a result, peak flows downstream of the basin sites are reduced and flood levels are lowered. The Georges River catchment area is such that a conventional size detention basin, which would be considered in other smaller catchments, would be ineffective in reducing downstream flood levels in the lower Georges River. A much larger structure, such as a flood mitigation dam, would be required to have an appreciable impact on flood behaviour.

Flood mitigation dams have previously been investigated in the upper Georges River catchment, both for flood mitigation benefits and for recreational purposes. Dams can also provide a water supply component, but this does not appear to have been a consideration on the Georges River. The Georges River Upper Valley Flood Mitigation Storage – Damsite Investigation [PWD, 1985] looked at five different sites where a suitable dam could be constructed. Preliminary plans and cost estimates were prepared for dams at each of these locations.

Whilst a preferred dam location was identified, no firm recommendation was provided as to whether the dam should or should not be constructed. This could, in part, be due to an absence of flood data at that time from which the flood mitigation benefits could be properly assessed. The flood model and flood damages database that has been assembled as part of the current study provide an opportunity to further evaluate the merits of a flood mitigation dam in the upper catchment, particularly in view of the community support for such a measure.

Further assessment of the previously preferred flood mitigation dam has therefore been undertaken. The preferred dam site, which was referred to as Dam Site 2A, is shown on **Figure 9.1**. The dam site is located in a deep gorge in the Georges River, adjacent to Kentlyn, near Campbelltown. Various dam types were considered, including a mass concrete gravity structure, a roller compacted concrete gravity dam, and a decked rockfill dam. The more conventional mass concrete gravity dam was estimated to cost \$52M (1983).

Two different dam options were considered in the current assessment. The first option largely included the dam as originally proposed. This included a permanent water depth within the dam, for recreational purposes, 20m above the normal creek bed. The main outlet from the dam was a 2.5m diameter conduit tunnel, with a higher level spillway provided for floods exceeding the 100 year flood. The second

dam option was a smaller structure with no permanent water, in an attempt to reduce the size and cost of the dam. The 2.5m diameter conduit was also replaced by a 2m wide rectangular slot through the dam wall, in order to increase normal outflows and further reduce the necessary size of the dam. This second option results in a smaller, less costly dam, but the flood mitigation benefits will not be as great. Further details concerning the dam structure and the impact on flood behaviour, is summarised in **Table 9.1**.

**TABLE 9.1**  
**Summary of Dam Characteristics and Flood Benefits**

Description	Option 1 (Large Dam)	Option 2 (Smaller Dam)
<b>Details of Dam</b>		
Invert of dam (existing bed level)	44.0m AHD	44.0m AHD
Permanent water level	64.0m AHD	N/A
Permanent water volume	3,500 ML	N/A
Normal outlet structure	1.5m diameter tunnel	2.0m rectangular slot
Height of main spillway	96.0m AHD	78.0m
Flood storage volume (to spillway)	42,500 ML	13,100 ML
Total embankment height	58m	41m
<b>Impact on Flood Behaviour (100 year flood)</b>		
Peak Inflow	1,060 m <sup>3</sup> /s	1,060 m <sup>3</sup> /s
Peak outflow	83 m <sup>3</sup> /s	677 m <sup>3</sup> /s
Flood level reduction at Liverpool	1.8m	0.8m
Flood level reduction at Milperra Bridge	0.9m	0.6m
Flood level reduction at East Hills	0.6m	0.4m
Reduction in houses flooded	456	287
Reduction in commercial buildings flooded	150	124
<b>Economic Evaluation</b>		
Approximate cost*	\$100M	\$60M
Savings in 100 year flood	\$74M	\$57M
Savings in average annual damage	\$3.2M	\$2.5M
Net Present Value of flood benefits	\$37M	\$28M
Benefit/cost ratio	0.4	0.5

\* Costs based on previous estimates [PWD, 1985] and increased to reflect 2003 values.

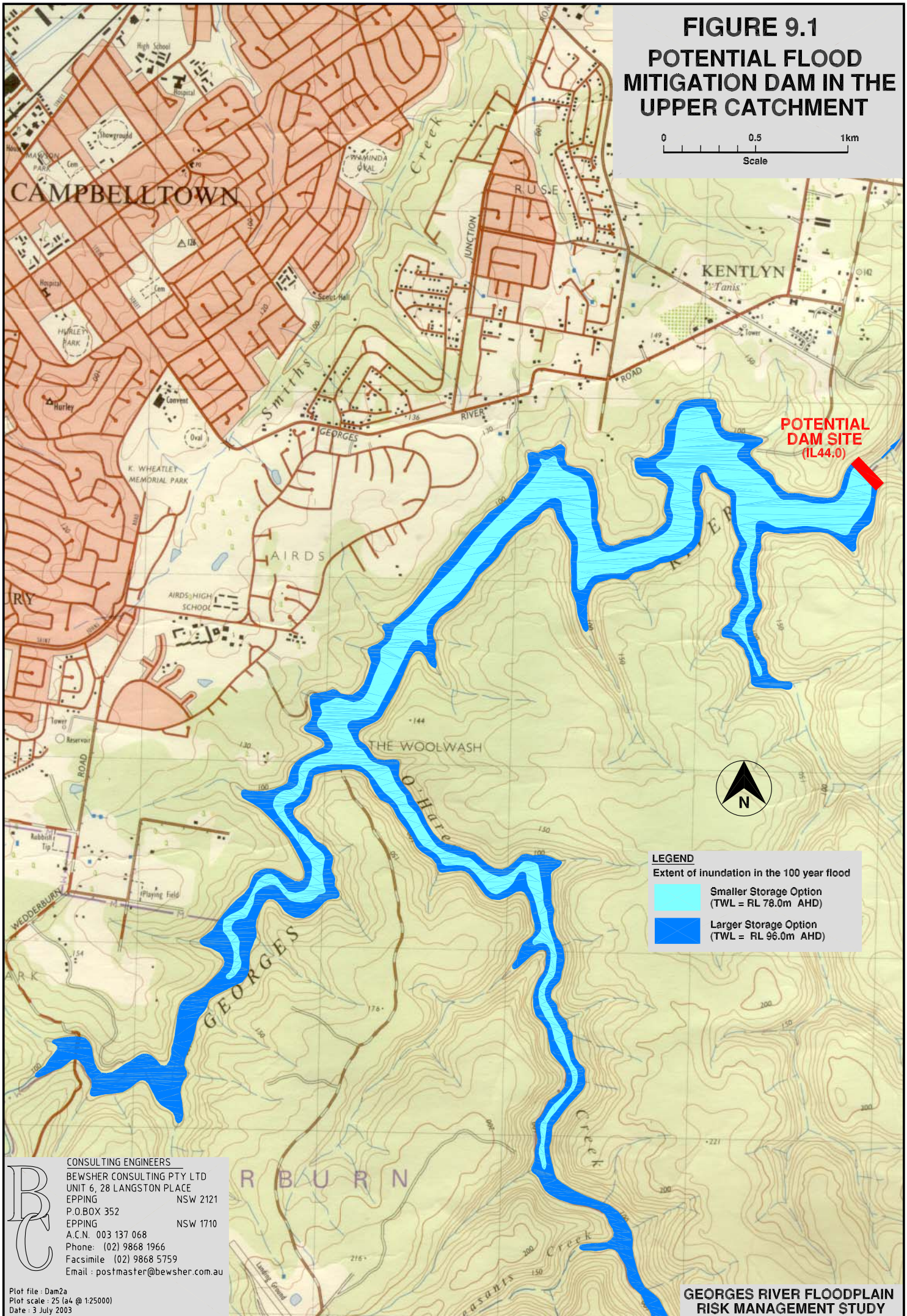
Both dam options considered result in significant flood mitigation benefits.

For the larger dam, the number of houses that would be flooded in a 100 year is reduced from 721 to 265 (ie 456 houses benefit). The number of commercial and industrial buildings that would be flooded is also reduced from 216 to 66 (150 buildings benefit). The present value of flood damage (from all floods) is reduced from \$91M to \$54M (a saving of \$37M).



**FIGURE 9.1**  
**POTENTIAL FLOOD**  
**MITIGATION DAM IN THE**  
**UPPER CATCHMENT**

0 0.5 1km  
Scale





For the smaller dam, the number of houses that would be flooded in a 100 year is reduced from 721 to 434 (ie 287 houses benefit). The number of commercial and industrial buildings that would be flooded is also reduced from 216 to 92 (124 buildings benefit). The present value of flood damage (from all floods) is reduced from \$91M to \$63M (a saving of \$28M).

Whilst the flood mitigation benefits of both dam options are high, the cost of constructing the dam is higher. Both options have benefit cost ratios that are less than 1.0, and their adoption would be difficult to justify from a purely economic viewpoint.

It should also be noted that both dam options are also likely to result in major environmental concerns, with many areas of the Upper Georges River catchment previously being recognised for their important biodiversity values. Some of the environmental issues associated with the proposed dam include:

- ▶ backwater effects into high quality ecosystems such as O'Hares Creek (NPWS working with former Planning NSW have undertaken extensive biodiversity surveys in this area with significant community involvement);
- ▶ dams and basins that impound water often result in litter and weed seed to deposit up the river bank wall, thus impacting on otherwise good bushland (ie. the low flow channel area is usually the most heavily impacted);
- ▶ slow release from dams and basins can result in sediment deposition that may smother vegetation or make vegetation more disease prone with time;
- ▶ the dam wall may immediately shade the adjacent riparian vegetation;
- ▶ the dam wall will form a barrier to fauna movement along the river/ creek corridor eg. some species will not pass through a tunnel or other narrow opening;
- ▶ funnelling of fauna through dam openings in the base of the wall can result in "ambush" by predators such as foxes, cats & dogs;
- ▶ changed hydrology/ altered flow regime can result in changes to vegetation communities in the long-term;
- ▶ likely erosion problems downstream of the outlet structure; and
- ▶ visual amenity issues in relation to the dam wall are also likely to be a major issue.

Significant opposition from environmental groups to the proposal could be anticipated.

Given the high costs, environmental and other concerns, neither dam option is recommended for inclusion in the floodplain management plan.

## 9.2 RIVER DREDGING

*Findings: Not recommended due to environmental concerns*

Dredging of the Georges River to increase its capacity to carry floodwater was also a very popular option suggested by the community. This option featured more in the list of "top 5" options than any other option. Interestingly, it also featured most

frequently in the “top 5” least favoured options. This suggests that there is somewhat mixed community support for dredging.

The impact of dredging on flood behaviour was assessed using the MIKE-11 flood model and flood benefits quantified using the flood damages database. Two variations of dredging were considered for this assessment. The first assumed dredging between Milperra Bridge and the East Hills Railway Bridge, a distance of approximately 6.0km. The second assumed dredging between the East Hills Railway Bridge and a location just downstream of Salt Pan Creek, a distance of some 10.0km. In both cases, it was assumed that dredging would increase the existing river depths by an average of 1.0m.

**TABLE 9.2**  
**Impact of Dredging on Flood Behaviour**

Description	Option 1 Milperra to East Hills	Option 2 East Hills to Salt Pan
<b>Impact on Flood Behaviour (100 year flood)</b>		
Maximum flood level reduction	0.20m	0.41m
Maximum increase in downstream flood level	0.02m	0.05m
Flood level reduction at Liverpool	0.00m	0.00m
Flood level reduction at Milperra Bridge	0.10m	0.04m
Flood level reduction at East Hills	0.01m	0.38m
Reduction in houses flooded	34	64
Reduction in commercial buildings flooded	5	5
<b>Economic Evaluation</b>		
Quantity of dredged material	580,000 m <sup>3</sup>	1,430,000 m <sup>3</sup>
Approximate cost	\$12M	\$28M
Savings in 100 year flood	\$5.6M	\$5.3M
Savings in average annual damage	\$0.45M	\$0.41M
Net Present Value of flood benefits	\$5.3M	\$4.8M
Benefit/cost ratio	0.4	0.2

Dredging increases the capacity of the river to convey floodwaters. Consequently there is a reduction in flood levels through the dredged area, and immediately upstream. Conversely, there is also a slight increase in flood levels downstream of the dredged area.

Maximum flood level reductions in the 100 year flood of 0.20 and 0.41m were obtained for the two dredging options considered. This reduction is sufficient to reduce the number of houses that would be flooded in a 100 year flood from 721 to 687 (benefits 34 houses) or 657 for the second option (benefits 64 houses). The present value of flood damage (from all floods) is reduced from \$91M to \$86M for both options.

The cost of dredging can be highly variable. It is dependent on such factors as the dredging techniques, potential contaminants in the dredged material, and how the

material is to be disposed of. Large scale dredging of clean sand, where there are no disposal problems, can be as low as \$5 to \$10 per m<sup>3</sup>. Additional environmental safeguards are likely to be required along the Georges River, and disposal of the dredged material may not be that simple. A rate of \$20 per m<sup>3</sup> is considered more appropriate for the Georges River.

The estimated cost of dredging is \$12M (Option 1) and \$28M (Option 2). This provides an economic benefit/cost ratio of 0.4 (Option 1) and 0.2 (Option 2). Both benefit cost ratios are less than 1.0 and from an economic viewpoint would be difficult to justify on flood mitigation benefits alone.

Other problems associated with dredging include:

- ▶ it disturbs sediments and releases organics as well as a range of potential pollutants into the water column. This can directly smother or reduce the light to remaining aquatic plants, kill or seriously impact animal life (from microscopic organisms in the food chains to fish and waterbirds) and cause chemical changes to the water resulting in events such as fish kills;
- ▶ it physically disturbs aquatic and semi-aquatic vegetation;
- ▶ bed lowering in the river as a result of dredging can result in bank collapse, loss of riparian vegetation and loss of property;
- ▶ subsequent deposition of material will require further dredging in future years;
- ▶ results in the loss of instream habitat eg. sand bars and tree logs for fish and other animals; and
- ▶ a full environmental impact assessment would be required, and numerous permits from various authorities obtained (eg Fisheries, EPA, DIPNR). Also, many environmental groups are likely to be opposed to dredging of the River.

Given the cost, limited flood mitigation benefits and significant environmental concerns, dredging is not recommended for inclusion in the floodplain management plan.

### 9.3 LEVEE AT MILPERRA

*Findings: Individual property measures to be further evaluated*

The Milperra Industrial Estate was identified as an area with high potential flood damages. An option to build a levee in the vicinity of Henry Lawson Drive was previously considered to protect this area, but it is understood that this option was not pursued due to the likely increase in flood levels elsewhere. Further review of this option has been undertaken as part of this study.

The levee could be formed as an earth embankment or block wall beside Henry Lawson Drive, to the south of Milperra Road. The levee would also need to run in an east-west direction along Milperra Road. Alternatively, Henry Lawson Drive and Milperra Road could be raised to form the levee, which would also improve flood access. This later option is likely to be very costly due to the required height that the road would need to be raised.

The levee option was previously investigated during the 1980's using the Georges River physical model. It was estimated that the levee would result in an increase in flood levels of approximately 0.15m and it was not considered further. The adverse impact on flood behaviour is largely due to the lost floodplain storage and the obstruction of a potential flow path through the airport leading to the Milperra Drain area, as a result of the proposed levee. However, recent filling of the airport site has significantly reduced the floodplain storage and overland flow path through this area. The impact of the proposed levee will therefore be smaller than previous estimates if the recent activities within the airport site can not be rectified.

The change in flood behaviour and estimated flood benefits of the proposed levee are shown in **Table 9.3**. These impacts are additional to the impacts of recent earthworks undertaken within the airport site. Should the airport earthworks be removed or other compensatory measures undertaken (as recommended) then the impacts on flood behaviour due to the levee will increase.

**TABLE 9.3**  
**Impact of Milperra Levee on Flood Behaviour**

Description	Impact
<b>Impact on Flood Behaviour (100 year flood)*</b>	
Maximum flood level reduction	River flooding excluded behind levee <sup>#</sup>
Maximum increase in flood level	+0.03m
Flood level increase at Liverpool	+0.00m
Flood level increase at Milperra Bridge	+0.03m
Flood level increase at East Hills	+0.02m
Reduction in houses flooded	24
Reduction in commercial buildings flooded	45
<b>Economic Evaluation</b>	
Approximate cost	\$6M
Savings in 100 year flood	\$16M
Savings in average annual damage	\$0.63M
Net Present Value of flood benefits	\$7M
Benefit/cost ratio	1.2

\* Additional to impacts already realised from earthworks within the airport site

<sup>#</sup> It may be impractical to exclude all river floods due to the height of the levee required.

The proposed levee has a good economic benefit/cost ratio, particularly if the adverse impacts from the airport activities are not considered. However, the benefits are mainly realised by the industrial sector, and government assistance to fund the work may not be forthcoming, particularly as there are some adverse impacts to other residential areas.

The flood benefits may also be somewhat overstated as flooding will still occur under local catchment floods, or during extreme floods in the river. The levee can actually

exacerbate local flood conditions, as drainage to the river will be impeded by the outlet structure provided in the levee.

An alternative to the levee bank option that could be considered is the construction of local floodwalls, or property filling, within the Milperra Industrial Estate to exclude floodwater from entering individual developments. This measure was in fact examined in the Milperra Industrial Area Hydraulic Study [Willing & Partners, 1990]. The advantages of this measure over the levee option include:

- ▶ it achieves similar objectives;
- ▶ the total loss in floodplain storage is reduced;
- ▶ local catchment flooding will not be impeded; and
- ▶ it can be funded by individual businesses.

It is difficult to provide a recommendation on the above works whilst the outcome of negotiations with Bankstown Airport Limited over the removal of recent fill, or other compensatory works, are still uncertain. However, the individual property measures would appear to be more desirable and practicable than the main levee option.

It is understood that a local catchment study has recently been commissioned by Bankstown Council for the Milperra Drain area. The drainage study could further investigate issues associated with the airport and the merits of the individual property measures.

## 9.4 STORMWATER CONSIDERATIONS

*Findings: On-going local catchment studies recommended*

The focus of the current study is flooding from the Georges River. However, flooding can also occur in local catchment areas, due to poor local drainage, blockage of culverts or inadequate overland flow paths. This type of flooding is often referred to as stormwater or local catchment flooding.

Many respondents to the community questionnaire raised stormwater issues as a major concern. The issue was also raised in several of the community workshops.

In the past, many of these local flood problems were overlooked or paid inadequate attention by many NSW councils. The State Government Flood Policy also did not address the issue and funding for studies or remedial works was generally unavailable. The recently released Floodplain Management Manual [NSW Government, 2001] now includes local flood considerations within the Flood Policy, and funding for studies and works are now available.

The magnitude of potential stormwater problems within the Georges River catchment is likely to be considerable, and is beyond the scope of the current study. Nevertheless, recommendations have been provided on planning considerations for stormwater flooding issues. These recommendations are included in the report that has been prepared on planning issues for the study (**Volume 2**).



A coordinated program of local catchment studies to identify the main problem areas and to assess works to alleviate these problems is recommended for each of the four councils. It is understood that all four councils have already commenced programs to undertake such studies.

## 9.5 ADDITIONAL INVESTIGATIONS

*Findings: Anzac Creek Flood Study & refinement of flood risk maps recommended*

A potential flood problem area was identified on a tributary in the upper catchment area, known as Anzac Creek. No previous flood studies have been undertaken on this creek, and the full extent of potential flood problems is uncertain.

Anzac Creek commences in the military reserve, between Chatham Village and Holsworthy Village. The creek drains in a northerly direction beside Holsworthy Village and Anzac Village to Heathcote Road, and through Moorebank to Newbridge Road, where it finally joins Lake Moore and the Georges River. Whilst some flood risk mapping of the lower reaches of this creek have been undertaken on the assumption of backwater flooding from the Georges River, there is the possibility that the level of flooding could be elevated due to additional flood flows from this creek. Flood problems could also extend further upstream on this tributary.

It is recommended that a flood study on this creek be undertaken to provide additional flood data. This will involve the collection of additional survey data, levels of low-lying buildings, and additional flood modelling. The existing Georges River MIKE-11 flood model could be extended upstream to include this tributary. This would ensure consistency with results in the main Georges River, and allow the effects of tailwater conditions to be properly considered. The estimated cost of the survey and flood study is estimated to be about \$80,000.

Fairfield and Bankstown Councils have recently commissioned airborne laser scanning of their local government areas. This is a relatively new technique that provides a cost-effective means of obtaining accurate topographic data over a wide area. The topographic data has principally been obtained as base data to help identify local overland flow paths that are to be investigated as part of various stormwater studies proposed by both councils. The improved topographic data can also be used to refine the flood risk mapping that was undertaken during the early stages of the current study, or to define other hydraulic criteria. Once this data is available, it is recommended that the flood risk maps are reviewed and refined in accordance with the improved topographic data.

Liverpool and Sutherland Shire Councils could also consider the collection of airborne laser scanning. This would not only assist in the refinement of their flood risk maps, but the data could be used for many other purposes (for example the proposed flood study on Anzac Creek of other proposed stormwater studies).

## 9.6 COMPENSATORY DEVELOPMENT MEASURES

*Findings: Compensatory measures for past development recommended*

This study has identified several activities that have been undertaken within the catchment that are estimated to have had a detrimental impact on flood behaviour. This includes:

- ▶ filling that has occurred on the Bankstown Airport site;
- ▶ the access track constructed below the M5 Motorway bridge across the Georges River at Hammondville; and
- ▶ temporary stockpiling and earthworks associated with dredging and other activities at Moorebank, between the M5 motorway and Newbridge Road.

Whilst some discussion has occurred between officers from Bankstown Council, the Georges River Floodplain Management Committee and Bankstown Airport Limited, no agreement has yet been reached on what, if any, compensatory measures are to be undertaken. The main problem from these activities is loss in floodplain storage, and the only complete solution is the removal of the material from the floodplain, or the excavation of similar quantities from elsewhere in the floodplain. It is recommended that the Georges River Floodplain Management Committee further pursue this issue with Bankstown Airport Limited. Assurances should also be sought that no further filling will occur within the floodplain on this site without appropriate compensatory works.

Negotiations held with the operators of the M5 Motorway have been successful in reaching an agreement to remove the access track under the M5 Motorway bridge at Hammondville. It is anticipated that the access track will be removed prior to the end of 2003.

It is understood that stockpiling and other earthworks that have occurred at Moorebank have been approved on the condition that the floodplain will ultimately be returned to natural floodplain conditions. It is understood that these conditions were made a number of years ago, and there may have been a subsequent change in ownership since this time. It is recommended that Liverpool Council review the development conditions associated with the activities in this area and to seek further advice on their legal standing in relation to these conditions. The area needs to be carefully monitored to ensure that further exacerbation on flood conditions does not occur, and when opportunities arise to correct for past activities, these opportunities are not lost.

## 9.7 PLANNING AND DEVELOPMENT CONTROLS

*Findings: Consistent planning controls recommended to be applied through new flood risk management DCPs*

Land use planning and development controls are key mechanisms by which the four councils can manage flood-affected areas within the Georges River study area. Such mechanisms will influence future development (and redevelopment) and therefore the benefits will accrue gradually over time. Without comprehensive floodplain planning, existing problems may be exacerbated and opportunities to

reduce flood risks may be lost. There was also strong support from the community for controls on future development in flood prone areas (78% of questionnaire respondents believed that development in areas subject to flooding should be controlled through building controls, whilst only 7% favoured no building controls).

The general approach to floodplain planning and a review of existing flood related planning controls is presented in Volume 2 – Planning Issues. Specific amendments to existing planning controls have been proposed and revised development control plans (DCPs) recommended for the four councils, in order to provide consistent planning controls for floodplains across the study area.

The proposed floodplain risk management DCPs have been prepared in a generic form to allow their application across the entire LGA of each Council area. A matrix of planning controls for use in the assessment of individual development applications has been formulated specifically for the Georges River floodplain. A second matrix of planning controls was also formulated for application to other floodplains within the LGA (excluding Bankstown Council, where this is currently under review), as well as areas affected by local overland flooding, pending the development of specific matrices for other areas through other floodplain risk management studies. These would be appended to the DCPs as additional matrices once the other studies have been completed.

The matrices provide a graded set of planning controls tailored to the proposed land use and flood level, and which recognise flood risks up to and including the probable maximum flood. The matrix of planning controls proposed for the Georges River floodplain is included on **Figure 9.2**. The matrix proposed for other areas (including areas affected by stormwater overland flow) is shown on **Figure 9.3**. These planning matrices should be monitored and reviewed and updated as future floodplain management plans are prepared, or existing ones reviewed.

The recommended planning issues, as summarised in **Volume 2**, include:

- a) That the Floodplain Management Committee endorses the planning approach outlined within this study. This approach requires a graded set of planning controls for different land uses relative to different levels of flood risk within the study area, be adopted, consistent with the requirements of the NSW Floodplain Management Manual.
- b) That the Committee formally endorses the recommended changes to the Georges River REP provided in **Volume 2** (Appendix A), for referral to Planning NSW.
- c) That each Council considers amending their LEP in the manner outlined above and summarised in **Volume 2** (Appendix B), to provide a consistent framework for more detail controls to be provided in a DCP.
- d) That Sutherland Shire Council discourage building in the High Flood Risk precinct by utilising foreshore building line provisions embodied within LEPs and the other Councils utilise alternate suitable mechanisms. (These mechanisms include a review of zonings within the High Flood Risk precinct having regard to the ambit of planning considerations, including flooding).
- e) That each Council adopt or amend their current DCPs and/or Policies to generally accord with the Model DCPs appended to the **Volume 2** report (Appendices C to F).

# GEORGES RIVER FLOODPLAIN

Planning & Development Controls

Temple V4.0

Planning Consideration	Flood Risk Precincts (FRP's)																	
	Low Flood Risk						Medium Flood Risk						High Flood Risk					
	Critical Uses & Facilities	Sensitive Uses & Facilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Critical Uses & Facilities	Sensitive Uses & Facilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Critical Uses & Facilities	Sensitive Uses & Facilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development
Floor Level	3	2.6,7	5.6,7	2.6,7	1.6	4.7	2.6,7	5.6,7	2.6,7	1.6	4.7	2.6,7	5.6,7	2.6,7	1.6	4.7	2.6,7	5.6,7
Building Components	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Structural Soundness	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
Flood Effects	2	2	2	2	2	2	1	2	2	2	2	2	1	2	2	2	2	2
Car Parking & Driveway Access	1,3,5,6,7	1,3,5,6,7	1,3,5,6,7	1,3,5,6,7	2,4,6,7	6,7,8	1,3,5,6,7	1,3,5,6,7	1,3,5,6,7	2,4,6,7	6,7,8	1,3,5,6,7	1,3,5,6,7	1,3,5,6,7	2,4,6,7	6,7,8	2,4,6,7	6,7,8
Evacuation	2,3,4	6	2,3	1 or 2,3	2,3	4,3	2,3	6	2,3	1,3	2,3	4,3	2,3	6	2,3	1,3	2,3	4,3
Management & Design	4,5	1	2,3,5	2,3,5	2,3,5	2,3,5	1	2,3,5	2,3,5	2,3,5	2,3,5	2,3,5	1	2,3,5	2,3,5	2,3,5	2,3,5	2,3,5

COLOUR LEGEND:  Not Relevant  Unsuitable Land Use

**General Notes**

- Freeboard equals an additional height of 500mm.
- The relevant environmental planning instruments (generally the Local Environmental Plan) identify development permissible with consent in various zones in the LGA. Notwithstanding, constraints specific to individual sites may preclude Council granting consent.
- Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.
- Refer to Section 2.5 of the DCP for planning considerations for proposals involving only the erection of a fence. Any fencing that forms part of a proposed development is subject to the relevant flood effects and Structural Soundness planning consideration.
- Refer to section 2.7 of the DCP for special considerations such as for house raising proposals and development of properties identified for voluntary acquisition.
- Terms in italics are defined in the glossary of this plan and Schedule 2 specifies development types included in each land use category. These development types are generally as defined within Environmental Planning Instruments applying to the LGA.
- From time to time, Council may adopt mapping showing the *Boundary of Significant Flow* and/or *Flood Storage Areas* for this floodplain. Refer to Council to find out if these areas have been defined and mapped for this floodplain.

**Floor Level**

- All floor levels to be no lower than the 20 year flood unless justified by site specific assessment.
- Habitable floor* levels to be no lower than the 100 year flood level plus freeboard.
- Habitable floor* levels to be no lower than the *PMF* level. *Non-habitable floor* levels to be no lower than the *PMF* level unless justified by a site specific assessment.
- Floor levels to be no lower than the *design floor level*. Where this is not practical due to compatibility with the height of adjacent buildings, or compatibility with the floor level of existing buildings, or the need for access for persons with disability.
- The level of *habitable floor* areas to be equal to or greater than the 100 year flood level plus freeboard. If this level is impractical for a development in a Business zone, the floor level should be as high as possible.
- Non-habitable floor* levels to be no lower than the 20 year flood unless justified by site specific assessment.
- A restriction is to be placed on the title of the land, pursuant to S 88B of the Conveyancing Act, where the lowest *habitable floor area* is elevated more than 1.5m above finished ground level, confirming that the undercroft area is not to be enclosed.

**Building Components & Method**

- All structures to have *flood compatible building components* below the 100 year flood level plus freeboard.
- All structures to have *flood compatible building components* below the *PMF* level.

**Structural Soundness**

- Engineer's report to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year flood plus freeboard.
- Applicant to demonstrate that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year flood plus freeboard. An engineer's report may be required.
- Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a *PMF*. An engineer's report may be required.

**Flood Effects**

- Engineer's report required to certify that the development will not increase flood effects elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels and velocities caused by alterations to the flood conveyance; and (iii) the cum
- The flood impact of the development to be considered to ensure that the development will not increase flood effects elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels and velocities caused by alterations to the flood conv

**Note:** (1) If a *Boundary of Significant Flow* has been defined for this floodplain, any development inside this area will normally be unacceptable as it will reduce flood conveyance and increase flood effects elsewhere. (2) If a *Flood Storage Area*

**Car Parking and Driveway Access**

- The minimum surface level of open car parking spaces or carports shall be as high as practical, but no lower than the 20 year flood or the level of the crest of the road at the location where the site has access. In the case of garages, the minimum surf
- The minimum surface level of open car parking spaces, carports or garages, shall be as high as practical.
- Garages capable of accommodating more than 3 motor vehicles on land zoned for urban purposes, or *enclosed car parking*, must be protected from inundation by floods equal to or greater than the 100 year flood.
- The driveway providing access between the road and parking space shall be as high as practical and generally rising in the egress direction.
- The level of the driveway providing access between the road and parking space shall be no lower than 0.3m below the 100 year flood or such that the depth of inundation during a 100 year flood is not greater than either the depth at the road or the depth a
- Enclosed car parking* and *car parking* areas accommodating more than 3 vehicles (other than on Rural zoned land), with a floor level below the 20 year flood or more than 0.8m below the 100 year flood level, shall have adequate warning systems, signage and e
- Restraints or vehicle barriers to be provided to prevent floating vehicles leaving a site during a 100 year flood
- Driveway and parking space levels to be no lower than the *design ground/floor levels*. Where this is not practical, a lower level may be considered. In these circumstances, the level is to be as high as practical, and, when undertaking alterations or add

**Note:** (1) A flood depth of 0.3m is sufficient to cause a typical vehicle to float. (2) *Enclosed car parking* is defined in the glossary and typically refers to carparks in basements.

**Evacuation**

- Reliable access for pedestrians or vehicles required during a 100 year flood.
- Adequate flood warning is available to allow safe and orderly evacuation without increased reliance upon the SES or other authorised emergency services personnel.
- The development is to be consistent with any relevant *flood evacuation strategy*, *Flood Plan adopted by Council* or similar plan.
- The evacuation requirements of the development are to be considered. An engineer's report will be required if circumstances are possible where the evacuation of persons might not be achieved within the *effective warning time*.
- Reliable access for pedestrians or vehicles required to a publicly accessible location above the *PMF*.
- Applicant to demonstrate that evacuation in accordance with the requirements of this DCP is available for the potential development flowing from the subdivision proposal.

**Management and Design**

- Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this DCP.
- Site Emergency Response Flood Plan* required where floor levels are below the *design floor level*, (except for single dwelling-houses).
- Applicant to demonstrate that area is available to store goods above the 100 year flood level plus freeboard.
- Applicant to demonstrate that area is available to store goods above the *PMF* level.
- No storage of materials below the *design floor level* which may cause pollution or be potentially hazardous during any flood.

**FIGURE 9.2**  
**PROPOSED PLANNING MATRIX – GEORGES RIVER FLOODPLAINS**

## Other Floodplains Including Areas Affected by Local Overland Flooding

Planning & Development Controls

Temple V4.0

Planning Consideration	Flood Risk Precincts (FRP's)																	
	Low Flood Risk						Medium Flood Risk						High Flood Risk					
	Critical Uses & Facilities	Sensitive Uses & Facilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Critical Uses & Facilities	Sensitive Uses & Facilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development	Critical Uses & Facilities	Sensitive Uses & Facilities	Subdivision	Residential	Commercial & Industrial	Tourist Related Development
Floor Level	3	2.6, 2.7	2.6, 2.7	1.6	4.7	1.6	2.6, 2.7	2.6, 2.7	1.6	4.7	1.6	4.7	2.6, 2.7	2.6, 2.7	1.6	4.7	1.6	4.7
Building Components	2	1	1	1	1	1	2	1	1	1	1	1	2	1	1	1	1	1
Structural Soundness	3	2	2	2	2	2	3	2	2	2	2	2	3	2	2	2	2	2
Flood Effects	2	2	2	2	2	2	1	2	2	2	2	2	1	2	2	2	2	2
Car Parking & Driveway Access	1.3, 5.6, 7	1.3, 5.6, 7	1.3, 5.6, 7	1.3, 5.6, 7	2.4, 6.7	2.4, 6.7	1.3, 5.6, 7	1.3, 5.6, 7	1.3, 5.6, 7	2.4, 6.7	2.4, 6.7	2.4, 6.7	1.3, 5.6, 7	1.3, 5.6, 7	1.3, 5.6, 7	2.4, 6.7	2.4, 6.7	2.4, 6.7
Evacuation	2.3, 4	2.3	2.3	2.3	2.3	2.3	6	2.3	1.3	2.3	4.3	2.3	6	2.3	1.3	2.3	4.3	2.3
Management & Design	4.5	1	2.3, 5	2.3, 5	2.3, 5	2.3, 5	1	2.3, 5	2.3, 5	2.3, 5	2.3, 5	2.3, 5	1	2.3, 5	2.3, 5	2.3, 5	2.3, 5	2.3, 5

COLOUR LEGEND:  Not Relevant  Unsuitable Land Use

**General Notes**

- Freeboard equals an additional height of 500mm.
- The relevant environmental planning instruments (generally the Local Environmental Plan) identify development permissible with consent in various zones in the LGA. **Notwithstanding, constraints specific to individual sites may preclude Council granting consent.**
- Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.
- Refer to Section 2.5 of the DCP for planning considerations for proposals involving only the erection of a fence. Any fencing that forms part of a proposed development is subject to the relevant flood effects and Structural Soundness planning consideration.
- Refer to section 2.7 of the DCP for special considerations such as for house raising proposals and development of properties identified for voluntary acquisition.
- Terms in *italics* are defined in the glossary of this plan and Schedule 2 specifies development types included in each land use category. These development types are generally as defined within Environmental Planning Instruments applying to the LGA.
- From time to time, Council may adopt mapping showing the *Boundary of Significant Flow* and/or *Flood Storage Areas* for this floodplain. Refer to Council to find out if these areas have been defined and mapped for this floodplain.

**Floor Level**

- All floor levels to be no lower than the 20 year flood unless justified by site specific assessment.
- Habitable floor* levels to be no lower than the 100 year flood level plus freeboard.
- Habitable floor* levels to be no lower than the *PMF* level. *Non-habitable floor* levels to be no lower than the *PMF* level unless justified by a site specific assessment.
- Floor levels to be no lower than the *design floor level*. Where this is not practical due to compatibility with the height of adjacent buildings, or compatibility with the floor level of existing buildings, or the need for access for persons with disability.
- The level of *habitable floor* areas to be equal to or greater than the 100 year flood level plus freeboard. If this level is impractical for a development in a Business zone, the floor level should be as high as possible.
- Non-habitable floor* levels to be no lower than the 20 year flood unless justified by site specific assessment.
- A restriction is to be placed on the title of the land, pursuant to S.88B of the Conveyancing Act, where the lowest *habitable floor area* is elevated more than 1.5m above finished ground level, confirming that the undercroft area is not to be enclosed.

**Building Components & Method**

- All structures to have *flood compatible building components* below the 100 year flood level plus freeboard.
- All structures to have *flood compatible building components* below the *PMF* level.

**Structural Soundness**

- Engineer's report to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year flood plus freeboard, or a *PMF* if required to satisfy evacuation criteria (see below).
- Applicant to demonstrate that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a 100 year flood plus freeboard, or a *PMF* if required to satisfy evacuation criteria (see below). An engineer's report may be required.
- Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a *PMF*. An engineer's report may be required.

**Flood Effects**

- Engineer's report required to certify that the development will not increase flood effects elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels and velocities caused by alterations to the flood conveyance; and (iii) the cum.
- The flood impact of the development to be considered to ensure that the development will not increase flood effects elsewhere, having regard to: (i) loss of flood storage; (ii) changes in flood levels and velocities caused by alterations to the flood conveyance.

**Note:** (1) If a *Boundary of Significant Flow* has been defined for this floodplain, any development inside this area will normally be unacceptable as it will reduce flood conveyance and increase flood effects elsewhere. (2) If a *Flood Storage Area*.

**Car Parking and Driveway Access**

- The minimum surface level of open car parking spaces or carports shall be as high as practical, but no lower than the 20 year flood or the level of the crest of the road at the location where the site has access. In the case of garages, the minimum surf.
- The minimum surface level of open car parking spaces, carports or garages, shall be as high as practical.
- Garages capable of accommodating more than 3 motor vehicles on land zoned for urban purposes, or enclosed car parking, must be protected from inundation by floods equal to or greater than the 100 year flood.
- The driveway providing access between the road and parking space shall be as high as practical and generally rising in the egress direction.
- The level of the driveway providing access between the road and parking space shall be no lower than 0.3m below the 100 year flood or such that the depth of inundation during a 100 year flood is not greater than either the depth at the road or the depth at the driveway.
- Enclosed car parking and car parking areas accommodating more than 3 vehicles (other than on Rural zoned land), with a floor level below the 20 year flood or more than 0.8m below the 100 year flood level, shall have adequate warning systems, signage and egress.
- Restraints or vehicle barriers to be provided to prevent floating vehicles leaving a site during a 100 year flood.
- Driveway and parking space levels to be no lower than the *design ground/floor levels*. Where this is not practical, a lower level may be considered. In these circumstances, the level is to be as high as practical, and, when undertaking alterations or add.

**Note:** (1) A flood depth of 0.3m is sufficient to cause a typical vehicle to float. (2) *Enclosed car parking* is defined in the glossary and typically refers to carports in basements.

**Evacuation**

- Reliable access for pedestrians or vehicles required during a 100 year flood.
- Reliable access for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest *habitable floor* level to an area of refuge above the *PMF* level, or a minimum of 20% of the gross floor area of the dwelling to be.
- The development is to be consistent with any relevant flood evacuation strategy, Flood Plan adopted by Council or similar plan.
- The evacuation requirements of the development are to be considered. An engineer's report will be required if circumstances are possible where the evacuation of persons might not be achieved within the *effective warning time*.
- Reliable access for pedestrians or vehicles required to a publicly accessible location above the *PMF*.
- Applicant to demonstrate that evacuation in accordance with the requirements of this DCP is available for the potential development flowing from the subdivision proposal.

**Management and Design**

- Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this DCP.
- Site Emergency Response Flood Plan required where floor levels are below the *design floor level*, (except for single dwelling-houses).
- Applicant to demonstrate that area is available to store goods above the 100 year flood level plus freeboard.
- Applicant to demonstrate that area is available to store goods above the *PMF* level.
- No storage of materials below the *design floor level* which may cause pollution or be potentially hazardous during any flood.

**FIGURE 9.3**  
**PROPOSED PLANNING MATRIX – OTHER FLOODPLAINS**  
(Excluding Bankstown Council, where this is currently under review)

- f) That each Council incorporates notations upon Section 149(2) Certificates, the wording subject to consideration by each Council, consistent with the approach discussed above and summarised in the **Volume 2** report.

It is considered that the above recommendations provide appropriate responses to the issues raised and evaluated within the context of the floodplain risk management plan and the legislative framework associated with planning.

The above measures can be implemented now at minimal cost, and should be pursued by each council with a high priority.

## 9.8 FLOOD WARNING ENHANCEMENTS

*Findings: Better utilisation of existing flood warning scheme recommended*

Flood warning is an important part of floodplain management. It provides advice on impending flooding so that people and relevant agencies can take action to minimise the impacts of flooding.

Flood warning systems usually monitor rainfall and river gauges in the upper catchment in real time and, through hydrologic/hydraulic models, predict the resulting flow and flood levels at some time in the future in the lower catchment. The Bureau of Meteorology provides an excellent flood warning system for the Georges River. However, other flood intelligence data concerning the number and location of property likely to be affected by a particular flood prediction is not currently available.

Development of a property database system that is able to link a flood warning prediction for one or more gauges on the Georges River with affected property would significantly improve emergency management operations.

Software could be quite readily developed that links information from the flood damages database developed as part of the current study with flood warning advice issued by the Bureau of Meteorology. With some manipulation of the existing databases, it would be possible to translate a flood warning prediction on the Georges River to a specific flood level at every property within the database. A determination can then be made on which properties are likely to be directly affected by the flood warning prediction. The information can be tabulated on a locality basis to allow the State Emergency Service to direct personnel to evacuate or otherwise assist those residents that are likely to be affected by flooding. If flood warning predictions are revised, a new list of potentially affected residents could be readily generated.

The database could be imported into a GIS system, such as MapInfo. This would allow a spatial representation of property likely to be affected by a particular flood warning prediction. Scripts could also be developed to improve the method of entering the flood warning prediction and in the graphical and tabular results that are provided.

There is also scope to extend the system as a flood awareness initiative, by providing advice to individual residents on the critical gauge heights that will affect

their property. With this knowledge, residents will be better able to appreciate the likely magnitude of a particular flood warning prediction and whether or not they are likely to be directly affected. It will allow increased time for residents to take appropriate action to reduce their personal risks and to minimise the potential flood damage to their homes.

The nearest gauge would need to be related to some point within the property, preferably the floor level of the building. The information could be attached to the inside of the meter box of each house or building below the PMF. As the majority of floor levels contained in the database have been estimated, floor levels should be confirmed by survey prior to fixing this advice.

The database would also need to be reviewed and updated from time to time to account for development or redevelopment within the study area. Most changes are likely to be confined to the area above the 100 year flood, where planning controls will be less restrictive. The database should be reviewed and updated at say 5 yearly intervals. Responsibility for this will need to be determined between the State Emergency Service and the councils.

The cost of preparing the necessary software and database for use by the State Emergency Service is estimated to cost \$20,000. This is recommended as a priority measure.

Extension of the system as a flood awareness initiative would involve additional costs, particularly if accurate floor level surveys were required. It would also need to be undertaken in conjunction with a carefully planned community awareness program. Further consideration of this component of the scheme is recommended once the initial software and databases are developed.

## **9.9 EMERGENCY MANAGEMENT OPERATIONS**

*Findings: Update local flood plans and undertake an Evacuation Strategy Study*

The State Emergency Service (SES) has formal responsibility for emergency management operations in response to flooding. Other organisations normally provide assistance, including the Bureau of Meteorology, the various councils, police, fire brigade, ambulance and community groups.

As many organisations have important roles to play, it is imperative that there is a clear understanding of the role and responsibilities of each organisation. This should be defined, agreed, understood and acted upon in a flood situation according to a predetermined flood action plan. The plan needs to be continually updated, as new information on flood behaviour becomes available and as lessons are learnt from other flood experiences.

Emergency management operations in relation to flooding are outlined in Local Flood Plans that are developed by the SES.

It is recommended that the Local Flood Plan covering the Georges River is updated with additional flood information developed as part of this study. This includes:

- ▶ mapping of the different flood risk areas (**Figure 5.1**);
- ▶ details of residential property affected by flooding (**Table 5.1**);
- ▶ details of commercial and industrial property affected by flooding (**Table 5.2**);
- ▶ inundation depths for houses in the 100 year flood (**Table 5.3**);
- ▶ inundation depths for other buildings in the 100 year flood (**Table 5.4**);
- ▶ details of main arterial roads likely to be affected by flooding (**Section 5.5**);
- ▶ other flooding characteristics, such as rate of rise of floodwaters and duration of flooding (**Tables 5.6 and 5.7**); and
- ▶ results from the evacuation strategy study (see recommendation below).

Additionally, information from the flood damages database will also provide valuable data on specific properties that are affected for a range of floods up to the PMF. The database includes estimated ground, floor and flood levels for every property within the Georges River study area.

The above details will assist the SES develop an improved Local Flood Plan for the Georges River, comprising flood preparedness measures, the conduct of response operations, and the coordination of immediate recovery measures. The Georges River Floodplain Management Committee would be an ideal group to help progress the development of the Local Flood Plan and to enlist the support of other authorities.

Given the potential for most of the major arterial roads to be cut early by floodwaters, and the large number of residents that could be affected during severe floods, an evacuation strategy study is recommended. This would determine appropriate evacuation centres, numbers to be allowed for, evacuation routes and other evacuation methods. The cost of the evacuation study is estimated to be about \$50,000.

These measures can be implemented now at minimal cost, and are therefore recommended as part of the recommended floodplain risk management plan.

## 9.10 PUBLIC AWARENESS

*Findings: Program recommended incorporating flood certificates and flood markers*

Raising and maintaining flood awareness will provide residents with an appreciation of the flood problem and what can be expected during floods. It will provide them with an opportunity to plan what to do to reduce potential flood damage and to avoid personal risk during future floods.

The majority of respondents from the community questionnaire (84%) believed that information on flood risks should be made available to the community. Many respondents (70% in favour, 11% opposed) also believed that council should advise every resident and property owner of the flood risk on a regular basis by way of a flood certificate. There was also strong support for flood markers (70%) and public education programs (73%).



There are many means of raising and maintaining flood awareness within the community. These measures include:

- ▶ the issue of Section 149 Certificates;
- ▶ the issue of flood certificates;
- ▶ community education programs; and
- ▶ the construction of flood markers.

Whilst there are merits in all of these measure, the most effective solution is the regular issue of flood certificates to all occupiers of the floodplain [Bewsher, Grech and Maddocks, 1998]. The NSW Government's Floodplain Management Manual also recommends that Councils promote community flood readiness by supplying flood data and advice, which can readily be achieved by the use of flood certificates.

A flood certificate issued to individual property owners would inform them of the flood situation at their particular property. The certificate would contain vital information such as the expected flood levels in a range of design floods. It would also provide information on ground and floor levels where this information is available, which would allow an assessment of the depths of flooding over the property and building. Where property levels are unknown, residents could be encouraged to obtain these levels using a registered surveyor.

Much of this data is currently available from the flood damages database developed as part of the floodplain risk management study. The database would need to be incorporated into Council's GIS computer based system and mechanisms to keep the data up-to-date established. It would be relatively simple to print out a flood certificate for one or more properties once this link is established.

A sample flood certificate is included as **Figure 9.4**. Different certificates would be produced where information on floor levels are either known or unknown. The certificate could be attached to Section 149 certificates and also posted out with Council Rates Notices every 1 – 2 years. The certificate could also be provided on request for a nominal fee.

A second method of raising flood awareness, which is also recommended, is the construction of one or more flood markers within the Georges River floodplain. Flood markers can be constructed in parks, reserves or along low points in roads. An appropriate location where a flood marker might be considered is along Newbridge Road, adjacent to the Liverpool voluntary purchase area. This is a particularly flood prone area where there are already flood depth indicators to show the depth of floodwater over the road. There is likely to be less community opposition to a flood marker at this location than other locations within the catchment. The height of different probability floods could also be shown, along with heights of previous flood events, such as the 1988, 1956 and 1873 floods.

An awareness program, as outlined above, could be implemented for a very low cost. Approximate costs are \$40,000 for its development and about \$5,000 per annum to maintain, and is recommended for further consideration.

*Fairfield City Council*

**Flood Certificate**

Certificate Issued for Property at : 16 River Road, Lansvale  
Lot 14, DP 25843

Owners Name : Mr & Mrs John Smith

**1. Classification of Flood Risk**

Council records indicate that the above property is located within a Medium Flood Risk area.

*Land that is potentially subject to inundation is classified as low, medium or high flood risk. Council has prepared a development control plan that provides details of flood related controls that may be applicable.*

**2. Known Floor and Ground Levels**

The lowest floor level of the main building on this property is : 6.3m AHD  
Source of information : 1997 Survey

The lowest ground level on this property is : 5.2m AHD  
Source of information : Estimate from plans

*If the floor level is currently unknown and you would like to know what the level is, this can be surveyed by a registered surveyor. Alternatively, Council can arrange this for a fee of \$90.*

**3. Estimated Flood Levels**

Flood levels in the vicinity of the above property have been extracted from the “Georges River Flood Study” report (Public Works Department, 1991).

Size of Flood*	Flood Level	Depth over Lowest Floor Level	Depth over Lowest Ground Level
Probable Maximum Flood	9.1m AHD	2.8m	3.9m
100 Year Flood	6.4m AHD	0.1m	1.2m
20 Year Flood	5.4m AHD	Not flooded	0.2m

*\*The Probable Maximum Flood (or PMF) is the largest flood likely to occur, and is extremely rare.  
A 100 year flood is a large flood. It has a 1 in 100 (ie 1%) chance of occurring in any year.  
A 20 year flood has a 1 in 20 (ie 5%) chance of occurring in any year.*

Issued by Fairfield City Council  
24<sup>th</sup> April 2003.

**FIGURE 9.4**  
**SAMPLE FLOOD CERTIFICATE**

## **10 DRAFT FLOODPLAIN MANAGEMENT PLAN**

### **10.1 THE RECOMMENDED MEASURES**

The works and other measures that are recommended for inclusion in the Georges River Floodplain Risk Management Plan are shown on **Figure 10.1** and are summarised in **Table 10.1**.

#### **10.1.1 Findings from Review of Existing Works and Measures**

Floodplain management works and measures that have been undertaken within the study area since the early 1980s have been reviewed as part of the current study. Some of these works are on-going, and provision for their completion is included in the Plan. In some cases, variations to previous schemes or works have also been proposed. These measures comprise:

- ▶ Voluntary acquisition of the remaining 71 properties in the Liverpool Voluntary Purchase Scheme at Moorebank (99 properties have been purchased to date). Increasing property prices and the withdrawal of Commonwealth funds are a major impediment to the completion of the scheme. Investigation of self-funding initiatives involving private-sector development are recommended, to provide a source of income to complete the scheme in as short a time frame as possible.
- ▶ Voluntary acquisition of the remaining 4 properties in the Bankstown Voluntary Purchase Scheme at Milperra (21 properties purchased to date). There are similar impediments as the Liverpool Scheme, however costs to complete the scheme are manageable.
- ▶ A geotechnical review of the Kelso levee, including raising of a low spot along the crest of the levee by approximately 0.2m on the north side of the outlet structure. A second low spot further to the north to be reinforced and maintained as a defacto spillway.
- ▶ Relocation/removal of seven buildings within the East Hills Flood Mitigation Scheme. These buildings are located adjacent to the river and experience high hazard flood conditions. Four of the seven buildings could be relocated towards the front of the property (away from the river), possibly as part of eventual redevelopment proposals. Bankstown Council should address the most appropriate means of addressing this issue.
- ▶ A detailed review of the Carinya Road flood mitigation measures, using a 2-dimensional hydraulic model, to assess the reduction in flood hazard arising from the constructed scheme, the identification of any residual high hazard areas where further measures should be considered, and a review of flood-related planning provisions such as elevated walkway requirements.

#### **10.1.2 Recommended Measures in Specific Areas**

Other measures that have been proposed for specific areas comprise:

- ▶ The preparation of local catchment studies to address stormwater issues and overland flow issues within the four local government areas. This was identified as a major issue by a number of residents during the study. The 2001 Floodplain Management Manual also recommends such studies in potential problem areas.

- ▶ A flood study for Anzac Creek, upstream of Newbridge Road and Heathcote Road at Liverpool, to quantify potential flood problems in this area.
- ▶ Airborne laser scanning to provide improved topographic data within the Liverpool and Sutherland Shire Council areas, to assist with local catchment studies and also to be used to further refine the flood risk maps, or other hydraulic criteria, for the Georges River and other floodplains.
- ▶ Council to pursue compensatory measures to be undertaken by BAL/Commonwealth Government to mitigate the impact of various earthworks that have occurred at the Bankstown Airport site. Remedial measures are also required to address the impacts of earthworks that have occurred below the M5 Motorway bridge at Hammondville, and stockpiling activities on land adjacent to the river at Moorebank. These matters should be pursued with the owners or operators of these facilities.

### 10.1.3 Recommended Measures for all Floodplains

The most effective components of the floodplain risk management plan are a number of catchment-wide measures. These measures are expected to provide significant benefits over the full range of floods that can be anticipated within the catchment, and can be implemented at a relatively low cost. The catchment-wide measures that are recommended for inclusion in the Plan comprise:

- ▶ Adoption of consistent planning and development controls between the four councils, to be applied through a new flood risk management DCP. The application of sensible planning controls will ensure that the potential for flood damage does not increase in time, but actually reduces as flood-compatible redevelopment gradually takes place.

Specific planning recommendations are outlined in the **Volume 2** report and summarised in **Section 9.7** of this report. They include the adoption of a graded set of planning controls for different land uses relative to different levels of flood risk within the study area through a flood risk management DCP; proposed amendments to the Georges River REP and each Council's LEP; and incorporation of notations upon Section 149 Certificates to identify the flood risk category up to the PMF event.

- ▶ Flood warning enhancements to make better use of the existing flood warning service provided by the Bureau of Meteorology for the Georges River. This involves the development of software to link flood warning predictions with the database of potentially flood liable properties that was developed during the current study. This will greatly assist SES operations during floods. An extension of this proposal is to provide individual residents with specific notification (eg affixed to meter boxes) on the critical gauge height that will inundate their home.
- ▶ Improved emergency management operations, including the update of SES Local Flood Plans with information available in this study and an evacuation strategy study to determine appropriate evacuation centres, numbers to be accommodated, evacuation routes and other evacuation methods.
- ▶ Improved public awareness of flooding. A flood aware community will be able to take steps to reduce flood damage and to minimise their own personal risk (eg by raising contents to higher levels and evacuating at an early stage). Councils' computer-based GIS systems should be updated with information from the flood

damages database developed during the study to facilitate the provision of flood advice to the community. It is also recommended that flood certificates are used as a means of providing information on flood risks, and these could be distributed on a regular basis. The construction of one or more flood markers is also recommended within the floodplain to indicate the levels of historic floods.

#### **10.1.4 Measures Not Recommended**

Several other floodplain management works were also investigated, but have not been recommended due to high capital costs, low economic benefits, and/or significant environmental issues associated with these proposals. Works that were considered, but not recommended include:

- ▶ a large flood mitigation dam in the upper catchment;
- ▶ dredging of the river; and
- ▶ a levee to protect the Milperra Industrial Estate.

### **10.2 FUNDING AND IMPLEMENTATION**

#### **10.2.1 Estimated Costs**

The total cost of implementing the Georges River Floodplain Risk Management Plan is approximately \$33.6M. This amount is dominated by the \$30M that is estimated to be required for the completion of the Liverpool Voluntary Purchase Scheme at Moorebank.

The \$30M for the Liverpool Voluntary Purchase Scheme is a high financial burden on both Liverpool Council and the State Government. The investigation of alternative self-funding initiatives, involving private sector development within the voluntary purchase area, has been recommended. If such initiatives are fruitful, then the total cost of the Georges River Floodplain Risk Management Plan will reduce to a much more modest \$3.6M

#### **10.2.2 Other Funding Sources**

Apart from potential private sector funding, there are a variety of sources of funding that could be considered to implement the Plan. These include:

- ▶ State funding for flood risk management measures through the Department of Infrastructure, Planning and Natural Resources through the subsidised Flood Mitigation Program;
- ▶ Council funds;
- ▶ Section 94 contributions from future development where a nexus can be established between that development and flooding; and
- ▶ contributions from residents or businesses to fund measures from which they will benefit.

Councils can expect to receive the majority of financial assistance through the Department of Infrastructure, Planning and Natural Resources. These funds are available to implement measures that contribute to reducing existing flood problems.

Funding assistance is usually provided on a 2:1 basis (State:Council).

Although much of the Plan may be eligible for Government assistance, funding can not be guaranteed. Government funds are allocated on an annual basis to competing projects throughout the State. Funding of investigation and design activities as well as any works and on-going programs such as voluntary purchase schemes is normally available.

### **10.2.3 The Next Steps**

The next steps in progressing the floodplain management process from this point are as follows:

- ▶ the draft Georges River Floodplain Risk Management Study and Plan is placed on public exhibition by each of the four Councils;
- ▶ the Georges River Floodplain Management Committee reviews the comments and submissions received on the draft study and plan;
- ▶ any amendments considered necessary are made, and a final report prepared and submitted to each of the four Councils for adoption;
- ▶ each Council determines a program of works that are their responsibility, based on overall priority, available Council funds and any other constraints;
- ▶ each Council submits an application for funding assistance to the Department of Infrastructure, Planning and Natural Resources and negotiates other sources of funding;
- ▶ implementation of the Plan proceeds, as funds become available and in accordance with established priorities.

## **10.3 ON-GOING REVIEW OF PLAN**

The Plan should be regarded as a dynamic instrument requiring review and modification over time. The catalyst for change could include new flood events and experiences, legislative change, alterations in the availability of funding, or changes to the area's planning strategies. In any event, a thorough review every ten years, or as needed, is warranted to ensure the ongoing relevance of the Plan.

**TABLE 10.1**  
**Recommended Floodplain Management Measures**

Report Section	Description	Estimated Cost	Potential Funding Sources	Principal Responsibility	Priority
8.1	<b>Liverpool Voluntary Purchase Scheme</b> a) Investigate self-funding initiatives b) Purchase remaining 71 properties	\$50,000 \$30,000,000	Council, DIPNR Council, DIPNR, Private Sector	Liverpool Liverpool	High Medium
8.2	<b>Bankstown Voluntary Purchase Scheme</b> a) Purchase remaining 4 properties	\$2,000,000	Council, DIPNR	Bankstown	Medium
8.4	<b>Kelso Levee</b> a) Geotechnical review and minor crest adjustment	\$50,000	Council, DIPNR	Bankstown	High
8.5	<b>East Hills Flood Mitigation Scheme</b> a) Relocation/removal of 7 buildings	\$1,200,000	Council, DIPNR, Owners	Bankstown	Medium
8.6	<b>Carinya Road Flood Mitigation Scheme</b> a) Review existing scheme, including 2D model.	\$30,000	Council, DIPNR	Bankstown	Medium
9.4	<b>Stormwater/Local Catchment Studies</b>	TBA	Council, DIPNR	All Councils	Medium
9.5	<b>Additional Flood Investigations</b> a) Anzac Creek Flood Study (incl. survey) b) Airborne Laser Scanning c) Update Floodplain Risk Management Maps	\$80,000 TBA \$20,000	Council, DIPNR Council, DIPNR Council, DIPNR	Liverpool Liverpool, Sutherl. All Councils	High High Medium
9.6	<b>Compensatory Development Measures</b> a) Mitigation of fill on Bankstown Airport b) Remove access track under M5 Motorway c) Activities at Moorebank	N/A N/A N/A	Bankstown Airport Limited Interlink Pty Ltd Owners/developers	All Councils Liverpool Liverpool	High High Medium
9.7	<b>Consistent Planning &amp; Development Controls</b> a) Adoption of low/medium/high flood risk classification b) Adoption of Flood Risk Management DCP c) Remove inconsistencies in the GR REP and LEPs d) Improve notations on S149 Certificates	Staff costs Staff costs Staff costs Staff costs	Council Council Council Council	All Councils All Councils All Councils, StGovt All Councils	High High High High
9.8	<b>Flood Warning Enhancements</b> a) Link flood warning prediction with property database b) Survey of floor levels c) Advise residents with specific advice on prediction	\$20,000 \$80,000 \$50,000	Council, DIPNR, SES Council, DIPNR, SES Council, DIPNR, SES	SES SES SES	High Low Low
9.9	<b>Emergency Management Operations</b> a) Update Local Flood Plans b) Evacuation Strategy Study	Staff costs \$50,000	Council, SES Council, DIPNR, SES	SES SES	High High
9.10	<b>Improved Public Awareness</b> a) Update Council's GIS databases b) Provide Flood Certificates c) Flood markers to indicate levels of historic floods	Staff costs \$20,000 \$20,000	Council Council, DIPNR Council, DIPNR	All Councils All Councils All Councils	High Medium Medium

**Total \$33,670,000**



**FIGURE 10.1  
RECOMMENDED FLOODPLAIN  
RISK MANAGEMENT PLAN**



0 0.5 1 1.5 2 km  
Scale 1 : 50000

**LEGEND**

— Probable Maximum Flood Extent

**Stormwater Inundation**

- Local drainage studies to define stormwater problems
- Formulate measures to reduce problems

**Improved Survey Data & Mapping**

- Airborne Laser Scanning or other survey
- Update Flood Risk Maps

**Consistent Planning Controls**

- Adoption of Low/Medium/High Flood Risk Classification
- Application of a graded set of Planning Controls
- Adoption of Flood Risk Management DCP's
- Remove inconsistencies in the Georges River REP and Council LEP's
- Improve notations on S149 Certificates

**Flood Warning Enhancements**

- Review application of existing flood warning procedures
- Prepare GIS database to relate flood warning predictions to individual properties
- Provide residents with specific advice concerning prediction levels

**Anzac Creek Flood Study**

- Detailed Flood Investigations

**Remove Obstruction**

- Removal of access track under M5 bridge at Hammondville

**Emergency Management Measures**

- Update Local Flood Plans
- Formulate Evacuation Strategy
- Flood Warning Dissemination Study

**Public Awareness**

- Update Council GIS databases
- Provide Flood Certificates
- Construct Flood Markers indicating heights of historic floods

**East Hills Flood Mitigation**

- Relocate/remove up to 7 buildings

**Carinya Road Flood Mitigation**

- Review existing scheme and planning provisions, including 2D model

**Compensatory Measures**

- Pursue measures to mitigate impact of Airport fill with BAL

**Bankstown Voluntary Purchase Scheme**

- Complete purchase of remaining 4 properties

**Kelso Levee Augmentation**

- Geotechnical review and minor crest adjustment

**FLOODPLAIN MANAGEMENT CONSULTANTS**

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Plot file : J1046-fig10.1  
Plot scale : 50 (a3@150000)  
Date : 5 May 2003

**GEORGES RIVER FLOODPLAIN  
RISK MANAGEMENT STUDY**



## 11 ACKNOWLEDGEMENTS

This report was prepared by Bewsher Consulting Pty Ltd, on behalf of the Georges River Floodplain Management Committee, for Liverpool, Fairfield, Bankstown and Sutherland Shire Councils. Don Fox Planning Pty Ltd also provided assistance on town planning issues, and in the preparation of **Volume 2** of this study.

The study was jointly funded by the State Government and the four participating councils on a 2:1 (State Government:Council) cost sharing basis under the NSW Floodplain Management Program, administered by the Department of Infrastructure, Planning and Natural Resources (formerly DLWC).

The assistance of the Committee in undertaking this study is gratefully acknowledged, in particular staff from Bankstown City Council and the Department who were responsible for the management and other administrative matters associated with the study.

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## 13 GLOSSARY

*Note that terms shown in bold are described elsewhere in this Glossary.*

<b>100 year flood</b>	A <b>flood</b> that occurs on average once every 100 years. Also known as a 1% flood. See <b>annual exceedance probability (AEP)</b> and <b>average recurrence interval (ARI)</b> .
<b>50 year flood</b>	A <b>flood</b> that occurs on average once every 50 years. Also known as a 2% flood. See <b>annual exceedance probability (AEP)</b> and <b>average recurrence interval (ARI)</b> .
<b>20 year flood</b>	A <b>flood</b> that occurs on average once every 20 years. Also known as a 5% flood. See <b>annual exceedance probability (AEP)</b> and <b>average recurrence interval (ARI)</b> .
<b>afflux</b>	The increase in flood level upstream of a constriction of flood flows. A road culvert, a pipe or a narrowing of the stream channel could cause the constriction.
<b>annual exceedance probability (AEP)</b>	AEP (measured as a percentage) is a term used to describe <b>flood</b> size. AEP is the long-term probability between floods of a certain magnitude. For example, a 1% AEP flood is a <b>flood</b> that occurs on average once every 100 years. It is also referred to as the '100 year flood' or 1 in 100 year flood'. The terms <b>100 year flood</b> , <b>50 year flood</b> , <b>20 year flood</b> etc, have been used in this study. See also <b>average recurrence interval (ARI)</b> .
<b>Australian Height Datum (AHD)</b>	A common national plane of level approximately equivalent to the height above sea level. All <b>flood levels</b> , floor levels and ground levels in this study have been provided in metres AHD.
<b>average annual damage (AAD)</b>	Average annual damage is the average flood damage per year that would occur in a nominated development situation over a long period of time.
<b>average recurrence interval (ARI)</b>	ARI (measured in years) is a term used to describe <b>flood</b> size. It is a means of describing how likely a flood is to occur in a given year. For example, a 100 year ARI flood is a flood that occurs or is exceeded on average once every 100 years. The terms <b>100 year flood</b> , <b>50 year flood</b> , <b>20 year flood</b> etc, have been used in this study. See also <b>annual exceedance probability (AEP)</b> .
<b>catchment</b>	The land draining through the main stream, as well as tributary streams.
<b>Development Control Plan (DCP)</b>	A DCP is a plan prepared in accordance with Section 72 of the <i>Environmental Planning and Assessment Act, 1979</i> that provides detailed guidelines for the assessment of development applications.
<b>design flood level</b>	A flood with a nominated probability or average recurrence interval, for example the 100 year flood.
<b>DIPNR</b>	Department of Infrastructure, Planning and Natural Resources. Now incorporates the floodplain management responsibilities of the former Department of Land and Water Conservation.

<b>discharge</b>	The rate of flow of water measured in terms of volume per unit time, for example, <b>cubic metres per second (m<sup>3</sup>/s)</b> . Discharge is different from the speed or <b>velocity</b> of flow, which is a measure of how fast the water is moving.
<b>DLWC</b>	Department of Land and Water Conservation. Since May 1995, this is the new name for the Department of Water Resources (DWR), the Department of Conservation and Land Management (CALM) and flood sections of the Public Works Department (PWD). DLWC has been used in this report, except for work and/or studies carried out by these departments prior to May 1995.
<b>DUAP</b>	The former Department of Urban Affairs and Planning (NSW). Previously the Department of Planning (NSW). Now called <b>Planning NSW</b> .
<b>DWR</b>	The former Department of Water Resources. This department became a major component of the Department of Land and Water Conservation (DLWC) in May 1995.
<b>ecologically sustainable development (ESD)</b>	Using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the <i>Local Government Act 1993</i> .
<b>effective warning time</b>	The time available after receiving advice of an impending <b>flood</b> and before the floodwaters prevent appropriate flood response actions being undertaken. The <b>effective warning time</b> is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.
<b>emergency management</b>	A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.
<b>EP&amp;A Act</b>	<i>Environmental Planning and Assessment Act, 1979.</i>
<b>extreme flood</b>	An estimate of the <b>probable maximum flood (PMF)</b> , which is the largest flood likely to occur.
<b>flood</b>	A relatively high stream flow that overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunamis.
<b>flood awareness</b>	An appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures.
<b>flood hazard</b>	The potential for damage to property or risk to persons during a <b>flood</b> . Flood hazard is a key tool used to determine flood severity and is used for assessing the suitability of future types of land use.
<b>flood level</b>	The height of the <b>flood</b> described either as a depth of water above a particular location (eg. 1m above a floor, yard or road) or as a depth of water related to a standard level such as <b>Australian Height Datum</b> (eg the flood level was 7.8m AHD). Terms also used include <b>flood stage</b> and <b>water level</b> .

<b>flood liable land</b>	Land susceptible to flooding up to the <b>probable maximum flood (PMF)</b> . Also called <b>flood prone land</b> . Note that the term flood liable land now covers the whole of the <b>floodplain</b> , not just that part below the <b>flood planning level</b> , as indicated in the superseded Floodplain Development Manual (NSW Government, 1986).
<b>flood planning levels (FPLs)</b>	The combination of flood levels and <b>freeboards</b> selected for planning purposes, as determined in <b>floodplain management studies</b> and incorporated in <b>floodplain management plans</b> . The concept of flood planning levels supersedes the designated flood or the flood standard used in earlier studies.
<b>flood prone land</b>	Land susceptible to flooding up to the <b>probable maximum flood (PMF)</b> . Also called <b>flood liable land</b> .
<b>flood proofing</b>	A combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate damages during a <b>flood</b> .
<b>flood stage</b>	see <b>flood level</b> .
<b>Flood Study</b>	A study that investigates flood behaviour, including identification of flood extents, <b>flood levels</b> and flood velocities for a range of flood sizes.
<b>floodplain</b>	The area of land that is subject to inundation by floods up to and including the probable maximum flood event, that is, <b>flood prone land</b> or <b>flood liable land</b> .
<b>Floodplain Risk Management Plan</b>	The outcome of a <b>Floodplain Management Risk Study</b> .
<b>Floodplain Risk Management Study</b>	The current study. These studies are carried out in accordance with the <i>Floodplain Management Manual</i> (NSW Government, 2001) and assess options for minimising the danger to life and property during <b>floods</b> . These measures, referred to as 'floodplain management measures/options', aim to achieve an equitable balance between environmental, social, economic, financial and engineering considerations. The outcome of a Floodplain Risk Management Study is a <b>Floodplain Risk Management Plan</b> .
<b>floodway</b>	Those areas of the <b>floodplain</b> where a significant discharge of water occurs during <b>floods</b> . Floodways are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in <b>flood levels</b> .
<b>flow</b>	see <b>discharge</b>
<b>freeboard</b>	A factor of safety expressed as the height above the <b>design flood level</b> . Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the <b>floodplain</b> , such as wave action, localised <b>hydraulic</b> behaviour and impacts that are specific event related, such as levee and embankment settlement, and other effects such as "greenhouse" and climate change.
<b>high flood hazard</b>	For a particular size <b>flood</b> , there would be a possible danger to personal safety, able-bodied adults would have difficulty wading to safety, evacuation by trucks would be difficult and there would be a potential for significant structural damage to buildings.

<b>hydraulics</b>	Term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and <b>velocity</b> .
<b>hydrology</b>	Term given to the study of the rainfall and runoff process; in particular, the evaluation of <b>peak discharges</b> , flow volumes and the derivation of hydrographs (graphs that show how the discharge or stage/flood level at any particular location varies with time during a flood).
<b>km</b>	kilometres. 1km = 1,000m = 0.62 miles.
<b>km<sup>2</sup></b>	square kilometres. 1km <sup>2</sup> = 1,000,000m <sup>2</sup> = 100ha ≈ 250 acres.
<b>LGA</b>	Local Government Area, or Council boundary.
<b>local catchments</b>	Local catchments are river sub-catchments that feed river tributaries, creeks, watercourses and channelised or piped drainage systems.
<b>Local Environmental Plan (LEP)</b>	A Local Environmental Plan is a plan prepared in accordance with the <i>Environmental Planning and Assessment Act</i> , 1979, that defines zones, permissible uses within those zones and specifies development standards and other special matters for consideration with regard to the use or development of land.
<b>local overland flooding</b>	Local overland flooding is inundation by local runoff within the local catchment.
<b>local runoff</b>	local runoff from the local catchment is categorised as either major drainage or local drainage in the NSW Floodplain Management Manual, 2001.
<b>low flood hazard</b>	For a particular size flood, able-bodied adults would generally have little difficulty wading and trucks could be used to evacuate people and their possessions should it be necessary.
<b>m</b>	metres. All units used in this report are metric.
<b>m AHD</b>	metres <b>Australian Height Datum (AHD)</b> .
<b>m/s</b>	metres per second. Unit used to describe the <b>velocity</b> of floodwaters. 10km/h ≈ 2.8m/s.
<b>m<sup>2</sup></b>	square metres. 1m <sup>2</sup> ≈ 10.8 square feet.
<b>m<sup>3</sup>/s</b>	Cubic metres per second or 'cumeecs'. A unit of measurement for creek flows or <b>discharges</b> . It is the rate of flow of water measured in terms of volume per unit time.
<b>MHL</b>	Manly Hydraulics Laboratory, formerly a branch of the NSW Public Works Department.
<b>ML</b>	Megalitre. 1ML = 1,000 m <sup>3</sup> .
<b>merit approach</b>	The principles of the merit approach are embodied in the <i>Floodplain Management Manual</i> (NSW Government, 2001) and weigh up social, economic, ecological and cultural impacts of land use options for different <b>flood prone</b> areas together with flood damage, <b>hazard</b> and behaviour implications, and environmental protection and well being of the State's rivers and <b>floodplains</b> .
<b>MIKE-11</b>	The software program used to develop a computer model that analyses the <b>hydraulics</b> of the waterways within a <b>catchment</b> and calculates water levels (flood levels) and flow <b>velocities</b> . Known as a hydraulic model.



<b>mm</b>	millimetres. 1m = 1,000mm
<b>overland flow path</b>	The path that floodwaters can follow if they leave the confines of the main flow channel. Overland flow paths can occur through private property or along roads. Floodwaters travelling along overland flow paths, often referred to as 'overland flows', may or may not re-enter the main channel from which they left — they may be diverted to another water course.
<b>peak discharge</b>	The maximum <b>flow</b> or <b>discharge</b> during a flood.
<b>Planning NSW</b>	Formerly the <b>Department of Urban Affairs and Planning (NSW)</b> and the Department of Planning (NSW), at present DIPNR (since March 2003)
<b>present value</b>	In relation to flood damage, is the sum of all future flood damages that can be expected over a fixed period (usually 20 years) expressed as a cost in today's value.
<b>probable maximum flood (PMF)</b>	The largest flood likely to ever occur. The PMF defines the extent of <b>flood prone land</b> or <b>flood liable land</b> , that is, the <b>floodplain</b> . The extent, nature and potential consequences of flooding associated with the PMF event are addressed in the current study.
<b>PWD</b>	Public Works Department. Formerly the State Government Department responsible for floodplain management matters in tidal waterways.
<b>reliable access</b>	During a <b>flood</b> , reliable access means the ability for people to safely evacuate an area subject to imminent flooding within <b>effective warning time</b> , having regard to the depth and <b>velocity</b> of floodwaters, the suitability of the evacuation route, and other relevant factors.
<b>REP</b>	Regional Environmental Plan. A plan prepared in accordance with the EP&A Act that provides objectives and controls for a region, or part of a region. For example, the Georges River REP.
<b>risk</b>	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of this study, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
<b>RORB</b>	The software program used to develop a computer model that analyses the <b>hydrology</b> (rainfall– <b>runoff</b> processes) of the <b>catchment</b> and calculates hydrographs and <b>peak discharges</b> . Known as a hydrological model.
<b>runoff</b>	The amount of rainfall that ends up as flow in a stream, also known as rainfall excess.
<b>SES</b>	State Emergency Service of New South Wales.
<b>stage–damage curve</b>	A relationship between different water depths and the predicted flood damage at that depth.
<b>velocity</b>	the term used to describe the speed of floodwaters, usually in <b>m/s</b> (metres per second). 10km/h = 2.7m/s.
<b>water level</b>	see <b>flood level</b> .
<b>water surface profile</b>	A graph showing the height of the <b>flood</b> ( <b>flood stage</b> , <b>water level</b> or <b>flood level</b> ) at any given location along a watercourse at a particular time.

## **APPENDIX A**

### **CONSULTATION MATERIAL**

**Community Correspondence,  
Community Questionnaires,  
Issues Raised through the Questionnaires**

# Georges River Floodplain Management Committee

For more information:  
Please visit the study web site at [www.bewsher.com.au/georges.htm](http://www.bewsher.com.au/georges.htm)  
or contact your Council liaison officer

14<sup>th</sup> October 2002

«BCC\_Owners\_Name»  
«BCC\_Address\_Line\_1»  
«BCC\_Address\_Line\_2»

Dear Sir/Madam,

**Ref: Georges River Floodplain Management Study**

The Georges River has created a beautiful environment, but the very nature of the landscape leaves it prone to flooding. The recent floods in Europe, which were much larger than most people had ever experienced, should remind us all of the importance of being prepared for such risks. Significant floods have also occurred on the Georges River in the 1980s, and in 1956, and much larger floods also occurred in the late 1800s.

Under the State Government's new Floodplain Management Manual, Councils now have a responsibility to manage land that could be potentially affected by all floods, up to what is known as the "probable maximum flood". A floodplain management study on the Georges River is currently underway, which will look at ways to manage the risk of flooding. **This letter has been sent to you because your property could be affected by flooding some time in the future.**

The Georges River Floodplain Management Committee is preparing this Study. The committee includes representatives from the State Emergency Service, Liverpool City Council, Fairfield City Council, Bankstown City Council, Sutherland Shire Council, Department of Land and Water Conservation, and a number of community representatives. Outcomes from the floodplain management study will include:

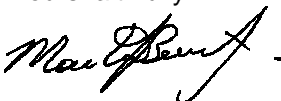
- improved public awareness of flooding;
- improved flood warning times and evacuation procedures, thereby ensuring better security for our residents;
- an assessment of the impacts of recent development on flood conditions;
- an investigation of measures to reduce the flood risk; and
- development of a strategic plan to manage the flood risk within the catchment.

The study will also categorise all land that could be at risk of flooding into three different flood risk areas (high, medium and low). Land above Council's previous standard (the 100 year flood), would generally be categorised as having a "low flood risk".

The Committee is now seeking the views of the community on how to manage land that may be subject to flooding. This is your opportunity to participate in the study. If you would like further information, or would like to complete a questionnaire or attend one of several workshops planned to commence in late November, please fill out the attached form and return it in the enclosed envelope (no stamp is required). The workshops will be held in local centres and will provide you with an opportunity to have your say as the study progresses.

I have also attached a "FloodSafe" brochure for your information. Finally, if you have any questions, please contact me on 9707-9890.

Yours faithfully



**Martin Beveridge**  
**Georges River Floodplain Management Committee**  
**(Bankstown Council Liaison Officer)**

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Project partners in the Georges River Floodplain Management Study



# Georges River Floodplain Management Study

For more information:  
Please visit the study web site at [www.bewsher.com.au/georges.htm](http://www.bewsher.com.au/georges.htm)  
or contact your Council liaison officer

Please complete this form and return it to your local Council by Friday 1 November. A Reply Paid Envelope has been provided.

All information provided will remain confidential, and only used for the purpose of this study.

Please tick (Yes or No)

**Would you like to be included on the mailing list for the study?**

We can then send you further information as the study progresses.

☐

Yes

☐

No

**Would you like to be sent a Questionnaire?**

This will provide us with information about your flood experiences, your views on floodplain management measures, and other issues that you feel are important.

☐

Yes

☐

No

**Would you like to participate in a workshop?**

The workshops are scheduled to commence in late November. They will provide more information about the study and allow you to have your say in the floodplain management plan that is prepared.

☐

Yes

☐

No

**Are there any issues that you would like the study to consider?**

Please provide your comments below, or provide your contact details so we may call you.

☐

Yes

☐

No

**Other Comments**

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**Contact Details** *(Please complete if you answered yes to any of the above)*

Name:

Address:

Telephone Business:  Home:

*Thank you for your participation in this study*

## Georges River Floodplain Management Committee

For more information:  
Please visit the study web site at [www.bewsher.com.au/georges.htm](http://www.bewsher.com.au/georges.htm)  
or contact your Council liaison officer

6<sup>th</sup> December 2002

«Name»  
«Other\_Name\_Organisation\_etc»  
«Street\_Address»  
«Suburb»

Dear Sir/Madam,

### Ref: Georges River Floodplain Management Study

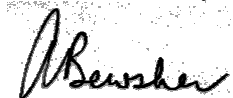
Thank you for your interest in the Georges River Floodplain Management Study, and for taking the time to complete the response form that was distributed to residents in late October. We are now pleased to enclose a copy of the Study Questionnaire, which you requested.

The questionnaire will provide us with information on your flood experience and your attitudes to the types of controls Council should consider for development. The questionnaire also provides a range of measures that could be considered to minimise the effects of flooding from the Georges River. Your opinions on these measures, and any other measure you think should be considered, will greatly assist our study. Please feel free to also raise any other issues or concerns that you would like the study to address.

We would appreciate it if you could complete the questionnaire and return it to us in the reply paid envelope by Friday 20<sup>th</sup> December. Please note that no postage stamp is required.

Again, thank you for your interest in the study. We look forward to receiving your views on the study through the questionnaire.

Yours faithfully,



Drew Bewsher  
Georges River Floodplain Management Committee  
(Bewsher Consulting)

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Project partners in the Georges River Floodplain Management Study



# GEORGES RIVER FLOODPLAIN RISK MANAGEMENT STUDY

## IMPORTANT COMMUNITY QUESTIONNAIRE FOR RESIDENTS AND BUSINESSES

### ARE YOU "FLOOD READY"?

What if a very large flood, like those that struck the Georges River more than 100 years ago, happened tomorrow? Rather than 'if', it is 'when' a big flood like this happens again. Are you "Flood Ready"? There would be many of you who have not experienced a 'big flood'. Would you know WHAT to do, WHERE to go and WHO to contact? This will be one of the key issues of the **Georges River Floodplain Risk Management Study**, currently being undertaken jointly by Sutherland Shire, Bankstown, Fairfield and Liverpool Councils.

This questionnaire will help us determine the flood issues that are important to you. If you have a residential property near the Georges River, please complete Parts A to F. If you have a business property, please complete Parts A to G.

**Please place your completed questionnaire in the postage paid envelope provided and return it before FRIDAY 20 DECEMBER 2002**

**No postage stamp is required.** If you have misplaced the supplied envelope or wish to send an additional submission the address is: **Reply Paid Permit Number 32**

**GEORGES RIVER FLOOD QUESTIONNAIRE**

**Bewsher Consulting Pty Ltd**

**P.O. Box 352, Epping NSW 1710**

Your Address (optional) \_\_\_\_\_

Name of Business/Organisation (if applicable) \_\_\_\_\_

### PART A — YOUR FLOOD READINESS

**1. Do you think your property could be flooded sometime in the future?**

a. No 29%                      b. Yes 63%

Could you please supply some details below:

\_\_\_\_\_  
Details provided for 71% of respondents

**2. What information about flooding have you received about the property?**

(Tick one or more boxes)

a. No information whatsoever	33%
b. General advice from Council	38%
c. Flood levels from Council	22%
d. Viewed a Council Planning Certificate	10%
e. Information from Real Estate Agent	7%
f. Information from relatives, neighbours, friends or the previous owner	16%
g. Experienced flood myself	29%
h. Other (please specify _____)	2%

**3. Where would you expect to get information about what was happening if you thought a big flood was imminent (eg. what roads were cut, how high the flood might go, whether you needed to evacuate, etc.)?**

a. Door knock by Police or SES etc.	68%
b. Phone hotline	30%
c. Internet	10%
d. Radio	71%
e. TV	32%
f. Neighbours, relatives, friends, etc.	20%
g. Other (please specify _____)	3%

### PART B — YOUR FLOOD EXPERIENCE

**4. Have you ever experienced a flood at the property?**

a. No 62% (go to Part C)    b. Yes 34%

If yes, which floods?

c. June 1991	19%
d. April 1988	26%
e. August 1986	22%
f. June 1964	5%
g. November 1961	4%
h. February 1956	5%
i. Other (please specify _____)	5%

5. In the biggest flood you have experienced, was the property flooded above floor level of the main residence?

- a. No 43% b. Yes 8%
- If yes, what was the depth of water over the floor? 0.79m average
- What year? \_\_\_\_\_

6. In this biggest flood, what was the maximum depth of water over your grounds? (as best you can remember) 1.04m average

What year? \_\_\_\_\_

7. In this biggest flood, what was the actual warning time you received to take action to prevent possible flood damage?

- a. Less than half an hour 10%
- b. Half an hour to 2 hours 7%
- c. 2 hours to 6 hours 11%
- d. More than 6 hours 5%
- If more than 6 hours, how long? 15 hrs

8. In this biggest flood where did you hear the flood warning? (Tick one or more boxes)

- a. No warning whatsoever 14%
- b. Witnessed with own eyes 26%
- c. Police 3%
- d. State Emergency Service (SES) 6%
- e. Local radio 15%
- f. TV 12%
- g. Neighbours, relatives or friends 8%
- h. Other (source \_\_\_\_\_) 1%

### PART C

#### YOUR ATTITUDES TO COUNCIL'S CONTROLS ON DEVELOPMENT

9. Please rank the following development types according to which you think are the most important to protect from floods (1=highest priority to 7=least priority)

- a. Commercial or industrial 4
- b. Residential 1
- c. Essential community facilities 3
- d. Critical utilities 2
- e. Minor development and additions 6
- f. Recreation or agricultural land 7
- g. New residential subdivisions 5

10. What level of control do you consider Council should place on new development to minimise flood-related risks? (Tick only one box please)

- a. Prohibit all new development on land with any potential to flood. 29%
- b. Prohibit all new development only in those locations where it would be extremely hazardous to people and property. 38%

- c. Place restrictions on development such as minimum floor levels and/or the use of flood compatible building materials. 34%
- d. Advise of the flood risks, and allow people to choose how they would reduce flood damage. 13%
- e. Provide no advice regarding the potential to flood nor of the measures that could minimise potential flood risk. 0%

11. What notifications do you consider Council should give about the potential flood affectation of individual properties?

(Tick one or more boxes)

- a. Advise every resident and property owner on a regular basis of the known potential threat. 70%
- b. Advise only those who enquire to Council about the known potential flood threat. 15%
- c. Advise prospective purchasers of property of the known potential flood threat. 52%

### PART D

#### YOUR OPINIONS ON FLOODPLAIN RISK MANAGEMENT MEASURES

12. What floodplain risk management measures are most important to you?

Please list your 5 most favoured options in order. You can choose from the list provided in Question 14 or you can include your own options. (No.1 is your highest priority)

1. Dredge the river
2. Review/maintain existing flood mitigation work
3. Construct upstream dam(s)
4. Maintenance programs/clear unnecessary veg
5. Construct permanent levees

Please list your 5 least favoured options in order. (No.1 is your least favoured option)

1. Dredge the river
2. Enlarge bridges
3. Construct permanent levees
4. Flood proofing individual properties
5. Accelerate Voluntary Purchase Scheme

13. Are you aware of any flood mitigation measures that affect you and would reduce your flood risk should a big flood occur?

(Tick one or more boxes)

- a. Not aware of any measures 61%
- b. House built at minimum floor level 19%
- c. House raised 12%
- d. Flood compatible building materials 5%
- e. Area has finger or deflector levees 6%
- f. Area 'protected' by levees 7%
- g. Channel capacity has been enlarged 10%
- h. Known evacuation route 10%
- i. Other (please specify \_\_\_\_\_) 4%

**Have you received any information about these measures?**

a. No 71% Yes 14%

If yes, what information did you receive and who was it from? What you know about these measures? How do they affect you? Do you think they are adequate?.

Please use the space at the end of this questionnaire if more space is required.

**14. Below is a list of possible options that may be looked at to try to minimise the effects of flooding from the Georges River.**

This list is not in any order of importance and there may be other options that you think should be considered. For each of the options listed, please indicate "yes" or "no" to indicate whether you favour the option and think it should be investigated in detail. Please leave blank if undecided.

**Yes No**

Measures that modify the way a flood behaves

- |   |     |     |
|---|-----|-----|
| a. Increase capacity of bridge crossings                            | 35% | 36% |
| b. Dredge the river to increase capacity                            | 62% | 23% |
| c. Maintenance programs to clear river of unnecessary vegetation.   | 74% | 11% |
| d. Review/maintain existing flood mitigation works.                 | 86% | 1%  |
| e. Construct upstream dams/basins to temporarily store floodwaters. | 62% | 18% |
| f. Construct permanent levees.                                      | 52% | 25% |

Measures that modify properties

- |  |     |     |
|--|-----|-----|
| g. Accelerate the current voluntary purchase schemes in Moorebank and Milperra                             | 46% | 27% |
| h. Identify other areas where Council could offer to purchase the most severely flood-affected properties. | 56% | 20% |
| i. Provide funding or subsidies to raise houses above 100 year flood level.                                | 48% | 31% |
| j. Flood proof individual properties eg. by waterproofing walls, installing shutters                       | 29% | 43% |

Measures that control building and development

- |  |     |     |
|--|-----|-----|
| k. Ensure controls on future development in flood-labile areas (eg. minimum floor levels, controls on extent of filling allowed etc) | 78% | 7%  |
| l. Prohibit subdivision of properties within the floodplain  | 61% | 23% |
| m. Prohibit all rezoning for new development within the floodplain.  | 58% | 23% |

Measures that provide more information about flooding

- |  |     |    |
|--|-----|----|
| n. Improve flood warning both before and during a flood. | 87% | 2% |
| o. Improve evacuation and emergency assistance plans.    | 77% | 6% |

**Yes No**

- |  |     |     |
|--|-----|-----|
| p. Community education, participation and flood awareness programs.  | 73% | 8%  |
| q. Ensure all information about the potential risks of flooding is available to residents and business owners.                             | 84% | 3%  |
| r. Provide a certificate to all residents stating whether their property is flood affected and to what extent.                             | 70% | 11% |
| s. Making sure residents and business owners have a Flood Action Plan that outlines WHAT to do, WHERE to go and WHO to contact in a flood. | 76% | 6%  |
| t. Install flood markers (eg. on power poles) to act as reminders of heights of previous floods.   | 70% | 11% |

**PART E — ABOUT YOUR PROPERTY**

**15. What is your property?**

- |                        |     |
|------------------------|-----|
| a. House               | 93% |
| b. Business            | 5%  |
| c. Villa/Townhouse     | 1%  |
| d. Unit/Flat/Apartment | 0%  |
| e. Vacant land         | 0%  |
| f. Other (type _____)  | 2%  |

**16. What is the residential status of the property?**

- |                                 |     |
|---------------------------------|-----|
| a. Residential Owner            | 93% |
| b. Owner-operated business      | 3%  |
| c. Residential Tenant           | 1%  |
| d. Tenant operated business     | 0%  |
| e. Other (please specify _____) | 1%  |

**17. How long have you owned, lived at or conducted business at this property?**

average = 20 years

**18. If you are a resident, how many people normally reside in your house?**

average = 3.0 people

**19. Do you expect to undertake any further development on your land in the future?**

- |                                 |     |
|---------------------------------|-----|
| a. None                         | 65% |
| b. Minor extensions/alterations | 26% |
| c. New dwelling                 | 5%  |
| d. Dual occupancy (granny flat) | 3%  |
| e. Subdivision                  | 2%  |
| f. Other (please specify _____) | 1%  |

**20. Have you undertaken any steps to obtain approvals for further development on your land?**

- |  |     |
|--|-----|
| a. No                                      | 87% |
| b. Made preliminary enquiries with Council | 3%  |
| c. Engaged someone to prepare plans        | 1%  |
| d. Lodged plans with Council               | 1%  |
| e. Have approved plans but not proceeded   | 3%  |



[illegible]

(Tick one or more boxes)

- a. Please put me on your mailing list 86%
- b. Please contact me for a phone interview 18%
- c. I am interested in attending a meeting of Council's Floodplain Risk Management Committee 31%
- d. I am interested in attending one of the public workshops to be held later in the study to consider options for my area 43%

(Tick one or more boxes)

- |  |     |
|--|-----|
| a. Council's website   | 24% |
| b. Articles in local newspaper                               | 72% |
| c. Open days or drop-in days                                 | 22% |
| d. Community workshops                                       | 25% |
| e. Public meetings   | 34% |
| f. At formal Council meetings                                | 9%  |
| g. Through Council's Floodplain Risk<br>Management Committee | 40% |
| h. Other (please specify _____)                              | 14% |

a. No 90%                      b. Yes 3%

**24. Please provide more information here if required. More space is available on the back of Part G 'Supplementary Questions for Businesses' or please attach a separate sheet.**

This image shows a single page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, leaving small margins at the top and bottom. There are no vertical margin lines, no text, and no other markings on the paper.

**Name:** \_\_\_\_\_

**Address:** \_\_\_\_\_

**Phone (Home)** \_\_\_\_\_

**Best time to call is** \_\_\_\_\_

**Phone (Work)** \_\_\_\_\_

**Best time to call is** \_\_\_\_\_

**Fax No.** \_\_\_\_\_

**Email:** \_\_\_\_\_

Are you a member of any local community group? If yes, please specify:

---

[www.bewsher.com.au/georges.htm](http://www.bewsher.com.au/georges.htm)

**or contact one of the following:**

**Phone: 9868-1966**

**Phone: 9821-9381**

Georges River Floodplain Risk Management Study  
Community Questionnaire

## PART G — SUPPLEMENTARY QUESTIONS FOR BUSINESSES

Please complete this part only if you operate a business from this property.

### 25. Name of Business:

---



---

### 26. Which of the following best describes the type of building you operate your business from? (Tick one or more boxes)

- a. Industrial unit in larger complex ☐
  - b. Stand alone factory ☐
  - c. Stand alone warehouse ☐
  - d. Shop ☐
  - e. Office ☐
  - f. Education ☐
  - g. Club ☐
  - h. Community building ☐
  - i. Other ☐
- If other, please specify \_\_\_\_\_

### 27. What is the approximate floor area of these premises? \_\_\_\_\_ m<sup>2</sup>

### 28. How many employees are there normally working at your premises?

- a. 1–5 ☐
- b. 5–10 ☐
- c. 10–20 ☐
- d. More than 20 ( \_\_\_\_\_ employees) ☐

If you have not experienced a flood at this property, please go to Part F.

### 29. In the biggest flood, what action did you take to protect your property against flood damage?

- a. Took no action ☐
  - b. Moved vehicles ☐
  - c. Lifted carpet, stock, equipment ☐
  - d. Used sandbags to try to prevent water entering the premises ☐
  - e. Other action ☐
- If other, please specify: \_\_\_\_\_

### 30. In the biggest flood, was your business or facility closed or disrupted in any way (including any clean up)?

- a. No ☐
- b. Yes ☐

### If yes, for how long was your business or facility closed or disrupted?

- c. Less than 1 day ☐
- d. 1 to 2 days ☐
- e. 2 days to 1 week ☐
- f. More than 1 week ☐

### 31. During the biggest flood, were your premises flooded above the floor level of the main work area?

- a. No ☐
  - b. Yes ☐
- If yes, what was the depth of the water over the floor? \_\_\_\_\_

### 32. During the biggest flood, did floodwaters damage any of the following? (Tick one or more boxes)

- a. No damage occurred ☐
  - b. Vehicles ☐
  - c. Electrical equipment, machinery, tools ☐
  - d. Stock and other goods ☐
  - e. Carpet, furniture, fittings and/or office equipment ☐
  - f. Your premises (paint, structurally, etc.) ☐
  - g. Other part of your property ☐
- If other, please specify \_\_\_\_\_

### 33. During the biggest flood, what was the approximate cost to you (at the time) from the damage caused by the flood?

\$ \_\_\_\_\_

### 34. As a result of the biggest flood, did any of the following happen to you or any of your staff during or after the flood? (Tick one or more boxes)

- a. No problems experienced ☐
- b. Inconvenience or disruption to normal routine ☐
- c. Isolation (blocked by floodwaters) ☐
- d. Employees unable to come to work ☐
- e. Loss of business trade ☐
- f. Experienced general ill-health ☐
- g. Higher employee absenteeism ☐
- h. Higher insurance premiums ☐
- i. Considered selling/moving the business ☐

PLEASE USE THIS SHEET FOR MORE COMMENTS IF REQUIRED

[illegible]

**TABLE A1**  
**Issues Raised from Short Questionnaire**

ID	Issue Raised
<b>Bankstown</b>	
B4	Study should address the determination of flood risk categorisation and available flood warning time.
B14	Blocked drains, Property runoff.
B20	Concern over bank erosion of private property, which is reportedly due to waves from boats that use the river. No one is prepared to fund or undertake bank protection works on private property.
B30	Pollution during floods or otherwise.
B32	A study of the effect of flooding on the sewerage system, electrical supply, and phone service would be useful. Back-up generators could be considered. The relevant authorities could be invited for input to the study.
B33	The clearing of street drains so in a sudden downpour the streets don't flood.
B36	Traffic management & property access guidelines.
B37	What, if any, work is being done to involve insurance companies - to enable them to assess or cover flood risks?
B39	Clearing of rubbish that is dumped into the river or is washed in during high tides. Dredging of the river.
B40	Concern that Council permits solid fences, which stop the natural flow of water in a flood area, causing flooding to other houses.
B43	Post flood clean-up assistance.
B45	Would like to know how high Saltpan Creek can rise in a flood.
B47	Would like to know the location of appropriate response centres to contact in the event of flooding. Where are the nearest centres for each Council ward in Panania/East Hills?
B49	Effect on houses (new and old) - Is building allowed? What about new residential buildings?
B51	Dredge the river. Investigate the flood levee at Kelso and new development behind the levee. Concerned about the impact of the levee on flood levels and whether there is entitlement to compensation should flooding be caused by the levee.
B57	Would like to know the percentage of impervious developed area of catchment in 1873, 1986 & 1988. Concerned that development has and will increase flooding.
B62	Would like to know the maximum height that floodwater can reach and whether house raising is a practical solution.
B63	Smell and visual pollution from sewer pipe outlet into Little Salt Pan Creek from Main Sewer Line.
B65	The implementation of appropriate civil engineering works to eliminate/minimise risk.
B66	Concerned about how the study will affect their property, in particular their property value. Also concerned that a larger area of land is now affected by floodwater, despite much previous work being undertaken.
B67	What provision, if any, can be made to remove & store furniture.
B72	Current & future sewerage outflows, and plans to preserve and improve fishing health in the river.
B80	Management/Maintenance of drainage systems, especially between properties and Bankstown Golf Course.
B81	Approvals for development and building (and also drainage works) outside the flood area which impact on properties downstream. Lack of maintenance and clearing of drain, canals and creeks downstream from developed areas which results in floodwater backing up in developed areas.
B86	The effect of development at Bankstown airport - both proposed and completed - and how this will affect flood levels in commercial and residential districts nearby.
B89	Clean up of Mangroves as the over-population has congested the water.
B93	The impact of the growth of mangroves in the river systems on build up of silt and subsequent flooding.
B96	Impact of higher density housing, eg dual occupancies and townhouses or villa developments.
B97	Is there a working model of the flood plan program? How effective is the current flood mitigation program?
B101	My husband and his father were flood wardens in the 1956 flood at Georges Hall. Hanley Street was severely affected and Council bought all the houses (Garrisons Point). We moved our house to a higher point within our property.

ID	Issue Raised
B120	Alternative evacuation procedures other than by road.
B122	I have lived in Milperra for 32 years and I do not see a great improvement in the river water quality. River banks are not cleared on a regular basis - more maintenance could be carried out during drought times.
B123	Most concerned that Council can change the natural fall of the land by building up area around Killara Ave (Park), thus stopping natural runoff to river. This area has flooded previously and should the occasion arise again, natural flow would be impeded substantially.
B126	Clean out creek under Killara Ave so water can escape quicker.
B128	Concerned about drainage system at back of property. Her neighbour has built a 2 storey home resulting in water running onto her property.
B129	Restrictions on government bodies with land fill to allow further development where once floodwater flowed. Floodwater has now been redirected elsewhere, affecting other properties that were previously OK.
B130	Saltpan Creek should be dredged out, made wider and mangroves cleared. The creek has been spoiled with sludge. At one time you could catch prawns in it and it had the best green weed, but it has all been spoiled.
B138	Survey showed that one small corner of this property was affected by the 100 year flood. We have lived here for 30 years and this street has never flooded. We believe that the flooding notation should be removed from this property.
B139	The explosion of multi-development on single blocks and particularly the town houses built on the old dog track in Horsley Road, Panania. The impact on flooding was the main reason local residents were so against the development.
B140	Earthworks need to be done on the northern side of Milperra Road to protect the properties on the northern side of Milperra Road.
B143	All rivers need to be cleared of debris that may block flows. Flooding can also be caused by uncleared gutters.
B144	Removal of silt on a regular basis from Lucas Drain to prevent flooding in minor situations.
B145	Concern that Lucas Drain is not cleared of silt on a regular basis. As a result, heavy rain frequently results in flooding problems. Particular problem area is near the culvert under Henry Lawson Drive, which is an eyesore and a health risk.
B146	Many residents at Carinya Rd use the Reserve as the access to their property, even though Council has requested access is to be from Carinya Rd. This situation is not only bad for the Reserve but could be a considerable problem should there be a flood. In 1986 trees fell across the roads cutting off access roads. Cars were left stranded and required emergency services.
B148	Removal of Debris after Floods & High Tides
B160	Flooding problems on Little Salt Pan Creek, on road from No.59 Virginius Street to end of street. Has flooded once in 30 years and close to flooding on a number of other occasions.
B169	Witnessed the 1986 flood at East Hills. The grounds of Kelso Park have since been raised and no further flooding has occurred.
B177	I think it is a good idea to develop this kind of study, so residents can be prepared. I would be interested in knowing more about the river.
B178	We have recently moved to this address and were aware that we are in the 100 year flood zone. Would appreciate any updated information on the ongoing management of this beautiful area.
B180	Study is a waste of money. Money should be used to plant trees along Rabaul Road to make it look more suburban.
B182	Lived at this address for more than 53 years and have not experienced a flood on this property since 1946.
B185	Enquiry concerning the status of levees that were proposed along the river following a management plan prepared after the 1956 flood.
B189	Would like the study to consider dredging of the river.
B193	Received a Letter from BCC that their property was not flood prone.
B194	Home in Iberia St, Padstow is classed as flood prone. Major drainage reconstruction took place in 1994, and a subsequent study recommended the lifting of the flood zone. All results lost in the Council fire. Would like to see Iberia street rezoned.
B196	I would like to know what effect the works in Amaroo Reserve are likely to have on any flood situation.
B197	All property owners should be advised of evacuation centres. Need to plan where we will need to go.
B208	Would be helpful if the maximum extent of flooding were overlaid on relevant street directory maps and provided to residents.
B209	Very concerned with further development of Bankstown Airport, which would have an impact on flooding. Also increased density of new houses being built. Also reluctance of Council to clean and cut back local bushland.

ID	Issue Raised
B210	Concern over impacts of global warming and rising ocean and river levels on natural flooding.
B211	1988 flood rose 2.1m above the high water mark, and my waterfront land and boatshed at Picnic Point were badly affected. The water would need to rise another 2.6m above that level to affect this residence and property.
B215	Evacuation Procedures, exits roads, effects of University grounds on possible flooding.
B219	What future development is Council planning at the old Bankstown tip area? Would like more information on proposals for this area.
B226	Wildlife concerns during flooding.
B233	Impact on drainage caused by leaves and branches blocking drains
B234	Feels that it is unlikely that this property could be affected by flooding. Is there any information available showing the extent of the 100 year flood?
B236	I have been a resident of the area for over 50 years, including my involvement in the 1956 floods. I feel I could contribute to the study and would like to be involved.
B237	Flooding is always a concern in these areas and I would be interested in participating or assisting in such a study.
B240	Some information on the likelihood of a flood occurring to break the current drought.
B250	Redevelopment of Bankstown airport & effect on flooding. Also change in land use of golf courses close to the river and possible increase in flood problems.
B259	Main problem is access. Employees are unable to get to work in moderate rain, which impacts on business. Other problems include backing up of water in the canals that feed into the Georges River.
B267	Deepening and/or widening the Georges river and its feeder streams where silt has built up due to man made structures (such as the road bridge on Henry Lawson Drive over Salt Pan Creek. Another problem area is at Deadmans Creek where it joins the Georges River.
B273	The study needs to consider the impact on persons already living in areas designated as flood prone - their amenity, investment and lifestyle - and their ability to make decisions about their lifestyle and property without undue beaurocratic influence.
B274	Concern over land filling operations in the area. Widen the river in narrow areas.
B276	Can be flooded by both the Georges River and from runoff that is trapped by the park at the western end of Lawson Street and diverted into private property. This has happened on two occasions. Suspect there is no drainage from the park to the river.
B277	Concerned that the East Hills footbridge has not been repaired/replaced. Would like to know when it will be opened.
B278	Would like to know statistics or estimates on how high the 100 year flood could get.
B283	Would like to participate in any activity to help the neighbourhood and help save our home.
B286	Concern over access from property being cut by the creek that flows through the front of the property. The neighbouring property has been filled to alleviate the problem, but Council will not permit filling of this property.
B292	The provision of adequate sewerage and drainage; as it appears that every house that is pulled down is replaced by 2 or 3 new ones. Also problem with stormwater drainage almost flooding this house.
B305	I don't consider my property as flood prone and hope it is not classes as such if I wish to sell.
B306	Stores Chemicals on site what to do.
B307	Concerns about the creek at Auld Ave
B310	Keep the Georges River free of pollutants, especially from Industry.
B319	Believe that business has come first over resident's safety. Development at Bankstown Airport (KFC, Tacobell & Burger King) has resulted in land being raised above surrounding residential land at Milperra, which will increase flood problems. It will be too late for Council to take action when there is a lot of rain. Council needs to take notice now. Why isn't anything being done about the development?
B320	Believe that this property is above any flood level.
B323	Build more dams and canals for the main water to run into.
B328	Concerned over impact of levee around Bankstown Golf Course and Kelso Park, and the filling of land opposite the airport on Milperra Road. All these measures will divert floodwaters to residential areas instead of over golf courses, open areas, etc. Also concerned over the issue of flood maps that could lead to devaluation of properties.

ID	Issue Raised
<b>Liverpool</b>	
L4	Flood levels in Bent Street raised in new sub-division, drainage problems
L10	Land fill in Voyager Point, new release of land and the use of land fill in new development
L12	Development Controls on flood prone land, Flood prone land should be recreation areas, residents need training for emergency evacuation.
L15	Flood mitigation methods
L22	Flood water removal
L24	Support from the Council to clean up the banks of the river
L26	Development along the river - older areas
L36	Best management practices for run-off from new developments.
L40	Impact of Hammondville Sports Fields on the area.
L42	Closure of Milperra and Newbridge Roads.
L45	Water heights are the sewerage, electricity, phone cut and access roads.
L46	Residential development upstream – Bringelly? What effects will stormwater have?
L48	What precautions are put in place for local flooding?
L51	Efficient management of access to waterways
L54	New Development, run off and flooding due to new development replacing open parklands and green space.
L55	Immediate response and direction by people on the ground who have been given authority to deal with it.
L56	Interested in how to help keep the river clean and healthy and free of rubbish.
L57	Council responsibility; changes to natural levels of land on the river flats where there are now residents.
L63	Vulnerability of transport links, details to residents of flood depths, duration and flow velocities, changes in flood patterns and catchment
L65	Regenerate flood plain areas rather than building.
L71	The provision of a map which shows high, medium and low risk areas along the river - to each property that is affected.
L72	Local flooding - stormwater drains not cleared of rubbish - people not keeping drains and gutters clear.
L74	Removing 100 year flood restriction on our land.
L75	What are the possibilities of a major flood in the next 5-10 years? What strategies are in place for the outlet roads eg. Governor Macquarie Drive; Riverside Road; and Barry Road, all of which are in drastic disrepair.
L77	Sand bagging strategy. Better mapping of real (1 in 50) with reference to 86 and 88 flood levels (1 in 100). Preparing your belongings could include 200L garbage tie bags for clothes, books etc.
L78	I am interested in revegetation of reserves with a limited number of suitable trees to back up the very old trees close to the bank.
L79	I have had no flood experiences directly, but I am interested to find out more about the Chipping Norton Lakes & Georges River and its water quality and projects that may be also underway.
L82	Concerned about the filling of creek beds or similar, for developments which could lead to a problem for existing housing which is currently above 100 year flooding - but within possible flooding levels which puts this level of housing at increased risk.
L83	Incentive to make homes safer upgrading of drainage systems.
L85	Where Anzac Creek goes under M5 & Heathcote Road in a moderate storm the water backs up.
L86	The 1986 flood at East Hills was for a short duration. Was it caused because of the choking affect of the river plain downstream near Carinya Ave? After a prior flood the people living there managed to have lesser block fences and earth brought in to make
L87	I have lived in Liverpool since 1940 and have experienced periodic floods since then. 1956 was the worst. Albert Childs Mayor of Liverpool in 1940 took me around Moorebank Chipping Norton other areas including the old tip (now called Lighthorse Park).
L88	I would like to talk to somebody regarding the parkland at the western end of Riverside Road at Chipping Norton, which has not been opened and has mounds of dirt and weeds growing in the park.
L92	Consideration of the damming of the Georges River at Georges Hall, with a view to having a fresh water lake in the metropolitan area for Liverpool Fairfield/Bankstown Councils usage, ie, gardens etc.

ID	Issue Raised
L93	Likely water level at each suburb (on street, house) in the event of 'very rare flood' a detailed evacuation plan, drill (?) Impact study on house prices in flood affected areas.
L94	Please it is necessary to indicate a height to the area you have indicated in your regional map as compared to your 1956 flood level. It would be an idea to install a height-gauge on say a few spots an Governor Macquarie Drive or a comparison to the 1956
L103	I have photos of the floods mentioned and at one time I was a dredge operator on the Georges River working for T Gal Ex Mayor Liverpool when the floods took all our lines and reached up almost Newbridge Road from Epsom Road.
L104	I would like to know when a workshop will be (weekday / weeknight etc) and whether sign language interpreter for the deaf can be provided.
L105	If there is ever a flood in the Chipping Norton area, why hasn't Liverpool Council widened Governor Macquarie Drive, to accommodate the extra traffic that would be generated when residents evacuate??? There is plenty of land to do this and there is very l
L125	With the very serious risk of bush fires destroying homes this summer perhaps it would have been appropriate to include information covering that topic.
L129	Will it affect land valuations?
L135	The choking effect of the box drains which are in the creek to the west of our property with particular notice being taken of the box drains which pass under the M5 Motorway. It has been my experience in recent downpours that the drains do not cope with
L141	Williams Creek flooding at Voyager Point.
L145	Does the water retention system (reserve) on the corner of Yachtsmans Drive and Frank Oliveri Drive make any difference to the drainage of Chipping Norton's Lakeside estate? We were told when we purchased the land that it would.
L149	I would like the Harris Creek near Holsworthy train station to be dug out throughout the length of the creek. Beginning from its mouth, the Georges River at Voyager Point so that it becomes a nice flowing creek instead of what it is a the moment - stagnant
L151	Impact upon insurance as a result (potential) of find of study.
L152	Trees are our main concern, we built our home back in 1980 when this area was just starting up we were told that it was going to be the gate way to Liverpool, with landscaping on the nature strip opposite. The nature strip has been planted with Gum trees
L156	Probably of a selfish nature: "What particular management work is being considered or carried out in the Chipping Norton area!"
L159	Recent floods in Europe were an abnormal situation. No one can prepare for that. Georges River floods quite regularly and the water levels and their impact on the area are well documented. Some 20 years ago I did attend a flood demonstration, at Manly
L161	Keep me informed of the proposed developments. Good Stuff!!
L163	Would like to see AHD (Australian Height Data) or dive in one hundred flood levels marked in every street so that people are able to access their property's and street's exposure to flood levels.
L165	Preventing rubbish going into drains and rivers that can increase severity of flooding.
L172	Have the flood levels of 1 in 100 years, 1 in 20 years etc. changed in the last 10 to 20 years? Will these levels be effected now that sand dredging has stopped in the river at Chipping Norton?
L174	Insurance coverage? How impact could be minimised? Readiness of the SES to deal with flooding?
L178	The amount of new development and drainage into the river since 1986. How this would effect water flows when the river is in flood. Because flooding last time did not come from the river but up through the drains in to the streets.
L184	The clearing on a regular basis of stormwater drains to prevent road flooding.
L185	Basically I would like to know the current flood risk for my street and to what level the water could reach as a maximum, as current Council regulations are to build .05m above sea level.
L187	The study should consider the impact, if any on "classification" and its influence on insurance companies and their policies in respect to flooding.
L188	We own property in Chipping Norton and Pleasure Point.
L195	Planning is required to identify "safe areas" within the flood zone where livestock and goods might be stored dry and safe. Affected local residents and businesses would have access when flood warnings are issued, eg furniture, horses etc
L201	I am older and lived at Flinders Road, Georges Hall from late 1937, for 28 years. Have lived in Warwick Farm and Chipping Norton for the past 30 years so, have experienced a few of the Georges River floods. Maybe I can give some help.
L204	Cleaning up of the Georges River foreshores, in the upper end of river in Chipping Norton area. If someone travels by boat up river, it will be obvious, if this is not this committees job please advise the correct parties.



ID	Issue Raised
L212	We are planning to build shortly. Is there a way that the height restriction of a flood affected property can be raised so that the house can be built with a higher ground level?
L215	Council stormwater drains are congested with rubbish, promoting water retention. Council constructed a footpath on the eastern side of Ernie Smith Reserve, no drainage or runoff. This allows water to "pond" between the houses in Gall Crescent and the foot
L216	What the chances are of the flood effecting us?
L217	I would specifically like to know whether my street is considered flood prone given that the 1873 flood (on the map) looks as though it covered the area now occupied by the suburb of Wattle Grove.
L221	Environmental impact measures to reduce flood risk may have.
L223	The drains on Newbridge Road opposite Flower Power don't seem to cope with excess water.
L226	We are particularly interested in how Council plans to reduce the risk of flooding is this to include improved drainage systems, building up riverbanks, retaining walls etc.
L229	How has recent development of land between Chippenham and Ascot Drive affected water run off and build up of water to surrounding houses? Is there was a 5 metre valley stretching for the length of Chippenham and width of being the length of Bent Street.
L232	During rain periods some yards of houses in this street have problems with drainage from back up through drains in the street. Ring Council and they don't come near your for 3 weeks after the rain has subsided.
L239	Do you have a map which shows the worst case scenario superimposed on the Gregory's style street maps? Are the mounds of earth, in the reserve east of the WM Long Bridge?
L244	Just, the 1986 flood came within 50 yards from my house, in Greenwood Close, Hammondville. I took a video of duck swimming at the end of my block.
L247	We are concerned about runoff from new subdivisions and the large lot of land between Pleasure Point Road and Voyager Point (ex bushland)
L249	I think some study should be done on the dredging of Clinches Pond to remove all the bark and wood chips that the Council let be washed into it. I think this could be a factor in flood time.
L251	How we can prevent / divert impact?
L268	In the event of my home being listed as flood prone. Where do I stand in regard to future insurance coverage.
L270	If there are previous flood level records available, maybe those figures can be plotted as a graph to make people aware that what potential flood risk is around this area.
L271	Are people discouraged by Council to purchase our homes?
L273	Progress on clearing of houses at Milperra Bridge. I know this well overdue however I am sending in case you have not finalised workshops etc. I have been resident a Charlton Avenue since 1976. Have seen a few floods.
<b>Fairfield</b>	
F1	Not only flooding caused by the rising of The Georges River but also run off from housing as back in 1873 there would not have been the housing that is around today
F2	I would like to take part in the workshop or at least be kept informed. My availability due to work commitment is a problem. I have been a resident in Lansvale since 1990. The beautification the parkland and better boat launching facilities for local fisherman. Is a new wider boat ramp. Our parkland and water access compared to the Chipping Norton side is disgusting. Pollution is also a factor to be considered socks must be placed on all discharge points into the river system
F3	Better cleaning up Prospect Creek of rubbish and noxious weeds and trees along the lower Prospect Creek Lansvale East from the Hume Highway to the junction of Georges River where the Prospect Creek and Georges River join.
F6	The impact further development of land in the catchment area has on flooding
F9	Prospect Creek dredging and Georges River catchment dredging to accommodate excess water/regular policing of polluters around the area
F10	Units and buildings built 2001-2002 Cnr Knight St & Hume Highway Lansvale that's where Prospect Creek first break bank between Caravan Park and Lansvale Bridge Hume Highway. Now with elevated ground approx. 1 1/2 metre filling higher making a dam, water will now go down Knight St now rather than old low ground to Day Street
F11	I would suggest that previous studies in the past be considered:- 1) The Chipping Norton Lake Planning Study (Cox & Corkill P/L Planning and Environment Oct 1977). 2) Water Resources Commission NSW Mitigation works, Fairfield City April 1983. 3) The Chipping Norton Lake Authority Act, passed by State Parliament in 1977 under which the Minister for Public Works became the Chipping Norton Lake Authority. I'm sure the above studies would benefit the committee.
F12	Free and quick movement of water down river

ID	Issue Raised
F13	I think you will find letter written after 1986 & 1988 + 1991 from my late husband, Mr Colin Strandgard sent to Fairfield Council concerning these floods just so you can tell how deep it truly was at this end of Lansvale.
F14	See completion of Lansvale foreshore embankments and pathways, see completion of parks area on Lansvale peninsula, see foot/bike bridges across Prospect Creek and Georges River.
F15	Issues to consider are in relation to 490 Hoxton Park Road site, which houses Integral Energy Depot. This site was once flooded in the past.
F23	I came to Lansvale in 1954, and until January 1971 lived in Beach Road which was subject to many floods. Luckily I haven't had any floods since living in Mars Place.
F30	We have already had 2 floods hope no more
F40	May I ask is there any chance in the future that "Lansvale" area will be flood? I mean which is the main parts or areas of Lansvale will actually occur flooding?
F41	I would be happy to help the Floodplain Management Committee in this serious issue, but my husband and I are old people
F43	My property is currently, just outside the 100 year flood area, if I understand correctly my property will be rezoned as Low Flood Risk so, in effect I am going from having no flood zoning on my property to being flood zoned. My question is this, what effect will that have on my insurance and land value?
<b>Sutherland</b>	
S4	I am interested to know about flooding in Illawong - what depth it floods to. What is the position now - have things improved?
S8	That Councils are consistent in their administering of any rules that may be voted for and not to succumb to the desires of individual applicants who have the expertise, money and fortitude to fight Government bodies as against those who are battlers or are less educated and not be financial enough to mount a fight against "City Hall"
S10	The effect of future residential development further up the river - recent newspaper reports 30,000 homes being planned for Bringelly area - the storm water from which will flow into the Georges River.
S11	Make sure you consult residents who have lived in the areas for the past 40-80 years as they have more idea of reality regarding floods than someone behind a desk making predictions. Put the two resources together and you should come up with something fair and applicable for everyone. PS Water conservation would be more applicable at this time considering the dry spell we're going through at the moment Eg. Water tanks etc.
S13	How to control "Building" on the floodplain like what happened at Sandy point
S15	The impact on services infrastructure such as sewerage, water, gas and electricity.
S16	I was Involved with evacuating people from cottages near the Illawong – Lugana Ferry on many occasions and from memory the late 1940's and possibly 51/52 floods were more impacting Illawong than the 1956. It would be interesting to overlay the effect of tide and the siltation of Jewfish and Gungah Bays on the impedance of flow through Como bridge.
S21	In my local area of Illawong flooding has been rare, this I know from personal experience and my father's recollections. He has known the area since the late 1920's. Local flooding only occurred during unusually high rainfall and unusually high tides.

**TABLE A2**  
**Issues Raised in Detailed Questionnaire**

No.	Locality	Issue Raised
127	Cabramatta	When I bought my property Council had given me permission to build but had never told me up front that the property was flood affected. Only after 5 years Council gave me a letter stating that my land was flood affected in the 100 year flood. I complained to the general valuers for my land valuation and he said that Council has given them notice that my property was flood prone every 100 years. If I wanted to increase my land value that I had to go to court. This attitude from Council is very rude and bureaucratic. Council is there to help people and not to rip off or degrade people to make a profit. I hope my situation is considered and taken into account.
17	Chipping Norton	At Carinya Road, Picnic Point, after a flood, the residents living on the section where houses flooded complained. Construction of better brick fences and earthwalls then occurred. This choked this section of the river and the next flood was at East Hills only to houses that were not flooded in two previous floods. This was a flood that lasted less than 3 hours, which suggests the choking of the river downstream. If I remember, no houses were flooded in Carinya Road. If a larger flood occurs and this choking stays, a higher level of flooding will occur in Moorebank, Milperra, Chipping Norton and Lansvale.
37	Chipping Norton	Could not go to work, roads blocked
46	Chipping Norton	Development controls and requirements for some types of developments above 1:100 level may be appropriate. For example, there are areas above 1:100 but close to Georges River. If development density is increased, eg conversion to medium density housing, requirements for runoff controls, detention basins, etc. may be desirable. Impact of flood events could be reduced by identifying and addressing local "hot spots" ie areas where there are problems such as local road disruptions. While these may be considered local rather than catchment flooding, they could be a large impact as they are often frequent and impact on many people.
51	Chipping Norton	I lived in Flinders Road, Georges Hall, from 1937 to 1964. Then in Manning Street, Warwick Farm, before coming to this address in 1984. I have not had any of my homes flooded at anytime but I am well aware there may be a problem here in the future. We had an acreage in Flinders Road and the water would come onto the back portion. I know how quickly the Georges River can overflow and cut off roads, etc.
111	Chipping Norton	Sea level controls river levels. Provide information on flood compatible building materials, please.
118	Chipping Norton	Road closed only. Our home does not flood but Newbridge Road at Flowerpower does and the drains always block in heavy rain and cause the road to close. I think they should be fixed to cope with the runoff.
134	Chipping Norton	Prevention is better than cure. The only way to prevent flooding is: 1) Stop (or slow) the water coming in. 2) Get the water out quicker. Remember the 1986 floods cost over \$40 million in damages. That money did not come from Government. It is important to let the insurance companies know that flood minimisation is also their risk minimisation.
136	Chipping Norton	One of the main problems is drains. We have one outside our place. In 14 years I have never seen Council inspect or clean it out. Also the tree roots have damaged the gutter causing water to build up.
137	Chipping Norton	Although I am naturally concerned about the impact of floods on my property, I also believe that information should be handled discretely and that it should not be published in newspapers as this could cause media hysteria and unnecessarily reduce house values. If it turns out that my house is unsaleable, I believe it is the government's responsibility to buy me out because I was not provided with adequate information when I recently purchased my property.
170	Chipping Norton	Regular communication is a must.
206	Chipping Norton	Residents in Chipping Norton don't realise how high the water level can and will rise. Advising individual residents with a certificate whether their house will be affected and to what degree will certainly effect people's attitudes to the damage that floods can cause.
28	East Hills	Why can't they get the bridge fixed? It must be 12 months now and nothing has been done to get it back in operation.
98	East Hills	Separate letter attached. No development upstream of Georges River. No more controls on 1:100 flood level. Consultation should be with 3 groups, ie. low, medium and high
148	East Hills	See attached map of proposal at Kelso Levee

No.	Locality	Issue Raised
161	East Hills	The river has never risen up to the corner of Burbank and Henry Lawson Drive. The highest it has come since 1970 was in 86 or 88 when it crossed the Drive where the stormwater canal comes under the drive, skirts around Monash Park and into the river. Possibly 6 inches to a foot over the Drive. That's the highest it has ever come in 100 years. Can't see it ever being worse than that unless some river further back inland were to be diverted into the Georges. Still I am no expert, that's just my opinion.
185	East Hills	Water only reached the bottom of lower fence (nearer river)
53	Georges Hall	Councils should stop further expansion of Bankstown airport. They also allowed the food outlet garage on corner of Henry Lawson Drive and New Bridge Road. I have seen all this land under 2-3 feet of water. Henry Lawson Drive near where we live should be upgraded above river levels with better drainage on both sides not just for a large flood but for the general flooding which happens often.
72	Georges Hall	This house was moved to higher ground. Suggest more mangroves in the river to stabilise the banks.
92	Georges Hall	After reviewing the web site, we found no evidence as to why the present flood categories should be changed. The only apparent reason is to make the Council less liable for flood damage. But this does not help us as we stand to lose many thousands of dollars on our property price should it be rezoned into a flood area. I strongly object to completing a questionnaire which suggests that things have changed and we are now living in a flood zone. Your questionnaire does not provide scientific evidence. Please supply evidence such as street maps with proven new flood zone areas and flood mitigation work.
153	Georges Hall	Was flooded in 1990 when hail blocked the drains
109	Hammondville	All systems have drawbacks, as too many people are disinterested until there is a crisis. Sporting facilities and parks are satisfactory for less than 1 in 100 year flood areas. All new major developments to include emergency storage to cover flash flooding generated by impermeable surfaces in the area developed whether in a flood zone or elsewhere.
184	Illawong	Flooding on Ovens Reach between Lugarno and Como has not been experienced by me nor have other generations talked of flooding in the past. The only sign of flooding has been where floodwaters came downstream and there were a few unusually high tides for a brief period.
7	Lansvale	Quite serious erosion of river banks. Many trees falling into main river course - potential blockage and hazard to rescue craft. Would like to see riverside pedestrian/cycleway developed along river banks/levees (Not Liverpool Council's Plan). In 86 flood highway and access cut. Regular cleaning of stormwater drains. Connect waterways/cycle paths on Lansvale Peninsula with bridges to Mirambeena and Chipping Norton tracks.
154	Lansvale	Why build residential subdivisions in floodprone areas?
188	Lansvale	There was 10cm of water in front yard only
189	Lansvale	As I am 73 years old I don't know what could be done. All I want to do is not see another flood, it's too stressful. Received levels from Council after we were flooded.
194	Lansvale	Flooding in street only.
203	Lansvale	The local native bird population is being threatened by the increased invasion of Indian Mynor birds and sparrows
204	Lansvale	House has been raised since the 1956 flood.
8	Milperra	There are a number of rocky outcrops impeding the flow of the river at the Kelso Beach area at East Hills. These may be removed or lowered to ease river flow.
44	Milperra	Ground absorption of water prevents river from flooding. Houses should be able to allow water to go to ground. Gutters are a fire hazard. In some countries houses are designed without gutters. Dredging the river for more water storage. The river water level is determined by the ocean level. Dredging will therefore do nothing, as the hole is already full. If you want to do something really useful, then widen the river in its narrow parts. Stop raising the levels of surrounding properties, eg. airport and factories on Milperra Road.
64	Milperra	I am concerned that the changing government attitude to flood mitigation will now incorporate properties developed after the decisions of what is a flood affected property made in the mid 1980s where properties were indicated free and constructed as non-flood affected blocks. Large storage areas, such as the airport, are filling areas to make commercial gain. The study should recognise current storage areas, public and private, and assist in reducing the impact on river flooding.

No.	Locality	Issue Raised
123	Milperra	What a silly place to put the Blue Gum Farm. It floods there. It would not flood if the Council would not fill in the floodplain where the water crosses. But the Council made a tip on swampland where the water should go.
207	Milperra	We back onto Bankstown Golf Course and are concerned as to the soil they have put on the practice range to grow turf. When it does rain now the water sits against our back fence & does not drain away. I think this needs to be looked at.
3	Moorebank	Over 4 years ago Council promised to clean creek at the E. Smith Reserve, nothing has been done. The stormwater drains from the street go into this creek. Consequently all the water backs up.
52	Moorebank	As stormwater pipes which lay parallel with the street under the footpath get blocked, the stormwater will have no runoff from the property and will flood. Excess water will come from Heathcote Road between Cooper Avenue and Market Street which will run into Market Street. Heathcote Road has been widened from 2 to 4 lanes.
41	Padstow	I cannot attend any meetings because my wife is disabled. Also I am not near the Georges River but I do have Rieby Creek running through my property, we have been promised since I have been living here and that is 41 years.
99	Padstow	We are totally frustrated at Council's lack of action. Drainage work to eliminate flooding completed in 1994. We were advised Council would take the 1 in 100 zoning away, and a survey was done. Instead the Council INCREASED the flood zone. Monty Python would be proud. No more surveys Council. Remove the flood zone at the lower end of Iberia. We began writing to Council in 1994. We were actually told all our correspondence was destroyed in the fire. We have copies should anyone be interested.
26	Panania	I would like to know what work is being done with Councils, Governments and Insurers to address flood risk assessment standards and creating a significant and equitable insurance option.
197	Panania	With respect, we say these are too complex for the everyday person, they are more in keeping with a barrister and an engineer. We know Council and its associates do a splendid job servicing the public. We have total trust and confidence that they shall continue to do so. When disasters like bush fires or flooding occur there is very little that anyone can do to stop them. We are of the opinion that the citizens should do more to keep themselves well informed of pending disasters.
19	Picnic Point	Council controls don't make sense and are mainly ignorant of local conditions. They change in interpretation under influence. Some can subdivide, some can't. Some can build at the front. Why? Garages and storage areas up the back, why? Walkways are dangerous, both before and during floods, ask the SES. Councils should provide advice, not controls, and stay out of our homes! Council should concern itself with levees, dams, weirs, and drains. Our area is tidal, the flood rises slowly new levees in place. We need to keep sightseers out of the area during floods and fires. We expect a flood and will put up with it. If they help us clean up that would be a bonus. What about a tidal control gate or lock downstream, eg. Menai bridge to stop the incoming tide raising the flood level 1-2m.
124	Picnic Point	I am affected by a lack of stormwater control from above my property and from the Georges River below my property. I have been affected by a landslide and have photos but Bankstown Council couldn't care less until a life is lost.
10	Pleasure Point	I am concerned about development and vegetation removal directly on river, eg. Voyager Point and the land between Voyager Point and Pleasure Point as trees reduce runoff.
177	Pleasure Point	The mangroves slow the water on the reserve and around the properties. The mangroves and other trees are slowly being removed by some residents and I fear the water speed near the houses will be much higher next time. We may need a deflecting levee in the next few years.
199	Sandy Point	The mandatory installation of rainwater tanks to be installed on all existing and new developments. Retention tanks installed for slow release of stormwater. No development below the 1:100 year flood line. Existing development below the 1:100 year flood line should contribute to evacuation programs.

## **APPENDIX B**

### **FREQUENTLY ASKED QUESTIONS**

(The questions included in this Appendix are typical of those that were raised during the public workshops, or in response to the short questionnaire that was distributed to residents in the study area. Answers to each question are included.)

## **FLOODPLAIN MANAGEMENT STUDIES**

### **FREQUENTLY ASKED QUESTIONS**

#### **Why do flood levels change over time?**

There is a chance that floods of various magnitudes will occur in the future. As the size of a flood increases, the chance that it will occur becomes rarer. Because some of these rare floods have never been experienced since European settlement, the height of future floodwaters is normally predicted using computer models. These computer models simulate flood levels and velocities for a range of flood sizes and flood probabilities. Given the importance of estimating flood levels accurately, councils and the NSW Department of Land and Water Conservation (DLWC) engage experts to establish and operate the computer models.

From time to time the computer models are revised and predicted flood levels can change. The resultant change in flood levels however is normally very small. The reasons why the computer models are revised can include:

- ▶ new rainfall or ground topography information becomes available;
- ▶ new floods occur which provide additional data from which to fine-tune the models;
- ▶ better computer models become available as the science of flood modelling improves and computer capabilities increase; or
- ▶ flood mitigation works may have been carried out, or development within the catchment may have occurred, that was not previously simulated in the models.

#### **How are these studies funded?**

These types of studies are normally carried out under State Government guidelines and are funded on a 2:1 basis between the State Government and councils. This funding arrangement is also available for the construction of flood mitigation works.

#### **My property is in a Low Flood Risk Precinct. What does this mean?**

The classification of a 'Low Flood Risk Precinct' can differ slightly between councils. Generally it means that your property would not be inundated in a 100 year flood but still has a very slight risk of inundation from larger (i.e. rarer) floods.

If you are a residential property owner, there will be virtually no change to how you may develop your property. However, there may be controls on the location of essential services such as hospitals, evacuation centres, nursing homes and emergency services.

### **My property is in a Medium Flood Risk Precinct. What does this mean?**

The classification of a 'Medium Flood Risk Precinct' can differ slightly between councils. Generally it means that your property is inundated in a 100 year flood, however conditions are not likely to be hazardous. If you are a residential property owner development controls will probably be similar to those that currently exist.

### **My property is in a High Flood Risk Precinct. What does this mean?**

The classification of a 'High Flood Risk Precinct' can differ slightly between councils. Generally it means that your property will be inundated in a 100 year flood and that hazardous conditions may occur. This could mean that there would be a possible danger to personal safety, able bodied adults may have difficulty wading to safety, evacuation by trucks may be difficult, or there may be a potential for significant structural damage to buildings. This is an area of higher hazard where stricter controls may be applied.

### **Will my property value be altered if I am in a Flood Risk Precinct?**

Any change in a council's classification of properties can have some impact on property values. Nevertheless, councils normally give due consideration to such impacts before introducing a system of flood risk classifications or any other classification system (e.g. bushfire risks, acid sulphate soil risk, etc). If your property is now classified as being in a Flood Risk Precinct, the real flood risks on your property have not changed, only its classification has altered. A prospective purchaser of your property could have previously discovered this risk if they had made enquiries themselves.

If you are in a Low Flood Risk Precinct, generally there will be no controls on normal residential type development. Previous valuation studies have shown that under these circumstances, your property values will not alter significantly over the long term. Certainly, when a new system of classifying flood risks is introduced, there may be some short-term effect, particularly if the development implications of the precinct classification are not understood properly. This should only be a short-term effect however until the property market understands that over the long-term, the Low Flood Risk Precinct classification will not change the way you use or develop your property.

Ultimately, however, the market determines the value of any residential property. Individual owners should seek their own valuation advice if they are concerned that the flood risk precinct categorisation may influence their property value.



**My property was never classified as ‘flood prone’ or ‘flood liable’ before. Now it is in a Low Flood Risk Precinct. Why?**

The State Government changed the meaning of the terms ‘flood prone’, ‘flood liable’ and ‘floodplain’ in 2001. Prior to this time, these terms generally related to land below the 100 year flood level. Now it is different. These terms now relate to all land that could possibly be inundated, up to an extreme flood known as the probable maximum flood (PMF). This is a very rare flood.

The reason the Government changed the definition of these terms was because there was always some land above the 100 year flood level that was at risk of being inundated in rarer and more extreme flood events. History has shown that these rarer flood events can and do happen (e.g. the 1990 flood in Nyngan, the November 1996 flood in Coffs Harbour, the August 1998 flood in Wollongong, the 1998 flood in Katherine, the 2002 floods in Europe, etc).

**Will I be able to get house and contents insurance if my house is in a Flood Risk Precinct?**

In contrast to the USA and many European countries, flood insurance is generally not available for residential property in Australia. Following the disastrous floods in Coffs Harbour in November 1996 and in Wollongong in August 1998, some insurance companies are now offering very limited flood cover. The most likely situation is that your insurer does not offer you flood cover. If limited flood cover is offered, the classification of your property within a Flood Risk Precinct is unlikely to alter the availability of cover. Obviously insurance policies and conditions may change over time or between insurance companies, and you should confirm the specific details of your situation with your insurer.

**Will I be able to get a home loan if my land is in a Flood Risk Precinct?**

Most banks and lending institutions do not account for flood risks when assessing home loan applications unless there is a very significant risk of flooding at your property. The system of Flood Risk Precinct classification will make it clear to all concerned, the nature of the flood risks. Under the previous system, if a prospective lending authority made appropriate enquiries, they would have identified the nature of the flood risk and considered it during assessment of home loan applications. As a result, it is not likely that the classification of your property within a Flood Risk Precinct will alter your ability to obtain a home loan. Nevertheless, property owners who are concerned about their ability to obtain a loan should clarify the situation with their own lending authority.

## **How have the flood risk maps been prepared?**

Because some large and rare floods have often not been experienced since European settlement commenced, computer models are used to simulate the depths and velocities of major floods. These computer models are normally established and operated by flooding experts employed by local and state government authorities. Because of the critical importance of the flood level estimates produced by the models, such modelling is subjected to very close scrutiny before flood information is formally adopted by a council. Maps of flood risks (e.g. 'low', 'medium' and 'high') are prepared after consideration of such issues as:

- ▶ flood levels and velocities for a range of possible floods;
- ▶ ground levels;
- ▶ flood warning time and duration of flooding;
- ▶ suitability of evacuation and access routes; and
- ▶ emergency management during major floods.

## **What is the probable maximum flood (PMF)?**

The PMF is the largest flood that could possibly occur. It is a very rare and improbable flood. Despite this, a number of historical floods in Australia have approached the magnitude of a PMF. Every property potentially inundated by a PMF will have some flood risk, even if it is very small. Under the State Government changes implemented during 2001, councils must now consider all flood risks, even these potentially small ones, when managing floodplains. As part of the State Government changes, the definitions of the terms 'flood liable', 'flood prone' and 'floodplain' have been changed to refer to land inundated by the PMF.

## **What is the 100 year flood?**

A 100 year flood is the flood that will occur or be exceeded on average once every 100 years. It has a probability of 1% of occurring in any given year. If your area has had a 100 year flood, it is a fallacy to think you will need to wait another 99 years before the next flood arrives. Floods do not happen like that. Some parts of Australia have received a couple of 100 year floods in one decade. On average, if you live to be 70 years old, you have a better than even chance of experiencing a 100 year flood.

## **Why do councils prepare floodplain management studies and plans?**

Under NSW legislation, councils have the primary responsibility for management of development within floodplains. To appropriately manage development, councils need a strategic plan which considers the potential flood risks and balances these against the beneficial use of the floodplain by development. To do this, councils have to consider a range of environmental, social, economic, financial and engineering issues. This is what happens in a floodplain management study. The outcome of the study is the floodplain management plan, which details how best to manage flood risks in the floodplain for the foreseeable future.

Floodplain management plans normally comprise a range of works and measures such as:

- ▶ improvements to flood warning and emergency management;
- ▶ works (e.g. levees or detention basins) to protect existing development;
- ▶ voluntary purchase or house raising of severely flood-affected houses;
- ▶ planning and building controls to ensure future development is compatible with the flood risks; and
- ▶ measures to raise the community's awareness of flooding so that they are better able to deal with the flood risks they face.

## **Will the Flood Risk Precinct maps be changed?**

Yes. All mapping undertaken by council is subjected to ongoing review. As these reviews take place, it is conceivable that changes to the mapping will occur, particularly if new flood level information or ground topography information becomes available. However, this is not expected to occur very often and the intervals between revisions to the maps would normally be many years. Many councils have a policy of reviewing and updating floodplain management studies and plans about every five years. This is the likely frequency at which the maps may be amended.

## **APPENDIX C**

### **Summary of Submissions received from the Public Exhibition of Draft Reports**

(Draft Reports and other information about the study were placed on public exhibition from 21<sup>st</sup> January to 5<sup>th</sup> March, 2004.)

# Summary of Submissions received from the Public Exhibition

## 1. Liverpool Council

### 1.1 *Submission concerning the draft Liverpool Flood Risk Management DCP*

This submission concerned the list of flood compatible materials that were included in Schedule 1 of the draft Liverpool DCP. The respondent did not believe that a prescriptive list of building materials should be provided. In addition, some technical matters concerning the names of products were raised.

Schedule 1 provides a list of flood compatible materials to be considered for new building applications that are sited below the 100 year flood. It attempts to limit the potential for flood damage and only applies to that part of the building that is below the 100 year flood (or the PMF in the case of sensitive uses and facilities). Schedule 1 is not intended to be a prescriptive list, but rather to provide guidance on the range of building materials that will limit potential flood damage.

### 1.2 *Submission from CARE Engineering Pty Ltd in relation to future development*

This submission was lodged on behalf of a commercial property owner on the Georges River Floodplain. Some concern was expressed that the proposed flood risk management DCP would unnecessarily prohibit all development identified within the high flood risk precinct, without the provision for merit based considerations that might facilitate development in some situations.

The development control matrix specified in Schedule 3 of the draft DCP does prohibit most land uses other than *recreation & non-urban*, and *concessional development* within the high flood risk precinct. However, there is provision for a change in the flood risk precinct of an area by filling or other means, provided that such activity does not increase flooding elsewhere.

There has been some further discussion with CARE Engineering on the above, and there are no longer concerns over this issue.

### 1.3 *Email from resident concerning the Liverpool Voluntary Purchase Scheme*

A Liverpool resident emailed the consultant seeking more information on the recommendation for the Liverpool Voluntary Purchase Scheme, that self funding initiatives involving the private sector be investigated with a view to completing the scheme. A response was issued to the resident providing further clarification of the proposed measure.

### 1.4 Letter concerning illegal filling on a particular site

This company raised concerns over the impact of illegal filling that had occurred on a particular site on flood levels at their property. Whilst the study has attempted to quantify the impact of all major filling activities within the floodplain, it has not been possible to include every instance where fill has been placed on individual

properties. The site in question was not flagged by Council as being a major activity, nor was this evident from an assessment of aerial photography. Consequently, an assessment of this particular site was not undertaken. The issue has been brought to the attention of staff from Liverpool Council, for further action if appropriate.

## **2. Fairfield Council**

Fairfield Council advised that there had been a number of general phone calls and enquiries at the counter on the draft floodplain management study and plan. Most of these concerned development issues in Lansvale, the proposed planning and development controls, and the Floodplain Risk Management Maps. No formal submissions were made to Council in relation to the study and plan.

One feedback form was received by the consultant from a resident in Knight Street, Lansvale. The resident indicated support for the floodplain management study and plan, and for the proposed planning and development controls. It was also suggested that Prospect Creek needed to be dredged from the Georges River up to the Hume Highway, and that overhanging trees and other debris needed to be cleared from the Creek. Specific works on Prospect Creek are covered by the Lower Prospect Creek Floodplain Management Study. Fairfield Council has proposed that a review of this study be undertaken, which will consider such options.

Council officers requested that the study reference other studies that have been undertaken on Lower Prospect Creek and Cabramatta Creek.

## **3. Bankstown Council**

### **3.1 Letter from the Insurance Council of Australia**

The Insurance Council of Australia strongly endorsed the draft Study and Plan, and the joint cooperation of each of the four participating councils.

The acceleration of the Liverpool Voluntary Purchase Scheme, through potential funding from private sector development, was particularly noted as these properties have little chance of obtaining any form of insurance coverage for flood damage.

Also strongly endorsed was the Study recommendation in relation to public awareness, and the concept of providing flood certificates for flood-affected properties.

In relation to insurance cover for riverine flooding, it was noted that *“the position has not changed very much to that which is outlined in the Study. For Insurance Companies to accept the transfer of the risk of flood damage they must be able to assess the risk and rate appropriately. Much of the concerns in the past, which influenced their decisions not to offer cover, were due to inappropriate development on floodplains”*.

It was also noted that *“Implementation of the Plan would be a significant step in addressing the major concerns of insurers in the area of development controls, data*

*collection and availability, transparency around planning issues and the absolute imperative of public education about flood risk and mitigation measures”.*

### *3.2 Submission to Bankstown Council*

This submission raises two issues. The first deals with the accuracy of the delineation of the different flood risk precincts; the second with flood insurance.

The submission proposes that the flood risk precincts need to be accurately defined prior to any notifications such as those contained on Section 149 Certificates. Also noted are difficulties that occur when only a small portion of a property is affected by flooding and that in some cases site plans may need to be prepared showing the actual portion of a property affected by the different flood risks.

It is a recommendation of the floodplain management study that airborne laser scanning be undertaken to provide improved topographic data to allow further refinement of the flood risk precincts. This survey was recently completed within both the Bankstown and Fairfield Council areas. Refinement of the flood risk precinct maps for these two Council areas could therefore commence relatively soon.

The issue on flood insurance refers to anomalies that exist for instances where insurance companies may or may not pay insurance claims. This is beyond the scope of the current study, and largely an issue for the Insurance Companies and the State Government.

### *3.3 Feedback form from resident of Henry Lawson Drive, Picnic Point*

Support was indicated for the floodplain management study and plan, and the proposed development controls. However, it was suggested that further clarification of the flood risk for waterfront properties along Henry Lawson Drive was warranted. The extent of the flood risk was also questioned, based on the resident's experience of flooding at this property. Some concern was also expressed on the amount of stormwater now entering the river as a result of recent development. It was suggested that dredging the river should be considered.

The study has recommended that additional information on flood risks for individual properties be communicated through the regular issue of flood certificates. The option for dredging was also considered as part of the floodplain management study, but was not recommended due to high capital costs and relatively low flood benefits.

### *3.4 Letter from resident of Carinya Road*

This resident believes that the existing flood controls on buildings in Carinya Road are both onerous and unnecessary, and should be removed. In particular, controls relating to walkways, breezeways and hard stands and garages above the 100 year flood level. He believes that the required walkways are dangerous, provide a false sense of security, and are an unnecessary cost.

One of the recommendations of the floodplain management study is that a review of the Carinya Road flood mitigation measures be undertaken. This would include a detailed review of flood conditions using a 2-dimensional computer model. A review

of the existing requirements for walkways and other flood related provisions would logically form part of this review.

#### **4. Sutherland Council**

Residents of Sandy Point in Sutherland Shire requested a public meeting to discuss the draft floodplain management study and plan. The meeting was held on 8<sup>th</sup> March 2004 at the Sandy Point Community Centre. The meeting was attended by approximately 30 residents, Bewsher Consulting, and staff from Sutherland Shire Council and the Department of Infrastructure, Planning and Natural Resources.

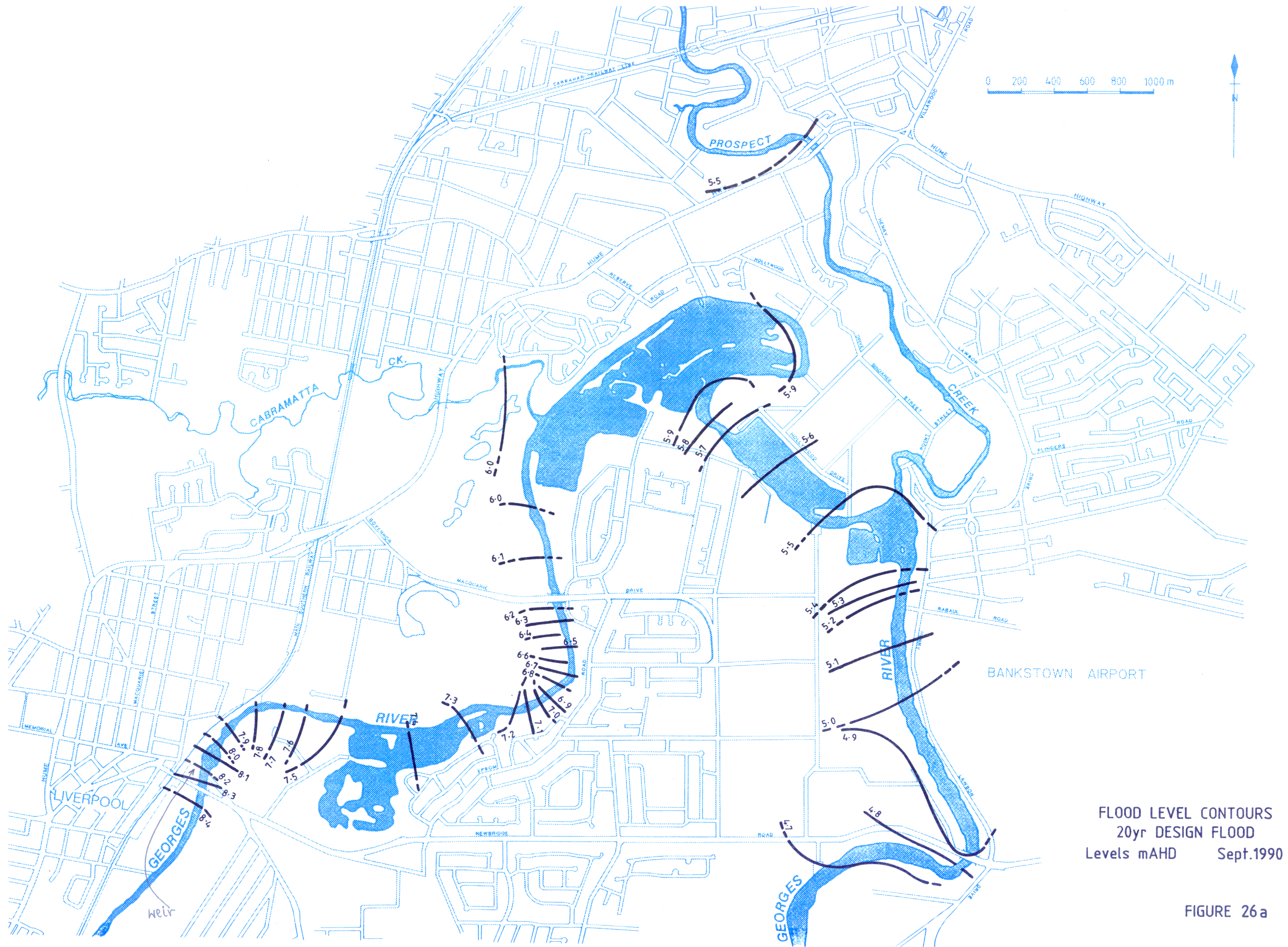
A presentation on the floodplain management study and plan was provided by Bewsher Consulting. This was followed by a general question period. At the conclusion of the meeting, residents were asked to forward any outstanding concerns or issues on the study to Council. No submissions were received.



## **APPENDIX D**

### **Flood Level Contours from the 1991 Georges River Flood Study Report [PWD 1991]**

No changes are proposed to the design flood levels previously determined from the 1991 Flood Study report. The relevant figures from that report are included in this Appendix.









FLOOD LEVEL CONTOURS  
50yr DESIGN FLOOD  
Levels mAH Sept.1990

FIGURE 27a













FLOOD LEVEL CONTOURS  
100yr DESIGN FLOOD  
Levels mAHD Sept.1990

FIGURE 28b

