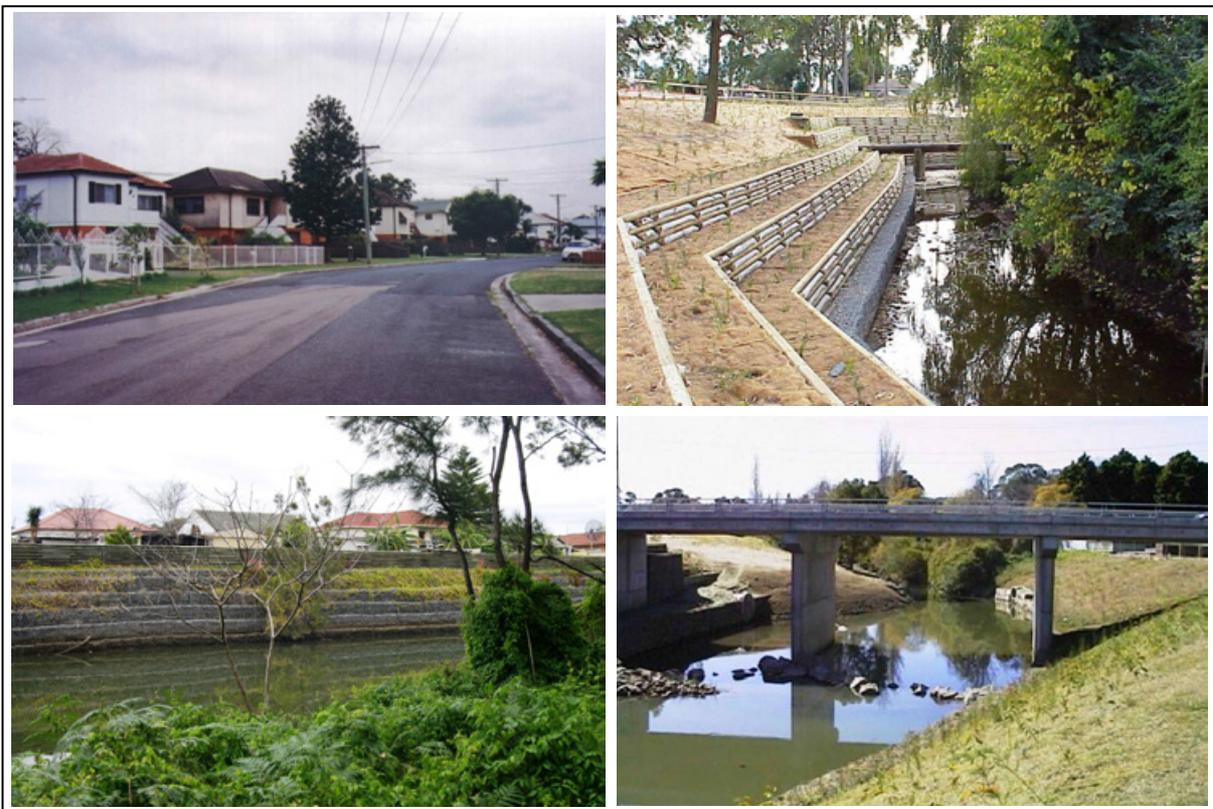




Prospect Creek Floodplain Management Plan Review



Final Report

March 2010

FAIRFIELD CITY COUNCIL

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PREFACE

The Prospect Creek Floodplain Management Plan was reviewed by Bewsher Consulting Pty Ltd for Fairfield City Council.

Funding and technical assistance was provided for the study through the Department of Environment, Climate Change and Water (formerly Department of Natural Resources) under the State Government's Floodplain Management Program.

This Plan is based on a review of previous floodplain management studies and other flood investigations carried out in the study area, including the *Lower Prospect Creek Floodplain Management Study* (Willing & Partners, 1990), the *Upper Prospect Creek Floodplain Management Study* (Willing & Partners, 1993), and the *Review of Prospect Creek Flood Levels* (Cardno Willing, 2004). The Plan reviews previous floodplain management measures proposed for Prospect Creek and provides a revised floodplain management plan for the full length of Prospect Creek.

A draft copy of the Plan was placed on public exhibition for a 10 week period from 16th December 2009 to 24th February 2010. No comments from the community on the draft Plan were received during this period.

The Plan will be further considered by the Fairfield City Council's Five Creeks Committee and Council prior to being formally adopted.

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SUMMARY

Reasons for the Review

A floodplain management study was previously prepared for Lower Prospect Creek (Willing & Partners, 1990) and Upper Prospect Creek (Willing & Partners, 1993). These studies provided a plan of flood mitigation works to alleviate flooding in Prospect Creek. The estimated cost of these plans was \$33M (1990) and \$1m (1993). Fairfield City Council has been implementing measures from both Plans since the early 1990's, with financial support through the State Government.

A significant flood was experienced along Prospect Creek in January 2001. A number of houses and property grounds were flooded during this event. A review of flood behaviour within the catchment was completed in 2004 (Willing & Partners, 2004).

Given the time that has elapsed since the two floodplain management plans were prepared, and subsequent information on flood behaviour from the 2004 Flood Study Review, it was considered appropriate to prepare a review of these plans.

The boundary between the two original studies reflected the jurisdictional boundary between the (then) Department of Public Works and the (then) Department of Water Resources, both of whom provided technical support and financial assistance for the development and implementation of these plans. These two Departments were subsequently amalgamated, and have recently been transferred to the newly created Department of Environment, Climate Change and Water. This removes the need to have separate floodplain management plans for the upper and lower creeks, allowing the development of a single, strategic plan covering the whole of the Prospect Creek floodplain.

Responsibilities

The prime responsibility for planning and management of flood prone land in New South Wales rests with local government. The NSW Government provides assistance on state-wide policy issues and technical support. Financial assistance is also provided to undertake floodplain management studies and plans, such as the current project, and for the implementation of works identified in these studies.

Fairfield City Council's Five Creeks Committee oversaw the preparation of the Plan. The committee includes councillors and staff from Fairfield City Council, staff from Liverpool and Holroyd Councils, officers from the Department of Environment, Climate Change and Water, the State Emergency Service and community representatives.

Study Area

The study area essentially covers the whole Prospect Creek floodplain, from its junction with the Georges River to upstream of Widemere Road. The lower reaches of Orphan School Creek and Burns Creek are also included in the study area.

History of Flooding

Long term flood records are available for Prospect Creek at Lansdowne Bridge, where records date back to 1860. The highest recorded flood occurred in 1873. It reached a height of RL 8.0m AHD at the bridge, which is approximately 1.5m higher than the estimated 100 year flood.

More recent floods occurred in August 1986, April 1988 and January 2001. The 1988 flood was the largest of these floods through the lower creek, reaching a height of RL 5.8m AHD at the Lansdowne Bridge. The January 2001 flood was a shorter duration flood that produced higher flood levels through the upstream catchment areas.

Consultation

Consultation has been an important component during the review of the floodplain management plan. Key elements of the consultation process include:

- i) presentations to Council's Five Creeks Committee;
- ii) individually addressed letters to all residents potentially affected by flooding;
- iii) three public workshops;
- iv) a community questionnaire; and
- v) exhibition of the draft Plan, prior to formal consideration by Council.

Flood Behaviour

A review of Prospect Creek Flood Levels was completed in 2004 by Cardno Willing using a two-dimensional hydraulic model. Further refinement and calibration of this model was undertaken during the current investigations. These model refinements are presented in Appendix A.

The revised flood model was used to simulate flood behaviour for the 20 year, 50 year, 100 year, and Probable Maximum Flood (PMF). Maps showing the extent of flood inundation and flood level contours for these events are included in Appendix A. These maps have been provided to Council as larger A1 size plans, and in digital format for inclusion in Council's GIS computer system.

The floodplain has also been delineated into three different flood risk precincts – termed *High Flood Risk*, *Medium Flood Risk* and *Low Flood Risk*. These flood risk precincts are based on the same classification adopted by Fairfield City Council in the Fairfield City Wide Development Control Plan (2006), and other floodplain management plans recently prepared for Council on the Georges River and Cabramatta Creek catchments.

The Flood Problem

A flood damages database has been prepared for the study area. The database provides information on close to 6,000 properties and buildings that are potentially affected by flooding up to the PMF event. There are a total of 406 homes estimated to be inundated above floor level in a 100 year flood in the Fairfield City Council study area. This includes:

- i) 6 homes upstream of the Granville Railway Line;
- ii) 245 homes between the Granville Railway Line and the Hume Highway; and
- iii) 155 homes downstream of the Hume Highway.

There are a total of 62 commercial and industrial buildings estimated to be inundated above floor level in the 100 year flood in the Fairfield City Council study area.

A number of regional roads and other access roads are also significantly affected by flooding within the catchment.

Flood Damages

A flood damage assessment has been undertaken for the catchment. This assessment indicates that:

- i) The total flood damage in a 100 year event is estimated at \$52M;
- ii) The estimated average annual flood damage (from all floods) is estimated at \$3.8M per annum;
- iii) The present value of flood damage (from all floods) is estimated at \$40M;
- iv) Most flood damage occurs downstream of the Granville Railway Line;
- v) Most flood damage is incurred by the residential sector.

Floodplain Management Measures Completed to Date

Significant progress has been made by Council in implementing measures identified from the previous plans for Prospect Creek. Measures implemented to date include:

- i) Substantial progress on the Prospect Creek Voluntary Purchase Program – 76 homes have been purchased to date (20 remain in the scheme);
- ii) Substantial progress on the Prospect Creek Voluntary House Raising Scheme – 204 homes have been raised above the 100 year flood level, or otherwise treated (an estimated 230 remain eligible for house raising);
- iii) Detention basins on Upper Prospect Creek have been modified to improve their hydraulic performance;
- iv) Floodways have been constructed opposite Justin Street and through Fairfield Park to reduce flood levels;
- v) Vine Street Bridge has been upgraded to lower flood levels and Vine Street raised to improve flood access.
- vi) Hollywood Drive was raised to improve flood access in the Lansvale; and
- vii) Other bank stabilisation and stream clearing measures have been implemented within the creek corridors.

The Revised Floodplain Management Plan

Measures previously recommended for Prospect Creek have been reviewed, and other new measures have been considered for inclusion in the revised Plan. Previous measures that are no longer recommended include:

- i) raising the Hume Highway;
- ii) relief Culvert under the Hume Highway;
- iii) floodway either side of the Hume Highway;
- iv) dredging of Prospect Creek;
- v) Vincent Crescent Levee; and
- vi) Carrawood Park Deflector Levee.

New measures that have been included in the revised Plan include:

- i) Vincent Crescent urban renewal option (in lieu of the levee proposal);
- ii) Water quality and quantity solutions for the industrial channel at Widemere Road;

- iii) amplification of the waterway area under the Cumberland Highway bridge, and immediately upstream;
- iv) a basin safety review for the major basins located throughout the Prospect Creek catchment;
- v) further flood warning initiatives;
- vi) review of the SES Local Flood Plan, particularly in relation to the availability of new flood level data and evacuation requirements;
- vii) additional climate change investigations; and
- viii) specific development controls for Prospect Creek that can be added to the flood risk management chapter of the Fairfield City Wide DCP (2006) as an additional schedule.

The revised Floodplain Management Plan for Prospect Creek is shown on **Figure 8.1** and is summarised in **Table 8.1**

Timing and Funding

The total cost to complete the revised Floodplain Management Plan is estimated at \$32M (2009). This is largely dominated by the voluntary house raising scheme (\$14.0M) and the voluntary purchase scheme (\$7.0M), which are on-going.

It is envisaged that the Plan will continue to be implemented progressively over the next 10 years. This timing will be dependent on the overall budgetary commitments of Council and the availability of funds from various sources (including State Government, Section 94 contributions, State Emergency Service, Bureau of Meteorology and other sources).

1 INTRODUCTION

1.1 BACKGROUND

Prospect Creek is a heavily urbanised catchment situated in Sydney's west. It is a tributary of the Georges River and includes the suburbs of Lansvale, Canley Vale, Carramar, Fairfield, Smithfield and Wetherill Park. The catchment is mostly located within the Fairfield City Council Local Government Area, although Holroyd, Bankstown and Liverpool Councils also share smaller parts of the catchment.

Major flooding was recorded along the banks of Prospect Creek in August 1986, and again in April 1988. These floods caused significant damage to residential and commercial premises within the catchment. Over 500 residential properties along Prospect Creek were estimated to have been inundated in the 1986 flood, with a total estimated damage bill approaching \$5M (ANU, 1990).

Floodplain management studies were subsequently commissioned by Fairfield City Council, which led to a program of flood mitigation works throughout Prospect Creek. The studies and flood mitigation works were divided into *Lower Prospect Creek* and *Upper Prospect Creek*. The boundary between these two areas was the Cabramatta-Granville railway line. This reflected the jurisdictional boundary between the (then) Department of Public Works and the (then) Department of Water Resources, both of whom provided technical and financial assistance for the studies and flood mitigation works.

The total cost of the flood mitigation works program was estimated to be in excess of \$34M (1990). Substantial progress has been made by Fairfield City Council in implementing the flood mitigation programs on Prospect Creek. This includes a mix of voluntary purchase, house raising, road raising, bridge works, creek improvements, and detention basin works. However, due to the size of the program, full implementation of the program will take many more years to complete.

Major flooding was again experienced throughout Prospect Creek in January 2001, highlighting the flood risk that still exists on Prospect Creek and the importance of Council's flood mitigation program within the catchment. *A Review of Prospect Creek Flood Levels* (Cardno Willing, 2004) provided revised flood levels throughout Prospect Creek, using a more sophisticated flood model and additional flood data for model calibration. The new flood level estimates will have some implications to the flood mitigation measures previously recommended. Given the passage of time since the previous floodplain management studies were undertaken, it is also an opportune time to review the recommendations from these earlier studies.

Bewsher Consulting was subsequently commissioned by Fairfield City Council to review the previous floodplain management studies on Prospect Creek, and to prepare a revised Floodplain Management Plan covering the full length of the Creek. Don Fox Planning provided assistance to Bewsher Consulting on town planning issues.

Fairfield City Council, and their Five Creeks Committee, has overseen the review of the Floodplain Management Plan. The Committee comprises councillors and council staff from Fairfield City Council, Holroyd City Council, Liverpool City Council, representatives from the Department of Environment, Climate Change and Water (now assuming the role originally provided by the Department of Public Works and the Department of Water Resources), the State Emergency Service (SES) and other community members.

1.2 THE STUDY AREA

The study area covers all area of land potentially affected by flooding (up to the probable maximum flood) along Prospect Creek, from upstream of Widemere Road at Wetherill Park to the Georges River at Lansvale.

Prospect Creek forms the boundary between Fairfield City Council and Holroyd City Council in the upper catchment area. The study area therefore lies within both council areas. The main emphasis of the study is to manage the flood risk within the Fairfield Council area; nevertheless, information from the study (such as flood levels and flood risks) will also be of assistance to Holroyd Council. Works within the catchment and floodplain, either previously undertaken or proposed as part of the floodplain management plan, will also have a direct influence on flood behaviour on both sides of the creek.

Orphan School Creek is a major tributary that joins Prospect Creek in the lower catchment. Orphan School Creek includes other smaller tributaries of Clear Paddock Creek and Green Valley Creek. Burns Creek is another tributary that joins Prospect Creek in the lower catchment. These creeks are subject of separate floodplain management investigations, and except for the lower most reaches of Orphan School Creek and Burns Creek, are not included in the study area for this project.

A map of the study area is included on **Figure 1.1**.

1.3 THE GOVERNMENT'S FLOODPLAIN MANAGEMENT PROCESS

The prime responsibility for planning and management of flood prone land in New South Wales rests with local government. The NSW Government provides assistance on state-wide policy issues and technical support. Financial assistance is also provided to undertake floodplain management studies and plans, such as the current project, and for the implementation of works identified in these studies.

A Flood Prone Land Policy and a *Floodplain Development Manual* (NSW Government, 2005) forms the basis of floodplain management in New South Wales.

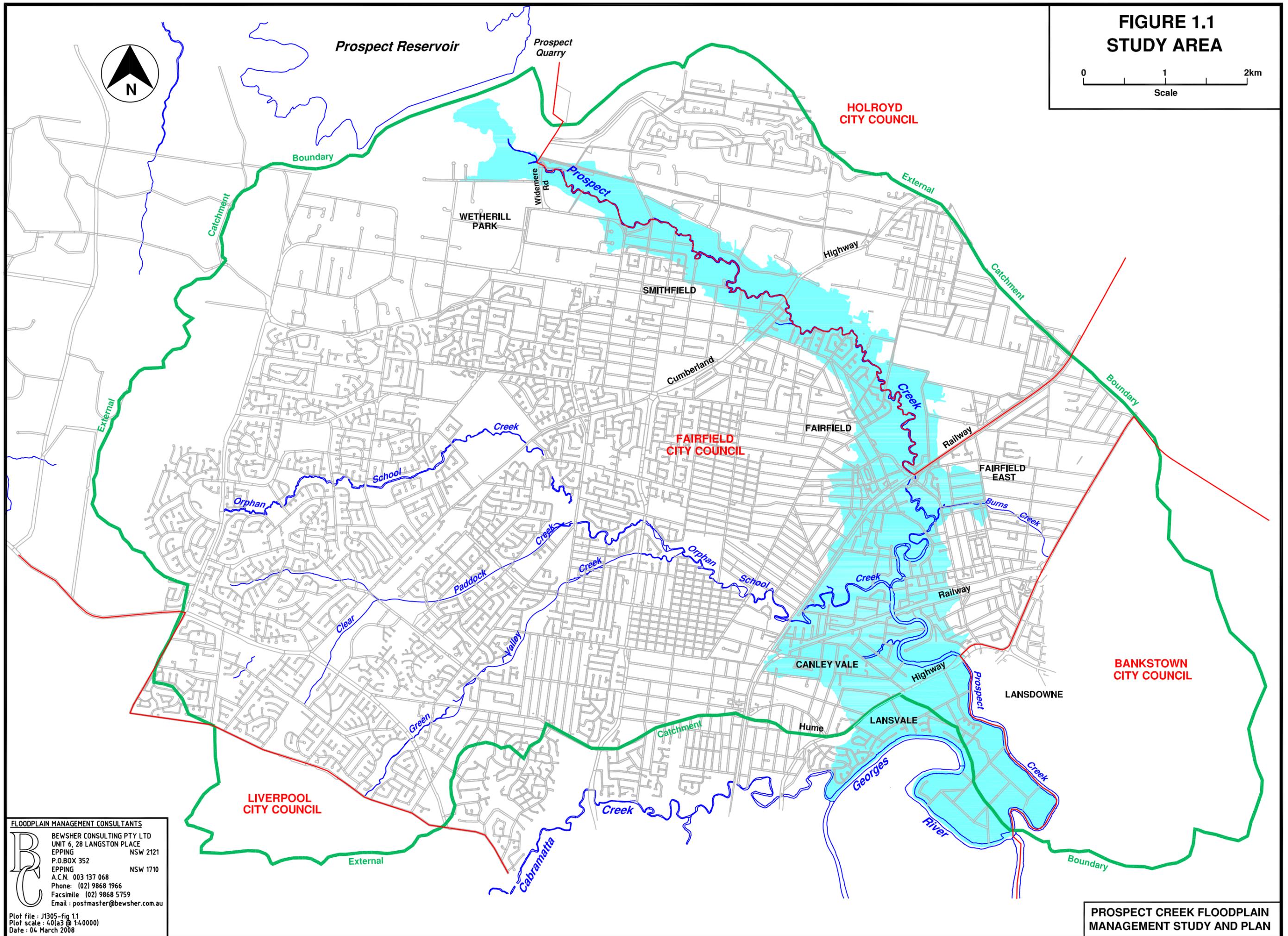
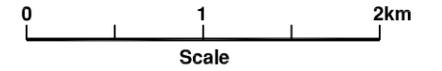
The objectives of the Policy include:

- i) reducing the impact of flooding and flood liability on existing developed areas by flood mitigation works and measures, including ongoing emergency management measures, the raising of houses where appropriate, and development controls; and
- ii) reducing the potential for flood losses in new development areas by the application of ecologically sensitive planning and development controls.

The Policy provides some legal protection for Councils and other public authorities and their staff against claims for damages resulting from their issuing advice or granting approvals on floodplains, providing they have acted substantially in accordance with the principles contained in the *Floodplain Development Manual*.

The implementation of the Flood Prone Lands Policy, shown on **Figure 1.2**, generally culminates in the preparation and implementation of a Floodplain Management Plan. The Policy also provides for the Plan to be reviewed from time to time, for example on a regular basis or after a significant flood event. Given the time since the original plans were prepared on Prospect Creek, and the data provided from the January 2001 flood, a review of the Prospect Creek Floodplain Management Plan is opportune.

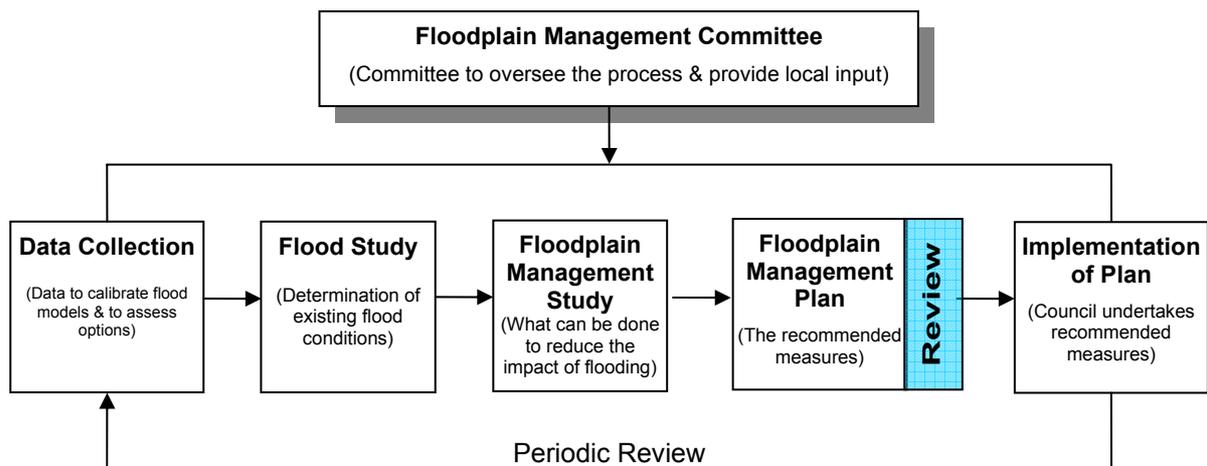
**FIGURE 1.1
STUDY AREA**



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Plot scale: 40(a3 @ 1:40000)
Date: 04 March 2008

**PROSPECT CREEK FLOODPLAIN
MANAGEMENT STUDY AND PLAN**



 Steps undertaken as part of the current study

FIGURE 1.2
The Floodplain Management Process

1.4 STRUCTURE OF REPORT

This report is structured as follows:

- Chapter 1 – Introduction to the Study
- Chapter 2 – Background information, including a description of the catchment, history of flooding and previous investigations
- Chapter 3 – A review of consultation activities undertaken during the review process
- Chapter 4 – Description of flood behaviour based on new model studies, including delineation of the catchment into different flood risk management areas, review of properties potentially at risk, and identification of road inundation problem areas
- Chapter 5 – A flood damage assessment throughout the catchment for a range of flood events
- Chapter 6 – A review of previous floodplain management recommendations
- Chapter 7 – An assessment of additional floodplain management measures that may be warranted
- Chapter 8 – An outline of the revised floodplain management plan for Prospect Creek

2 BACKGROUND INFORMATION

2.1 THE PROSPECT CREEK CATCHMENT

Prospect Creek commences at Prospect Reservoir and flows in a south-easterly direction towards its confluence with the Georges River at Lansvale. The creek is approximately 20km in length and has a total catchment area of 95km². Major tributaries include Orphan School Creek (including Green Valley Creek and Clear Paddock Creek) and Burns Creek, both of which join Prospect Creek in the lower catchment.

Prospect Reservoir was constructed in 1888 as a storage reservoir to augment Sydney's water supply. Sitting at the top end of the Prospect Creek catchment, the reservoir has little catchment area of its own (less than 10km²) and relies on water being diverted from the Nepean River system through a series of tunnels and open channels. Today the reservoir serves as a water distribution dam, allowing water to be transferred from Warragamba Dam to a number of smaller reservoirs around Sydney.

Prospect Quarry is located below Prospect Reservoir on the edge of the catchment. The quarry forms part of a 350Ha parcel of land owned by Boral and Sydney Water, known as the Greystanes Estate. The Estate was rezoned for urban development in 1999, with the aim of providing employment generating land and residential land. Part of this land, identified as the Southern Employment Land, is proposed to drain to Prospect Creek and could potentially have an impact on flood behaviour.

The upper catchment area is heavily urbanised and consists largely of industrial development. This includes the Wetherill Park industrial area, which drains to Prospect Creek through a concrete lined channel. Other industrial areas include Smithfield, Greystanes, Guildford and Yennora. The mid to lower catchment area consists primarily of residential development, including the suburbs of Fairfield, Carramar, Canley Vale and Lansvale. The commercial area of Fairfield is also located within the catchment.

A number of major roads and railways cross Prospect Creek. These include the Cumberland Highway in the upper catchment and the Hume Highway, Cabramatta-Granville railway line and Cabramatta-Carramar railway line in the lower catchment.

A number of detention basins have been constructed throughout the catchment to mitigate the impacts of flooding. The largest are located in the Upper Prospect Creek catchment, known as the Hassall Street and Rosford Street detention basins. The majority of other basins are located within the Orphan School Creek catchment. These basins, whilst located outside of the current study area, can still have an influence on flood behaviour within Prospect Creek.

2.2 HERITAGE

Heritage issues are important in forming an understanding of the social and cultural context of the floodplain and ensuring that flood mitigation measures do not unduly impact upon the heritage of the study area. Heritage items are classified as having either Local, Regional or State significance. Advice from the Heritage Council is required prior to any item of State Significance being demolished, defaced or damaged.

The Fairfield LEP provides a list of heritage items within the Fairfield LGA. Those heritage items that are within the proximity of the Prospect Creek floodplain have been listed in **Table 2.1**. Other heritage items within the floodplain that are located within the Holroyd LGA have also been included, based on information listed in the Holroyd LEP.

Table 2.1
Heritage Items within the Study Area

Location	Description	Significance
Fairfield City Council		
13 Artie St, Carramar	Inter-War Houses	Local
Oakdene Park, Bland St, Carramar	Blands Oak	State
45 Chifley St, Smithfield	Victorian/Georgian Cottage	Local
Fairfield St, Fairfield	Railway Viaducts	Local
19 Harris St, Fairfield	School of Arts	Local
21-25 Harris St, Fairfield	Church and Hall	Local
Haughton St, Carramar	Von Heiden Gardens	Regional
Hume Highway, Lansvale	Lansdowne Bridge	Regional
Hume Highway, Lansvale	Milestone	Regional
Kaluna Ave, Smithfield	Kaluna Cellars	Local
23 Lawson St, Fairfield	Federation Cottage	Regional
16 North St, Fairfield	Federation Cottage	Local
Railway Pde, Canley Vale	Railway Viaduct	Local
275 River Ave, Carramar	Oak and Peppercorn tree	Local
10 Riverview Rd, Fairfield	Inter-war Bungalow	Local
Sandal Cr, Carramar	Railway Bridge	Regional
2 Second Ave, Canley Vale	Temple	Local
31 The Crescent, Fairfield	Façade of shop	Local
35A The Crescent, Fairfield	Façade of shop	Local
87 The Crescent, Fairfield	Façades of buildings	Local
93-97 The Crescent, Fairfield	Façade of shop	Local
452 The Horsley Drive, Fairfield	Inter-War Bungalow	Local
542 The Horsley Drive, Smithfield	Victorian Cottage	Local
632 The Horsley Drive, Smithfield	Victorian Museum Building	Regional
Holroyd City Council		
2 Hyland Rd, Greystanes	House and farm buildings	
Widemere Rd, Prospect to Military Rd	Pipehead, canal, former residence	

2.3 HISTORY OF FLOODING

The only long term flood records available for Prospect Creek are available at the Lansdowne Bridge on the Hume Highway. Lansdowne Bridge was constructed in 1835 and flood records have been noted at this bridge dating back to 1860. These early records are fairly sparse, and only indicate the more extreme flood events. An automatic water level recorder was more recently installed at this location by Manly Hydraulics Laboratory. The available flood records are included in **Table 2.2** and shown diagrammatically on **Figure 2.1**.

Lansdowne Bridge is located at the lower end of Prospect Creek, some 3.5km upstream of its confluence with the Georges River. Flooding in this vicinity is largely dominated by flood conditions in the Georges River, and the flood history at this location for major flood events correlates closely with recorded flood heights on the Georges River at Liverpool weir (Bewsher Consulting, 2004).

Table 2.2
Historical Flood Records at Lansdowne Bridge

Date	Flood Level (m AHD)	Source of Data (Reference)
May 1809	8.2*	Sonter
April 1860	7.5	Sonter
February 1873	8.0	Stewart, 1968
May 1889	7.2	Stewart, 1968
February 1898	5.5	Sonter
June 1950	5.3	Stewart - MHL, 1986
February 1956	5.7	PWD, 1991
November 1961	4.6	Sonter – MHL, 1986
March 1978	3.7	PWD, 1991
March 1983	1.5	MHL, 1986
August 1986	5.1	MHL, 1987
April 1988	5.8	MHL, 1989
April 1989	1.3	Auto gauge
February 1990	3.1	Auto gauge
June 1991	4.7	Auto gauge
August 1996	2.4	Auto gauge
January 2001	4.2	Gauge failed. Observation from debris mark

*Data reliability uncertain as bridge not yet constructed

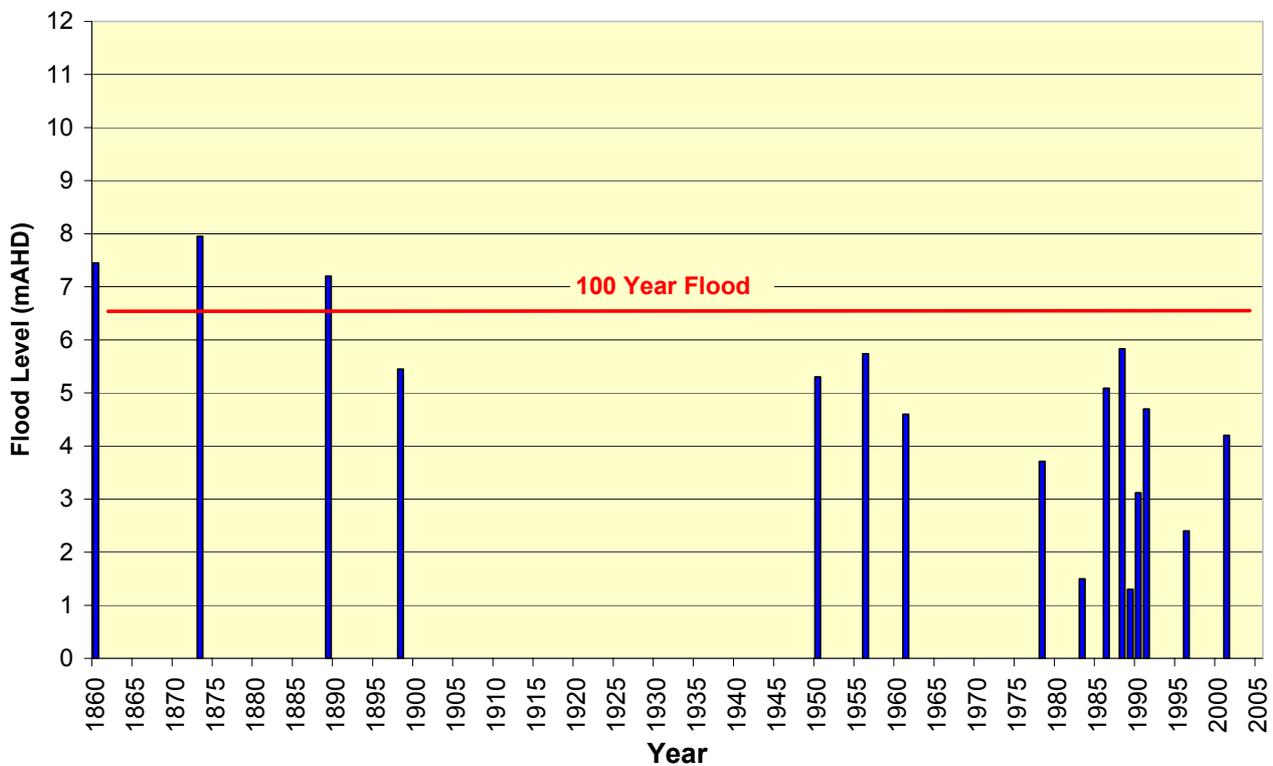


Figure 2.1
Historical Flood Heights at Lansdowne Bridge

Based on these records, the highest flood to occur within the Lower Prospect Creek catchment was in 1873. This reached a height of 8.0m at the Lansdowne Bridge, which is approximately 1.5m higher than the estimated 100 year flood level at this location. This flood is also the largest flood to have been recorded on the Georges River. Other large floods have occurred in 1860 and 1889. Floods have been less severe on Lower Prospect Creek in the period following these floods (ie over the last 118 years).

The most recent significant floods to have been experienced throughout the Prospect Creek catchment include:

- i) August 1986;
- ii) April 1988; and
- iii) January 2001.

Both the 1986 and 1988 floods caused serious flooding and property damage throughout Prospect Creek. These floods provided the impetus for the preparation of floodplain management studies along Lower Prospect Creek (Willing & Partners, 1990) and Upper Prospect Creek (Willing & Partners, 1993), and the program of flood mitigation works that subsequently followed.

The 1988 flood was the higher of the two floods throughout the Georges River and the lower reaches of Prospect Creek, with an average recurrence interval of approximately 20 years. Conversely, the 1986 flood produced the higher flood levels through the upper reaches of Prospect Creek, suggesting greater flood discharge in Prospect Creek for this event.

The January 2001 flood was a shorter duration flood which affected Prospect Creek but not the Georges River. Flood levels through the lower reaches of Prospect Creek were relatively minor due to the low tailwater levels experienced in the Georges River. At the Hume Highway the 2001 flood was approximately 0.9m lower than the 1986 flood and 1.6m lower than the 1988 flood. Further upstream the 2001 flood exceeded the 1988 flood and was generally similar to levels experienced in the 1986 flood. The 2001 flood was estimated to have an average recurrence interval between 20 years and 50 years upstream of the Granville Railway line (Cardno Willing, 2001).

2.4 PREVIOUS FLOOD INVESTIGATIONS

The floodplain management plan is based on numerous studies and investigations that have previously been undertaken in the Prospect Creek catchment.

The most relevant studies to this project include the Lower Prospect Creek Floodplain Management Study (Willing & Partners, 1990) and the Upper Prospect Creek Floodplain Management Study (Willing & Partners, 1993). These reports form the basis of floodplain management measures that have been progressively implemented over the last 15 years or so. The Review of Prospect Creek Flood Levels (Cardno Willing, 2004) also provides further data on flood behaviour throughout the study area.

Other reports have also been reviewed in the preparation of the revised floodplain management plan for Prospect Creek. A list of relevant reports and investigations that have been reviewed is provided in **Table 2.3**. A brief comment on the relevance of each report is also provided.

TABLE 2.3
List of Previous Investigations Reviewed

No.	Date	Title	Author	Comment
1	Apr 1985	Fairfield Flood Mitigation Study	SMEC SKP	Provides recommended floodplain management works within Prospect Creek and Cabramatta Creek. Recommended Measures included: <ul style="list-style-type: none"> < Hassall St detention basin < Rosford St detention basin < Other basins in tributary catchments < Levee from Market St to O'Connell St < Stream clearing/floodway excavation (various) < Amplification of Kenyons Br < Selective house raising and voluntary purchase
2	May 1988	Flood Evacuation Strategy Hollywood Drive Precinct, Lansvale	Kinhill Engineers	The report investigates strategies to improve flood evacuation in the Hollywood Drive precinct (Lansvale Peninsula). Improvements include road raising low spots in roads to avoid residents needing to travel through deeper pockets of water, and other evacuation strategies.
3	~1988	Specification for Bank Reconstruction, Prospect Creek for FCC	Dalland & Lucas	Provides a description of landslips along the banks of Prospect Creek following the 1988 floods, and provides specifications for bank restoration works. The areas include 1-7 Atkins Ave, 15-39 Waterside Cr, 65-69 Waterside Cr and 1 Bromley St.
4	Apr 1990	Report on Vincent Crescent Levee Canley Vale	Willing & Partners	Investigation of a levee bank to protect houses in Vincent Crescent and Togil Streets, Canley Vale. Investigates local ponding issues behind the levee and options to reduce local stormwater storage requirements in Parkes Reserve. Catchment diversions were recommended to reduce the contributing catchment area, and various pumping station options investigated to reduce local storage requirements. No definitive conclusion is reached.
5	May 1990	Lower Prospect Creek Floodplain Management Study	Willing & Partners	A comprehensive floodplain management study of Lower Prospect Creek, between the Georges River and the Granville Railway Line. The study analysed flood behaviour using the RAFTS hydrologic model and the WILCEL hydraulic model. A preferred Floodplain Management Plan was prepared with flood mitigation works totalling \$29M (1990). Many of the measures in the Plan have since been implemented by Fairfield Council. The remaining measures are subject to review by the current study.
6	Sep 1990	Losses and Lessons from the Sydney Floods of August 1986	ANU Centre for Resource and Environmental Studies	Provides a review of flood damages following the 1986 floods on Prospect Creek, the Georges River and Toongabbie Creek. It concludes that most residents were unprepared for the floods and that losses could have been significantly less had there been a better warning system and improved flood awareness.
7	June 1991	Burns Creek Barrass Drain Catchment Management Study	Kinhill Engineers	Problems associated with urban runoff in the Burns Creek catchment (a tributary of Prospect Creek) are investigated, including flooding problems and water quality. The study was undertaken for Sydney Water. A catchment management strategy is proposed at a cost of \$1.9M. The strategy involved one detention basin, formalisation of roadways as overland flow paths, enlarging one culvert, minor channel works, a channel maintenance program and other non structural measures.

TABLE 2.3
List of Previous Investigations Reviewed

No.	Date	Title	Author	Comment
8	Sep 1993	Upper Prospect Creek Floodplain Management Study	Willing & Partners	A comprehensive floodplain management study of Upper Prospect Creek, between the Granville Railway Line and Hassall Street. The study analysed flood behaviour using the RAFTS hydrologic model and the HEC-2 hydraulic model. A preferred Floodplain Management Plan was prepared with flood mitigation works totalling \$1M (1993). The majority of measures in the Plan have since been implemented by Fairfield Council. The remaining measures are subject to review by the current study.
9	Aug 1993	Vincent Crescent Levee – Levee Wall along Prospect Creek	Willing & Partners (letter to FCC)	Provides levee bank cost estimate of \$2.1M and maintenance costs (of pumps) at \$8,000 pa. Further details of proposed levee, excavated storage area and pumping station are provided.
10	May 1994	Vincent Crescent Levee – House Raising Alternative	Dalland & Lucas (letter to FCC)	Provides an assessment of house raising (for 47 residential buildings) at Vincent Crescent, Togil St and Bonham St as an alternative to the previously proposed levee. The total cost of house raising was estimated at \$1.9M. A description and cost estimate for each individual house is provided. Houses that are difficult to raise have been identified with flood proofing proposed as an alternate measure.
11	Feb 1994	Proposed Dredging of Prospect and Orphan School Creeks	Manly Hydraulics Laboratory	Assesses the feasibility of dredging the lower reaches of Prospect Creek and Orphan School Creek, which had been proposed in earlier studies to compensate for other proposed flood mitigation measures (Vincent Crescent Levee, and other deflector levees). The report details the results of bank stability investigations and concludes that dredging is not feasible within the study area without bank stabilisation works. It was also noted that dredging may also compromise existing bank protection measures. Levee bank construction on top of existing banks was also cautioned.
12	April 1996	Carrawood Park Deflector Levee, Carramar – Preliminary Concept Options Report	Willing & Partners	Presents three design options for a deflector levee that had been proposed in the 1990 floodplain management study for Carrawood Park, downstream of Waterside Crescent. The option of providing an evacuation route along the top of the levee for resident of Waterside Crescent (as recommended in the 1990 FPMF) was considered impractical. A vertical wall, either along the fence line or within the park, were noted as preferred options.
13	Oct 2001	Prospect Creek – Analysis of January 2001 Flood	Cardno Willing	Provides an investigation of the flood which occurred on 31 January 2001, which was the largest flood in Prospect Creek since 1988. This involved collection of rainfall data, flood data and modelling of flood behaviour. The 2001 flood was estimated as a 40 year event in the upper catchment, 35 years at Smithfield Road, 30 years at Fairfield Railway Bridge, and less than 20 years further downstream.

TABLE 2.3
List of Previous Investigations Reviewed

No.	Date	Title	Author	Comment
14	Aug 2002	Fairfield Park Floodway – Flood Impact Assessment	Cardno Willing	Provides a description of modifications proposed to a floodway scheme downstream of the Vine Street Bridge, and an assessment of the performance of the modified floodway in reducing flood levels. Despite these modifications, and a different hydraulic model, it was concluded that the final floodway scheme provided similar flood level reductions to that which had previously been envisaged.
15	~2003	Action Plan Prospect Creek Catchment Stormwater Management Plan	Fairfield City Council	The revised Plan provides guidance to decisions made about intended works and programs in the Prospect Creek catchment, which are to be incorporated on a yearly basis in Council's Management Plan.
16	June 2004	Review of Prospect Creek Flood Levels	Cardno Willing	A review of flood levels in Prospect Creek was undertaken following the January 2001 flood. Additional flood data from the 2001 flood was available for model calibration, and a more sophisticated 2-dimensional hydraulic model was used to analyse flood behaviour. The new flood model has been further refined as part of the current study, and updated maps of flood behaviour produced. The latest review is included in Appendix A of this report.
17	Dec 2004	Fairfield City Overland Flood Study	SKM & Fairfield Consulting Services	An investigation to identify main overland flow paths within the Fairfield LGA. Overland flow paths have been mapped and properties at risk identified. The report establishes priority areas for further detailed investigations.

3 COMMUNITY CONSULTATION

3.1 CONSULTATION PROCESS

Community consultation is an important component in the development of a floodplain management plan. Consultation provides an opportunity to collect feedback and ideas from the community on problem areas and potential floodplain management measures. It also provides a mechanism to alert the community about the flood risk, and to improve their awareness and readiness for flooding.

Much of the community consultation for Prospect Creek was undertaken during the early stage of the study, in conjunction with other consultation activities prepared for the Georges River Floodplain Management Study and Plan.

Key elements of the consultation process for Prospect Creek included:

- i) presentations to Fairfield City Council's Five Creeks Committee;
- ii) community notification through individually addressed letters to residents on the floodplain;
- iii) three public workshops;
- iv) a community questionnaire; and
- v) public exhibition of the recommended floodplain management plan prior to formal consideration by Council.

These elements are discussed further below.

3.2 THE FIVE CREEKS COMMITTEE

Fairfield City Council has overseen the preparation of the Prospect Creek Floodplain Management Plan, with assistance provided through their floodplain management committee (known as the Five Creeks Committee).

The Committee comprises representatives from:

- i) Fairfield City Council;
- ii) Holroyd City Council;
- iii) Liverpool City Council;
- iv) the State Emergency Service;
- v) Department of Environment, Climate Change and Water (formerly DNR); and
- vi) other community members.

The Committee meets on a regular basis to consider floodplain management issues, including the review of the Prospect Creek Floodplain Management Plan. As many of the representatives on the Committee are themselves members of other associations or groups, the committee provides a valuable mechanism for the views of many interested parties to be represented.

3.3 COMMUNITY NOTIFICATION

Fairfield City Council wrote to all property owners within their LGA that were potentially affected by flooding (up to the PMF) from Prospect Creek. Over 5,800 residents received a personally addressed letter during October 2002, advising of the risk of flooding and providing an invitation to attend one of three public workshops to discuss flooding issues and the review of the Prospect Creek Floodplain Management Plan.

The notification letter was aimed at raising public awareness of the flood risk and to notify residents about the study. Residents were also advised of the proposed mapping of the floodplain into three different flood risk areas.

Residents were provided with a mechanism to obtain further information, or to raise concerns, through attending one of the three public workshops or by contacting a nominated Council officer.

An SES FloodSafe brochure and a community questionnaire were also distributed with the notification letter to obtain feedback on potential floodplain management measures and any other community concerns.

A copy of the community notification letter is included in **Appendix B**.

Further refinement of the flood model and mapping of the PMF extent was undertaken during this review. This led to the identification of some 190 additional properties potentially affected by flooding, that were not initially identified. Council wrote to these property owners during April 2006 to notify them of the revised flood mapping and the flood risk classification applicable to their property.

3.4 PUBLIC WORKSHOPS

Three public workshops were held during the review. The different workshops covered different parts of Prospect Creek, so that common issues within each region could be dealt with. This also helped to limit the attendance at each workshop to a management number. Workshops were conducted for the following regions:

- i) Georges River and Lower Prospect Creek, downstream of the Hume Highway;
- ii) Lower Prospect Creek, between the Hume Highway and the Granville Railway; and
- iii) Upper Prospect Creek, upstream of the Granville Railway.

Each resident with property potentially affected by flooding was invited to attend the workshop relevant to their area, but was also free to attend workshops in other areas.

A list of anticipated questions and answers were compiled and distributed to residents at each workshop. Most of these questions relate to the proposed flood risk mapping within the catchment, and whether property values and insurance will be affected by the mapping. The list of 'frequently asked questions' is included in **Appendix C**.

Workshops were conducted using an independent facilitator. Presentations were provided by Council, the State Emergency Service, Department of Land and Water Conservation, and the Consultant. These presentations provided information about the review of the floodplain management plan, the various parties involved, previous flood problems, and some of the likely results from the review. A question and answer session followed these presentations. Questions raised were recorded and a written response subsequently provided to all attendees.

The main issues raised at the workshops include:

- i) concern that development was allowed to occur in flood liable areas;
- ii) concern over specific, recent development approvals;
- iii) the building controls that apply to various flood risk areas;
- iv) whether landfill is allowed within the floodplain;
- v) measures that Council have taken to reduce flooding problems;
- vi) the impact of detention basins in reducing flood problems;
- vii) questions concerning Council's OSD policy;
- viii) the effect of flooding and flood mapping on property values and insurance;
- ix) that information on flooding should be available to the public;
- x) the impact of Prospect Dam, including possible dam failure, on flood behaviour;
- xi) sewerage problems during floods;
- xii) the option of clearing, widening or dredging the creek; and
- xiii) the role of the SES and other authorities during floods

3.5 COMMUNITY QUESTIONNAIRE

Over 5,800 questionnaires were distributed to residents of property potentially affected by flooding from Prospect Creek in the Fairfield LGA. A total of 822 questionnaires were completed and returned to Council, representing a response rate of 14%.

One third of respondents indicated that flooding had previously been experienced on their property. Floods experienced were noted (in order of frequency) as August 1986, April 1988 and January 2001. A similar number of respondents indicated that they expect their property could be flooded some time in the future, which suggests that only those people who have already experienced a flood on their property expect that they could be affected in the future.

Approximately 10% of respondents indicated that they had experienced flooding above floor level, with an average inundation depth of over 0.5m.

Residents were asked to provide opinions on the types of floodplain management measures that should be considered to reduce flooding problems. The most frequent floodplain management measures suggested are listed in **Table 3.1**.

**Table 3.1
Floodplain Management Measures suggested by the Community**

Ranking	Proposed Measure	Times Suggested
1	Clean creek of rubbish, debris or vegetation	97
2	Dredge or widen the creek	45
3	Better maintenance of the creek corridor	35
4	Better maintenance of stormwater drainage	28
5	Amplification of stormwater drainage	25
6	Construction of levee banks	23
7	Upstream basins, on-site detention or water tanks	13
8	Better development controls on future development	12
9	More public information about the flood risk	9
10	Increase the capacity of the creek	7

A copy of the questionnaire and more detailed summary of results is provided in **Appendix B**.

3.6 PUBLIC EXHIBITION OF DRAFT REPORT

The final stage of the community consultation for this study is the public exhibition of the draft Prospect Creek Floodplain Management Plan.

A draft copy of the Plan was placed on public exhibition over a 10 week period from 16th December 2009 to 24th February 2010. The report was available to download from Council's web site and copies of the report made available for viewing at Council's administrative centre and a number of local libraries. No comments from the public were received during the exhibition period.

4 DESCRIPTION OF FLOOD BEHAVIOUR

4.1 FLOOD STUDY REVIEW

Flood behaviour along Prospect Creek was previously documented in the Lower Prospect Creek Floodplain Management Study (Willing & Partners, 1990) and the Upper Prospect Creek Floodplain Management Study (Willing & Partners, 1993).

A review of Prospect Creek Flood Levels was completed in 2004 by Cardno Willing. The study was based on a RAFTS hydrologic model of the catchment and two separate TUFLOW hydraulic models of the creek and floodplain.

Further refinement of these models was undertaken during the review of the Prospect Creek Floodplain Management Plan. These refinements included:

- i) minor adjustment of design storm rainfall patterns and intensities for consistency with other concurrent studies within Fairfield City Council;
- ii) amalgamation of the separate TUFLOW models into a single model;
- iii) additional survey of the channel section upstream of Widemere Road;
- iv) other model refinements; and
- v) re-calibration of the final TUFLOW model to the January 2001 flood.

Further information concerning the flood models, and the refinements undertaken, are provided in **Appendix A**.

The flood models were used to simulate flood behaviour for the 20 year, 50 year, 100 year and PMF floods. Maps showing the extent of flood inundation and flood level contours for each flood event are included in **Appendix A**. These maps have been provided to Council as larger scale A1 size plans; and in digital format for inclusion in Council's GIS computer system.

Flood levels were extracted from the flood model for each property within the study area, and assembled within a geographical database. The database is intended to assist Council in releasing flood data to the community, either through issue of Section 149 Certificates, flood information sheets, or other enquiries.

4.2 FLOOD RISK MANAGEMENT PRECINCTS

Floodplain management is all about managing the risk of flooding across the floodplain. In doing so, it should be recognised that different parts of the floodplain are subject to different degrees of flood risk.

It is important not to confuse 'flood risk' with 'flood hazard' or 'provisional flood hazard'. The terms 'hazard' and 'provisional hazard' are defined in the 2005 *Floodplain Development Manual* and relate to the magnitude of a *specific* flood. For example, a site may experience high hazard conditions in a 100 year flood and low hazard conditions in a 5 year flood. On the other hand, flood risks (as used to define land use planning precincts) do not relate to a single flood, but rather to all floods.

Flood risk precincts consider the probabilities and consequences of flooding over the full spectrum of flood frequencies that might occur at a site. When expressed in mathematical notation:

$$Flood Risk = \int_{\substack{all \\ floods}} Probability * Consequence$$

where probability is the chance of a flood occurring, and consequence is the property damage and personal danger resulting from the site's flood characteristics. Note that in carrying out this assessment, the existing land uses and any private warning/evacuation plans at the site are ignored, and typical residential land uses and the normal public warning/evacuation plans are assumed.

The system adopted by Council for Flood Risk Management in the Fairfield City Wide Development Control Plan has been to classify floodplains into three flood risk precincts: 'high', 'medium' and 'low'. This is the same classification that was adopted by the four participating Councils in the Georges River Floodplain Management Plan (Fairfield, Liverpool, Bankstown and Sutherland).

After a review of the probabilities and consequence of flooding over all flood frequencies, the 'high', 'medium' and 'low' flood risk precincts were mapped as described below, and are shown on **Figure 4.1**.

- ▶ **High flood risk precinct** includes all areas of the floodplain which would be provisionally high hazard in a 100 year flood (based on Figure L2 of the *Floodplain Development Manual*). In addition to including the 100 year provisionally high hazard areas in the high flood risk precinct, other parts of the floodplain are also included where:
 - (a) in a 100 year event, significant evacuation difficulties exist (e.g. islands surrounded by provisionally high hazard conditions);
 - (b) in floods rarer than a 100 year event, the potential for significant or extreme consequences exist which are not otherwise apparent from consideration of only the 100 year flood or more frequent flood events. Some events that may result in these consequences (depending on their scale) include catchment diversions, areas subject to overtopping of levees and embankments, areas subject to severe bank or bed erosion, or other conditions that can lead to unusually high depths, velocities or otherwise produce very dangerous flood conditions. Whilst the probabilities of these events might be low, the consequences can in some cases be extreme and thus produce a high risk.
- ▶ **Medium flood risk precinct** is the remaining area inundated in a 100 year flood event, not defined as the 'high' flood risk precinct. For reasons similar to those discussed above under (a) and (b), it is possible for some otherwise 'low' flood risk areas to be elevated to 'medium', when the flood conditions warrant it, though this is rarely required.
- ▶ **Low flood risk precinct** comprises all remaining areas of the floodplain (defined as the limit of inundation in a PMF) but not identified as either a high flood risk or medium flood risk precinct, and where the risk of damages is low for most land uses.

Prospect Reservoir

**FIGURE 4.1
FLOOD RISK MANAGEMENT
PRECINCTS**

0 0.5 1km

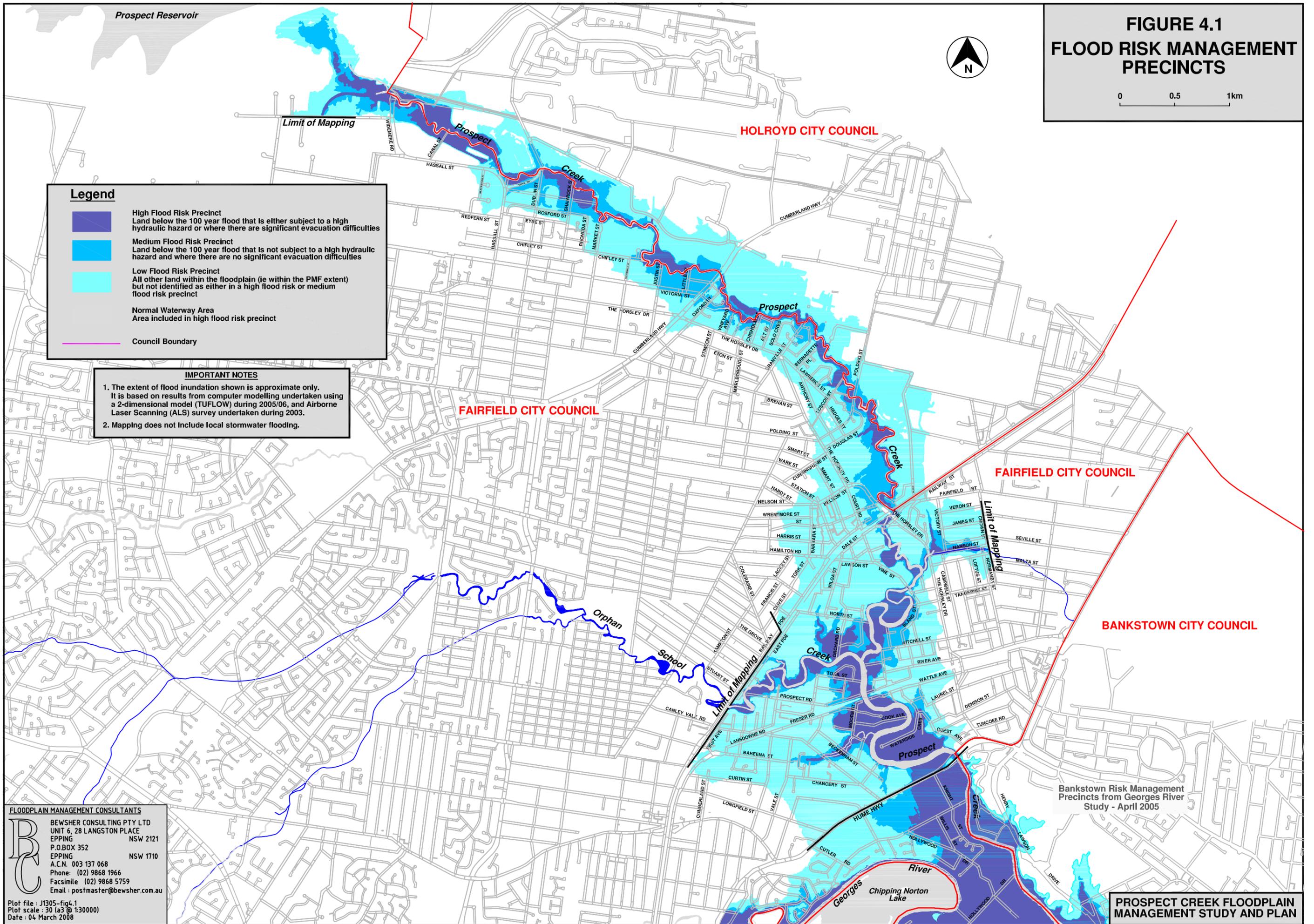


Legend

- High Flood Risk Precinct**
Land below the 100 year flood that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties
- Medium Flood Risk Precinct**
Land below the 100 year flood that is not subject to a high hydraulic hazard and where there are no significant evacuation difficulties
- Low Flood Risk Precinct**
All other land within the floodplain (ie within the PMF extent) but not identified as either in a high flood risk or medium flood risk precinct
- Normal Waterway Area**
Area included in high flood risk precinct
- Council Boundary**

IMPORTANT NOTES

1. The extent of flood inundation shown is approximate only. It is based on results from computer modelling undertaken using a 2-dimensional model (TUFLOW) during 2005/06, and Airborne Laser Scanning (ALS) survey undertaken during 2003.
2. Mapping does not include local stormwater flooding.



Bankstown Risk Management Precincts from Georges River Study - April 2005

FLOODPLAIN MANAGEMENT CONSULTANTS

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Plot file: J1305-fig4.1
Plot scale: 30 (a3 @ 1:30000)
Date: 04 March 2008

**PROSPECT CREEK FLOODPLAIN
MANAGEMENT STUDY AND PLAN**

The merit of mapping floodways on Prospect Creek has been considered. Floodways are defined as areas of significant flow that, even if partially blocked, would cause a significant redistribution of flood flow. Often floodways are delineated on the basis of the product of flood depth and velocity being greater than 1.0 in the 100 year flood. In the case of the Prospect Creek floodplain, generally all such areas have been identified to be in the high provisional hazard area in the 100 year flood, and therefore have been incorporated into the high flood risk precinct. The proposed planning controls (i.e. those in Council's DCP) prohibit all new development (apart from recreational or non-urban uses) within the high flood risk precinct. Any 'concessional development' (for existing property) is permissible only upon the conditions that an engineer's report certifies that the development will not increase flood affectation elsewhere, and that safe evacuation is possible. For this reason, it was concluded that a separate exercise to control development within floodways would add little practical value.

4.3 SUMMARY OF PROPERTY INUNDATION

A flood damages database has been prepared for the study area. The database provides information on properties and buildings that are potentially affected by flooding up to the PMF event. The database has been used to estimate flood damages and to highlight problem areas within the catchment.

A summary of homes and other buildings estimated to be inundated by flooding is included in **Table 4.1** and **Table 4.2**. The location of homes and other buildings most susceptible to flooding (estimated to be inundated in the 100 year flood) is shown on **Figure 4.2**.

Most residential homes that are affected by flooding above floor level are located downstream of the Granville Railway Line. This includes an estimated 245 homes between the railway and the Hume Highway and an estimated 155 homes downstream of the Hume Highway. Only 7 homes are estimated to be inundated above floor level upstream of the Granville Railway line.

Most commercial/industrial buildings estimated to be inundated above floor level are located either upstream of the Cumberland Highway (25 premises) or downstream of the Hume Highway (26 premises). Another 12 premises are located between the two highways.

Table 4.1
Residential Buildings Inundated in Various Floods

Location	20 Year	50 Year	100 Year	2,000 Year	PMF
Fairfield City Council					
Upstream of Cumberland Hwy	0	0	0	0	63
Cumberland Hwy to Granville Rail	0	4	6	38	752
Granville Rail to Hume Hwy	69	162	245	601	2,082
*Downstream Hume Hwy	39	117	155	266	397
Total FCC	108	283	406	905	3,294
Holroyd City Council	0	1	1	6	39
TOTAL (Both Councils)	108	284	407	911	3,333

* Data from Georges River Floodplain Management Study

**Table 4.2
Commercial and Industrial Buildings Inundated in Various Floods**

Location	20 Year	50 Year	100 Year	2,000 Year	PMF
Fairfield City Council					
Upstream Cumberland Hwy	0	2	24	41	107
Cumberland Hwy to Granville Rail	0	0	6	19	283
Granville Rail to Hume Hwy	2	5	6	19	123
*Downstream Hume Hwy	10	19	26	44	80
Total FCC	12	26	62	123	593
Holroyd City Council	1	1	1	3	63
TOTAL (Both Councils)	13	27	63	126	656

* Data from Georges River Floodplain Management Study

4.4 ROAD INUNDATION PROBLEMS

An understanding of where roads are likely to be cut by floodwater is an important issue for residents within the Prospect Creek catchment. Residents that are directly affected by flooding may need to evacuate their homes. Other residents may be indirectly affected where road closures restrict them travelling to or from work, school, or other destinations.

Road access is also an important issue for the planning of emergency management operations in response to flooding. Emergency personnel need to know which roads are likely to be inundated, and the possible depth of inundation in a major flood. There may also be opportunities to identify critical locations where road raising is desirable for improved flood access.

Inundation depths have been determined for all roads within the Prospect Creek floodplain estimated to be inundated in a 100 year flood. Inundation depths have been determined by subtracting the 100 year flood level from a digital terrain model of the floodplain from Council's ALS survey. Inundation depths have been trimmed to the road reserve and colour coded to represent different flood depths over the road, as shown on **Figure 4.2**.

The major regional roads within the catchment that are affected by the 100 year flood include:

- i) The Cumberland Highway – estimated to be inundated by up to 0.3m on the south side of Prospect Creek. The highway is inundated over a distance of approximately 200m, between Prospect Creek and Victoria Street.
- ii) The Hume Highway – estimated to be inundated by over 1.0m on the south side of Prospect Creek. The bridge over Prospect Creek is relatively high and not affected by the 100 year flood. The highway falls to the south and is cut by floodwater 150m south of Prospect Creek, over a distance of some 400m. The highway is also potentially inundated further to the south by floodwater from the adjacent Cabramatta Creek catchment. The highway has been estimated to be potentially cut by up to 1.5m in a 100 year flood from Cabramatta Creek (Bewsher Consulting, 2004).

Other arterial roads and other important access roads that are affected by the 100 year flood in Prospect Creek (starting upstream) include:

- i) Widemere Road (Wetherill Park) – currently provides access to the Boral quarry at Greystanes. The Boral quarry has been identified as a future industrial development site, and the road may assume a more important access link in the future. The existing road is particularly low and is subject to frequent overtopping. The maximum inundation depth across the existing road is estimated at over 1.0m in a 100 year flood. The road is overtopped over a length of 250m in the vicinity of Prospect Creek.
- ii) Gipps Road (Smithfield) – provides a link across Prospect Creek, joining Wetherill Park, Smithfield and Greystanes. The road is cut by 0.3 to 0.6m in a 100 year flood, over a distance of 200m on the north of Prospect Creek.
- iii) The Horsley Drive – forms an important arterial route along the length of Prospect Creek, linking the Cumberland Highway with the Hume Highway. The Horsley Drive is inundated by between 0.6 to 1.0m in the 100 year flood just upstream of the Granville Railway Line, between Court Road and Alan Street, Fairfield.
- iv) Polding Street North/Fairfield Road (Fairfield) – provides a link across Prospect Creek, joining Fairfield with Yenora and Guildford. The road is inundated by up to 0.3m in the 100 year flood in the vicinity of the Prospect Creek culverts, and south of this crossing. Inundation depths up to 1.0m are experienced 100m north of Prospect Creek.
- v) Vine Street, Fairfield – provides an important east-west thoroughfare across Prospect Creek. Konemanns Bridge, across Prospect Creek, was raised in 1996 to improve access conditions. The road is inundated by up to 0.3m at several locations on the downstream side of Prospect Creek.
- vi) Hollywood Drive (Lansvale) – provides an important access route to residential and industrial property located in the Lansvale Peninsula. A number of smaller side streets also feed off Hollywood Drive. A large portion of Hollywood Drive is inundated by over 1.0m in a 100 year flood, potentially isolating many residents in the Lansvale Peninsula. A section of Hollywood Drive, between Day Street and Willis Street, was raised by Council in the 1990's in an attempt to improve flood access.
- vii) Knight Street (Lansvale) – provides a secondary exit link for residents of the Lansvale Peninsula. Knight Street is estimated to be inundated by over 1.0m in a 100 year flood over the entire length of this road.

FIGURE 4.2
PROPERTY AND ROAD
INUNDATION PROBLEM
AREAS

0 100 200 300 400 500m
 Scale

SHEET 1 OF 4

LEGEND

Estimated extent of inundation in 100 year flood

Buldngs flooded above floor level in 20 year flood

- Residential
- Commercial / Industrial

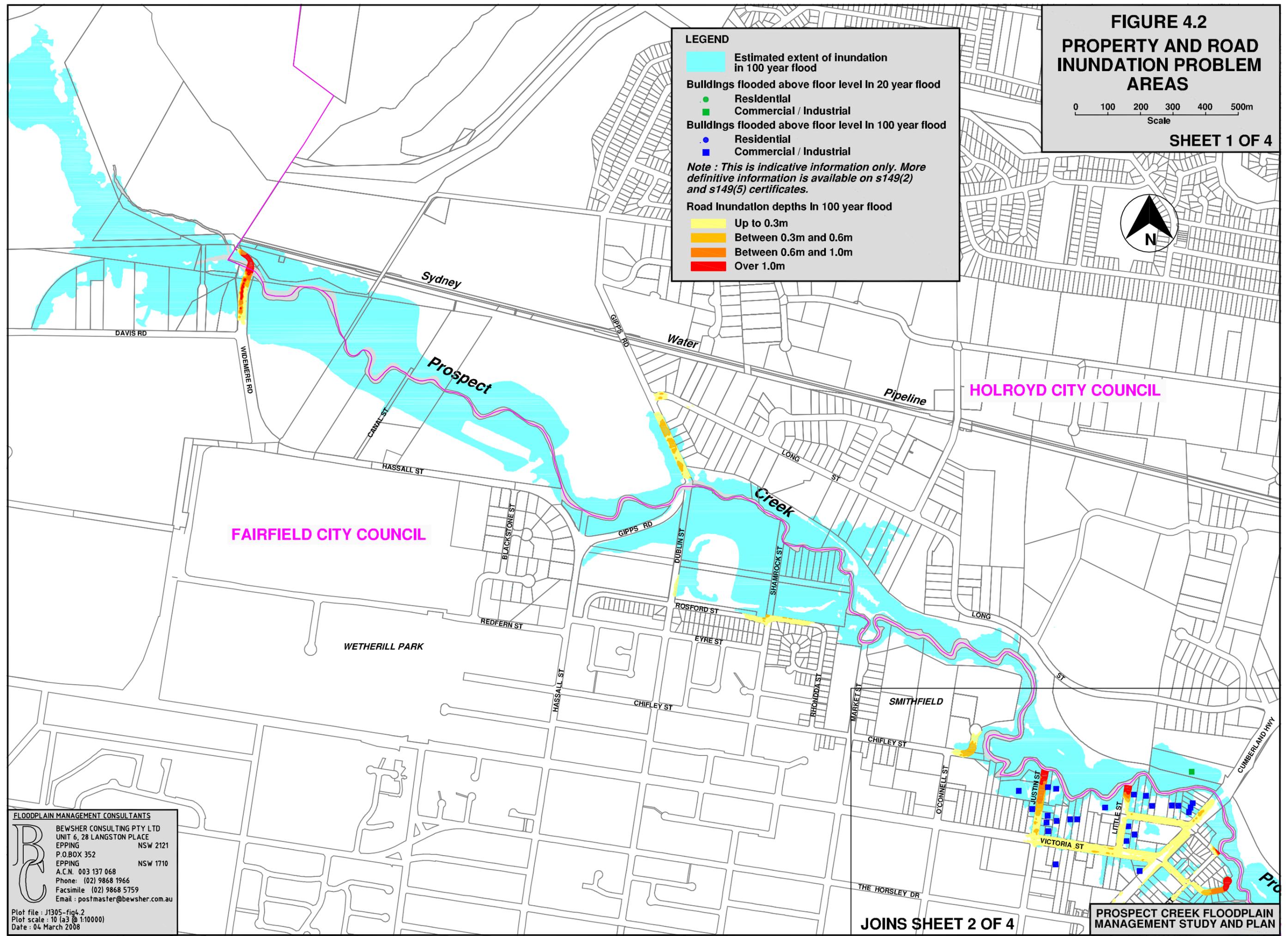
Buldngs flooded above floor level in 100 year flood

- Residential
- Commercial / Industrial

Note : This is indicative information only. More definitive information is available on s149(2) and s149(5) certificates.

Road Inundation depths in 100 year flood

- Up to 0.3m
- Between 0.3m and 0.6m
- Between 0.6m and 1.0m
- Over 1.0m



FLOODPLAIN MANAGEMENT CONSULTANTS

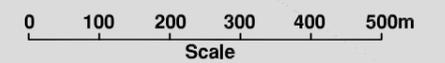
BEWSHER CONSULTING PTY LTD
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 Date : 04 March 2008

JOINS SHEET 2 OF 4

PROSPECT CREEK FLOODPLAIN
MANAGEMENT STUDY AND PLAN

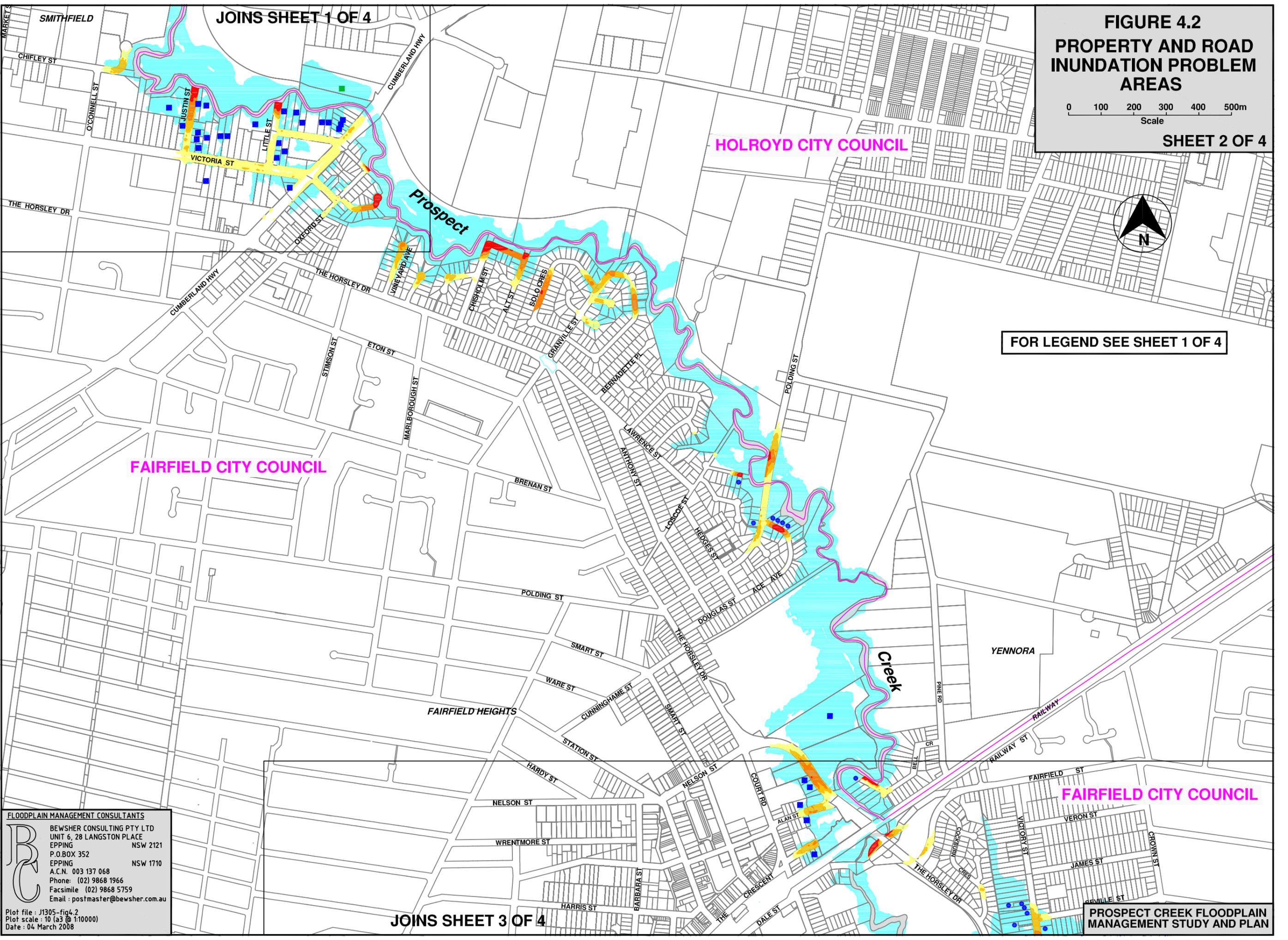
**FIGURE 4.2
PROPERTY AND ROAD
INUNDATION PROBLEM
AREAS**



HOLROYD CITY COUNCIL

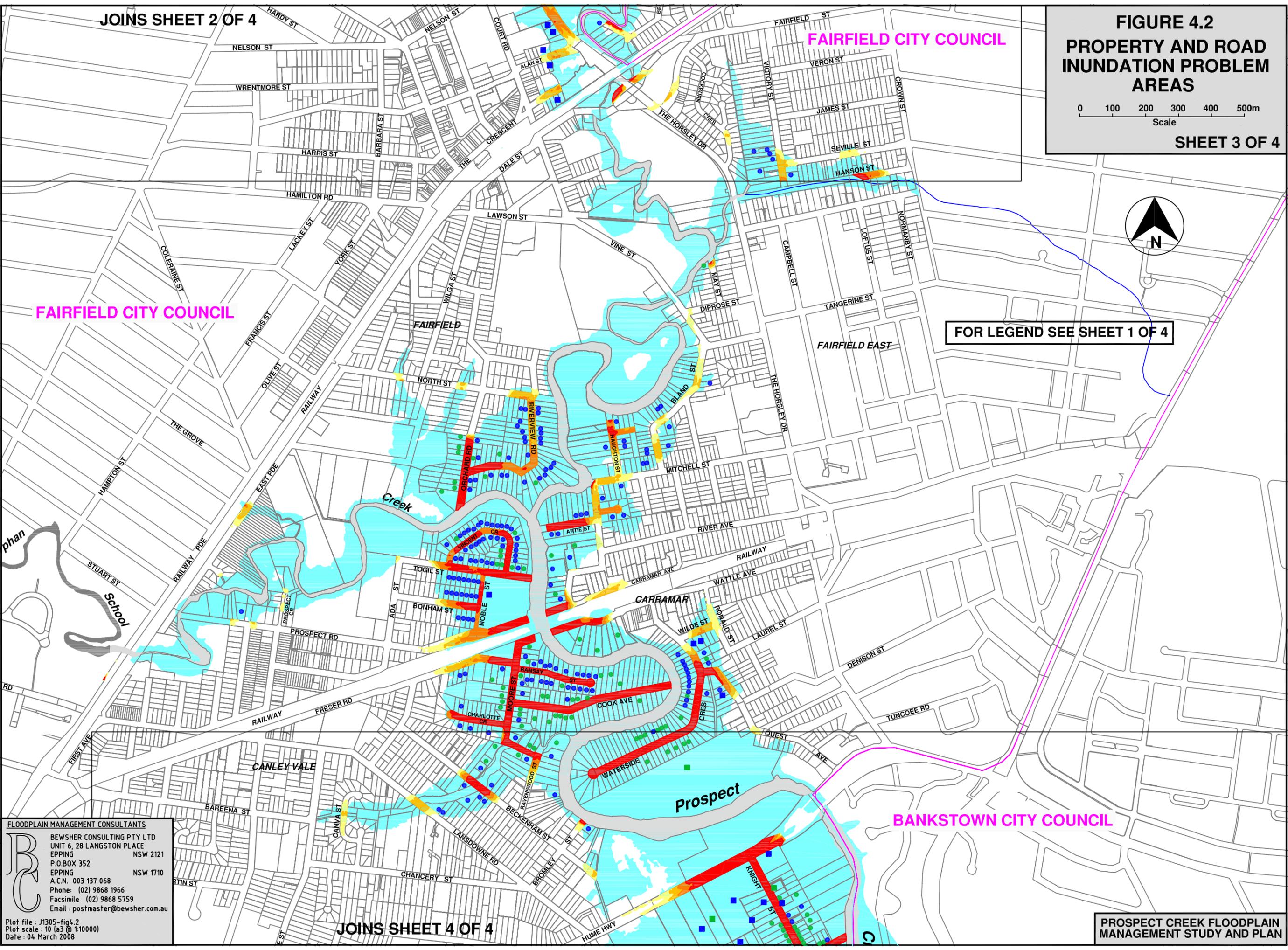
FAIRFIELD CITY COUNCIL

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FAIRFIELD CITY COUNCIL

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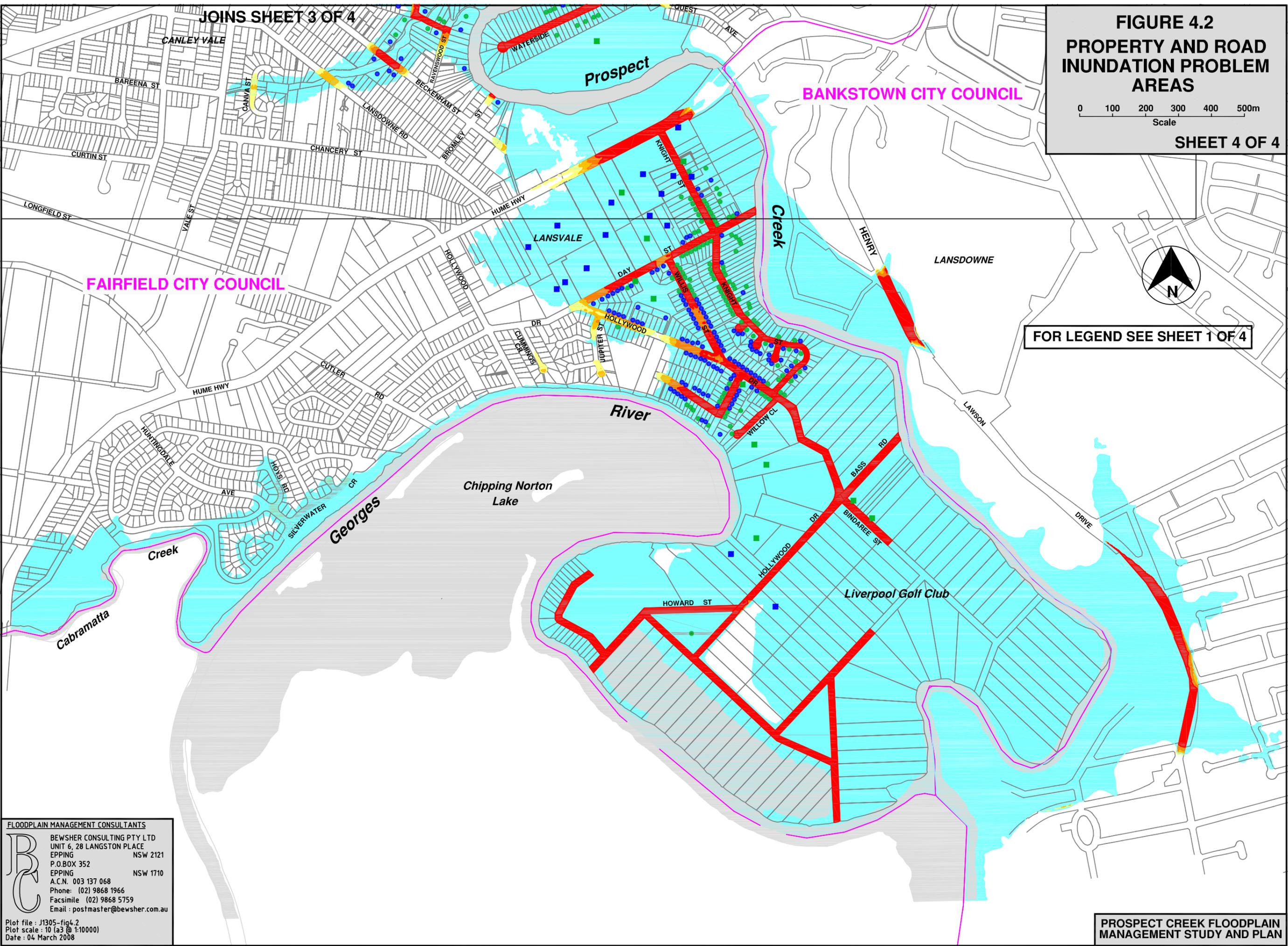
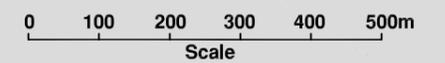
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**FIGURE 4.2
PROPERTY AND ROAD
INUNDATION PROBLEM
AREAS**



FOR LEGEND SEE SHEET 1 OF 4

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5 FLOOD DAMAGE ASSESSMENT

5.1 FLOOD DAMAGES DATABASE

A flood damages database was assembled for the Prospect Creek catchment. The database provides information on all properties within the floodplain potentially affected by flooding. It provides information on the type of buildings located on each property; the depth of inundation at each property; and an estimate of the potential flood damage for a range of flood events. These damage estimates are summed over the catchment to provide an economic assessment of the existing flood problem, and to assess the economic benefits of undertaking various flood mitigation measures.

Some 5,662 properties are included in the database upstream of the Hume Highway (including properties within Fairfield City Council and Holroyd City Council). A separate database containing properties located downstream of the Hume Highway was previously prepared for Fairfield City Council as part of the Georges River Floodplain Management Plan. Properties from this database were added to the Prospect Creek database to provide a single, consistent database covering the whole of Prospect Creek.

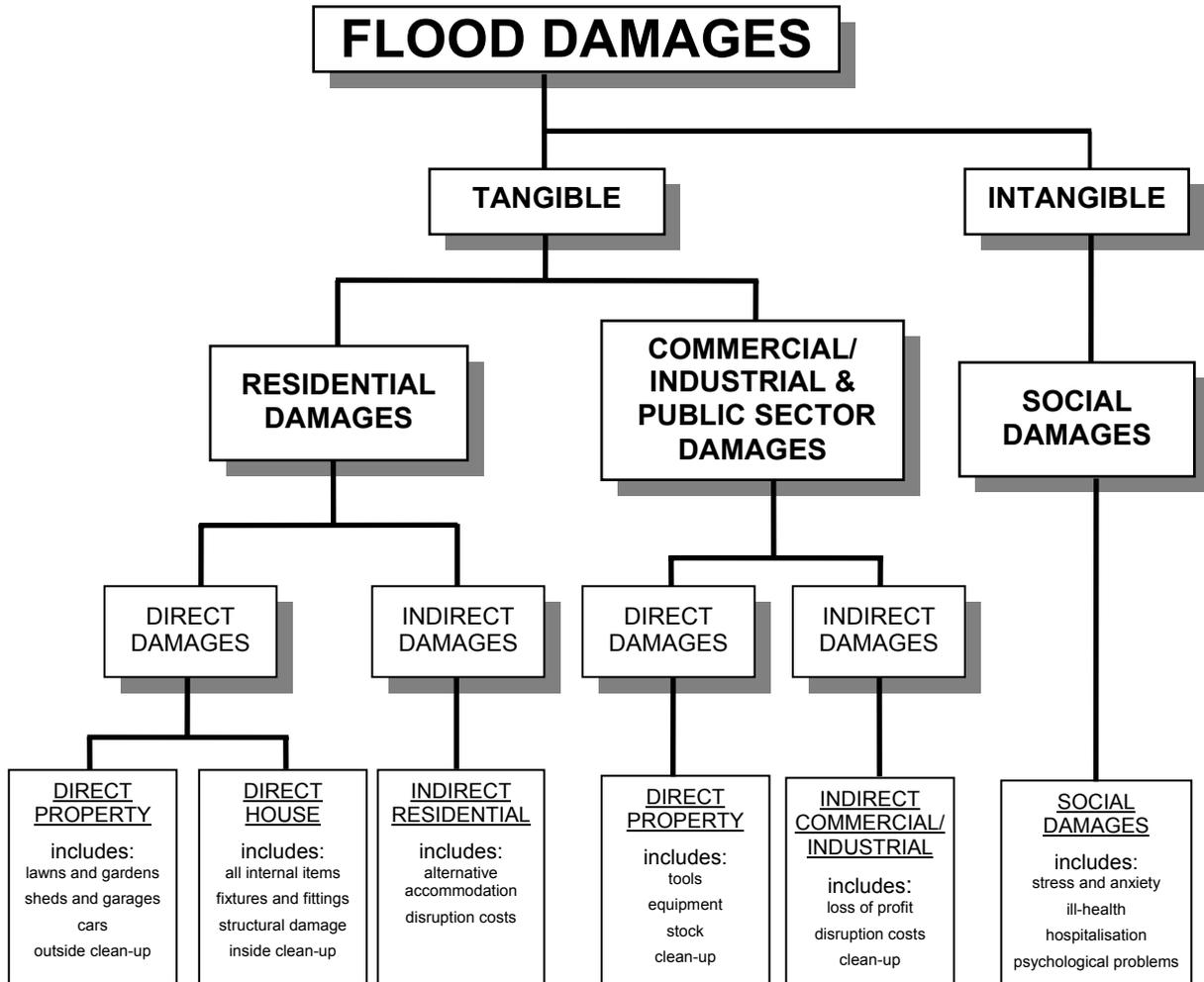
The database includes information on:

- i) the type and location of each property;
- ii) the number and type of buildings within the property;
- iii) ground levels near each building, based on ALS survey;
- iv) surveyed floor levels for those buildings most susceptible to flooding (1,318 in total);
- v) estimated floor levels for other buildings, based on the ground level near the building plus an average 'height above ground level' of 0.5m;
- vi) flood levels for the 20 year, 50 year, 100 year, 2000 year and PMF floods; and
- vii) a damage code to select an appropriate stage-damage curve to be applied to each property.

5.2 TYPES OF FLOOD DAMAGE

The types of flood damages examined in this study are summarised in **Figure 5.1**. The main categories include 'tangible' and 'intangible' flood damages. Tangible flood damages are those that can be more readily evaluated in monetary terms, while intangible damages relate to the social cost of flooding and therefore are much more difficult to quantify.

Tangible flood damages are further divided into direct and indirect damages. Direct flood damages relate to the loss or loss in value of an object or a piece of property caused by direct contact with floodwaters. Indirect flood damages relate to loss in production or revenue, loss of wages, additional accommodation and living expenses, and any extra outlay that occurs because of the flood.



**FIGURE 5.1
TYPES OF FLOOD DAMAGE**

5.3 BASIS OF FLOOD DAMAGES CALCULATIONS

Potential flood damages have been calculated by applying a number of stage-damage curves to every property included in the database. These curves relate the amount of flood damage that would potentially occur at different depths of inundation, for a particular property type.

Stage-Damage curves were developed during previous investigations undertaken for Fairfield City Council and adjoining Councils on the Georges River and Cabramatta Creek. These curves were based on specific consideration of the types of development within the catchment, information available from previous investigations, and flood damage surveys undertaken following major floods in Coffs Harbour (1996); Inverell (1991); Forbes (1990); Nyngan (1990); and the Georges River (1986).

The Department of Environment, Climate Change and Water (DECCW) recently released guidelines for the preparation of site-specific *residential* stage-damage curves (DECC, October 2007). The guidelines provide for the development of representative stage-damage curves for typical houses in different floodplains, based on work undertaken by the Risk

Frontiers in the Natural Hazards Research Centre at Macquarie University. This approach is recommended by DECCW to ensure the consistent assessment of flood mitigation projects across NSW. The new procedures have been adopted for estimating residential flood damages within the Prospect Creek catchment. Commercial and industrial flood damage estimates are based on those previously derived for the Georges River and Cabramatta Creek.

The different flood damage components are further discussed below.

5.3.1 Residential

Residential flood damages have been calculated in accordance with DECCW guidelines. This is based on standardized stage-damage curves representing low set buildings, high set buildings and two-storey buildings. The standard damage curves have been adjusted based on a number of parameters specific to the Prospect Creek catchment, including:

- i) regional cost variations (1.0);
- ii) average house size (180m²);
- iii) typical duration of immersion (6 hours);
- iv) average contents value (\$45,000);
- v) level of flood awareness (low);
- vi) effective warning time (2 hours); and
- vii) damage reduction factor (ratio of actual to potential losses) of 0.93 based on the flood awareness and effective warning time.

Damage estimates for ground floor units or villas were further reduced by 25% to account for the likely reduction in flood damages to these premises due to their smaller size.

It is noted that the DECCW residential stage-damage curves make allowance for both clean-up costs (\$4,000 per flooded house) and the cost of time in alternative accommodation. Nevertheless, a further measure of indirect damages has been estimated by taking 20% of the total direct damages, in keeping with advice received from DECCW.

5.3.2 Commercial/Industrial

No standard stage-damage curves were issued by DECCW for *commercial* and *industrial* damages. The stage-damage relationships used to estimate these damages in this study are based on those previously derived for the Georges River and Cabramatta Creek. For consistency with the residential damages assessment, predicted losses were estimated by applying a ratio of actual to potential damages of 0.93. Indirect commercial/industrial losses were estimated as 20% of direct actual commercial/industrial damages, in accordance with advice received from DECCW.

5.3.3 Infrastructure

The predicted value of damage to infrastructure (including roads and bridges, water supply and sewerage, electricity and telephone supplies, natural gas supplies) has been estimated at 15% of the 'total damages'. No allowance has been made for possible damage reduction in response to flood warnings.

5.3.4 Motor Vehicles

Losses to private motor vehicles have been modelled as a separate component of the process. This is to ensure that the assessment of flood mitigation measures is not unduly influenced by this component of damages. It has been assumed that there are on average

1.7 motor vehicles per residential household in the study area, based on data from the Australian Bureau of Statistics. Assuming that about 25% of these cars will be present during working hours (40 hours per week), and 90% will be present during non-working hours (128 hours per week), then the expected number of vehicles present at any given time that a flood may occur is estimated at about 1.3 per household.

Vehicles are assumed to be at the ground level assigned to each dwelling in the database. Based on insurance data from the Katherine flood (Jan 1998), Wollongong flood (Aug 1998) and Canberra bushfire (Jan 2003), it is assumed that the average cost of a written-off motor vehicle is of the order of \$12,000. Damage is expected to begin at a depth over the ground of 0.3m, and a write-off is assumed to occur at a depth of 0.6m over the ground.

For consistency with other components of the damages assessment, the same damage reduction factor of 0.93 has been applied to the estimation of predicted motor vehicle damages.

Damages to commercially owned vehicles are not assessed, since these may already be accounted for as part of direct commercial/industrial damages.

5.3.5 Social

Intangible, or social, flood damages are not readily quantifiable in monetary terms. Physical contact with floodwaters can cause residents to suffer physical and mental impacts to their health. Evacuation, the loss of personal property and cleaning up can trigger significant stress and trauma. While difficult to quantify, in keeping with advice received from DECCW, social damages have been estimated as 25% of 'total damages', which are interpreted as the sum of direct residential damages and direct commercial/industrial damages.

5.4 ECONOMIC ASSESSMENT

Flood damages under existing (2007) conditions have been calculated for each property in the flood damages database for the following floods:

- i) 5 Year flood (assumed to be negligible damage);
- ii) 20 Year flood;
- iii) 50 Year flood;
- iv) 100 year flood;
- v) 2,000 year flood; and
- vi) The PMF event.

Flood Damages are summed throughout the catchment to provide the total flood damage for each flood. The 'average annual damage' (AAD) and 'present value' of flood damage is also calculated. These are financial terms that are often used in the economic appraisal of flood damages and flood mitigation measures. The AAD is a measure of the cost of flood damage that could be expected each year, on average, by the community. The present value of flood damage is usually calculated to allow a direct comparison with the capital and on-going costs of proposed flood mitigation measures. This has been determined on the basis of a 7% discount rate and an expected life of 20 years, in accordance with guidelines provided by the NSW Treasury.

The flood damages database provides a valuable tool for assessing the economic merits of various flood mitigation options that may be considered for Prospect Creek. Flood level estimates within the flood damages database can be readily updated to reflect new conditions arising from proposed flood mitigation measures. The flood damages are then recalculated and the savings in flood damages can be calculated.

5.5 SUMMARY OF FLOOD DAMAGES

Flood damage calculations have been determined from the flood damages database for various areas within the Prospect Creek floodplain. **Table 5.1** summarises the predicted flood damages for a range of floods, including estimates of the annual average flood damage and the present value of flood damage. **Figure 5.2** shows the total estimated flood damage for various floods, whilst **Figure 5.3** shows the different components of flood damage in the Prospect Creek floodplain.

TABLE 5.1
Predicted Total Flood Damages under Existing Conditions

Location	Damage in Flood Event (\$)			Average Annual Damage	Present Value of Damage
	20 Year	100 Year	PMF		
<i>Fairfield City Council Area</i>					
Upstream Cumberland Hwy	0	580,000	41,290,000	40,000	380,000
Cumberland Hwy to Granville Rail	270,000	1,890,000	130,960,000	130,000	1,370,000
Granville Rail to Hume Hwy	12,170,000	30,700,000	333,220,000	2,310,000	24,480,000
Downstream Hume Hwy	7,030,000	18,820,000	71,700,000	1,290,000	13,680,000
Total FCC	19,470,000	51,990,000	577,170,000	3,770,000	39,910,000
<i>Holroyd City Council</i>					
Upstream Granville Railway	30,000	500,000	15,100,000	20,000	250,000
TOTAL	19,500,000	52,490,000	592,270,000	3,790,000	40,140,000

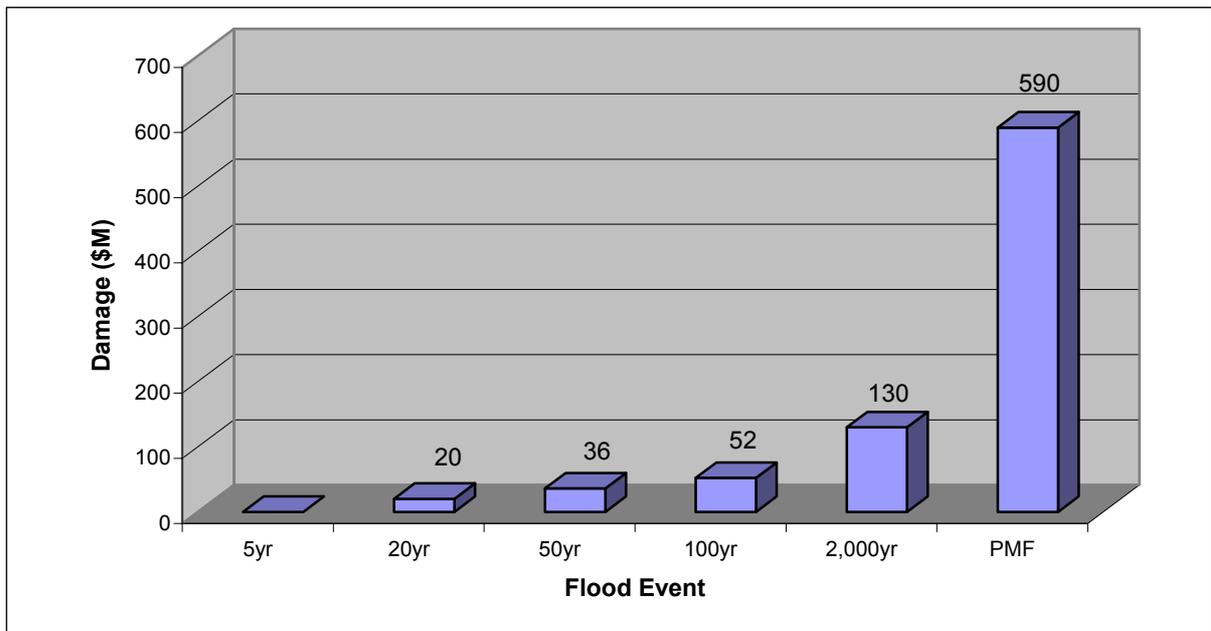
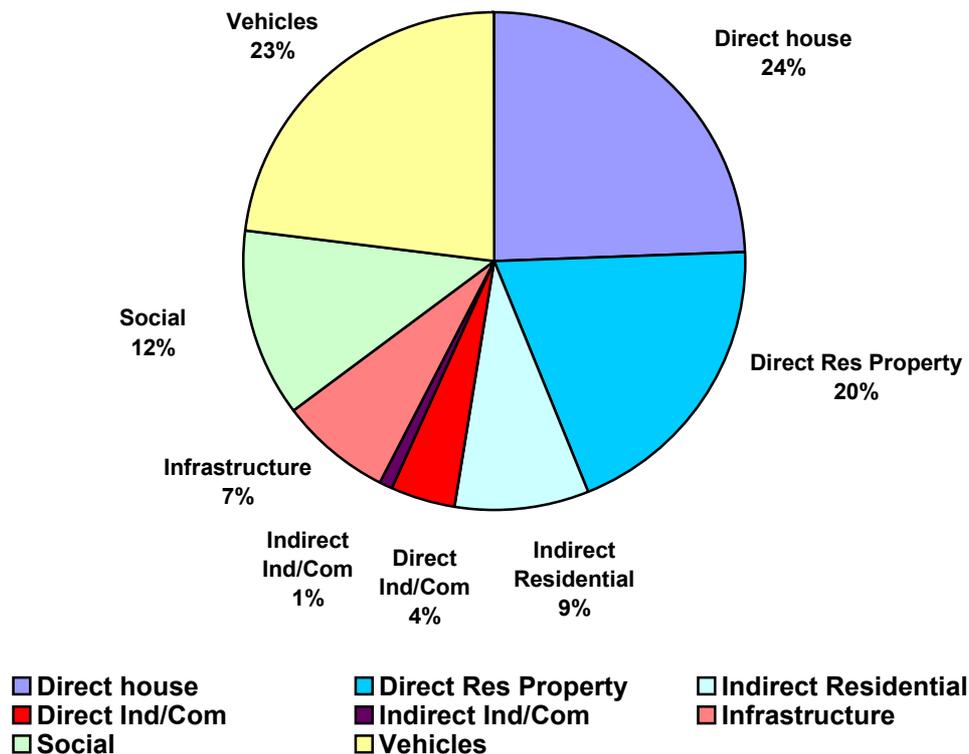


Figure 5.2
Total Estimated Flood Damage for Different Floods



**FIGURE 5.3
COMPONENTS OF FLOOD DAMAGE FOR PROSPECT CREEK
(AVERAGE ANNUAL DAMAGE)**

The following points are relevant from the above results:

- ▶ Components of expected average annual flood damages within the study area are estimated as:

- Direct House Damage	\$ 924,000	(24%)
- Direct Property Damage	\$ 737,000	(20%)
- Indirect Residential Damage	\$ 332,000	(9%)
- Direct Industrial & Commercial	\$ 156,000	(4%)
- Indirect Industrial & Commercial	\$ 31,000	(1%)
- Infrastructure & Public Sector Damage	\$ 274,000	(7%)
- Vehicular damage (residential)	\$ 878,000	(23%)
- Social Damages	<u>\$ 457,000</u>	(12%)
- TOTAL	\$3,790,000	

- ▶ Fairfield City Council bears almost the entire damage bill (99% of average annual damage) throughout the catchment.
- ▶ Most flood damage (95% of average annual damage) occurs downstream of the Granville Railway Line. Properties between the Hume Highway and the railway line account for 61% of total damage and properties downstream of the Hume highway account for 34% of total damage.

- ▶ Most damage occurs to the residential sector (76% of average annual damage).
- ▶ The estimated total flood damage in a 20 year flood is \$19M;
- ▶ The estimated total flood damage in a 100 year flood is \$52M;
- ▶ The estimated total average annual flood damage (from all floods) is \$3.8M per annum
- ▶ The present value of flood damage is estimated at \$40M.

6 REVIEW OF EXISTING RECOMMENDATIONS

The existing floodplain management plan for Prospect Creek is based on the Lower Prospect Creek Floodplain Management Study (Willing & Partners, 1990) and the Upper Prospect Creek Floodplain Management Study (Willing & Partners, 1993). Components of the existing plan, and the status of various works, are shown in **Table 6.1**. Further review of the previous floodplain management recommendations is provided in the remainder of this Section.

Table 6.1
Components of the Existing Floodplain Management Plan

Section	Recommended Measure	Estimate (\$)*	Status
Upper Prospect Ck			
6.1.1	Augmentation of Hassall St and Rosford St Basins	\$340,000	Completed
6.1.2	Stream Clearing works (Justin Street & Cumberland Hwy)	\$210,000	Completed
6.1.3	Stream Clearing works (North Fairfield Rd)	\$40,000	Partly completed
6.1.4	Bank stabilisation and raising 2 houses in Bell Cr	\$450,000	Partly completed
Lower Prospect Ck - Northern Sector			
6.2.1	Prospect Creek Channel Clearing (upstream of Burns Ck)	\$220,000	
6.2.2	Burns Creek Channel Improvements	\$380,000	Completed
6.2.3	Prospect Creek Widening	\$1,280,000	Completed
6.2.4	Vine Street Bridge Replacement & Raising	Not provided	Completed
6.2.5	Fairfield Park Floodway	\$720,000	Completed
6.2.6	Vincent Crescent Levee	\$1,340,000	
6.2.7	Creek Dredging	\$500,000	Abandoned
6.2.8	Orphan School Creek Improvements	\$320,000	
6.2.9	St Elmos Drain Improvements	\$2,000,000	Completed
6.2.10	Road Access Improvements	\$200,000	
6.2.11	Voluntary Purchase (x 11)	\$780,000	8 Purchased
6.2.12	House Raising (x 116)	\$1,030,000	47 Raised
6.2.13	Home Unit Floodproofing (Ruby St)	\$620,000	
Lower Prospect Ck - Central Sector			
6.3.1	Ramsay Avenue Deflector Wall	\$320,000	
6.3.2	Creek Dredging	\$750,000	Abandoned
6.3.3	Carrawood Park Deflector Wall	\$490,000	
6.3.4	Road Access Improvements	\$1,000,000	
6.3.5	Voluntary Purchase (x 54)	\$5,850,000	49 Purchased
6.3.6	House Raising (x 146)	\$1,280,000	68 Raised
6.3.7	Home Unit Floodproofing (Sandal Cr & Waterside Cr)	\$360,000	Partly completed
Lower Prospect Ck – Southern Sector			
6.4.1	Hume Highway Raising, Relief Culvert & floodway	\$5,000,000	
6.4.2	Road Access Improvements	\$1,000,000	Partly completed
6.4.3	Georges River Deflector Wall	\$240,000	
6.4.4	Voluntary Purchase (x 31)	\$2,860,000	19 Purchased
6.4.5	House Raising (x 202)	\$2,010,000	89 Raised

* Estimate at time of study – Upper Prospect Creek \$(1993), Lower Prospect Creek \$(1990)

6.1 UPPER PROSPECT CREEK

6.1.1 Augmentation of Hassall Street and Rosford Street Basins

The Hassall Street and Rosford Street basins are two of the larger retarding basins that are located within the Prospect Creek catchment. They are the only basins that are located directly on Prospect Creek, and both basins have the potential to significantly influence downstream flood conditions.

The performance of the two basins was reviewed as part of the Upper Prospect Creek Floodplain Management Study (Willing & Partners, 1993). The following augmentation measures, shown on **Figure 6.1**, were recommended to improve the hydraulic performance of these basins:

- (i) Raise the Hassall Street basin embankment by 1.0m to RL 31.10 to increase the available flood storage volume, including the construction of a secondary embankment to contain overflows on the north side of the basin and provision for piping local flows through the basin. The increased embankment height was intended to increase the maximum storage volume in the basin from 350,000m³ to 600,000m³ (FCC Plan No D/R3/23). The increased storage capacity was to be utilised by closing two of the four outlet culverts under the basin embankment, significantly reducing downstream flood flows.
- (ii) Close one of the five outlet culverts of the Rosford Street Basin to better utilise the available basin storage, in light of reduced inflows from the upstream Hassall Street basin.



Figure 6.1
Basin Augmentation Works

The total cost of these works was estimated at \$340,000 (1993). The recommended works have since been constructed.

A review of the basin modifications (Willing & Partners, January 2001) concluded that the augmentation works had increased the efficiency of the two basins. Flood level reductions in the estimated 100 year flood were quoted as between 0.12 to 0.31m between the basins and the Cumberland Highway, which were largely attributed to the basin augmentation works. It was noted, however, that catchment development since 1993 may have negated some of the benefits of the flood mitigation works that had been undertaken, with peak inflows to the Hassall Street basin increasing by around 6% in the 100 year flood.

Results from the latest computer modelling on Prospect Creek (refer Appendix A) confirm that both basins are operating effectively. The top water level predicted in the TUFLOW model for the Hassall Street Basin in the 100 year flood is RL 30.9m AHD, which is 0.1m above a 15m wide spillway and 0.2m below the crest level of the embankment. The Rosford Street Basin is estimated to reach a maximum level of 24.2m AHD, the approximate crest level of the embankment.

No further augmentation works would appear to be necessary for these basins, other than to confirm the operation and stability of both basin embankments in floods more extreme than the 100 year event. This is considered particularly important for the Hassall Street basin due to its large storage capacity. There may also be opportunities to install an automatic water level gauge within the basin to monitor flood conditions and to assist with flood warning procedures (discussed later).

6.1.2 Stream Clearing Works (Justin Street and Cumberland Hwy)

The Upper Prospect Creek Floodplain Management Plan included stream clearing measures in the vicinity of Justin Street and the Cumberland Highway.

The Justin Street works comprised stream clearing on the north side of the creek over a distance of 250m, and included excavation to increase the capacity of the creek system. The estimated cost of these works was \$150,000 (1993).

The Cumberland Highway works included stream clearing over 250m on the downstream side of the highway, and also included the removal or reshaping of a gabion wall on the downstream side of the bridge. A floodway downstream of the Highway on the north side of the creek was also investigated, but not recommended. The cost of recommended works was estimated at \$60,000 (1993).

Selective stream clearing measures have subsequently been implemented by Council in these two vicinities, and further upstream. A high level bypass floodway, known as the Justin Street Floodway, was also constructed in preference to widening the existing creek.

The location of stream clearing measures proposed in the floodplain management plan is shown on **Figure 6.2**, including the location of the constructed Justin Street Floodway and the industrial/commercial premises that are estimated to be currently inundated above floor level in a 100 year flood.

The objective of the above measures was to prevent floodwater from overflowing the southern bank into Justin Street and ultimately into Victoria Street. Despite the measures that have been undertaken, the industrial area upstream of the Cumberland Highway continues to flood in a 100 year flood, with some 24 industrial premises estimated to be inundated in this event.

Further strategies to reduce flood levels in this vicinity should be investigated. This could include opportunities to reduce the constricted floodplain between the Highway and Little Street.



Figure 6.2
Measures in the Vicinity of Justin St and the Cumberland Hwy

6.1.3 Stream Clearing Works (downstream of Polding Street)

Stream clearing works in the vicinity of the Polding Street Bridge was included in the Upper Prospect Creek Floodplain Management Plan to reduce flood levels in Ace Avenue, Jervis Street, Cawarra Place and Polding Street.

The cost of the proposed stream clearing measures was estimated at \$40,000 (1993).

Stream clearing and bush regeneration has been undertaken on the south side of the creek, within the Fairfield City Council area. In contrast, there is little evidence of works being undertaken on the north side of the creek, within the Holroyd City Council area. The northern bank is thickly covered with trees, fallen timber and vines, and has been noted as having minimal flood carrying capacity (Willing & Partners, 2001).

It is estimated that there are presently 4 homes in Ace Avenue and 1 home in Polding Street and 1 home in Cawarra Place that would be inundated above floor level in the 100 year flood in this vicinity. One home is inundated by only 20mm, with the remainder inundated between 220 and 350mm in the 100 year flood.

The stream clearing measure recommended in this area and the homes subject to inundation are shown on **Figure 6.3**.

Completion of the stream clearing measures on the north bank of the creek is recommended.



Figure 6.3
Stream Clearing Works downstream of Polding Street

6.1.4 Measures at Bell Crescent

The Upper Prospect Creek Floodplain Management Plan recommended that two houses in Bell Crescent (Holroyd City Council) be flood-proofed by raising, at an estimated cost of \$50,000 (1993). The two houses are at 23B Bell Crescent and 25 Bell Crescent. Floor level data recently provided by Holroyd City Council indicates higher floor levels for these two homes, suggesting that they have either been raised or reconstructed at a higher level, above the 100 year flood.

There is one additional home that has been constructed since the previous Plan at 37 Bell Crescent, which the flood damages database indicates could be below the 100 year flood. A closer inspection of this entry indicates that the floor level for this building has been estimated only, based on an average height above ground level of 0.5m. As this is a relatively new building, it is likely that minimum floor level controls would have been applied by Holroyd Council. The floor level of this building should be confirmed.

Bank stabilisation works in the vicinity of Bell Crescent was also listed as an optional consideration, given that there was some potential for structures such as the swimming pool at 26 Bell Crescent becoming dislodged and blocking the downstream waterway. The cost of the bank stabilisation works was estimated at \$400,000 (1993). These works do not appear to have been implemented, and the swimming pool and at least one other structure appear to be a potential restriction to flood flows. Further review of bank stability and the potential impact of these structures are warranted. In particular, Holroyd Council should ensure that no other structures are permitted at the rear of properties in Bell Crescent that could potentially impact on flood behaviour.

6.2 LOWER PROSPECT CREEK – NORTHERN SECTOR

The Lower Prospect Creek Floodplain Management Plan includes the area downstream of the Granville Railway Line. This area is further divided into three sectors, known as the Northern, Central and Southern Sectors. Works recommended in the Northern Sector are shown on **Figure 6.4**, and further discussed below.



Figure 6.4
Existing Floodplain Management Plan – Lower Prospect Creek (Northern Sector)

6.2.1 Prospect Creek Channel Clearing (Burns Ck to Fairfield St)

Channel Clearing on Prospect Creek, between Burns Creek and Fairfield Street, was recommended in the Lower Prospect Creek Floodplain Management Plan. The cost of the works was estimated at \$220,000 (1990).

The Plan is not very specific on the actual extent of works required in this reach. It is noted that the works (in conjunction with other measures) contributes to a 1.0m reduction in upstream flood levels, which would benefit properties in Bell Crescent and The Horsley Drive. Table 11.1 from the original Plan suggests that this measure alone would reduce flood levels by up to 0.5m (presumably in a 100 year flood).

There is no evidence that this reach of Prospect Creek has been cleared of dense vegetation. A review of the flood damages database indicates that there are no properties currently inundated above floor level in the 100 year flood in this vicinity. However, further upstream, floodwater does spill across The Horsley Drive and inundates a number of commercial premises within the Fairfield CBD. The proposed stream clearing measures may reduce the upstream flood depth by a sufficient amount to restrict overtopping of The Horsley Drive, benefiting 6 commercial premises and reducing flood problems around the grounds of residential units that are adjacent to the railway line.

Further consideration of the proposed stream clearing measures is recommended. Regular maintenance of the creek corridor will also be required to ensure that heavy vegetation, weeds or other debris do not re-establish over time.

6.2.2 Burns Creek Channel Improvements

Channel improvement works on Burns Creek were recommended in the previous Plan, at an estimated cost of \$380,000 (1990). The works are listed as channel clearing and straightening up to Normanby Street. The works are noted as benefiting properties upstream of the study area, and were not further quantified.

Significant work has been undertaken on Burns Creek by Fairfield Council, including the construction of a high level floodway beside the creek. These works are understood to have significantly reduced flooding problems along Burns Creek. Despite these improvements, there are 5 residential buildings in Victory Street and 1 residential building in Seville Street that are still affected by the 100 year flood. It would appear that the most appropriate action would be to include these buildings in a house raising scheme.

Burns Creek is outside the current study area, and is the subject of separate floodplain management investigations. However, in the absence of a formal house raising scheme on Burns Creek, and given the proximity of these buildings to the Prospect Creek study area, it may be desirable to include these 6 buildings in the Prospect Creek House Raising Scheme. No other structural floodplain management measures in this area are warranted for inclusion in the Prospect Creek Floodplain Management Plan.

6.2.3 Prospect Creek Widening

The creek between Fairfield Park and its confluence with Burns Creek was noted in the 1990 Plan as being narrow and severely constricting flood flows. Various creek widening options were considered to improve the capacity of the creek in this reach. The Plan recommended widening Prospect Creek by 30m over this reach, at an estimated cost of \$1,280,000 (1990). These works were estimated to lower flood levels by up to 1.0m.

Substantial channel improvement works have been undertaken by Fairfield City Council on this reach of Prospect Creek. Existing flood levels also appear to have been lowered in this area from previous estimates, although this will be a result of a combination of works that have subsequently been undertaken. The flood damages database indicates only 1 house currently inundated in a 100 year flood in this vicinity. This house is adjacent to the creek bank, at the end of May Street. The floor level for this property has not been surveyed, and has been estimated using Council's ALS data. Subject to confirmation of the floor level, this property could be included in the Prospect Creek house raising scheme.

The recommended works have been undertaken. No further flood mitigation works in this vicinity are warranted.

6.2.4 Vine Street Bridge Replacement

The Vine Street bridge replacement is shown on the drawings for the previous Floodplain Management Plan, although it is not included in the itemised list of recommended measures. Other works that have been proposed in this vicinity, including widening Prospect Creek and raising the approaches to the bridge to improve road access, would necessitate this action.

Vine Street Bridge, also known as Konemann's Bridge, was rebuilt in 1996. The length of the bridge was increased from 23m to approximately 44m. The height of the bridge was also increased by 2m from RL6.4m AHD to RL 8.4m AHD. The bridge and road approaches are now above the estimated 100 year flood level. The capacity of the structure has also been greatly improved, which in conjunction with creek widening and the downstream floodway has greatly reduced design flood levels.

The design 100 year flood level at the bridge has been reduced from RL 8.0 to RL 6.9m AHD. Several properties previously identified for house raising in this vicinity may no longer need to be raised as a result of this improvement.

The hydraulic restriction caused by the previous bridge has now been removed, and access conditions along Vine Street greatly improved. No further measures in this vicinity are required.

6.2.5 Fairfield Park Floodway

A floodway through Fairfield Park was proposed in the previous floodplain management plan, at an estimated cost of \$720,000 (1990). The floodway was estimated to lower flood levels by up to 0.2m, potentially benefiting up to 25 houses.

The floodway is located immediately downstream of the Vine Street Bridge. It was proposed to form a high level floodway by:

- i) excavating the left bank of Prospect Creek immediately downstream of the Vine Street Bridge;
- ii) lowering the inside bank of a meander within Fairfield Park; and
- iii) excavating the left bank of Prospect Creek downstream of Fairfield Park to streamline the downstream flow path.

Various combinations for the floodway scheme were subsequently investigated (Cardno Willing, 2002). The investigations concluded that excavation of the left bank downstream of Fairfield Park (Item c) provided minimal benefits. A revised scheme was subsequently adopted by Council with these works omitted. Some further modification of the floodway scheme was also made to retain a number of well established trees that would otherwise have been destroyed.

The floodway scheme has since been constructed.

6.2.6 Vincent Crescent Levee

Construction of the Vincent Crescent Levee at Canley Vale was proposed in the previous floodplain management plan at a total cost of \$1,340,000 (1990). The levee was intended to protect 47 houses in Vincent Crescent, Togil Street and Bonham Street from a 100 year flood. The proposed levee consisted of a block wall running at the rear of properties in Vincent Crescent, beside the right bank of Orphan School Creek and Prospect Creek, linking up with an earthen embankment around the perimeter of Parkes Reserve to join the Carramar Railway line embankment.

The cost of the levee proposal was estimated at \$28,000 per household (1990) when proportioned over the number of houses where flooding was alleviated. It was recognised that the cost per household was greater than the alternative option of house raising (then estimated at \$20,000). The additional cost was justified on the basis that flooding was also

reduced to the grounds of an additional 19 properties and when social and access conditions were also taken into consideration.

It was assessed that the levee would increase flood levels within Prospect Creek and Orphan School Creek by up to 0.1m unless other compensatory measures were included. Dredging of the tidal reaches of Prospect Creek and Orphan School creek upstream of the Carramar Railway Line, was therefore recommended to mitigate the flood impact. A subsequent study into the feasibility of dredging Prospect Creek and Orphan School Creek (MHL, 94) indicated that this would threaten the stability of the creek banks, and that substantial bank stabilisation works would be required should proposals to dredge proceed. The report also noted that constructing a levee on top of the existing banks could pose further stability problems, and that the levee bank would need to be set back a sufficient distance from the top of the creek bank. Further review of the dredging option is provided in the following section.

A separate report on the Vincent Crescent Levee (Willing & Partners, 1990) assessed the potential for stormwater flows to pond behind the levee when river levels are high. It was concluded that there was insufficient area in which to temporarily store this stormwater flow, and that local flooding problems would still occur, despite the construction of the levee.

Three options were suggested to alleviate this problem:

- i) excavate Parkes Reserve to provide for 8,000m³ storage volume, and include a pumping station with dual high capacity (600l/s) pumps;
- ii) excavate Parkes Reserve to provide up to 20,000m³ storage volume, and include a pumping station with dual (150-250l/s) pumps; or
- iii) excavate Parkes Reserve and Sherwin Park to provide up to 26,000m³ storage with no pumping station.

The disadvantage of the first two options is that a pumping station is required to pump impounded stormwater to Prospect Creek. This introduces high maintenance costs and reliability concerns that the pumps will actually operate when required – which could be as infrequently as once every 20 years. There was also the concern over the potential for power failure during storms, since pumps of this nature are typically electrically operated.

The disadvantage with the third option is the practical difficulties of providing this amount of storage. It would require substantial excavation within Parkes Reserve resulting in the loss of established trees and other aesthetic concerns. A transfer pipeline between the two parks would also be required, adding greatly to the cost of the scheme. This option was estimated to cost an additional \$890,000 (1990) over the first option.

The report also noted that the proposed block wall levee would be prohibitively high at the rear of seven properties along Vincent Crescent (Nos 22-34). It was recommended that the back yards of these properties be filled to a level of approximately RL 5.0m AHD (a depth of up to 2m) and the block wall constructed along the top of this fill. Raising the ground level of these properties was also seen as advantageous in diverting surface flows to a low point in Parkes Reserve where it could be temporarily stored.

A revised estimate for the proposed levee, based on the inclusion of a pumping station with dual pumps, was provided in 1993 (correspondence between Willing & Partners and Fairfield Council). Capital costs were estimated at \$2,100,000 (1993) and maintenance costs at \$8,000 per annum. This does not include the additional scour and bank protection works that would most likely be required along the banks of Prospect Creek and Orphan School Creek due to increased flood velocities.

Given the problems associated with dredging to compensate for the impacts of the levee; maintenance and reliability concerns with the required pumping facilities; and the increasing cost of the levee, an alternative house raising option was investigated for the properties at risk in this area (Dalland & Lucas, 94). A visual inspection was made of the dwellings identified from the floodplain management study and protection measures for each house identified as either:

- i) traditional house raising (estimated at between \$32,000 and \$40,000)
- ii) flood proofing measures to the existing dwelling (estimated at \$40,000); and
- iii) first floor extensions (estimated at \$60,000).

The total cost of the alternative scheme was estimated at \$1,900,000 (94). This represents a small cost saving over the revised levee scheme, and also avoids the need for costly bank stability and scour protection works.

A comparison with the existing flood damages database indicates that there could be up to 61 buildings that are currently below the estimated 100 year flood level in this area. This is an increase over the previous number of 53 that had been quoted. Reasons for the difference are not clear, however, at least one of these buildings is noted as being a shop and many others are only marginally affected by the 100 year flood. The estimated over-floor depth of flooding for this area is shown on **Figure 6.5**.

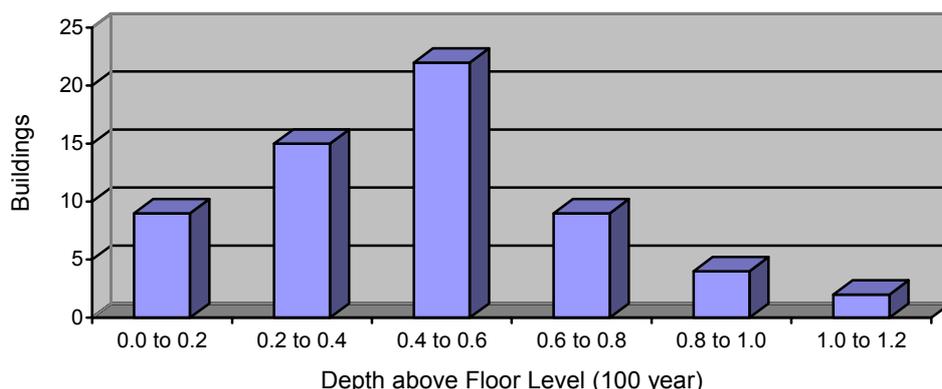


FIGURE 6.5
Depth of Flooding in Vincent Crescent Area

Fairfield Council conducted a special community workshop with residents of this area in September 2001. The levee option and alternative house raising option were considered at the workshop. A definitive decision on the preferred option was not reached, with Council giving an undertaking to further consult residents on an individual basis.

A final decision on the viability of the levee or the alternative house raising proposal does not appear to have been determined to date. There are a number of difficulties in building the levee that were not originally envisaged, and from an environmental and economic perspective, it may be less attractive than the alternative house raising option. A summary of the advantages and disadvantages of both options are provided in **Table 6.2**.

Table 6.2
Options in the Vincent Crescent area (including Bonham and Togil Streets)

Vincent Crescent Levee		House Raising Alternative	
Advantages	Disadvantages	Advantages	Disadvantages
Reduces flood problems for up to 61 properties in Vincent Crescent, Bonham St and Togil St for events up to the 100 year flood	Increases flood levels elsewhere if dredging is not feasible	No impact on flood levels	Not all buildings are suited to house raising, and others only marginally affected by flooding may not be included in the scheme
Reasonable access conditions will be maintained up to the 100 year flood	Velocities in the creek will increase necessitating additional scour protection measures	No impact on flood velocities	Some residents have expressed concerns over the visual impact of house raising
Does not require modification of existing dwellings (other than the relocation of minor structures at the rear of some properties)	Storage of stormwater behind the levee necessitates substantial excavation in established parks and reliance on pumps to reduce levels	No environmental issues or major excavation required in existing parks	Steps to the raised floor can be inconvenient and difficult for elderly people
Would appear to have reasonable community support	High maintenance costs associated with pumps and reliability concerns	House raising has proved a success in other parts of Fairfield	Houses can still become isolated by floodwater and residents trapped in their homes unless early evacuation occurs
	Higher construction costs and potential funding problems	Lower cost and can be progressively implemented	
	Loss of creek views and other aesthetic issues	Does not have to involve traditional house raising (for example, a subsidy payment could be provided to encourage appropriate redevelopment)	
	Increased risk when the levee overtops due to rapid inundation and increased complacency		

There are a number of impediments to constructing the levee that now make this option difficult to recommend, including:

- i) it will increase flood levels by up to 0.10m elsewhere in the catchment. Compensatory creek dredging had been proposed to mitigate this impact (see discussion below), but this is no longer viable;
- ii) velocities in the main creek will increase, which will exacerbate erosion problems on both sides of the creek, including existing problem areas identified opposite Sandal Crescent;
- iii) the proximity of the levee to Prospect Creek (behind properties at No. 1 Togil Street and Nos. 40-46 Vincent Crescent) may destabilise the bank of the creek due to the added weight of this structure;
- iv) disposal of local runoff behind the levee will require substantial excavation from Parkes Reserve to form a temporary flood storage area, and will also require the installation of a pumping station; and
- v) maintenance of the levee and reliability issues inherent with pumps that are required to operate on a very infrequent basis will provide a continuing liability for Council and residents.

The alternative house raising option also has some concerns, not the least being the visual impact of a house raising scheme on the local community, and the fact that not all buildings are suited to being raised. There are also some examples of newer buildings that have been constructed in the area with floor levels above the 100 year flood, and this type of development is likely to be more visually acceptable than an older home that has been raised on piers.

A variation to the traditional house raising scheme could be considered that encourages redevelopment of existing low lying homes through urban renewal. Instead of providing a subsidy to cover the full cost of raising the existing dwelling, a lower subsidy could be offered to home owners to assist with the expense of redevelopment, if and when the owner is ready to do so. The subsidy should be considered as an incentive to encourage redevelopment that is more compatible with the flood risk, whilst providing an outcome that is more visually acceptable than a traditional house raising scheme.

House raising subsidies that are currently offered range from \$10,000 to the current capped limit of \$81,000. The \$10,000 subsidy has been offered to eligible property owners that have raised their floor levels on their own accord, or have requested participation in the house raising scheme ahead of the established priority order. The full \$81,000 subsidy is based on the expected maximum cost of raising a typical timber clad home in the catchment. The amount of subsidy offered to residents in the Vincent Crescent area will need to be determined by Council in consultation with other State Government funding partners.

Given the problems associated with the proposed levee, raising existing low lying dwellings through urban renewal is considered to be the most appropriate management strategy for the Vincent Crescent area. The estimated cost of the scheme, based on providing say a \$20,000 subsidy to 60 eligible homes, is \$1.2M (2009).

6.2.7 Creek Dredging

The previous floodplain management plan includes dredging of the tidal reaches of Prospect Creek and Orphan School Creek upstream of Cook Avenue, at an estimated cost of \$500,000 (1990).

The dredging was included in the Plan to compensate for the increase in flood levels that were estimated to result from construction of the Vincent Crescent Levee. It was assumed that the creek would be dredged to increase the average depth by a minimum of 0.5m.

A report into the feasibility of dredging Prospect Creek and Orphan School Creek was commissioned by Council (MHL, 94). The report investigations included bank stability investigations and creek bed material testing.

The bank stability investigations concluded that dredging within the study area would not be feasible without considerable bank stabilisation works. It also found that any proposed dredging of the creek bed would necessitate additional scour protection of the existing bank stabilisation works. It was also noted that any levee bank construction on top of the existing bank will need to be reviewed for stability aspects, and that it was likely that the levee bank would need to be set back a sufficient distance from the top of the creek bank and that additional scour protection measures may also be required.

The creek bed material testing showed that the samples analysed were suitable for landfill except for their high iron leachability. It was noted that further testing and discussions with the EPA would be required before EPA approval for landfill could be ascertained.

As a result of bank stability concerns and difficulties disposing of the dredged material, the option of dredging Prospect Creek and Orphan School Creek has been deferred. This option no longer appears to be viable due to environmental and economic considerations.

6.2.8 Orphan School Creek Channel Improvements

The previous floodplain management plan includes an item for channel improvement works in Orphan School Creek, downstream of the Canley Vale-Fairfield Railway line, at an estimated cost of \$320,000 (1990).

The Plan shows the extent of the creek improvement works extending from the end of the proposed Vincent Crescent Levee upstream to the railway line. No further details are provided on the nature of the proposed improvements. It is noted that the works in association with the proposed dredging, voluntary purchase and other measures on Prospect Creek, will reduce flood levels by up to 0.5m along Orphan School Creek, benefiting approximately 80 houses in Canley Vale. This full benefit will not be attainable as dredging is unlikely to be a feasible measure in the

To date 3 properties have been purchased on Prospect Road, in the upper part of Orphan School Creek, and the banks cleared of low vegetation. A footpath/cycleway has also been constructed along the bank of the creek in this vicinity. There is no evidence of further stream clearing measures in the lower reaches of Orphan School Creek.

The proposed channel improvements were most likely a complementary measure to the proposed dredging on Orphan School Creek. This may no longer be feasible, however continued clearing of heavy undergrowth along the lower reaches of Orphan School Creek would still be beneficial.

6.2.9 St Elmos Drain Improvements

Drainage improvements in St Elmos Drain (a tributary of Orphan School Creek) were proposed in the previous floodplain management plan to improve flood conditions and access to properties adjacent to this Drain, between North Street and the Railway. The cost of the drainage improvements was estimated at \$2,000,000 (1990).

The main improvements include augmentation of the existing drain to increase its capacity and preventing overflows from cutting access to residential properties, including 3 blocks of home units. The main benefits occur upstream of the study area, and were not quantified in the floodplain management study.

Drainage improvements on St Elmos Drain have since been completed. No further work under the Prospect Creek Floodplain Management Plan is required.

6.2.10 Road Access Improvements

Several roads within Lower Prospect Creek were proposed to be raised under the previous floodplain management plan to improve access during floods. The objective of raising low sections of road is to provide access to residents that continually rise in the direction of evacuation, thereby avoiding low spots in evacuation routes and potentially hazardous areas.

Many of the properties at risk of flooding in Lower Prospect Creek have been identified for house raising. House raising in itself is not considered a total solution to the flood risk in Lower Prospect Creek due to the potential increase in flood heights in extreme floods, which can inundate the floor level of raised homes. Evacuation and reasonable road access for these properties is therefore an important requirement.

Roads identified for raising within the northern sector include parts of Orchard Road, Artie Street and Vine Street. The costs for the first two roads were estimated at \$20,000 (1990). No cost was provided for Vine Street, with these costs presumably included in the Vine Street Bridge replacement cost.

Vine Street was raised by Council during 1996 in conjunction with the construction of the new bridge. This has significantly improved conditions for through traffic in an east-west direction to Fairfield. No other road raising activities have been undertaken in the Northern Sector.

Orchard Road provides local access to residents from the south end of the road, adjacent to Orphan School Creek. Many of the dwellings in this area have been identified for house raising. To date, 7 homes have been raised, with a further 6 homes identified for future raising. Council's ALS survey indicates that the road generally rises in the direction of egress except for a 0.5m depression to the north of Riverview Street. Raising the road by up to 0.5m over a distance of 120m would improve evacuation conditions.

Artie Street provides similar access to local residents adjacent to Prospect Creek. This area includes 5 dwellings that have been raised, three dwellings that are still to be raised, and 4 other dwellings. Raising the road to remove a 0.5m depression over a length of 60m would improve evacuation conditions for local residents.

Both roads could be raised with minimal disruption to driveways and other services to improve local access conditions.

6.2.11 Voluntary Purchase

Voluntary Purchase is a major item in the Lower Prospect Creek Floodplain Management Plan, particularly throughout the central and southern sectors. In the northern sector, 6 dwellings were identified for voluntary purchase, at an estimated cost of \$780,000 (1990). Another 5 properties were subsequently identified and included in the scheme.

Voluntary purchase schemes involve Council purchasing properties that have been identified as severely flood affected and where continued habitation of the area is undesirable. Once purchased, buildings are removed from the property and the land rezoned to open space or other flood-compatible use. As its name suggests, the scheme is voluntary and subject to the agreement of the owner. It is also subject to the availability of funding provided by Council and the State Government.

Properties included in the voluntary purchase scheme are shown on **Figure 6.6**. Of the 11 properties identified in the northern sector, 8 have been purchased to date. These include:

- i) two properties on Vine Street, immediately downstream of the Vine Street Bridge;
- ii) one large property at the end of Haughton Street that had contained a number of retirement villas;
- iii) two properties at the end of Artie Street, near the confluence on Prospect Creek and Orphan School Creek; and
- iv) three properties on Prospect Road, just downstream of the Carramar railway line across Orphan School Creek.

Two other dwellings, at the end of Orchard Road and adjacent to Orphan School Creek, were identified for inclusion in the scheme, but have not yet been acquired. One other remaining dwelling was initially identified for house raising, but amended to voluntary purchase due to its location at the confluence of Orphan School Creek and Prospect Creek.



FIGURE 6.6
Voluntary Purchase Scheme – Northern Sector

6.2.12 House Raising

House raising forms a large component of the Lower Prospect Creek Floodplain Management Plan. The scheme is probably the largest to have been undertaken in New South Wales, and is being progressively implemented by Council. A total of 394 dwellings were originally identified for house raising in Lower Prospect Creek, with 104 of these located within the northern sector at an estimated cost of \$1,030,000 (1990). Some additional dwellings have since been identified and included in the scheme.

House raising involves lifting houses that are below the 100 year flood to a level that is at least 0.5m above the 100 year flood. The homeowner is responsible for arrangements with the builder, including the preparation of design plans and contractual matters. Council assists by providing a financial contribution towards the cost of the work. The easiest houses to lift are those that are timber clad and already constructed on piers. However, some brick houses have already been raised as part of the scheme, and other innovative measures have been used on other houses that are more difficult to raise (including acquisition, demolition and rebuilding).

Houses have been prioritised into three groups. The highest priority is for those dwellings located below the 20 year flood. The next priority is for dwellings located between the 20 year flood and the 50 year flood. The lowest priority is for dwellings that are located between the 50 year and 100 year flood. The original plan recommended different subsidies for each group, ranging from \$3,000 per dwelling for the lowest priority to \$20,000 per dwelling for the highest priority group. The scheme commenced in 1992 with the higher priority group and an equitable subsidy covering the full cost of raising each dwelling. With building cost increases over time, and in consultation with the State Government, Council implemented an upper limit subsidy of \$81,000. Residents from lower priority group could participate in the scheme ahead of time, but the subsidy offer was limited to \$10,000.

Properties included in the house raising scheme within the northern sector are shown on **Figure 6.7**. There are currently some 116 dwellings that have been identified for house

raising in this area. A total of 47 dwellings have been raised or floodproofed to date. Of the remaining 69 dwellings, there are 28 that have floor levels just above the revised 100 year flood level, and the merit of raising these houses is questionable. This is largely a consequence of other flood mitigation works undertaken within the northern sector, which has substantially reduced design flood levels. These dwellings could be placed on a deferred list and further reviewed following completion of climate change sensitivity modelling.

Further discussion on house raising is provided in Section 7.4.



Figure 6.7
House Raising Status – Northern Sector

6.2.13 Home Unit Floodproofing

A number of home units in Sandal Crescent and Ruby Street, Carramar were included in the previous floodplain management plan for floodproofing measures. These home units are located in both the northern and central sectors of Lower Prospect Creek. The Northern Sector includes floodproofing of 5 unit blocks at an estimated cost of \$620,000 (1990).

Floodproofing measures include the sealing of lower floor units through raising entry points, providing floodgates at other entrances, walls around balconies, and sealing other areas where floodwater may penetrate. Improved access between lower units and the street may also be feasible in some cases.

None of the home units identified in the Northern Sector have been floodproofed to date. A building survey of each unit block will be required to identify the scope of potential work within each block and to further assess the feasibility of providing floodproofing measures.

6.3 LOWER PROSPECT CREEK – CENTRAL SECTOR

Works recommended in the Central Sector of Lower Prospect Creek are shown on **Figure 6.8**, and further discussed below.

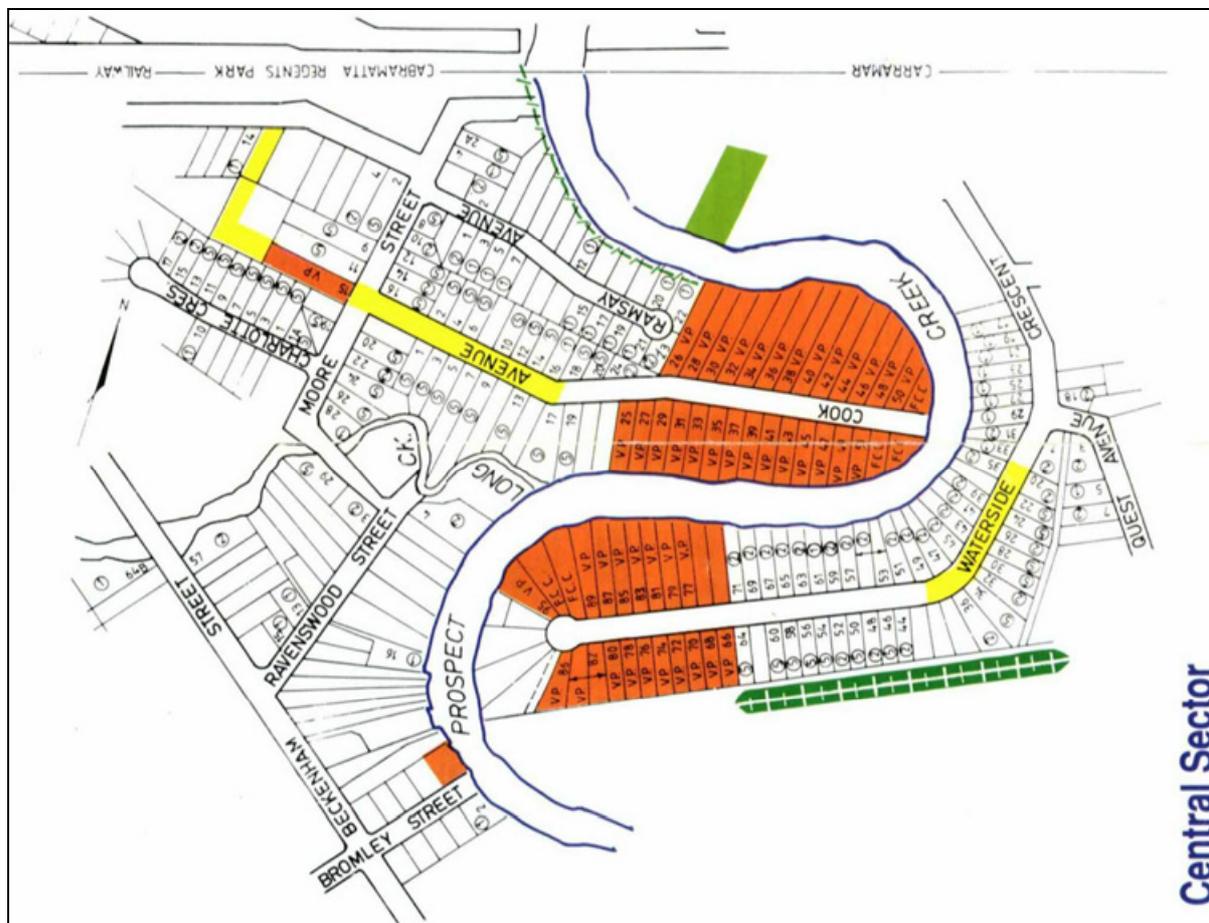


Figure 6.8
Existing Floodplain Management Plan – Lower Prospect Creek (Central Sector)

6.3.1 Ramsay Avenue Deflector Wall

A deflector wall was proposed behind properties in Ramsay Avenue in the Lower Prospect Creek Floodplain Management Plan, at an estimated cost of \$320,000 (1990).

The deflector wall was proposed along the right bank of Prospect Creek, between the Carramar Railway Line and the end of Ramsay Avenue. The objective of the wall was to reduce flood velocities in the Ramsay Avenue and Cook Avenue area, where many properties were identified for house raising. The reduced flood velocity improves safety and evacuation conditions for these residents.

Gabion bank stabilisation works were constructed along this part of Prospect Creek following severe bank erosion from the 1986 and 1988 floods. The deflector wall was later constructed along the boundary of properties in Ramsay Avenue. The wall is approximately 250m in length and constructed of copper logs.

The recommended works have been undertaken.

6.3.2 Creek Dredging

The dredging proposed in the Lower Prospect Creek Floodplain Management Plan in the northern sector was also proposed to be continued through the central sector, down to Cook Avenue. Dredging downstream of Cook Avenue was found to have negligible benefit due to the influence of high tailwater levels from the Georges River. The cost of dredging through the central sector was estimated at \$750,000 (1990).

The proposed dredging in both sectors, to a depth of 0.5m, was intended to compensate for the impact of the Vincent Crescent Levee. Dredging within the central sector was also noted as compensating for other deflector levees proposed at Ramsay Avenue and Carrawood Park.

A report into the feasibility of dredging (MHL, 94) concluded that dredging of the creek bed was likely to compromise the stability of existing banks and other bank protection measures already constructed. There are other environmental concerns associated with dredging, including increased water turbidity and disposal of the dredged material.

The proposal to dredge Prospect Creek has subsequently been deferred. It is unlikely to be a viable proposition on the balance of environmental and economic considerations.

6.3.3 Carrawood Park Deflector Levee

A deflector wall at Carrawood Park, on the downstream side of Waterside Crescent, was included in the Lower Prospect Creek Floodplain Management Plan at an estimated cost of \$490,000 (1990).

The deflector levee was intended to reduce flood velocities in the vicinity of Waterside Crescent, where a number of homes were proposed to be raised. This was intended to improve safety conditions for residents in this part of the floodplain. It was also noted that the deflector levee could provide a high level access path for residents of Waterside Crescent.

A preliminary concept report was prepared for the deflector levee (Willing & Partners, 96). The concept report notes a number of issues associated with the proposed levee, including:

- i) the height of the proposed structure (up to 4.6m above natural ground level);
- ii) the levee would impede the natural overland surface drainage from Waterside Crescent toward Carrawood Park;
- iii) loss of park area and established trees;
- iv) likely resident concerns due to aesthetics of the levee, loss of views and access to the park; and
- v) high construction costs.

It was also considered that the deflector levee could not practically provide an evacuation route for residents of Waterside Crescent, mainly as safe access from each property to the levee could not be guaranteed. The levee would also have to be constructed with a crest width of at least 4m in order to provide safe access, and would need to be extended beyond the limit of the proposed structure in order to tie in with higher ground to the east. Raising Waterside Crescent (also a recommended measure) was considered to provide a more suitable response to improved evacuation conditions.

Three options for the deflector levee were considered:

- i) an earth mound, constructed of compacted earth fill with side slopes of 1:4. This would result in the loss of at least 17 large trees and result in a significant loss of part area;

- ii) a vertical wall, constructed of masonry block-work or similar materials within the park, allowing for a drainage easement between Waterside Crescent properties and the wall; and
- iii) a vertical wall along the property fence line.

The third option was noted as providing a number of advantages over the other options, but was reliant on the full support of all residents adjacent to the wall. The cost was estimated at \$500,000 (1996). No further action on the deflector wall has been initiated.

Various issues have been raised that now make the deflector levee less attractive than originally envisaged. From a community perspective, there is likely to be local resistance due to aesthetic issues, loss of views and access to the park. The role of the deflector levee might also be questioned. It does not prevent inundation, but attempts to improve safety by reducing flood velocities. Flood conditions in this vicinity are also largely influenced by high tailwater levels in the Georges River, which provides the greatest flood depths but also lower flood velocities. However, it should be noted that higher flood velocities may occur under other flood scenarios where creek flooding coincides with a lower Georges River flood. The levee also does not fulfil one of its intended objectives of providing improved access conditions for residents during floods.

Road raising has been proposed along Waterside Crescent as a separate measure to improve flood access. This will also play a role in reducing flood velocities, although not to the same extent as the deflector levee given its lower height. However, given the problems associated with the Carrawood Park deflector levee, an extended version of the road raising proposal could provide a preferable solution.

Further investigation of the feasibility of raising Waterside Crescent in this vicinity, and its impact on flood behaviour, is recommended.

6.3.4 Road Access Improvements

Road access improvements were identified at Waterside Crescent and Cook Avenue in the Lower Prospect Creek Floodplain Management Plan, at an estimated cost of \$1,000,000 (1990).

Removal of a 0.6m dip in Waterside Crescent, over a distance of approximately 200m to the south of Quest Avenue, would provide a gradually increasing road profile to higher ground. Further raising this road, and extending it a further 130m towards the creek, would provide additional access improvements and act to reduce flood velocities across Waterside Crescent, where a number of homes have been raised and others are proposed to be raised. This could be an alternative to constructing the deflector levee that was originally proposed in Carrawood Park.

Cook Avenue provides similar local access for residents of raised homes in this area. Raising the road by up to 0.4m over a distance of 250m would provide improved access. Further improvements were also proposed by acquiring two properties in Moore Street and Fraser Road, and providing a new road connecting Cook Avenue with Fraser Road. If improvements are limited to removing the dip in Cook Avenue, then the existing route via Moore Street and Fraser Road provides a reasonable evacuation route that gradually rises out of the flood, and the expense of creating a new road link is unlikely to be justified.

Further consideration of measures to improve road access during floods for residents in Waterside Crescent and Cook Avenue is warranted.

6.3.5 Voluntary Purchase

Voluntary Purchase is a major component of the flood mitigation measures proposed for the central sector. The Plan lists the acquisition of a total of 45 dwellings, at an estimated cost of \$5.72M (1990).

There is some uncertainty regarding the number of properties in the scheme, as some dwellings are located across two lots and several other properties were already in Council ownership at the date of the Plan.

The majority of properties identified for voluntary purchase are those that are located at the lower end of Cook Avenue and the lower end of Waterside Crescent. Both streets are located on inside bends of the creek, where floodwater will tend to concentrate and the flood hazard will be greatest. All but five of these properties have been acquired by Council to date.

One other property was included in the scheme at the end of Bromley Street. It is understood that this house was included in the scheme as a result of the combined threat of flood and river bank erosion. The property has since been acquired.

Two other properties were included in the scheme, in Moore Street and Fraser Road, which have not been acquired. Acquisition had been proposed in order to construct a new road link between Cook Avenue and Fraser Road to improve flood access from Cook Avenue. A review of Council's ALS survey indicates that suitable access may be available via Moore Street and Fraser Road with minor improvements, without the need to construct a new road. Consequently, the dwelling in Fraser Road has been removed from the voluntary purchase scheme and the dwelling in Moore Street has been moved to the house raising scheme.

Properties included in the voluntary purchase scheme, and those that have been purchased to date, are shown on **Figure 6.9**. Five properties are still to be purchased in the central sector.

6.3.6 House Raising

House raising is also a large component of the recommended measures for the Central Sector of Lower Prospect Creek. The Plan originally identified 112 dwellings for house raising in this sector, at an estimated cost of \$1.28M (1990). Additional properties were subsequently identified, with the number increasing to 146 dwellings.

Properties included in the house raising scheme within the central sector are shown on **Figure 6.10**. A total of 68 dwellings have either been raised or floodproofed to date. Of the remaining 78 dwellings, there are 2 that have floor levels just above the revised 100 year flood level, and the merit of raising these houses is questionable. These dwellings could be placed on a deferred list pending further consideration of the impact of climate change on flood levels and further review of site-specific considerations.

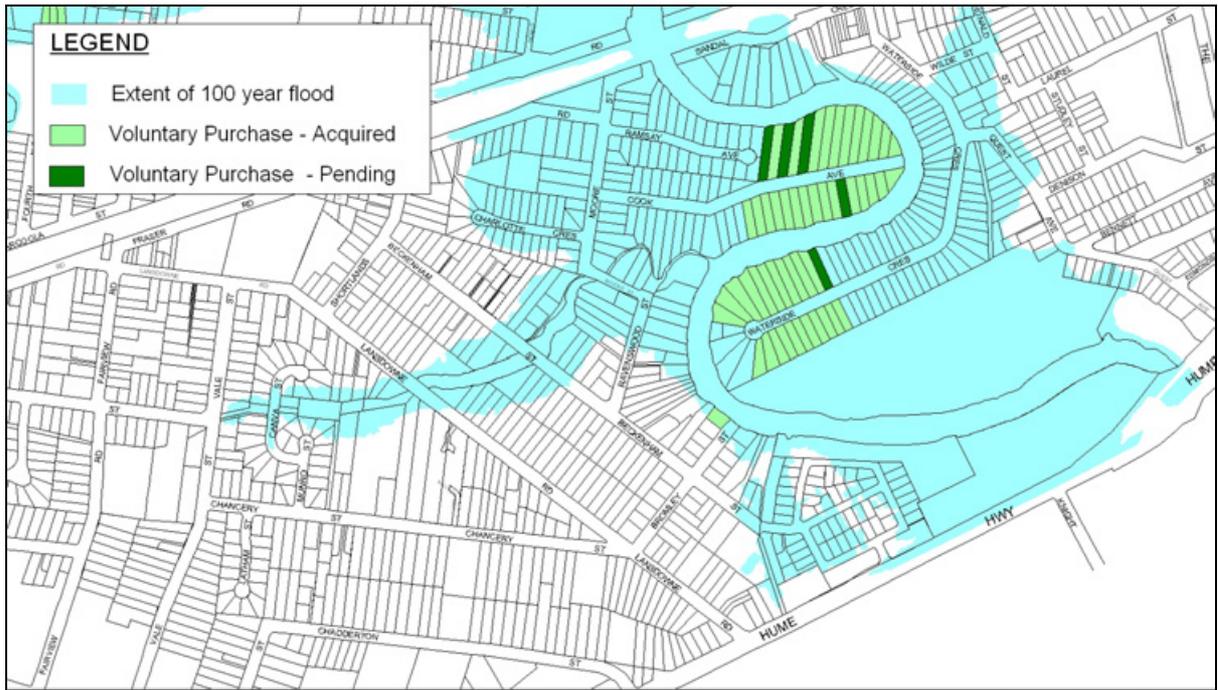


Figure 6.9
Voluntary Purchase Scheme – Central Sector

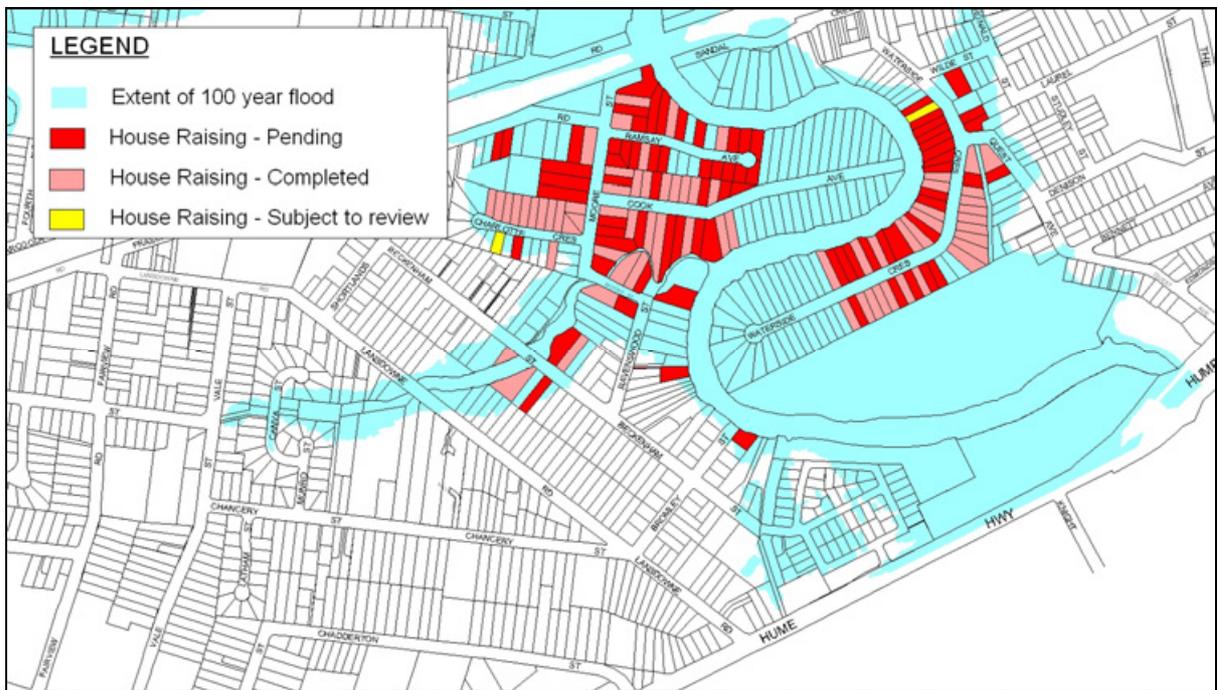
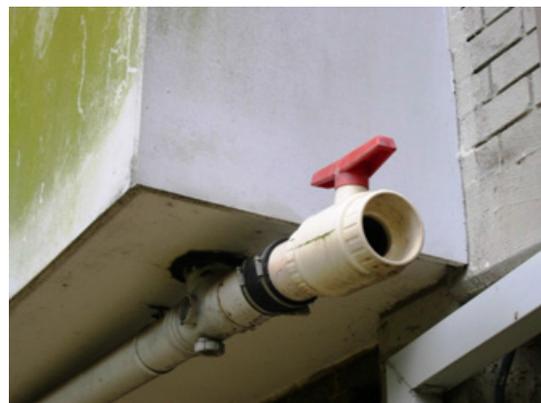


Figure 6.10
House Raising Status – Central Sector

6.3.7 Home Unit Floodproofing

Flood proofing of home units in Sandal Crescent, Carramar, was included in the Lower Prospect Creek Floodplain Management Plan at an estimated cost of \$360,000.

Floodproofing measures have been undertaken at 162 Sandal Crescent, and include such measures as sealing of lower floor units through raising entry points, providing floodgates at other entrances, walls around balconies, and sealing other areas where floodwater may penetrate.



Examples of floodproofing measures undertaken in Sandal Crescent include flood gates and enclosed balconies with stop-valves on drains to prevent intrusion of floodwater. Experience has highlighted issues related to maintenance of these facilities and maintaining the awareness of the occupants of the building of what needs to be done should a flood occur.

The measures undertaken at 162 Sandal Crescent are somewhat of a test case for other unit blocks where similar measures have been proposed.

A number of problems have been identified by Council since the works were implemented. For example, the floodproofing measures require owners to manually close flood gates and stop valves prior to flooding occurring. There is thus a need for ongoing education of owners and tenants concerning the nature of these facilities and what action needs to be taken during future floods. The problem is further magnified by the frequent turnover of occupants, and the high proportion of occupants from a non-English speaking background. Ideally, the body corporate should assume responsibility to maintain the facilities and to ensure that they are properly operated when necessary. However, it is understood that cooperation from the Body Corporate has been less than ideal.

A local flood warning alarm has been suggested as a potential measure to alert occupants of the need to take action. Whilst there is some merit in this proposal, without on-going public awareness the alarm may provide little added benefit.

Despite the limitations mentioned above, some of the floodproofing measures do not require manual operation and provide a positive flood reduction measure. For instance, modifications to basement car parking areas, through raising entry points and sealing walls, will significantly reduce flood damage. A building inspection of other unit complexes identified for floodproofing measures should be undertaken to identify the scope of potential measures. Preference should be given to those measures that are not reliant on manual operation or high levels of maintenance.

6.4 LOWER PROSPECT CREEK – SOUTHERN SECTOR

Works recommended in the southern RIVER sector of Lower Prospect Creek are shown on **Figure 6.11**, and further discussed below.



Figure 6.11
Existing Floodplain Management Plan - Lower Prospect Creek (Southern Sector)

6.4.1 Hume Highway Raising and Relief Culvert and Floodway

Raising the Hume Highway was included in the Lower Prospect Creek Floodplain Management Plan to reduce overland flows across the road and to make the Highway free from flooding in the 100 year flood. It was also proposed to construct a series of relief culverts under the raised highway and to construct a floodway parallel to Prospect Creek, through Lenox Reserve, to compensate for the impact of the raised highway on flooding.

The cost of raising the highway was estimated at \$2M, the relief culverts estimated at \$2.5M, and the floodway estimated at \$0.5M, giving a total cost of \$5M (1990).

Whilst some reduction in flood velocities can be anticipated downstream of the Hume Highway, the proposal is unlikely to have a significant impact on design flood levels, which are largely dominated by backwater levels from the Georges River. The proposed measures were mainly aimed at providing a high degree of flood protection for the highway, which at the time was an important national route. However, the subsequent construction of the M7 and M5 motorways through Sydney has now reduced the importance of keeping this part of the Hume Highway open to through traffic.

The Hume Highway is also cut by floodwater relatively frequently at the Cabramatta Creek crossing, less than 3km to the south. Raising the highway at Prospect Creek would have little benefit unless the highway was also raised at Cabramatta Creek. Raising the highway at Cabramatta Creek has not been included in the Cabramatta Creek Floodplain Management Study and Plan (Bewsher Consulting, 2004).

Given the limited flood benefits, high costs, and reduced importance of the Hume Highway to through traffic, it is considered that there is limited benefit in pursuing this option. Consequently, the relief culverts and floodway could also be deleted from the Plan.

6.4.2 Road Access Improvements

In the absence of a structural scheme capable of alleviating flooding in the southern sector, the Lower Prospect Creek Floodplain Management Plan recommended the raising of various roads to eliminate dips and provide a rising or at worst level path to high ground, thereby allowing safe and orderly evacuation of the area during floods. The total cost of the proposed road raising through the southern sector was estimated at \$1M (1990).

Evacuation is an important consideration for the southern sector. Many of the dwellings within this area were identified for house raising, and many have since been raised. This has provided only a partial solution to the flood risk, since there is a continuing risk of floods more extreme than the 100 year event that could inundate even the floor level of raised dwellings. Inundation depths over roads in a 100 year flood are shown on **Figure 4.2**. It is evident that many of the roads in Lansvale will be inundated by over 1m in a major flood. It is impractical to raise these roads to provide access in the 100 year flood, and removal of depressions and regrading to provide a constant rise to higher ground, coupled with early evacuation, is highly desirable.

A separate report on a flood evacuation strategy for the Lansvale area (Kinhill 88) provides additional detail on proposed road raising measures, many of which were adopted in the floodplain management plan.

The location and preferred sequence of road raising was noted in the Plan to include:

- i) Day St/Knight Street intersection and approaches, including upgrading of a culvert under Knight Street;
- ii) Day St outside Lansvale East Community Centre;
- iii) Hollywood Drive near Lansvale East Public School;
- iv) Knight, Erna, Lucy and Mena Streets; and
- v) Knight Street between Day Street and the Hume Highway.

The Day Street/Knight Street intersection is within a depression approximately 1m deep. This hinders evacuation for residents at the end of Day Street and residents of Knight Street, on both sides of the intersection. Raising this intersection, and another low point further to the west, would provide improved evacuation conditions for approximately 50 residential properties.

The other depression in Day Street mentioned above is located opposite the Lansvale East Community Centre. The depression in the road is also up to 1m in depth and extends over a length of approximately 150m. Regrading along Day Street could reduce the required the height to which both depressions would need to be raised.

Hollywood Drive was identified for raising to improve flood access. The road was subsequently raised by Council between Willis Street and Day Street. It now provides flood access that is close to the 100 year level down to the Lansvale East Public School. Road levels fall below the 100 year food further to the south. At Willis Street, the road is estimated to be inundated by about 1m in the 100 year flood, and at Knight Street by about 1.3m. Despite these inundation depths, the road provides a constant rise to higher ground from Knight Street.

Parts of Knight Street, including the cul-de-sacs at Erna Avenue, Lucy Avenue and Mena Avenue, have also been identified for raising. There are two depressions in this vicinity that are up to 0.5m deep that extend over a distance of 80-100m. Use of a laneway between Knight Street and Willis Street will provide access to Hollywood Drive along a route where the flood depth does not increase.

The northern end of Knight Street, adjacent to the Hume Highway, was also identified for raising. This would have been necessary in conjunction with the proposal to raise the Hume Highway. As this is not considered to be a viable option, the associated raising of this section of Knight Street is not warranted.

6.4.3 Georges River Deflector Wall

A deflector wall along the Georges River bank near Ferry Road was proposed in the Lower Prospect Creek Floodplain Management Plan at an estimated cost of \$240,000 (1990).

The deflector wall was initially recommended in an earlier report (Kinchill, 88). This location was identified as a critical location where floodwater first overtops the banks of the Georges River, inundating low lying areas within the Lansvale Peninsula. The 1988 report proposed that the bank of the river be raised by about 0.4m (to RL 5.2m AHD), to delay flooding by about an hour and provide additional time for evacuation. It was also noted that the deflector wall could also be beneficial in reducing flood velocities experienced by houses in Ferry Road and Willow Close.

The deflector wall along the bank of the Georges River is still considered to be a viable option that is worthy of further consideration.

6.4.4 Voluntary Purchase

The Lower Prospect Creek Floodplain Management Plan lists the acquisition of 22 properties from the southern sector, at an estimated cost of \$2.86M (1990).

Some additional properties were identified following more detailed property surveys, which are shown on the Floodplain Management Plan brochure. A revised total of 31 properties have been identified for voluntary purchase, as shown on **Figure 6.12**. These properties are located at:

- i) Knight Street (17);
- ii) Willow Close (6);
- iii) Bindaree Street (6);
- iv) Day Street (1); and
- v) Howard Street (1).

To date, 19 properties have been acquired with 12 other properties still to be acquired.

6.4.5 House Raising

The Lower Prospect Creek Floodplain Management Plan identified house raising subsidies for 178 properties, at total estimated cost of \$2.01M (1990). Additional properties were subsequently identified, with the number increasing to 209 dwellings.

Properties included in the house raising scheme within the central sector are shown on **Figure 6.13**. A total of 89 dwellings have been raised or floodproofed to date. Six dwellings in Knight Street and Day Street were initially identified in the scheme, but would not be eligible as they are zoned 4(b) light industrial. The remaining 113 dwellings included in the scheme are yet to be raised.

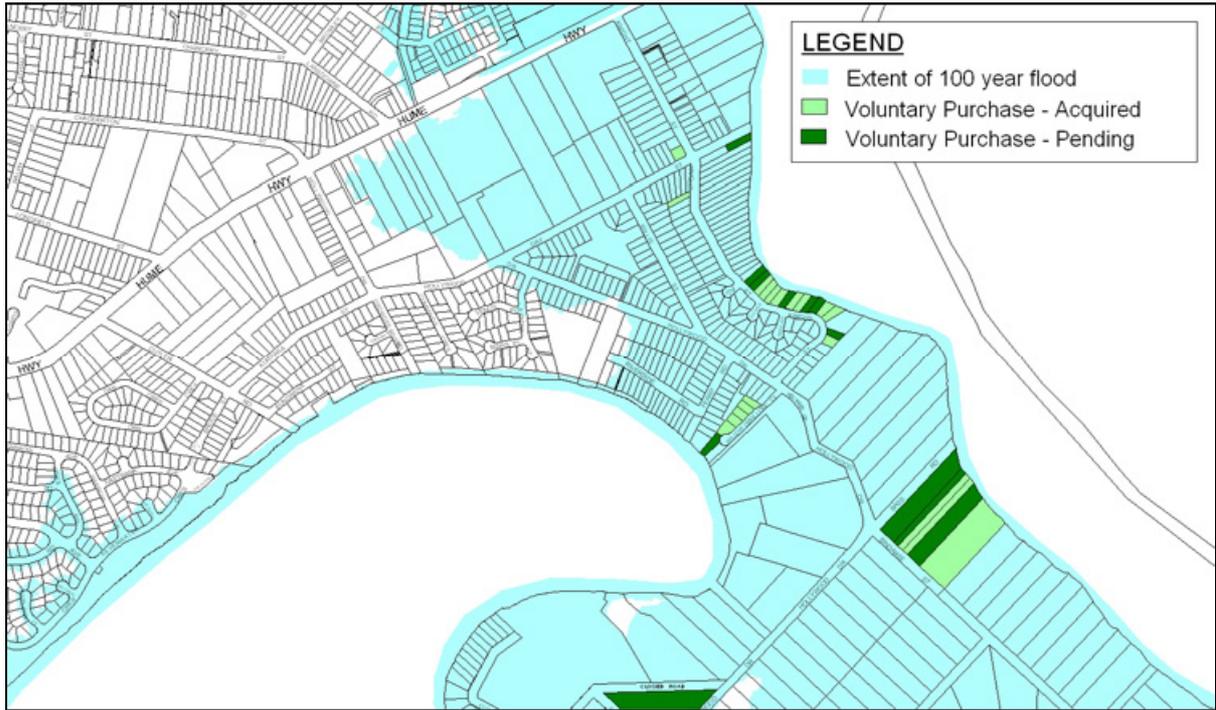


Figure 6.12
Voluntary Purchase Scheme – Southern Sector

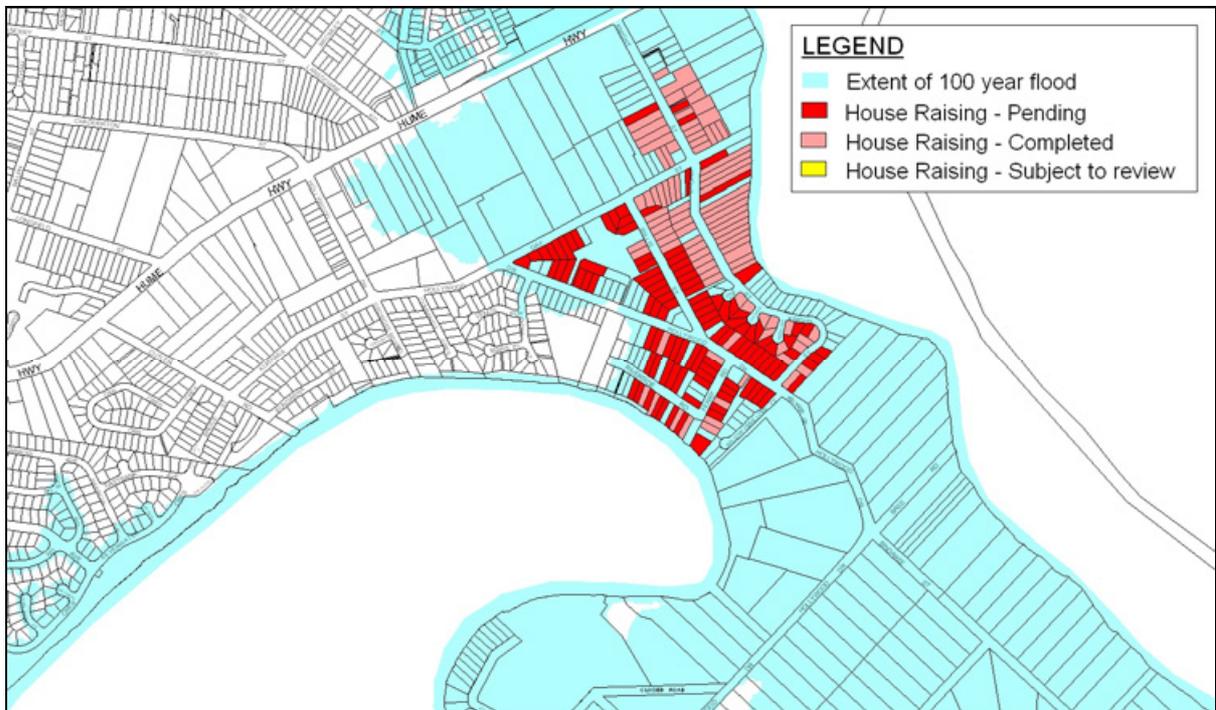


Figure 6.13
House Raising Status – Southern Sector

7 OTHER FLOODPLAIN MANAGEMENT CONSIDERATIONS

The floodplain management measures reviewed in the following section largely relate to structural measures that have previously been considered in specific parts of the floodplain. Other measures that could also be considered within the study area, and those measures that apply on a catchment-wide basis, are further discussed in this section.

7.1 MEASURES IN THE VICINITY OF WIDEMERE ROAD

A concrete-lined stormwater channel drains the Wetherill Park Industrial Area, at the top end of the Prospect Creek catchment. The stormwater channel terminates some 200m upstream of Widemere Road. An ill-defined depression continues from the Stormwater Channel, under the recently constructed transitway bridge, and on to two small pipes under Widemere Road. The area downstream of the stormwater channel has limited capacity and is significantly affected by flooding, including frequent overtopping of Widemere Road.



Figure 7.1
Stormwater Channel Upstream of Widemere Road

Flooding provides a constraint on the development of several vacant industrial properties in this proximity. The frequency and depth of overtopping on Widemere Road also provides a public safety risk for people using the road. At present the road primarily provides access to the Boral quarry, but may be upgraded in the near future to provide access to the proposed 'Southern Employment Lands' development at Greystanes. Any such proposal would need to carefully examine the impact of flooding on road users as well as the potential impact of any road works on flooding of nearby properties.

Siltation of this area has also been a significant problem, which is most likely exacerbated by the sudden slowing of floodwater at the end of the stormwater channel. Council cleared the stormwater channel of silt and vegetation during 2005 to restore its capacity and improve upstream flood conditions. Continued maintenance and flooding problems are likely in this area unless a more complete solution can be found.

An investigation of options for extending the concrete lined stormwater channel to Widemere Road was previously prepared for Council (Kinhill, 1989). The report proposed the continuation of the existing stormwater channel to the downstream side of Widemere Road, using the same cross-sectional shape and channel slope. Various options for the Widemere Road crossing were also investigated, with a standard single span bridge located 0.5m above the 100 year flood noted as being the preferred option. An energy dissipater was also included on the downstream side of Widemere Road.

Design drawings were prepared for the extended stormwater channel in 1991. These drawings show an extension of the concrete lined channel, a 5 cell box culvert under Widemere Road, and a gabion mattress structure downstream of Widemere Road. The plans also indicate the required relocation of two water mains and one gas main. A detailed cost estimate was not provided for this option, although the earlier investigation report did quote costs varying from \$0.9M to \$2.4M (1989) for a range of options.

In 2001 Storm Consulting was engaged to prepare a concept plan for a wetland system in the vicinity of Widemere Road, in lieu of the extended stormwater channel option. The preferred option included a sediment basin between the channel and the transitway bridge, an optional wetland between the transitway bridge and Widemere Road, and another two wetlands downstream of Widemere Road. The two lower wetlands are located within the footprint of the Hassall Street detention basin. No cost estimate was provided in their report.

No definitive conclusion appears to have been reached on a final proposal for this area. The final proposal is also influenced by other activities in this area, including the transitway crossing (now constructed) and the potential upgrade of Widemere Road. The wetland option also requires substantial excavation, and costs will be heavily dependent on the type of material to be excavated and the volume that can be used as fill on adjacent land. A comparison of the two options is summarised in **Table 7.1**.

**Table 7.1
Comparison of Options at Widemere Road**

Criteria	Extend Stormwater Channel	Construct series of Wetlands
Flood Benefits	Removes 'drowning' effect at end of existing channel to downstream of Widemere Road. Majority of 100 year flow carried within stormwater channel. Further development of vacant industrial land possible.	Sediment basin downstream of existing channel can be designed to lower tailwater levels. Similar benefits to extended stormwater channel may be feasible.
Environmental Benefits	'Hard' engineering solution, although only a small extension (0.2km) to existing channel (3.8km). Sediment basin and GPT could be constructed at end of extension.	Sediment basin reduces downstream siltation and improves maintenance of existing channel. Wetlands provide treatment for runoff from industrial area, and improve downstream water quality.
Impact on Widemere Rd	Easy to bridge floodplain as most flows contained within concrete channel. Estimated cost includes allowance for culverts under Widemere Road.	Wide extent of flooding still occurs across Widemere Road. Options to upgrade the road with minimal afflux will be more difficult to achieve. Road costs will be higher.
Estimated Cost	\$2.8M (2009) ¹	\$7.4M (2009) ²

1. Estimated cost assumes that all excavated material (15,000m³) can be used as fill on adjacent land
2. Estimated cost assumes that 50% of excavated material (55,000m³) can be used as fill on adjacent land and that the remaining material (55,000m³) can be disposed as landfill.

The estimated cost if the wetland option is substantially higher than the cost of the extended stormwater channel option. This is largely due to required earthwork quantities, with all storage areas being totally excavated within the floodplain, or the footprint of the Hassall Street detention basin. The cost is also highly variable, depending on the nature of the material to be excavated and disposal options for this material. If all material could be used as fill on adjacent land, the total cost could drop as low as \$4.1M, however it is unlikely that this quantity of fill could be reasonably accommodated without creating other local drainage problems.

Further investigations will be required prior to determining the best option for this area. These investigations should include:

- i) soil sample analysis at proposed excavation sites for both options, including the suitability of the material for landfill;
- ii) opportunities to use excavated material as fill on adjacent properties;
- iii) the implication of both options on plans to upgrade Widemere Road; and
- iv) revised designs and updated cost estimates.

A minimum allowance of \$3M should be provided in the Plan for further works in this area. It is anticipated that funding would primarily come from Section 94 contributions already collected from adjacent property owners.

7.2 WATERWAY IMPROVEMENTS UPSTREAM OF CUMBERLAND HIGHWAY

Despite the modifications undertaken to the Hassall Street and Rosford Street detention basins, and the construction of the high level floodway upstream of the Cumberland Highway, there remain a significant number of commercial and industrial properties with a flood risk in the 100 year flood. **Table 4.2** indicates that there up to 25 commercial or industrial properties upstream of the Cumberland Highway that are potentially inundated in a 100 year flood (see also **Figure 6.2**).

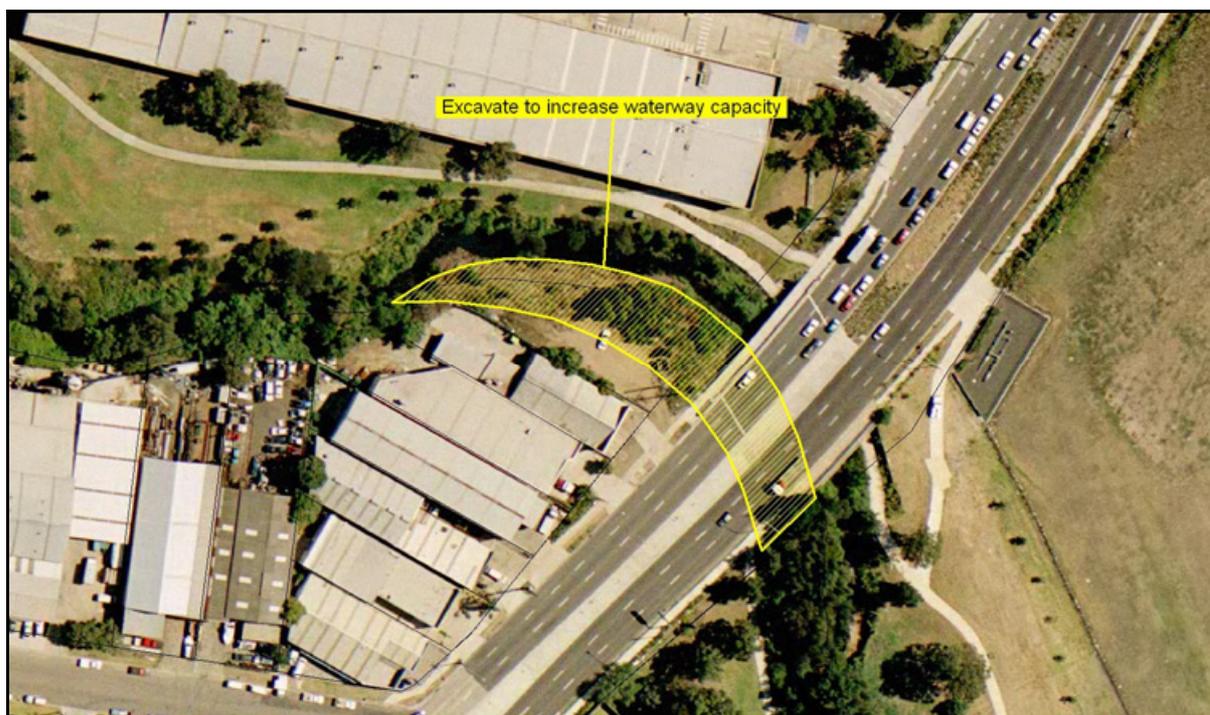
There appears to be some scope for further measures to reduce flood levels upstream of the Cumberland Highway. These include:

- i) excavation under the bridge to further increase its capacity;
- ii) widening the constricted channel immediately upstream of the bridge; and
- iii) reducing the density of in-bank vegetation between the highway and Justin Street.

The existing bridge is built on piers over Prospect Creek. The creek bank on the southern side of the bridge is relatively high (the left side of the photo) and it may be feasible to excavate this area to increase the waterway area under the bridge, with minimal impact on the existing structure. Combined with other upstream creek amplification measures, this could have an appreciable impact on lowering flood levels upstream of the Cumberland Highway.



The main constriction to Prospect Creek occurs immediately upstream of the Cumberland Highway, where industrial buildings on both sides of the creek reduce the available floodplain area to a minimum. The creek waterway could be excavated on the south side over a length of about 100m to increase its capacity by 10-20%. The property affected by the proposed works (2 Smithfield Road) is currently owned by Fairfield City Council, which will avoid expensive acquisition costs. Additional stream clearing measures up to Justin Street, as proposed in the original floodplain management plan, will also help to alleviate upstream flooding.



**Figure 7.2
Proposed Waterway Improvements near the Cumberland Highway**

The proposed works will need to be tested in the TUFLOW model to confirm the extent of work required, and to verify the impact of these measures on flood behaviour. The representation of this area in the existing model is relatively coarse for the necessary investigations, and the model resolution will need to be improved in this local area prior to assessing the impact of the proposed measures.

The estimated cost of model investigations and other site investigations is \$80,000. A nominal amount of \$500,000 has also been provided for construction costs, although this will be subject to latter studies.

7.3 REVIEW OF DETENTION BASINS WITHIN THE CATCHMENT

Two existing detention basins are located within the Prospect Creek study area. These are located in the upper reaches of Prospect Creek, at Hassall Street and at Rosford Street. These basins have previously been reviewed and works carried out to increase their flood capacity and improve their hydraulic performance in the 100 year flood.

There are also another 16 basins located within the Prospect Creek catchment on other tributaries, including Orphan School Creek, Clear Paddock Creek and Burns Creek. Another

basin is proposed to be constructed in the near future on Clear Paddock Creek. Although these basins are outside the current study area, they do have some influence on flood behaviour throughout Lower Prospect Creek through reduced tributary inflows. The majority of these basins are included in the RAFTS model for the Prospect Creek catchment.

The location of detention basins within the Prospect Creek catchment is illustrated on **Figure 7.3**. These basins are commonly identified by a number (as included in the RAFTS model) and a place name.

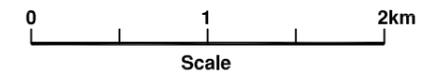
A preliminary review of the basins within the catchment was undertaken using available design drawings, aerial photography, ALS survey and information from the RAFTS model. The extent of flooding within each basin, as depicted on Figure 7.3, was determined by estimating the level at which significant overtopping of the embankment occurs, and contouring this level using the ALS survey. The available storage volume below this level was also determined and compared with the volume computed in the RAFTS model for the 100 year flood. The consequence of overtopping, either through embankment failure or more extreme floods, was also reviewed by considering spillway provisions and the proximity of downstream development. Results from the preliminary review are summarised in **Table 7.2**.

Based on the findings from the preliminary review, further detailed investigations are warranted. These investigations should include:

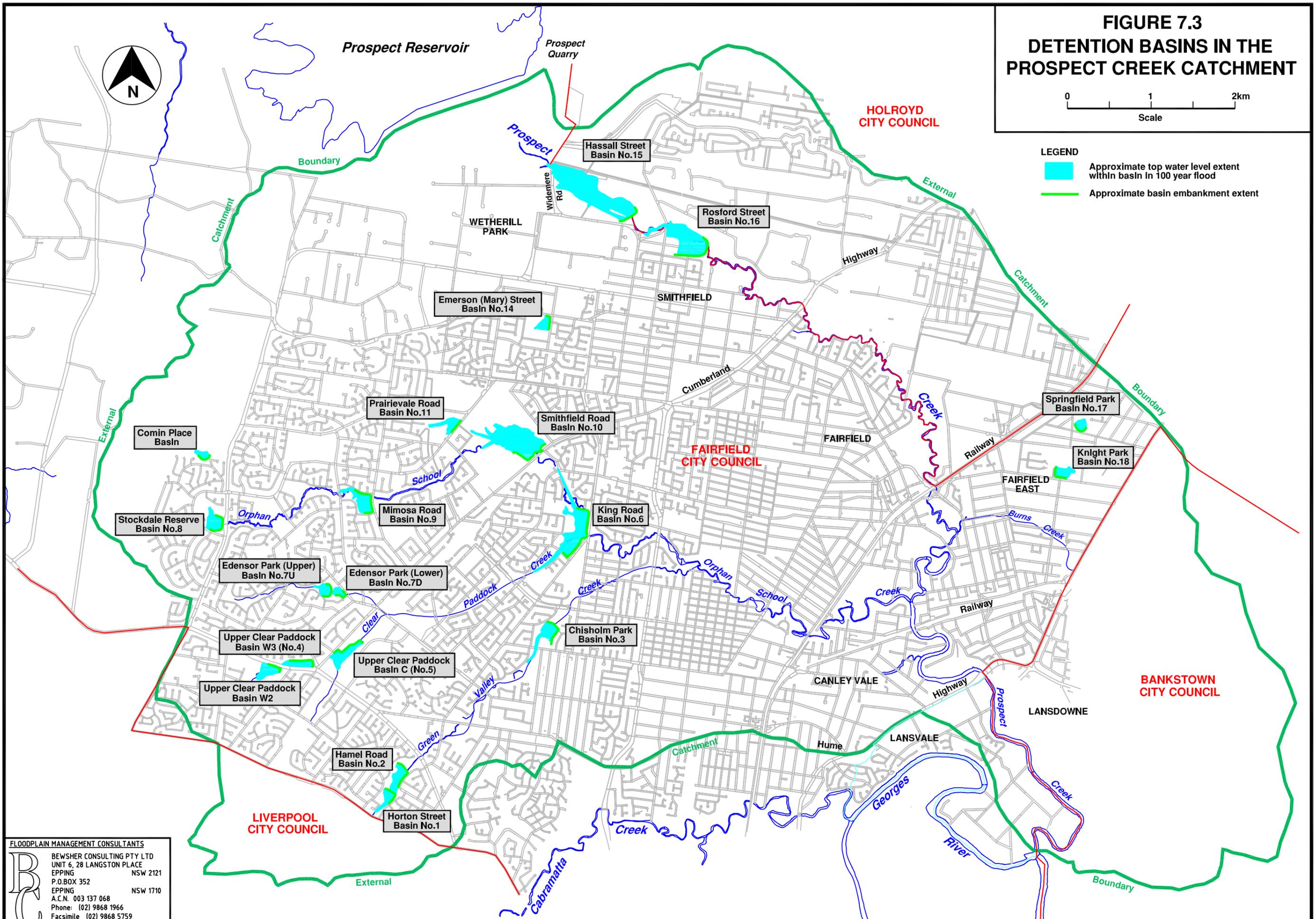
- i) The ability of each basin to safely pass floods more extreme than the 100 year event. Many of the basins include a small spillway, usually 5 to 10m in length, but these are inadequate for events larger than the 100 year flood. The ability of the main embankment to withstand overtopping in larger events should be verified. This is particularly important for the larger basins in the catchment, and should include as a minimum:
 - Smithfield Road Basin (Basin #10)
 - Hassall Street Basin (Basin #15)
 - Rosford Street Basin (Basin #16)
 - King Road Basin (Basin #6)
- ii) Verification of the available storage capacity and hydraulic performance of the King Road Basin. The available storage appears to be significantly lower than that which has been assumed in the RAFTS model. The effect of the basin on downstream flood behaviour may be overstated, and the basin may overtop more frequently than anticipated. Spillway levels, storage volumes and the representation of the basin in previous models should be verified.
- iii) The need to include some of the larger basins in the catchment on the list of prescribed dams with the Dam Safety Committee. Two basins are currently prescribed with the Committee, and another two may be added in the near future. There would be merit in also including the basins identified in point i) above.

Further review of the basins within the Prospect Creek catchment, as outlined above, is recommended at an estimated total cost of \$100,000 (2009).

**FIGURE 7.3
DETENTION BASINS IN THE
PROSPECT CREEK CATCHMENT**



LEGEND
 Approximate top water level extent within basin in 100 year flood
 Approximate basin embankment extent



FLOODPLAIN MANAGEMENT CONSULTANTS
 BEWSHER CONSULTING PTY LTD
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 EPPING NSW 2121
 P.O. BOX 352
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 A.C.N. 003 137 068
 Phone: (02) 9868 1966
 Facsimile (02) 9868 5759
 Email: postmaster@bewsher.com.au
 Plot file: J1305-fig 7.3
 Plot scale: 40(a3 @ 1:40000)
 Date: 13 August 2008

**Table 7.2
Preliminary Review of Detention Basins**

No.	Name	Creek	Storage Volume (m3)		Prescribed Basin ³	Potential Impact due to Failure or Extreme Floods	Other Comments
			RAFTS ¹	Available ²			
1	Horton St	Green Valley Ck	14,000	23,000		Overtops to lower basin.	
2	Hamel Rd		11,000	43,000		Relatively low embankment. No homes immediately downstream.	Impact may be underestimated in RAFTS
3	Chisolm Park		38,000	28,000		Relatively low embankment. Some homes located short dist d/s.	Spillway level should be verified
W2	Elizabeth Dr	Clear Paddock Ck	N/A	44,000	Yes	Overtops to lower basin. Elizabeth Drive provides buffer.	Proposed basin about to be constructed
4	Kalang Rd		35,000	40,000	Pending	Overtops to lower basin. Relatively low embankment.	Existing basin about to be upgraded
5	Basin C		68,000	71,000	Yes	Significant spillway provisions.	Recently upgraded with improved spillway
6	King Rd		201,000	135,000		Relatively low embankment. Numerous homes potentially affected.	Previous models assume greater storage. Need to verify operation & safety of basin.
7U	Edensor Pk		13,000	26,000		Overtops to lower basin.	
7D	Edensor Pk		11,000	13,000		Small basin and low embankment. Some homes immediately d/s.	
8	Stockdale Res	Orphan School Ck	51,000	57,000		Relatively low embankment Some homes immediately d/s.	
9	Mimosa Rd		75,000	56,000		Relatively low embankment Some development located d/s.	
10	Smithfield Rd		183,000	230,000		Large basin. Mary MacKillop College located immediately d/s.	Verify safety of basin as a priority
11	Prairievale Rd		10,000	19,000		Small basin. Some homes immediately d/s.	
-	Comin Place		N/A	25,000	Yes	Small basin. Overtopping will result in surface flow through developed area.	
14	Emerson St	Unnamed tributary	19,000	18,000		Small basin. Overtopping will result in surface flow through developed area.	
15	Hassall St	Prospect Creek	504,000	484,000		Large Basin with high embankment. No homes d/s but wider impact likely.	Verify safety of basin as a priority
16	Rosford St		147,000	135,000		Moderate size basin. Numerous homes immediately d/s.	Verify safety of basin as a priority
17	Springfield Park	Burns Ck	14,000	10,000		Small basin. Overtopping will result in surface flow through developed area.	
18	Knight Park		27,000	25,000		Some homes immediately d/s.	

1. Assumed storage volume in RAFTS model for 100 year flood
2. Available storage volume determined from A.L.S survey, up to the point of significant overtopping
3. Basin prescribed with Dam Safety Committee (DSC)

7.4 HOUSE RAISING REVIEW

The Prospect Creek house raising scheme is undoubtedly the largest and perhaps most ambitious programs in New South Wales to raise flood affected dwellings out of the 100 year flood. There are some 464 dwellings identified in the Prospect Creek catchment that could be eligible for inclusion in the scheme, and to date 204 houses have been raised or treated for flooding.

The scheme has developed over many years of operation into an innovative project that is capable of handling houses with different flood affectation; others that are difficult to raise; and home owners that wish to participate in the scheme ahead of established priorities.

The Lower Prospect Creek Floodplain Management Study divided houses into three different categories:

- HR-5 Houses with floor levels below the 5% (20 year) flood;
- HR-2 Houses with floor levels between the 5% and 2% (50 year) flood; and
- HR-1 Houses with floor levels between the 2% and 1% (100 year) flood.

A sliding subsidy was proposed in the study based on the degree of flood affectation. A \$20,000 (1991) subsidy was proposed for HR-5 category houses, which was intended to cover the full cost of house raising. Partial subsidies of \$8,000 and \$3,000 were proposed for houses in the HR-2 and HR-1 categories respectively, in recognition of the lower flood risk and consequently lower flood damages likely to be experienced by these houses.

Council further considered the recommended subsidy limits prior to commencing the scheme, and elected to proceed with a scheme providing an equitable subsidy based on the full cost of raising each dwelling for the higher priority houses.

The cost of raising a house has steadily increased from about \$25,000-\$30,000 (1991) to \$70,000-\$80,000 (2009). A number of houses have also proved more difficult to raise, including brick and two-storey homes. Subsequently, a limit of \$81,000 was recently applied to the house raising subsidy.

Options for homes that are difficult to raise include:

- i) flood proofing;
- ii) redevelopment; and
- iii) council purchase, demolition, and resale of vacant property with appropriate development controls.

The priority for house raising has been the HR-5 and HR-2 category houses. Nevertheless, some owners of HR-1 category houses have requested raising of their homes ahead of the priority schedule (also termed 'queue jumpers'). These owners have been offered a partial subsidy of \$10,000. There are also a number of property owners who raised their homes at their own expense prior to the house raising scheme being formally adopted. These homeowners were provided a 'retrospective' payment of \$10,000.

The status of the house raising program to date is summarised in **Table 7.3**. A complete list of properties that may be eligible for inclusion in the voluntary house raising scheme, that have not yet been raised, is included in **Appendix D**.

**Table 7.3
House Raising Progress**

Description	Northern Sector	Central Sector	Southern Sector	TOTAL
Completed				
Traditional raising	23	44	73	140
Retrospective (\$10K) ¹	9	9	6	24
Council Purchased ²	11	7	8	26
Floodproofed ³	4	8	2	14
SubTotal	47	68	89	204
Pending	41	76	113	230
Pending Review	28	2	0	30
TOTAL	116	146	202	464

1 Limited subsidy of \$10,000 to residents who raised their homes at their own expense prior to subsidies being available

2 Council purchase of homes that are difficult to raise, demolition and resale of vacant land with appropriate controls

3 Treated for flooding, and includes queue jumpers with limited subsidy

The original house raising categorisation has been updated to reflect new design flood levels, which have changed from the earlier study due to flood mitigation works completed in the catchment and updated flood modelling. In some areas, particularly within the northern and central sectors, flood levels have reduced to the extent that 30 houses from the original house raising scheme are no longer below the 100 year flood level. These houses would not normally qualify for house raising assistance. Any action to raise these houses should be deferred pending further climate change investigations (that is recommended), and a review of other local factors. Another 6 houses from the Southern Sector in Knight Street and Day Street have been omitted from the house raising scheme as they are currently zoned Industrial 4(b), and would not normally qualify for house raising.

As the scheme continues to progress there are a proportionately higher number of houses that are difficult to raise due to construction type, or are in the lower priority HR-1 category. Alternative solutions are required for houses that are difficult to raise, including floodproofing; redevelopment by the existing owner; and redevelopment assisted by Council. The question of appropriate subsidy levels also assumes increasing importance as the scheme progresses towards raising the lower priority HR-1 category houses.

Floodproofing has been used as an alternative to house raising for some difficult to raise houses. This involves treating the home to reduce the potential for flood damage, and may include the replacement of floor coverings, use of solid core doors, modification to walls, lifting power points, etc. The level of subsidy provided for these measures has been limited to \$10,000 for single storey houses and \$20,000 for two storey houses, which is understood to be comparable with the cost of these measures. This process could continue where home owners are willing to accept floodproofing measures as an alternative to raising their floor levels. It could also be an encouraged approach for many of the lower priority HR-1 category houses.

Redevelopment by the existing owner provides an opportunity to replace an older style low level home with a new home at a higher level. It's main advantage is that it is practical for any type of house, and will most likely look better than raising the existing house on piers (if this was practical). The owner also gains the obvious benefit of a new house, so would be expected to provide the greatest financial contribution and assume overall responsibility for the rebuilding process. The subsidy offered can be regarded as an incentive to encourage redevelopment of eligible houses in a more flood compatible manner, which ultimately

achieves the same objectives as the house raising scheme. The subsidy should be limited to that amount which would be offered for the traditional house raising approach, namely \$81,000 for HR-5 and HR-2 category houses. It is understood that no subsidy level has been formally adopted for HR-1 category houses, except that 'queue jumpers' from this category would qualify for a \$10,000 subsidy.

Assisted redevelopment involves Council purchasing the property, demolishing the existing dwelling, and reselling the vacant property with appropriate development controls to ensure that any new dwelling is constructed above Council's flood planning level. The net cost to the scheme will depend on market conditions at the time of purchase and resale, but may not be that much different from the cost of traditional house raising. Whilst this is considered an appropriate strategy for houses in the HR-5 and HR-2 category, it is unlikely to be cost effective for the HR-1 category houses.

The subsidy limit for HR-1 category houses will need to be reviewed by Council and other State Government funding partners prior to the scheme formally progressing to this point. A full cost subsidy will not be cost effective given the reduced flood damages from these houses. The \$10,000 subsidy currently on offer to home owners who wish to raise their houses ahead of schedule is also unlikely to be sufficient to act as a real incentive to raise their homes either through redevelopment or more traditional means.

For the purpose of cost estimating, it has been assumed that the remaining 154 HR-5 and HR-2 category houses will receive a subsidy amount equivalent to \$81,000 and that the remaining 76 HR-1 category houses will receive a subsidy of \$20,000. On this basis, the total estimated cost of completing the house raising scheme is \$14.0M (2009).

7.5 FLOOD WARNING MEASURES

The Lower Prospect Creek Floodplain Management Study noted that an effective flood warning system should be implemented to ensure public safety for residents within the floodplain. An ALERT (Automated Local Evaluation in Real Time) system was suggested for Fairfield to monitor rainfall and flood levels in the upper catchment. This would then form the basis of predictions for Prospect Creek and supplement the established Flood Warning System available for the Georges River. The cost of the system was estimated at \$800,000 (1990). No measures have been implemented to date on Prospect Creek.

Prospect Creek can be considered to be a 'flash flood' catchment due to its rapid response to flooding, which can be less than 6 hours. This provides little time for the dissemination of the flood warning to the community and for action to be taken to appropriately respond to the flood threat.

Nevertheless, a large proportion of the community at risk on Prospect Creek is located downstream of the Granville Railway line, where flooding is mostly dominated by flood conditions from the Georges River. The total flood damage in a 100 year flood for this area is \$49.5M or 95% of the total damages within the study area (**Table 5.1**). This area also accounts for 400 residential premises out of a total of 406 that are estimated to be inundated throughout the study area in this event (**Table 4.1**). The greatest flood threat for this part of the study area will be from a major flood on the Georges River, or a combination of flooding in both the Georges River and Prospect Creek (as occurred in 1986 and 1988). Longer warning times can be expected to be available under these conditions and the benefits of flood warning measures are more obvious.

The existing flood warning system for the Georges River aims to provide up to 6 hours warning based on recorded rainfall, or up to 12 hours warning based on predicted rainfall within the catchment. Flood warnings are provided for gauges located at Liverpool weir, Milperra Bridge, Kelso and Picnic Point.

There are a number of opportunities to build on the existing warning system for application within Prospect Creek, including:

- i) applying flood level predictions that are provided for Liverpool and Milperra to Lower Prospect Creek, to determine which properties are likely to be affected by flooding and to assist with emergency management operations; and
- ii) enhancing the existing flood warning system itself to provide additional input from the Prospect Creek catchment, to identify any additional flood height increases due to flows from the Prospect Creek catchment.

The Georges River Floodplain Management Study and Plan (Bewsher Consulting, 2004) recommended the development of a GIS based database to link available flood level predictions with flood affected properties on the Georges River floodplain. The database was developed by Bewsher Consulting during 2005 and provided to the SES for their operation during floods. The database effectively translates a flood warning prediction into a map or list of buildings that are likely to be inundated should the predicted flood level occur. It is also capable of identifying whether critical infrastructure within the catchment will be impacted, including major roads, levees or other important features. This database currently includes property on Prospect Creek downstream of the Hume Highway. This could be further expanded along Prospect Creek up to the Granville Railway line, using data assembled during the current investigations.

The existing flood warning system could also be enhanced by providing a separate prediction for Prospect Creek that allows for the additional inflow from the Prospect Creek catchment. Much of the instrumentation required for this purpose already exists within the catchment, including seven water level recorders and a number of surrounding rainfall stations (shown on **Figure 7.4**). Three of the existing water level recorders provide data in (near) real time through the Bureau of Meteorology’s web site.

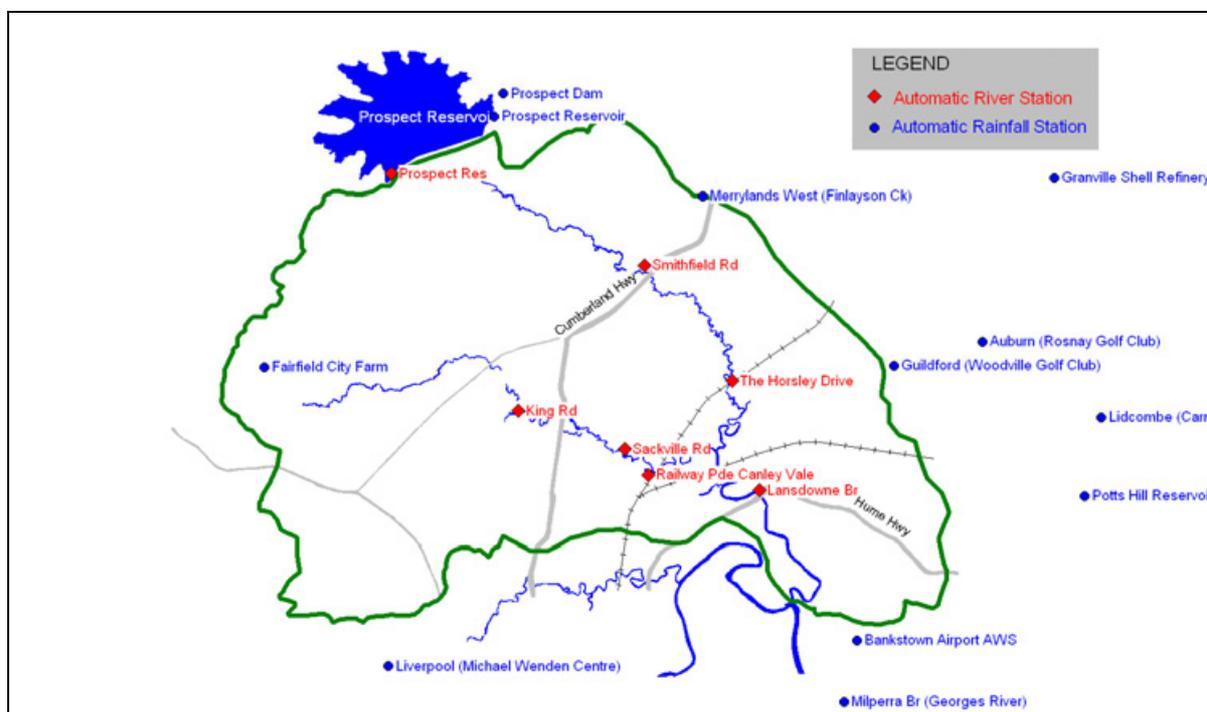


Figure 7.4
Existing Catchment Instrumentation

Further consultation with the Bureau of Meteorology's flood warning group will be necessary to determine the feasibility of incorporating a flood prediction for Prospect Creek within the existing Georges River Flood Warning scheme. Some additional gauges within the catchment may also be beneficial for flood warning purposes, including a gauge in the Hassall Street detention basin in the upper catchment and improving the rainfall coverage by including rainfall gauges at existing water level recorder sites. Some algorithms would also need to be developed to relate rainfall and flood levels in the upper catchment with flood conditions in the lower catchment.

Extension of the flood warning property database to include Prospect Creek, up to the Granville Railway Line, is recommended at an estimated cost of \$30,000 (2009).

Further enhancement of the Georges River flood warning scheme to provide specific predictions for Prospect Creek should also be pursued with the Bureau of Meteorology. This includes the review of existing catchment instrumentation, installation of some additional monitoring equipment, and the development of algorithms to represent flood behaviour throughout the catchment. The total cost is estimated at about \$100,000 (2009).

7.6 PUBLIC AWARENESS

Raising and maintaining flood awareness provides residents with an appreciation of the flood problem and what measures can be taken to reduce potential flood damage and to minimise personal risk during future floods.

Fairfield City Council has been particularly proactive in raising community awareness of the risk of flooding within the Prospect Creek catchment. This has included:

- i) Issuing flood information sheets to residents within the floodplain. These certificates include estimated flood levels and flood risk areas that apply to the property in question.
- ii) Community education programs, such as the flood icon project, which involved local schools and other groups in a competition to design an appropriate reminder of past floods. The flood icon is a sculpture that has been built in Fairfield Park, on the banks of Prospect Creek. It was constructed in 1998 to commemorate the 10th anniversary of the 1988 flood. The project received an Institution of Municipal Engineers Australia award.
- iii) Writing to all residents potentially affected by flooding within the Prospect Creek catchment, providing advice of the potential flood threat and details of studies underway to address this risk.
- iv) Conducting various community workshops on local flood issues.
- v) Providing various press releases in local papers, including a special commemorative edition of the Fairfield Advance in 1996 to mark the 10th anniversary of the 1986 flood.

Continuation of community awareness measures, such as those listed above, will help to maintain a reasonable awareness of the flood risk throughout the community.

7.7 IMPACT OF EXTREME FLOODS

The impacts of floods more extreme than the 100 year event were not considered as part of the previous floodplain management studies undertaken for Lower Prospect Creek and Upper Prospect Creek. The Lower Prospect Creek study acknowledged the possibility of more extreme floods occurring, but noted that this could not be readily quantified as estimates were not available at the time for similar floods in the Georges River.