SCONE SHIRE COUNCIL

SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN

The New England Highway (Kelly Street) during the February 1955 Flood

FEBRUARY 1999

Bewsher Consulting Pty Ltd

Adopted by Council December 1998

SCONE SHIRE COUNCIL

SCONE

FLOODPLAIN MANAGEMENT STUDY

AND PLAN

FEBRUARY 1999

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FOREWORD

The Government's Flood Policy is directed at providing solutions to existing flooding problems in developed areas, and ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas. Under the Policy, the management of flood liable land remains the responsibility of local government.

The Policy provides for a floodplain management system comprising the following four sequential stages:

1. Flood Study	—	Determines the nature and extent of the flood problem;
2. Floodplain Management Study	—	Evaluates management options for the floodplain with respect to both existing and future development;
3. Floodplain Management Plan	—	Involves formal adoption by Council of a plan of management for the floodplain;
4. Implementation of the Plan	—	Involves construction of flood mitigation works, where viable, to protect existing development;
	—	Uses planning controls to ensure that future development is compatible with flood hazard.

This Floodplain Management Study and Plan constitutes the second and third stages of the management process for the Scone district and has been prepared for Scone Council by Bewsher Consulting Pty Ltd.

The results of the Study and the Floodplain Management Plan contained in this report will provide Council with a sound basis from which to manage the urban areas along the Middle Brook, Kingdon Ponds, Parsons Gully and Figtree Gully floodplains.

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GLOSSARY

AHD	Australian Height Datum. A common national plain of level approximately equivalent to the height above sea level. Most flood levels, floor levels and ground levels in this study have been provided in mAHD.
AEP	Annual Exceedance Probability. AEP (measured in percentage) is the long term probability between floods of a certain magnitude. For example, a 1% AEP flood is the flood which occurs or is exceeded on average every 100 years. It is also referred to as the '100 year flood' or 1 in 100 year flood'.
ARI	Average Recurrence Interval. ARI (measured in years) is a means of describing how likely a flood is to occur in a given year. In this report, the frequency of different sized floods has been described using an abbreviated form of ARI.
BA	Building application.
BC	Bewsher Consulting Pty Ltd.
CALM	Department of Conservation and Land Management (NSW) (previously the Soil Conservation Service) became a major component of the Department of Land and Water Conservation (DLWC) in May 1995.
DA	Development application.
DCP	Development Control Plan. A plan prepared in accordance with Section 72 of the *Environmental Planning Assessment Act, 1979*, which provides detailed guidelines for the assessment of development applications.
Design flood	A flood used as a standard for design.
Designated flood	The size of flood selected for planning purposes. Traditionally only one`designated flood' has been adopted for a particular locality. However, more than one 'designated flood' can be used for planning, building and development controls. Unless the designated flood is a PMF, floods larger than the designated flood can occur. This term is now referred to as the flood planning level (FPL).
DLWC	Department of Land and Water Conservation (NSW). Since May 1995, this is the new name for Department of Water Resources (DWR), the Department of Conservation and Land Management (CALM) and flood sections of the Public Works Department (PWD). DLWC has been used in this report, except for work and/or studies carried out by these departments prior to May 1995.
DP	Deposited Plan.
DUAP	Department of Urban Affairs and Planning (NSW). Formerly the Department of Planning (NSW).
DWR	Department of Water Resources (NSW). This department became a major component of the Department of Land and Water Conservation (DLWC) in May 1995.
EP&A Act	*Environmental Planning and Assessment Act, 1979.*

Floodplain Management Study	The current study. These studies assess options for minimising the danger to life and property during floods. These measures try to achieve an equitable balance between environmental, social, economic, financial and engineering considerations.
Flood Standard	See designated flood.
FPL	Flood planning level. (See designated flood.).
FPM	Floodplain Management.
Flood hazard	The potential for damage to property or risk to persons during a flood.
Flood Planning Level	See designated flood.
Flood Study	A study which identifies the flood levels for a range of flood events.
Floodway	The *Floodplain Development Manual* (PWD, 1986) defines floodways as: *"those areas where a significant volume of water flows during floods. They are often aligned with obvious naturally defined channels. Floodways are areas which, even if only partially blocked, would cause a significant redistribution of flood flow, which may in turn adversely affect other areas. They are often, but not necessarily, the areas of deeper flow or the areas where higher velocities occur".*
FMA	Flood Mitigation Authorities of NSW.
Freeboard	A factor of safety usually expressed as a height above a particular flood. Freeboard also takes into account wave action, local increases in flood level between buildings and `wash' from passing vehicles during a flood, i.e. it is an allowance to protect against the design flood.
Gl	Gigalitre (1Gl = 1,000 Megalitres = 1,000,000,000 litres).
ha	Hectares. Measurement of land area (1ha = 10,000m^2 = 100m x 100m = 2.5 acres).
HEC-RAS	A computer program used to generate water surface profiles. A model of Figtree Gully was developed using this program to investigate the existing conditions along the Gully.
MIKE-11	A computer program used to generate water surface profiles. The Scone Flood Study (1996) by the DLWC used this program to investigate the existing conditions along Middle Brook, Kingdon Ponds and Parsons Gully.
High flood hazard	For a particular size flood, usually at the FPL, there is a possible danger to life and limb as well as structural damage.
km	Kilometres (1km = 1,000m = 0.62 miles).
km^2	Square kilometres. (1km^2 = 1,000,000m^2 = 100ha = 250 acres).
Low flood hazard	For a particular size flood, usually at the FPL, able-bodied adults would be able to wade and trucks can be used for evacuation.

LEP	Local Environmental Plan. A Local Environmental Plan is a plan prepared in accordance with the *Environmental Planning and Assessment Act*, 1979, which defines zones, permissible uses within those zones and specifies development standards and other special matters for consideration with regard to the use or development of land.
m	Metres. All units used in this report are metric. Whenever possible, the measurement of length that has been used in this report can be roughly equated to known imperial values:

METRIC	APPROXIMATE IMPERIAL VALUE
0.15m (150mm)	6 inches
0.2m (200mm)	8 inches
0.3m (300mm)	1 foot
0.6m (600mm)	2 foot
0.9m (900mm)	3 foot

mAHD	Metres Australian Height Datum (see AHD).
m^2	Square metres ($1m^2$ = 10.8 square feet).
m^3/s	Cubic metres per second or 'cumecs'. A unit of measurement for creek flows.
Met. Bureau	Commonwealth Bureau of Meteorology.
mm	Millimetres.
Outer floodplain	Refers to that part of the floodplain between the 100 year flood extent and the extent of the PMF.
Peak discharge	The maximum flow during a flood.
PMF	Probable maximum flood — the largest flood likely to ever occur.
PWD	Public Works Department. The sections dealing with flooding in this department were amalgamated into the Department of Land and Water Conservation (DLWC) in May 1995.
Rating curve	A relationship that relates river height with the flow for a particular stream location.
SES	State Emergency Service of New South Wales.
Stage	Equivalent to 'water level',
Stage–damage curve	A relationship between different water depths and the predicted flood damage at that depth.
Strategic planning	An assessment of the future need for rural, residential, commercial, industrial and open space land.
>	Greater than, e.g. >2.0m = greater than 2.0m.
<	Less than, e.g. <0.5m = less than 0.5m.

SUMMARY

This report has identified practical measures to minimise the impacts of floods on the community. A range of possible measures was examined to find those most suited based on economic, technical, social and environmental criteria, and the likely level of community support. As a result of this process, a Floodplain Management Plan for the Scone district has been prepared with works totalling $7.3 million (see **Figure 10**).

THE FLOODPLAIN MANAGEMENT PLAN

OPTION NO.	DESCRIPTION	CAPITAL COST (to Council)	MAINTENANCE COST per annum	PRIORITY
MEASURES WHICH MODIFY FLOOD BEHAVIOUR				
1.9	Reconstruct Figtree Gully from downstream of Barton Street to Park Street as a deeper and wider grass lined channel; and construct a box culvert system from Main Street / St Aubins Street to Parsons Gully at the downstream end of Guernsey Street	$6.5M	$5K	Medium
1.11	Remove obstructions in the Figtree Gully channel	<$10K	<$1K	High
1.12	Introduce an on-site stormwater detention policy in Figtree Gully	Nil	Nil	Medium
MEASURES WHICH MODIFY PROPERTIES				
2.2	House Raising of 10 severely flood affected properties (Parsons Gully only)	$400K(2)	Nil	High
2.3	Flood proof individual commercial properties (Figtree Gully Central Business District only)	$100K(2)	Nil	High
2.4	Improve existing building and development controls	Nil	Nil	High
2.6	Prepare a Vegetation Management Plan for each floodplain	$30K	Nil	High
MEASURES WHICH MODIFY PEOPLE'S RESPONSES TO FLOODING				
3.1	Issue flood certificates to all property owners on a regular basis	Nil	Nil	High
3.2	Improve emergency planning and management	Nil	Nil	Medium
3.3	Increase community education and flood awareness	$100K(1)	$10K(1)	Medium
3.4	Improve flood warning systems	$100K	$6K	High
3.5	Prepare flood action plans for individual properties	Nil	Nil	Medium
	TOTAL (rounded)	**$7.3 million**	**$22K**	

(1) Cost for whole of Scone local government area.
(2) These works could possibly be funded by local property owners (in part or full) as part of future redevelopment. If redevelopment is not imminent, funding by Council is recommended.

Study Area

This study covers a large part of the Scone district. The floodplains investigated comprise Middle Brook, Kingdon Ponds and Parsons Gully to the west of Scone township, and Figtree Gully which routes through the town from east to west.

Community Involvement

This study was prepared under the State Government's Flood Prone Lands Policy in accordance with the Floodplain Development Manual (**Reference 1**). The progress of the study and all its major findings were vetted by Council's Floodplain Management Committee — a group representing Council staff, community groups, the State Emergency Service (SES), and the Department of Land and Water Conservation (DLWC). A public meeting, community newsletter, questionnaire and personal interviews were undertaken to seek community input.

Flood Behaviour

A description of the flood behaviour along the Middle Brook, Kingdon Ponds and Parsons Gully floodplains was available from the 1996 flood study carried out for Council by the Department of Land & Water Conservation (**Reference 2**). Additional work was carried out during the current study to provide flood behaviour information along Figtree Gully during for the 5 year, 10 year, 50 year, 100 year average recurrence interval (ARI) events and the probable maximum flood (PMF).

The PMF flood levels along Parsons Gully are approximately 2 to 3 metres above the 100 year ARI level, and about 1 to 2 metres above the 100 year ARI flood level along Figtree Gully.

Potential Flood Losses

For the most severely affected parts of the study area, the cost of flood damage has been calculated in dollar terms. This calculation allows for damage to residential and business premises, property damage (e.g. parked cars), damage to infrastructure (e.g. roads, bridges) and social costs (e.g. hospitalisation, anxiety). Other indirect costs, (e.g. loss of business profits, loss of employment) have also been included.

The opportunity for the community to reduce the potential flood losses by taking action before a flood arrives, by moving goods and equipment, lifting carpets, moving cars, etc, has also been considered. The analysis indicated that the total damage cost to the community in 20 year and 100 year ARI floods would be about $0.6 million and $2.4 million respectively. This could increase to $10 million in a PMF event.

The 100 year ARI flood is a relatively rare event and the PMF is extremely unlikely, however the damage during these events would be large. When all future damages from both rare and frequent flood events are considered, an average annual damage of approximately $0.15 million was determined. This is the amount of money one would need to put in the bank each year (forever) to meet the costs of all future flood damages.

It should be noted that these flood losses may increase significantly if inappropriate development occurs within flood prone land in the future.

The Flood Planning Level

The flood planning level (FPL) (also called the 'designated flood' or the 'flood standard') is the level adopted by Council to determine where development controls relating to flooding should be applied. Council has previously adopted the 100 year ARI flood level as the interim FPL for all areas in the Scone district.

Use of a singular FPL can lead to difficulties given that different FPL's may be required in different areas, and that different FPL's may need to be applied to control different land uses. In addition, the community may not understand that areas of the floodplain above the FPL are still at risk from flooding. Within the study, a new approach involving a graded set of planning controls has been recommended, which does not rely on the definition of a singular FPL. This new approach is consistent with the Government's Floodplain Management Development Manual and its proposed revision, the Floodplain Management Manual.

The approach defines planning controls for various land uses and flood risks using a planning matrix. The proposed matrix for Scone district is presented in **Section 6.2.4**.

Floodplain Management Options

A range of works and measures to reduce the impact of flooding were evaluated. A list of all the options investigated is included below. Those options which were recommended, totalling some $7.3 million, are presented in the Draft Floodplain Management Plan.

Options which Modify Flood Behaviour — Parsons Gully

- Construct a large retarding basin(s) upstream of Parsons Gully (Option 1.1 — not recommended);
- Construct a levee on the eastern side of Parsons Gully (Option 1.2 — not recommended);
- Construct a formal channel in Parsons Gully to convey 100 year flows past the western fringe of Scone township (Option 1.3 — not recommended);

Options which Modify Flood Behaviour — Figtree Gully

- Construct a single large Council owned retarding basin upstream of Barton Street (Option 1.4 — not recommended);
- Construct a number of smaller Council owned retarding storages upstream of Park Street (Option 1.5 — not recommended);
- Reconstruct Figtree Gully downstream of Barton Street to Park Street as a concrete lined channel, and construct a box culvert system from Park Street to Parsons Gully at the southern end of Guernsey Street (Option 1.6 — not recommended);
- Reconstruct Figtree Gully downstream of Barton Street to Park Street as a deeper and wider grass lined channel, and construct a box culvert system from Park Street to Parsons Gully at the southern end of Guernsey Street (Option 1.7 — not recommended);
- Reconstruct Figtree Gully downstream of Barton Street to Park Street as a concrete lined channel, and construct a box culvert system from Main Street/St Aubins Street to Parsons Gully at the southern end of Guernsey Street (Option 1.8 — not recommended);
- Reconstruct Figtree Gully downstream of Barton Street to Park Street as a deeper and wider grass lined channel, and construct a box culvert system from Main Street/St Aubins Street to Parsons Gully at the southern end of Guernsey Street (Option 1.9 — recommended);
- Construct a permanent levee along Figtree Gully downstream of Barton Street to Park Street, and construct a box culvert system from Main Street/St Aubins Street to Parsons Gully at the southern end of Guernsey Street (Option 1.10 — not recommended);
- Remove obstructions in Figtree Gully channel (Option 1.11);
- On-site detention (OSD) for future developments (Option 1.12);

Options which Modify Properties

- Council purchase of severely affected flood liable properties (Option 2.1 — not recommended);
- House raising (Option 2.2);
- Flood proofing of individual properties (Option 2.3);
- Building and development controls (Option 2.4);
- Raise Liverpool Street across Parsons Gully, Kingdon Ponds and Middle Brook (Option 2.5 — not recommended);
- Preparation of a Vegetation Management Plan (Option 2.6).

Options which Modify People's Response to Flooding

- Flood certificates to property owners (Option 3.1);
- Improve emergency planning and management (Option 3.2);
- Increased community education and flood awareness (Option 3.3);
- Improved flood warning systems (Option 3.4);
- Preparation of flood action plans for individual properties (Option 3.5).

Changes to Council's Floodplain Management Practice

The current study is the first floodplain management study carried out for Council and so some of the recommendations will require changes to Council's current floodplain management practices, for example in relation to S149 certificates, flood certificates and building development controls.

Introducing these changes for other floodprone areas of Scone on an interim basis, until such time as floodplain management studies of these areas are carried out, may be prudent and would allow Council to maintain a consistent approach to floodplain management across the whole local government area.

Implementation

A plan for managing Scone's floodplains has been prepared in consultation with the local community. The plan is consistent with the Government's Flood Prone Land Policy and provides a sound basis for future floodplain management involving structural works, planning controls, emergency management, and measures for increasing and maintaining the community's awareness of flood issues.

It is recommended that Council implements all components of the proposed plan. Initially, it should submit a funding application to the Department of Land and Water Conservation and apply its own funding to ensure the plan is implemented.

1. INTRODUCTION

This Section discusses the principal aims of the Study and its relationship to the Government's Flood Prone Land Policy.

The objective of this study has been to develop a practical plan to minimise the impact of flooding on the urban areas of Scone within the Middle Brook, Kingdon Ponds, Parsons Gully and Figtree Gully floodplains.

Scone is located in the upper Hunter Valley, 250km north-west of Sydney. The study area catchment is bordered by mountain ranges on three sides: to the east mountains including Gateleys Mountain, The Black Mountain and Scone Mountain, to the west the Brawboy Range, and to the north the Liverpool Range.

Middle Brook, Kingdon Ponds and Parsons Gully lie to the west of Scone township and serve a catchment area upstream of Scone of approximately 358km^2. In times of flood these waterways impact on the town's western fringe and substantial neighbouring rural areas.

Figtree Gully, with a catchment area of 7.1km^2, is sourced in the hilly undeveloped area to the north east of Scone township and routes south easterly through its eastern residential areas, the central business area and the south western residential areas, before joining with Parsons Gully. Figtree Gully flooding affects significant residential and commercial areas in Scone.

In order to deal with the flooding problems in the catchment, Scone Shire Council has been implementing the guidelines set out in the New South Wales Government's *Floodplain Development Manual* (**Reference 1**), under the guidance of the Department of Land and Water Conservation (DLWC).

In accordance with the *Floodplain Development Manual*, Scone Shire Council commissioned this current study, the Floodplain Management Study (FPMS), in June 1997. The study has been undertaken by Bewsher Consulting Pty Ltd with the assistance of Don Fox Planning Pty Ltd and Warren Cole, surveyor. A Floodplain Management Plan has also been prepared.

1.1 THE FLOODPLAIN MANAGEMENT SYSTEM

1.1.1 NSW Flood Prone Land Policy

In New South Wales (NSW), the prime responsibility for local planning and the management of flood liable lands rests with local government. To assist local government with floodplain management, the NSW Government has adopted a Flood Prone Land Policy in conjunction with the *Floodplain Development Manual.*

The primary objective of the Flood Prone Land Policy (which is detailed in Appendix A of the *Floodplain Development Manual*) is to reduce the impact of flooding and flood liability on individual owners and occupiers, and to reduce private and public losses resulting from flooding (**Reference 1**). The policy recognises that as well as protecting existing development, growth in flood losses can only be contained by ensuring that new development takes into account the susceptibility of land to flooding. In particular, new development should be designed and constructed so that flood damage can be reduced and flood conditions at neighbouring properties are not made worse.

The policy states that:

- *"the impact of flooding and flood liability on existing developed areas shall be reduced by flood mitigation works and measures, the removal of unnecessary development, building controls, and the voluntary acquisition of property in hazardous areas;*
- *the potential for flood losses in all new developed areas shall be contained by the application of effective planning and development controls;*
- *a merits approach to all development and building decisions which takes account of social, economic and ecological as well as flooding considerations, shall be followed".*

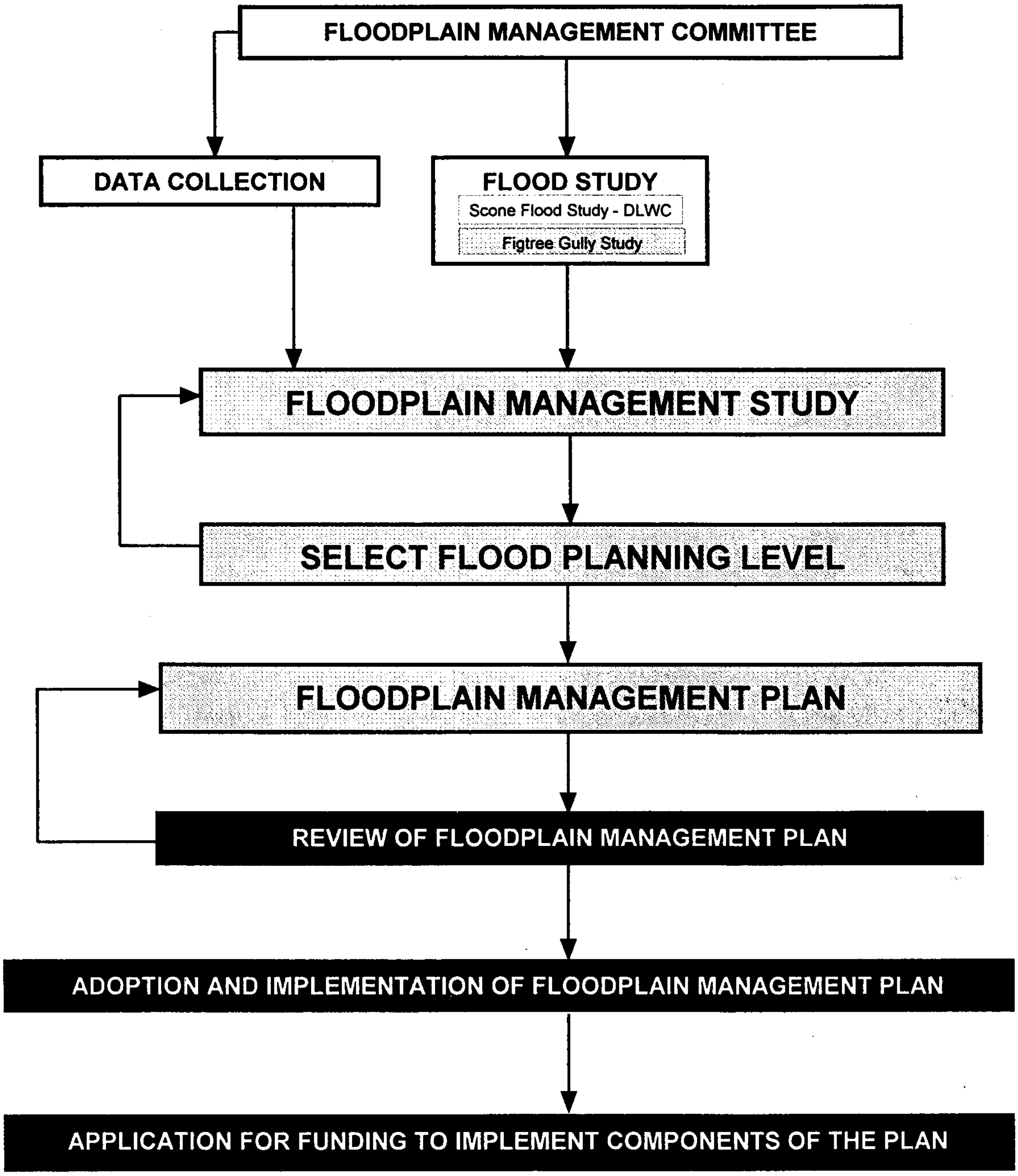
To help achieve its objectives, the policy provides for the protection of councils and other public authorities and their staff, against claims for damages resulting from them issuing advice or granting approvals on floodplains, providing they have acted substantially in accordance with the principles contained in the *Floodplain Development Manual.*

1.1.2 The Floodplain Management Process

The implementation of the Flood Prone Land Policy culminates in the formulation, adoption and execution of a Floodplain Management (FPM) Plan. The steps generally followed in the floodplain management process are presented in **Figure 1**. **Figure 1** also shows those steps already completed by Council, steps included as part of this report and steps which have yet to be completed.

1.2 PRINCIPAL AIMS OF THIS STUDY

The principal aim of this Study has been to develop a Floodplain Management Plan for the Scone district that addresses the existing, future and residual flood problems, and meets community expectations.



KEY:

Steps in the Floodplain Management Process already completed by Council

Steps in the Floodplain Management Process undertaken as part of this study

Steps in the Floodplain Management Process yet to be completed by Council

Source: adapted from Reference 1

DLWC = Department of Land & Water Conservation
BC = Bewsher Consulting Pty Ltd

FIGURE 1
THE FLOODPLAIN MANAGEMENT PROCESS

Key components of this study have included:

- collection and review all previous reports, surveys and maps relevant to the study;
- development and implementation of a community consultation strategy, to ensure community input is obtained at key times throughout the study;
- identification of the existing flood behaviour along Figtree Gully;
- assessment of the flood problems, the flood hazards and the cost to the community that can be expected from flood damage;
- review of the existing land use within the study area, having regard to the flood hazard;
- review of the existing framework of planning and development controls that are relevant to the assessments of building and development applications;
- analysis of the population characteristics and the demand for urban growth in order to determine an appropriate planning response to the identified flood hazard;
- identification of a number of flood modification options (such as channel improvements and retarding basins), property modification options (such as voluntary purchase and building controls) and response modification options (such as flood warning and community education) to mitigate the effects of flooding on existing and proposed development;
- assessment of how effective these mitigation options would be in reducing the impact of flooding on existing and new development;
- examination of the economic, social and environmental impacts (both negative and positive) of any proposed works and/or measures;
- formulation of an overview of strategic planning issues to help develop appropriate planning controls;
- assessment of an appropriate flood planning levels for the Middle Brook, Kingdon Ponds, Parsons Gully and Figtree Gully floodplains; and
- development of a Floodplain Management Plan in accordance with the guidelines of the Flood Prone Land Policy (see **Section 1.1**).

1.3 STRUCTURE OF THIS REPORT

Within **Chapter 2**, the characteristics of the study's catchments are described. This includes land use, social profile, heritage and vegetation issues. A list of authorities and agencies who may be affected when flooding occurs in the catchment is also provided.

Chapter 3 outlines the information that was available for this study including mapping and previous studies. The flood damages data base (a description of all residential and business properties in the Middle Brook, Kingdon Ponds, Parsons Gully and Figtree Gully floodplains) is described, together with the community consultation strategy utilised in this study, and the results of the community questionnaire.

Chapter 4 presents the assessment of flood behaviour within Figtree Gully which was carried out within the study.

A description of recent flood history, flood behaviour and the impacts and potential damage caused by floods is provided in **Chapter 5**. **Chapter 6** provides an overview of floodplain management including existing management measures, the selection of the flood planning level and funding. **Chapter 6** also details the methodology used for the assessment of floodplain management options.

The range of floodplain management options that was examined for the Scone district, as part of this study, is described in **Chapter 7**.

Chapter 8 outlines the Floodplain Management Plan for Scone, summarising the recommendations of the study.

A full list of references is provided in **Chapter 9**. An index of key words is contained in **Chapter 10.**

A number of appendices are included. **Appendix A** is the largest and comprises an extensive description of town planning issues.

2. THE STUDY AREA

*This Section describes the study area which is shown in **Figure 2**. The description includes the study area's waterways, land uses, people, heritage values and vegetation.*

The study area extends from approximately 6km north of Scone township to 6km south. To the west it comprises the floodplains of Middle Brook, Kingdon Ponds and Parsons Gully, whilst in the east, it includes the portion of the township along Figtree Gully as far as Barton Street.

This study concentrates on the Figtree Gully area through Scone township, and the western township fringe affected by Middle Brook, Kingdon Ponds and Parsons Gully flooding. Consideration is also given to rural areas to the west of the Main Northern Railway.

2.1 STUDY AREA WATERWAYS

2.1.1 Middle Brook, Kingdon Ponds and Parsons Gully

Middle Brook, Kingdon Ponds and Parsons Gully flow in a north to south direction through open rural lands to the west of Scone. Middle Brook and Kingdon Ponds are formalised natural streams to the west of Parsons Gully, while Parsons Gully is a broad generally lower lying area which receives breakout flows from Middle Brook and Kingdon Ponds during times of flood. Parts of Parsons Gully appear to have no defined watercourse.

2.1.2 Figtree Gully

Figtree Gully remains a natural waterway to the east of Barton Street. Immediately downstream of Barton Street, the Gully is an open grassed channel through the north eastern residential areas of Scone crossing several street causeways.

Downstream of Park Street the gully has been concrete lined through to downstream of Guernsey Street, with boxed sections at Main Street, from Kelly Street through to downstream of the Great Northern Railway, and under Guernsey Street.

Downstream of the RSL club, on Guernsey Street, Figtree Gully again becomes a grassed channel and extends through the south western residential areas of Scone and open recreational area before joining Parsons Gully.

FIGURE 2

Study Area

2.2 LAND USE

Land uses within the study area can be generally categorised as urban within the zoned town boundaries, and rural and rural residential beyond these boundaries.

The Scone township comprises two major components:

- the original Scone township area dissected by the New England Highway and Main Northern Railway, which contains the main commercial centre, small industrial area to the north, various special uses such as the abattoir, sales yard and garbage depot to the far northern extent, and a major recreational area to the south. This component contains the older established areas of Scone plus new developing areas to the east; and

- the satellite residential area know as Satur. This satellite residential area is adjacent to the Scone aerodrome, new racecourse and research centre, but separated from the main Scone urban area by a distance of approximately one kilometre.

The town's sewage treatment works are located to the south of the major recreation area, and is contained wholly within the Parsons Gully floodplain.

Substantial land has been identified for future residential development to the east of the existing Scone urban area.

2.3 PEOPLE

Between 1986 and 1996 the combined population of Scone urban area and Satur increased from 4,272 to 4,581 persons. During the same period, the adjoining rural lands experienced a minor increase in population.

The age structure of Scone indicates a slight increase in the number of older persons (i.e. 55 or greater), a slight increase in the proportion of middle aged population, a decrease in the proportion of school aged children and a slight increase in the proportion of infants. Almost conversely, the Satur area experienced a decrease in the proportion of older persons, a slight increase in the proportion of middle aged persons, a significant increase in the proportion of school aged children and a slight decrease in the proportion of infants.

The rural area experienced a definite aging of the population within all age groups above 25 years of age and decreases in the proportion of the population within the lower age groups — consistent with, but not as pronounced as the trend for NSW overall.

2.4 RELEVANT AGENCIES

Table 1 summarises the main agencies who are likely to be affected by issues relating to flooding in the Scone district (and hence this Floodplain Management Study). This list is by no means exhaustive but gives some indication of the wide cross-section of agencies which need to consider flood issues.

TABLE 1: AGENCIES LIKELY TO BE AFFECTED BY FLOOD ISSUES IN THE SCONE DISTRICT

ISSUES RELATING TO FLOODING	KEY PLAYERS AND RESPONSIBLE AGENCIES	COMMENTS
Planning and Development Controls	Department of Urban Affairs and Planning (DUAP)	Regional planning powers and overview of zoning matters
	Scone Council	Administration of LEP and Floodplain Management Plan
Floodplain Management	Department of Land and Water Conservation, Head Office and Newcastle Region	Administration of State Government's Flood Prone Land Policy and Floodplain Management Plan
	Scone Council	Local administration of Floodplain Management Plan
Floodplain Management Funding	National Landcare Project (Commonwealth Government)	Any request for funding for floodplain management works is submitted to the DLWC via the FMA. The FMA is responsible for prioritising those projects (see **Section 5.3**)
	Department of Land and Water Conservation, Head Office	
	Flood Mitigation Authorities of NSW (FMA)	
	Scone Council	
	Hunter Catchment Management Trust	Advisory and funding organisation for natural resources within the Hunter Valley
Flood Warning	Bureau of Meteorology (Met. Bureau)	Met Bureau do not issue warnings for Scone but are looking at regional warning systems
	State Emergency Service (SES)	Issuing and coordination of local warnings

TABLE 1: AGENCIES LIKELY TO BE AFFECTED BY FLOOD ISSUES IN THE SCONE DISTRICT (continued)

ISSUES RELATING TO FLOODING	KEY PLAYERS AND RESPONSIBLE AGENCIES	COMMENTS
Emergency Response	State Emergency Service	SES is responsible for coordination and action relating to flood emergencies.
	Police	
	Scone Council	
	Fire Brigade	
	Ambulance Service	
Welfare Management	Department of Community Services	A range of service groups is also involved in welfare management
	Department of Housing	
	State Emergency Service	
	Police	
	Scone Council	
Utilities and Services	Scone Council	Water supply and distribution; sewage collection, treatment and disposal, garbage collection and disposal
	Energy Australia	Electricity supply and distribution
	Optus	Telecommunications
	Telstra	Telecommunications
Floodplain Crossings	Roads and Traffic Authority	New England Highway
	Scone Council	Liverpool Street
	Rail Services Authority	Main Northern Railway Line

2.5 HERITAGE

To date Council has not undertaken a heritage study and the Consultant is not aware of any sites of high archaeological significance within the study area.

2.6 VEGETATION

The majority of the floodplain within the study area is cleared pasture land with minimal existing indigenous flora.

2.6.1 Middle Brook, Kingdon Ponds and Parsons Gully

Native vegetation within the main floodplain (Middle Brook, Kingdon Ponds and Parsons Gully) is restricted mainly to the tree species of Casuarina cunninghamiana (She Oak) and Eucalyptus sp. (Gum Tree). Minimal indigenous understorey flora remains.

There are extensive exotic plant species in the main floodplain, including various noxious weeds, particularly adjacent to the fringe of the urban areas and along roadways.

Within the main recreation area of the town immediately south of Kindgon Street recent plantings include Fraxinus sp., Grevillea robusta (Silky Oak), and a minimal proportion of indigenous species.

2.6.2 Figtree Gully

The Figtree Gully floodplain (west of Barton Street) is substantially developed. The majority of native flora has been removed and existing vegetation comprises predominantly domesticated exotic plants. Some portions of Figtree Gully (particularly that part adjoining Main Street) have some weed species such as Bamboo and Caster Oil Plant immediately along the formalised creek corridor. Further upstream the creek corridor exists within grass swales with minimal tree cover.

The portion of Figtree Gully to the west of the New England Highway similarly contains a number of domesticated exotic plant species. As with other areas of the floodplain there is minimal understorey, with ground cover comprising predominantly exotic grass species including Kikuyu and Paspalum.

It is considered desirable to discourage non-indigenous plant species from the primary creek corridors as they can develop unnaturally as a weed problem causing congestion to the flow of floodwaters and possible additional flood problems, as well as a general degradation to the ecological environment of the creek corridors.

The majority of the floodplain, including the immediate creek corridors, are within private ownership. Indeed, that area of Figtree Gully which traverses through smaller residential allotments is not contained within individual drainage easements. Accordingly, at present Council has minimal ability to implement a vegetation strategy along the Creek corridors as a single and comprehensive exercise. However, it is recommended that Council take whatever opportunities are available to them to secure the immediate creek corridors within easements or open space zonings (public reserves), particularly as part of the requirements of approvals issued for individual developments.

2.6.3 Need for a Vegetation Strategy

The Scone Landcare Group has recently formed and has as its main objective the revegetation of creek corridors. Council's support of this group's objectives would be desirable, but this should be in the context of a predefined vegetation strategy which adopts the following specific principles:

- species must be indigenous to the area;
- species must be suited to a creek environment;
- density of planting must be appropriate for a creek prone to flooding; and
- density of structure should ensure a healthy upper, middle and ground level cover which encourages a greater diversity of fauna.

Overall, the implementation of a vegetation strategy will provide not only a mechanism to improve the ecological and aesthetic quality of the creek corridors, but also a means to ensure that inappropriate exotic species do not result in a future weed infestation problem and the potential for the obstruction of floodwaters. Such a strategy will necessarily involve a long term and ongoing program involving maintenance on a regular basis to guarantee the sustainability of such an environment, and must be approached in a planned and coordinated manner.

3. DATA SOURCES

Various sources of data have been utilised within the study and are described in this Section. These data sources include mapping, other studies, property data, and the views of the local community.

3.1 MAPPING

Maps used in the study and their source are listed in **Table 2**.

TABLE 2: MAPS USED IN STUDY

MAP	SOURCE	SCALE
Digital Cadastral Map of study area with flood information	DLWC	-
Parkville 9034-II-S Topographic Map	DLWC	1:25000
Scone 9033-I-N Topographic Map	DLWC	1:25000
Scone town Cadastral Map with stormwater audit information	Council	-
Scone town spot level information	John F Berthon & Associates	-

A colour aerial photograph of the study area, enlarged to a scale of approximately 1:4500 was obtained from the Department of Land and Water Conservation (DLWC).

3.2 PREVIOUS STUDIES

There have been a number of previous studies carried out in the area which have provided useful information for the current study.

3.2.1 Scone Flood Study (1996)

The Scone Flood Study report (**Reference 2**) has been the primary reference document for the current study. The Flood Study was carried out by the DLWC on Council's behalf, as the first step in the implementation of the Government's Flood Prone Land

Policy (refer **Section 1.1** and **Figure 1**). It provides a comprehensive description of flood behaviour within Middle Brook, Kingdon Ponds and Parsons Gully, to the west of Scone township. The characteristics of flooding within Figtree Gully were not included however.

3.2.1.1 Hydrology

Hydrological modelling was carried out for the Middle Brook, Kingdon Ponds and Parsons Gully catchments using RAFTS-XP, and hydraulic modelling of the study area was carried out using the MIKE-11 computer program.

Calibration of the RAFTS-XP model utilised the three largest events for which recorded rainfall and flow data were available (i.e. the January 1976, March 1977 and February 1992 flood events). The calibration location was on Kingdon Ponds near Parkville.

Based on the calibration results, a storage factor of Bx=0.75 was adopted for modelling the 10 year ARI, 20 year ARI, 50 year ARI, 100 year ARI, 200 year ARI and PMF design storm events.

3.2.1.2 Hydraulics

Calibration of the MIKE 11 model utilised the two largest events for which recorded rainfall, flow data and flood levels were available, that being the January 1976 and February 1992 flood events. The calibration process indicated that the modelled flood levels for the floodplain areas immediately to the west of Scone township are expected to be more reliable than those areas further north and south.

The MIKE 11 model was then used to estimate flood levels, flows and indicative velocities for the range of recurrence intervals modelled with RAFTS-XP.

3.2.1.3 Results and Presentation

The DLWC report comprises two volumes, Volume I — Main Report, and Volume II — Drawings. The results were presented in tabular form in Volume I and as flood flow and flood contour drawings in Volume II.

The flood contour drawings utilise Council's AutoCAD cadastral mapping as a base. The flood contours for each of the three waterways (Middle Brook, Kingdon Ponds and Parsons Gully) are joined by broken lines which indicate the uncertainty (due to limited survey) of 'breakout flow' locations between waterways.

3.2.2 Figtree Gully Detention Basin Hydrological Analysis (1993)

Council conducted this study (**Reference 3**) in 1993. The study assessed the performance of a single storage located upstream of Barton Street to mitigate downstream flooding in Scone township. Catchment runoff and basin modelling upstream of Barton Street were carried out using the RORB computer software. Flows downstream of Barton Street were assessed using the ILSAX software.

3.2.3 Scone — Aberdeen Urban Drainage Concept Plan (1990)

John F Berthon & Associates completed this study (**Reference 4**) in October 1990 for Council. The study developed drainage concept plans for the urban areas of Scone and Aberdeen.

3.2.4 Proposed New Alignment and Associated Bridges at Parsons Gully, Kingdon Ponds and Middle Brook (1986)

Webb, McKeown & Associates completed this study (**Reference 5**) in December 1986 for Council. The study comprised investigations and concept designs for the construction of approximately 1.5km of Trunk Road 62 (Liverpool Street) between Aberdeen Street, Scone, and the satellite settlement of Satur.

3.2.5 Trunk Drainage Study Scone and Aberdeen (1985)

Sinclair Knight & Partners completed this study (**Reference 6**) in November 1985 for Council. Details of trunk drainage strategies developed for the towns of Scone and Aberdeen are presented.

3.3 FLOOD DAMAGES DATA BASE FOR WESTERN FRINGE OF SCONE TOWNSHIP

As discussed in **Section 5.6**, flood damage costs for parts of the study area have been calculated by different methods.

On the western fringe of Scone township, floodwaters originating from Middle Brook and Kingdon Ponds overflow into Parsons Gully and, when combined with local flows from the Gully's catchment, these flood waters inundate a number of properties. To assist with the estimation of flood damages to these properties, a flood damages data base was established. The data base contains all the township properties to the west of Hill Street and provides the following information for each property:

- flood levels for 5, 10, 20, 100 year average recurrence interval (ARI) discharge and the probable maximum flood (PMF) events;
- house and business floor levels;
- maximum depths of inundation over the floor and outside ground for the different sized floods;

- the flood hazard category (low or high — see **Section 4.4**) at the property during a 100 year ARI flood;

- the potential and predicted actual flood damage for each of the different flood sizes.

3.3.1 Council's Rates Mailing List and Town Map

To ensure a consistent link between the properties in the data base and the properties in the field, it was necessary to use information contained in Council's Rates Mailing List and Town Map showing developed properties and street addresses. Use of this data also had the advantage of ensuring all developed properties were included in the analysis, as well as facilitating the data entry process.

The information from Council's rates mailing list included in the data base comprises house and unit number (if applicable), street name and suburb.

3.3.2 Property Data Sheets

One of the important inputs to the flood damages data was the field collection of information about each residential, commercial and industrial property that was known to have been flooded above floor level and neighbouring properties which were considered as having a high potential of being flooded. This was completed by the Consultant during the course of the study. The following information was noted:

- *street name, street number, unit number and/or business name (type of business)* — this was also used as a confirmation of Council's mailing list.

- *construction type for main house* — this determined whether the house would be relatively easy to raise (that is, clad with fibro, timber or Hardiplank), much more difficult to raise (that is, brick construction on footings) or unable to be raised (that is, slab-on-ground brick construction);

- *house size (small, medium or large)* — this was a relative and subjective assessment of the house size as seen from the road;

- *house age (old, medium or new)* — this also was a relative and subjective assessment;

3.3.3 Other Inputs into Data Base

3.3.3.1 Flood Levels

Flood levels were interpolated from the Scone Flood Study (**Reference 2**) and entered into the database for each property.

The Flood Study velocities for the 100 year ARI flood were also entered into the database for use in flood hazard assessment.

3.3.3.2 Floor and Ground Levels

Floor and ground levels were obtained from survey undertaken as part of this study, or otherwise interpolated from street spot levels.

3.3.4 Output From Data Base

A full printout of the data base has been produced as a separate document and provided to Council, along with a copy on diskette.

3.4 COMMUNITY CONSULTATION

The success of any floodplain management plan hinges on community acceptance of the proposals. This can be achieved by involving the local community at all stages of the decision-making process. This includes the collection of their ideas and information, together with informing them of the issues and outcomes of the study.

All residents, business owners and landlords within the floodplain were consulted during the study. It was important to gain the community's input for the options available for minimising the danger to life and property during floods within the study area. It was also important to seek comments and feedback on the preferred options once the analyses had been carried out. After all, the proposals adopted in the Floodplain Management Plan will need to be accepted, endorsed and 'owned' by the local people if the ultimate plan is to succeed.

3.4.1 Community Consultation Strategy

The key elements of the Community Consultation Strategy for this study were as follows:

- the preparation, distribution and analysis of a community questionnaire and newsletter;
- regular meetings and discussions with the Floodplain Management Committee and Committee representatives;
- press releases in the local paper and coverage on the local radio station;
- an afternoon poster display in the Bi-Lo shopping arcade;
- a public meeting to formally introduce the floodplain management process, to present the results of the questionnaire and to present and explain the analysed

options to the community and other interested parties, and to seek feedback on the proposed ranking and prioritising of the options;

- face to face meetings prior to the public meeting with business and land owners in the catchment.

Some of the key components of the community consultation strategy are described below in more detail.

3.4.2 Floodplain Management Committee

The Scone Floodplain Management Committee (FPMC) was the principal link between the Consultant, the Council, the DLWC and the local people. The FPMC together with Council's Project Manager, overviewed the study and represented some of the 'community voices' within the study area. The following were present on the Committee:

- Scone Council:
  - Councillors;
  - Manager, Engineering Related Services;
  - Acting Director, Environmental Services;
  - Manager, Land Use Planning;

- Department of Land and Water Conservation (Newcastle Office);

- State Emergency Services;

- Community representatives.

3.4.3 Community Questionnaire

The community questionnaire was provided to all properties potentially impacted by flooding of Middle Brook, Kingdon Ponds, Parsons Gully and Figtree Gully within the study area. A total of 870 questionaries were distributed. An addressed, postage-paid envelope was provided to facilitate the return of the completed questionnaires. The number of responses received was 280 (or about 32%). This response rate was thought to be good, considering that the questionnaire was distributed to many properties which have never experienced flooding.

The questionnaire was divided into the following four parts:

- Part A — General Information about the Community:
- Part B — Flood Experience;
- Part C — Attitudes to Floodplain Management Options;
- General comments.

A blank copy of the questionnaire and the results from the questionnaire have been reproduced in **Appendix D**. The newsletter distributed with the questionnaire is included in **Appendix C**. The results for Part A and Part B are discussed below. The results for Part C and comments associated with floodplain management options are discussed in **Section 6.6**.

3.4.3.1 Part A — General Information about the Local Community

The results from Part A of the questionnaire highlighted the fact that a large proportion of the population are long-term residents. Over 25%of the respondents have lived in the area for more than 20 years, while more than 75% of the respondents have lived in their homes for more than five years. Approximately 71% of the respondents either own or are paying off their house. 11% of respondents said that their mobility was limited because of age or a disability.

3.4.3.2 Part B — Flood Experience

The questionnaire revealed the following information about the flood experiences of respondents:

- 27% of respondents had experienced their property being flooded;
- 8% of respondents had experienced a flood above floor level;
- 28% of respondents either had no warning of the arrival of the biggest flood or witnessed it with their own eyes. 11% had received warning from the Police, SES, radio or TV of the biggest flood experienced; and
- 2% of respondents were evacuated from their homes in the biggest flood experienced.

Only 7% of respondents received flood information about their property through 'official' sources such as Council Section 149 Certificates.

4. FLOOD BEHAVIOUR WITHIN FIGTREE GULLY

Flooding within Figtree Gully has a major impact on Scone township. As a definitive description of the Gully's flood behaviour was not available, an assessment was carried out as part of the current study.

The assessment methods used and the results are discussed in this Section.

Design flows were determined by hydrological modelling, and the adopted results are summarised in ***Table 4****.*

The design flows were then used in an hydraulic assessment to determine the flood regime along Figtree Gully. These results are presented in ***Figure 4*** *(located at the end of this report).*

4.1 HYDROLOGICAL MODELLING

4.1.1 Methodology

A RAFTS-XP model (Version 5.00) of was developed to determine design flows for Figtree Gully. The catchment was determined using 1:25000 topographic maps obtained from the Central Mapping Authority. The catchment is outlined in **Figure 3**. The model was developed with:

- two subcatchments. The upstream subcatchment which represents the largely undeveloped area to the north east of Barton Street, and extends up to Scone Mountain, and the downstream subcatchment (to the south west) of Barton Street which extends through the eastern residential areas of Scone, the central business district and the south western residential area of Scone before connecting into Parsons Gully;

- design intensity frequency duration rainfall data obtained from Council (included in **Appendix E**);

- probable maximum precipitation data calculated in accordance with **Reference 7** (included in **Appendix E**);

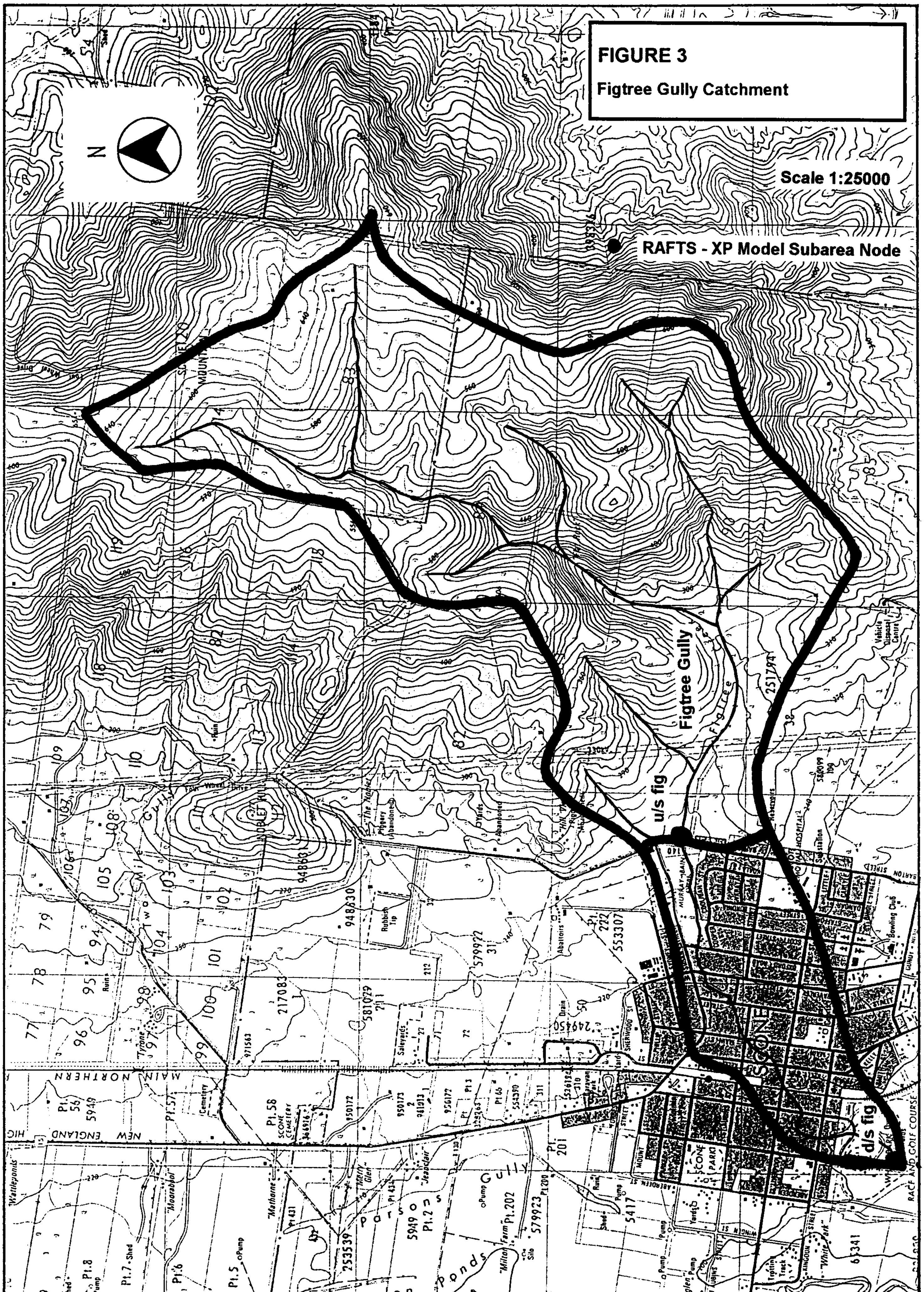


FIGURE 3
Figtree Gully Catchment
N
Scale 1:25000
RAFTS - XP Model Subarea Node
Figtree Gully
u/s fig
d/s fig

The one hour duration storm was determined to have design intensities of 340mm/h and 260mm/h for isohyetal lines A and B. By superimposing the isohyetal lines over the catchment, 260mm/h was adopted in the RAFTS-XP model for the downstream catchment area and 295mm/h for the upstream catchment area.

- initial loss and continuing losses for pervious areas of 20mm and 2.5mm/h, and for impervious areas 0mm and 1.0mm/h respectively, for design storm events up to the 100 year ARI in accordance with **Reference 8**.

- a 0.4 impervious fraction for the downstream subcatchment (to the south west) of Barton Street.

The catchment is ungauged with respect to stream flow, so the RAFTS-XP model storage routing factor (Bx) was adjusted so that the model's 100 year ARI flow at Barton Street (representing the undeveloped upstream subcatchment) approximated that determined by the Probabilistic Rational Method (PRM, **Reference 8**). The resulting routing factor was Bx=1.6.

4.1.2 Results

The PRM and RAFTS-XP results (for the adopted Bx=1.6) are compared in **Table 3**. The PRM parameters are presented in **Appendix E**.

TABLE 3: PROBABILISTIC RATIONAL METHOD AND RAFTS-XP DESIGN FLOWS AT BARTON STREET

Average Recurrence Interval (yr)	Design Flow (m^3/s)	
	Probabilistic Rational Method	RAFTS-XP (Bx=1.6)
5	10.1	11.5
10	13.0	14.3
20	16.9	18.9
50	22.6	24.2
100	28.2	28.7

The existing condition 5 year, 10 year, 20 year, 50 year, 100 year ARIs and Probable Maximum Flood (PMF) peak flows determined by the RAFTS-XP modelling for the upstream and downstream catchment locations are presented in **Table 4**.

TABLE 4: RAFTS-XP DESIGN FLOWS (Bx=1.6)

Average Recurrence Interval (yr)	Critical Storm Duration (min)	Design Flow (m^3/s)	
		Barton Street (U/S FIG)	Parsons Gully (D/S FIG)
5	720	11.5	14.1
10	540	14.3	17.3
20	540	18.9	22.1
50	540	24.2	28.5
100	540	28.7	33.9
PMF	60	260	270

Note: 1. RAFTS-XP file: figtree.xp
2. Initial loss (IL) = 20mm, Continuing Loss (CL) = 2.5mm/h for all events except the PMF, PMF IL = 0.0mm/h, CL = 1.0mm/h.

4.1.3 Sensitivity Assessment on Flows Downstream of Barton Street

The sensitivity of the subcatchment downstream of Barton Street to changes in impervious fraction was assessed, with the impervious fraction reduced from 0.4 to 0.3 is the RAFTS-XP model.

The impact of the reduced impervious fraction on the 100 year ARI flows for the downstream subcatchment (only) was to reduce the peak flow by approximately 20% to 25% for the shorter duration events (25 minute to 180 minute), and by approximately 5% to 10% for the longer duration events (270 minute to 720 minute). It was considered appropriate to adopt the 0.4 impervious fraction for the downstream subarea.

4.1.4 1992 Flow Assessment

February 1992 pluviograph station rainfall data from the Scone Research centre (station no. 061089), which was utilised in the Scone Flood Study (**Reference 2**), was input into the Figtree Gully RAFTS-XP model and resulted in a peak flow of $7m^3/s$ at Barton Street (U/S FIG), and $8.4m^3/s$ at the downstream end of Figtree Gully confluence (D/S FIG).

These 1992 model flows appear to under estimate the event, in which significant overland flows were observed by local residents. The discrepancy between modelled and observed catchment flows for this event may be due to the recorded rainfall not reflecting that which actually fell over the Figtree Gully catchment, (noting that there is only a single pluviograph station, and that it is located outside of the Figtree Gully catchment).

4.2 HYDRAULIC MODELLING

4.2.1 Assessment Procedures

4.2.1.1 HEC-RAS Model

A HEC-RAS model (**Reference 9**) was developed based on 29 waterway cross sections surveyed as part of this study and design flows determined from the RAFTS-XP modelling (discussed in **Section 4.1**). Channel roughnesses were determined from field observation and recommended text book values (**Reference 10**).

A series of culverts exist from Main Street through to Guernsey Street and these were modelled as open channels, apart from the culvert under Kelly Street (the Great Western Highway). At Kelly Street a single 3.5m(W)x1.0m(H) culvert was introduced into the model to represent the culvert sections which vary in size (and are partly obstructed) between Kelly Street and the Great Northern Railway line.

This modelling indicated that downstream of Waverley Street, the Figtree Gully system only conveys approximately $10m^3/s$ (i.e. less than the 5 year ARI flow).

Once flows exceed the capacity of the formal Figtree Gully system, flows route overland to the south and west through private properties and along road reserves, and could not be adequately modelled with HEC-RAS.

4.2.1.2 Uniform Flow Calculations

For those overland flows that could not be adequately modelled using the HEC-RAS model of Figtree Gully, depths have been estimated by uniform flow analysis for typical road reserves along which significant flows would travel. These streets extend from Oxford Road (in the upper north eastern area of Scone) through to Kingdon Street (in the lower south western area of Scone).

4.2.2 System Capacity

This section describes the existing Figtree Gully channel system capacity.

4.2.2.1 Barton Street to Oxford Road

Figtree Gully flows (up to the 100 year ARI event) essentially continue along the alignment of its natural channel, from the causeway crossing at Barton Street to Oxford Road. At the Oxford Road causeway, flows greater than approximately the 20 year ARI flow overtop the southern causeway crest and continue overland to the south.

4.2.2.2 Oxford Road to Park Street

The system capacity downstream of Oxford Road reduces to approximately 5 year ARI, with overbank flows spilling to the south. A little further downstream (to the west), from the Waverley Street causeway through to the Park Street causeway, the system remains an open earth channel, and can carry approximately 20 year ARI flows within its banks before overtopping occurs and flows spill to the south.

4.2.2.3 Park Street to Main Street

Downstream of Park Street the channel is an open concrete box section (above which there are grassed sides slopes). The capacity of this length of channel through to the Main Street culvert (before overbank flows would spill to the south) is approximately 10 year ARI. The Main Street culvert capacity is approximately 5 year ARI.

4.2.2.4 Main Street to Kelly Street (Great Western Highway)

The open concrete lined channel section downstream (to the west) of Main Street through to the Great Western Highway culvert (near the Westpac Bank) is approximately 5 year ARI. The Great Western Highway culvert capacity is less than 5 year ARI.

4.2.2.5 Kelly Street (Great Western Highway) to Guernsey Street

Downstream of the Great Western Highway culvert, is a larger culvert which continues through to a short uncovered box culvert length (of 16.5m) which then enters a brick arch culvert under the Great Northern Railway. Downstream (west) of the Great Northern Railway through to the culvert under Guernsey Street is an open concrete lined section (above which there are grassed sides slopes). This section of the Figtree Gully system, from downstream of the Great Western Highway to Guernsey Street, is limited by inlet capacity to approximately a 5 year ARI capacity.

The culvert under Guernsey Street leads into a smaller culvert which runs along the northern side of the RSL club. The capacity of this is approximately 5 year ARI.

4.2.2.6 Downstream of Guernsey Street

Downstream of the RSL club the system becomes an unlined open channel which then crosses Kingdon Street, after which it continues as an unlined open channel. Upstream of Kingdon Street, the open channel would only convey up to the 5 year ARI flow (being limited by "inlet capacity"). At the Kingdon Street causeway, overland flows would re enter the channel system with flows, up to approximately the 20 year ARI, being directed southward to the downstream recreation area. Flows greater than the 20 year ARI would spill over the western side of the Kingdon Street causeway and head towards Hill Street.

Flows entering the recreation area would spread over a broad area and join into Parson Gully.

4.2.3 Results

HEC-RAS model details and results, and uniform flow results for a "typical" road reserve are included in **Appendix B**.

Design flood levels upstream of Oxford Street and downstream of Kingdon Street are shown on **Figure 4** (which is folded into the back of this report) and are based on HEC-RAS model results.

Approximate system capacities, system "break out" locations, and catchments flows and indicative overland flow depths are also shown on **Figure 4**.

The PMF extent of inundation for Figtree Gully is shown in **Figure 6**. Due to the complexity of overland flow paths along streets and through properties, the position of the PMF line is only an approximation.

5. DESCRIPTION AND IMPACTS OF FLOODING

The key impacts of flooding presented in this Section are:

- *the number of properties inundated (see **Table 5** and **Table 6**);*
- *the extent of inundation and the flood hazard — see **Figure 4** (bound into the back cover of this report), and **Figure 5** and **Figure 6**);*
- *the dollar value of flood losses incurred by the community (see **Table 8** and **Table 9**).*

5.1 FLOODPLAIN CHARACTERISTICS AND HISTORY

The western fringe of Scone township and the neighbouring rural areas to the west of the New England highway are located on the common floodplain of Middle Brook, Kingdon Ponds and Parsons Gully. The catchment area upstream of Turanville Road (at the southern study area boundary) is approximately 358km^2.

Parsons Gully is a broad area of land generally on the low side of the common floodplain and conveys the breakout flows from Middle Brook and Kingdon Ponds which occur in events greater than approximately the 20 year ARI flood.

Figtree Gully enters the north eastern residential areas and CBD of Scone, and continues south east to Parsons Gully. The catchment area of Figtree Gully is 7.1km^2.

The largest floods recorded in the Scone district were in 1955, 1971, 1976, February 1992 and January 1997. Of these the 1955 flood was the largest and is estimated to have been approximately that of the 100 year ARI magnitude within Parsons Gully, and the largest event recalled by local residents within Figtree Gully. The February 1992 event is estimated to have exceeded the 20 year ARI magnitude on Parsons Gully, although possibly was somewhat less on Figtree Gully.

5.2 PARSONS GULLY

5.2.1 Catchment Response

The response of the Middle Brook, Kingdon Ponds and Parsons Gully catchments at Scone allows for several hours flood warning time.

5.2.2 Flood Behaviour

Because Parsons Gully carries surplus flows which break out from Middle Brook and Kingdon Ponds, changes in flood levels and velocities can be highly variable, particularly when surplus flows first enter the Gully.

The extent of inundation across the common floodplain varies in width from approximately 1km to 2kms as shown in **Figure 5**.

The survey details available from the Scone Flood Study (**Reference 2**) were not sufficient to accurately identify breakout locations and cross flows from Middle Brook and Kingdon Ponds into Parsons Gully, however it was sufficient to indicate that there are numerous such locations within the 12.5km length of floodplain modelled.

With respect to the inundation of rural areas away from the township, of particular interest is the sewage treatment works located approximately 2km south of Liverpool Street. Based on the Public Works Dwg No. 81/1952-2X (provided by Council, and the conversion of the drawing datum to mAHD by adding 2.56m) the Scone Flood Study indicates that the treatment works are protected against inundation up to the 100 year ARI event.

In major flood events flows inundate the western edge of Scone township, overtop Liverpool Street and thereby isolate the nearby settlement of Satur.

5.2.3 Summary of Flooded Properties

A summary of the properties flooded on the western fringe of Scone township is provided in **Table 5**, based on the Flood Study modelling results for various flood events.

TABLE 5: ESTIMATED NUMBER OF PROPERTIES FLOODED ON PARSONS GULLY ALONG THE WESTERN FRINGE OF SCONE TOWNSHIP

Average Recurrence Interval (years)	RESIDENTIAL		NON-RESIDENTIAL		TOTAL	
	Above Ground Level	Above Floor Level	Above Ground Level	Above Floor Level	Above Ground Level	Above Floor Level
5	7	0	0	0	7	0
10	22	1	3	1	25	2
20	55	10	3	3	58	13
100	92	42	4	3	96	45
PMF	206	188	8	8	214	196

PMF = Probable maximum flood

The Flood Study indicates that for Parsons Gully:

- the Liverpool Street series of culverts would be overtopped in floods greater than the 10 year ARI event;
- 100 year ARI peak average velocities on the western fringe of the town range from $0.9m^3/s$ to $2.0m^3/s$, but are generally about $1.1m^3/s$;
- the 100 year ARI extent of inundation is limited to the west of Hill Street;
- the PMF flood levels are predicted to be 2m to 3m above the 100 year ARI flood levels on the western edge of the town, with inundation extending east to the New England Highway at Mount Street and to the north, and midway between Hill Street and Guernsey Street to the south of Mount Street.

5.3 FIGTREE GULLY

5.3.1 Catchment Response

The Figtree Gully catchment, being relatively small with very steep rocky outcrops in its upper reaches and urban development in its lower reach, has a flood warning time of less than one hour.

5.3.2 Flood Behaviour

The description of flood behaviour presented in this section is based on questionnaire responses, and discussions with some 18 long term residents/property owners within the Figtree Gully catchment who had experienced past flood events.

The longer term residents identified the 1955 flood event as the most severe. Those not present in 1955 described either the 1992 or the recent January 1997 events as the most severe.

5.3.2.1 Barton Street to Cooper Street

Little information was available about the extent and behaviour of flood waters in the upper eastern area of Figtree Gully around Barton Street. Only one resident (at No.28 Coolibah Street) indicated that their garage, which backs onto the Gully, suffered 0.1m above (garage) floor level flooding in a 1995 storm event.

A little further to the east, the owner of No. 6 Scott Street described flows in the 1955 event coming down Mulga Street from Barton Street, crossing Boronia Street and continuing westward along the driveway of No. 5 Boronia Street and through the rear of No. 6 Scott Street. The depth of water being up to 0.6m, under the house and in the front yard.

The Mulga Street flows appeared to come from a local depression near the corner of Mulga Street and Barton Street.

Flows coming through No. 6 Scott Street entered Scott Street then travelled in a northerly direction and into Cooper Street. In Cooper Street flows travelled westward along the street with a considerable amount of flow also spilling overland to the north of Cooper Street, through the Preschool site, and into Figtree Gully.

5.3.2.2 Oxford Road to New Street

There is a low point in Oxford Road near No. 19 (approximately 150m south of Figtree Gully.

The resident in No. 19 Oxford Road was able to describe flooding in 1992 and observed that significant flows came along Oxford Road from both Cooper Street (to the north), and Birrell Street (to the south).

From the Oxford Road low point flows travelled west through the properties of Nos.15, 17 and 19 Oxford Road. In smaller events flood flows are limited to the driveway on the northern side of No. 19, however in 1992 water flowed down both sides of the house at a depth of 0.3m to 0.45m. This flooding was limited to a very short time with waters subsiding within half an hour to one hour.

At the rear of these Oxford Road properties, flows continue overland through the rear of properties fronting onto Waverley Street. These Waverley Street properties include Nos. 44 (driveway only), 46, 48, 50 and 52.

No.52 Waverley Street is adjacent to a low point, and in 1992 the owner described flows entering his property from the north and from Birrell Street to the south. Flooding in his yard during this event was up to 0.4m deep. Downstream to the west, flows from Waverley Street entered New Street (which is located opposite No.52 Waverley Street) and continued westward.

The Oxford Road and Waverley Street flows described above, are remote from Figtree Gully and are apparently local drainage flows within the catchment. The resident at No. 7 Oxford Road recalled 1955 flood flows as the worst experienced, and the event in 1992 as similar. On both occasions he observed flows about half way along Cooper Street flowing overland to the north and into Figtree Gully, with the remaining Cooper Street flows entering Oxford Road and flowing to the south. Downstream of Oxford Road, the Figtree Gully flows only just entered the backyard of No.7 Oxford Road in these two events.

5.3.2.3 Park Street to Main Street

Immediately west of New Street is Park Street. New Street is only about 20m south of Figtree Gully and flows along New Street enter Park Street and in major events (such as 1955 and 1992) are (apparently) joined by breakout flows from the Figtree Gully Park Street causeway, and travel south along Park Street.

The long term resident of No. 121 St Aubins Street described a split in flow at the corner of Park Street and St Aubins Street in the 1955 and 1992 flood events, with flows entering St Aubins Street (and travelling westward), and also continuing south along Park Street.

In 1955 flows entering St Aubins Street flowed overland through properties on the south side of the street, and continued south west into Main Street. Flood waters in this event reached verandah level at No. 121 St Aubins Street, and were approximately 0.3m lower in 1992, but still flooded the garage up to 0.1m deep.

It was noted that St Aubins Street was lower than footpath level in 1955 and that flows extended across the full street width. However St Aubins Street has been raised since 1955, and in the 1992 flood flows entering from Park Street travelled along the southern side of St Aubins Street only, before entering the properties on the south side. Overland flows through these St Aubin Street properties continued south west into Main Street, then south towards Liverpool Street.

Further west along St Aubins Street, on the north east corner of Main Street and St Aubins Street, No. 116 St Aubins Street (located adjacent to Figtree Gully) was flooded above floor level in 1955. On the south west corner of St Aubins Street and Main Street, the owner of Blooms Nursery recalled that in the 1992 flood, flows along the

Figtree Gully channel (which routes through the nursery) were at the top of the concrete lining and that there was no flow over the road intersection itself.

Flood flows that did not enter St Aubins Street continued south along Park Street.

The resident at No.37 Park Street described flows entering the properties of Nos. 37, 39 and 41 in 1955 and 1992 from Park Street, with the depth of water 0.1m in the front yard and 0.15m in the back yard in 1955, but much less severe in 1992. The resident at No.41 Park Street described the 1992 flows down the driveway "with great force" with the depth of water up to 0.15m, and 0.3m in the back yard. Flows that remained in Park Street continued south to Liverpool Street.

5.3.2.4 Kelly Street and Liverpool Street (east of Great Western Railway)

The owner of the hardware store at No.164 Kelly Street described flood flows at the rear of the property which is adjacent to the open channel of Figtree Gully (approximately 100m downstream of Blooms Nursery). The shop was flooded 0.05m above floor level in January 1997 with water entering through the rear door. It appeared that overland flow could not get into the channel system. In 1992 however the shop was not flooded, with water just lapping at the back door floor level.

It appears that Figtree Gully overland flows are largely remote from the channel system at the rear of the hardware store, reaching Liverpool Street via Park Street and Main Street.

Flows entering Liverpool Street from Park Street travel west and are joined by flows from Main Street. At the intersection of Main Street and Liverpool Street, flows turn south to a low point in Main Street. At this low point is a laneway that extends to the rear of the Commonwealth Bank (which fronts onto Liverpool Street).

A Bank employee recalled that the Bank was flooded 0.05m above floor level in January 1997, and had been flooded above floor level on two previous occasions over the years. Flows in 1997 entered Main Street from Liverpool Street, overtopped the kerb of the laneway at the rear of the Bank and entered the Bank through its back door. The neighbouring shops including "A Country Future" were also flooded above floor level. Flows also ponded in front of the Bank on Liverpool Street. Since the 1997 flood, the Bank has constructed a wall at the rear of the property to prevent flooding of the Bank.

Almost opposite the Commonwealth Bank on Liverpool Street is Chad's Furniture Store. The owner recalled that approximately eight times in 17 years the shop has been barricaded to prevent flooding, with passing trucks causing waves that splash into the shop. In 1992 flood water was prevented from entering the shop but reached a level of 2 inches (0.05m) above floor level on the barricade. The neighbouring Bilo Store was reportedly flooded above floor level.

A long term resident, who in 1955 was working at Campbell's Store (located on the north west corner of intersection of Liverpool Street and Kelly Street), recalled that despite sand bagging efforts, water entered the store and was also above floor level in the Golden Fleece Hotel on the opposite (north east) corner. He observed flows travelling west along Liverpool Street then splitting at the Great Western Railway Line, with flows travelling both south along the railway line and continuing west along Liverpool Street.

5.3.2.5 West of The Great Western Railway Line to Guernsey Street

The same resident (as noted above) lives in Guernsey Street and recalled in the 1955 flood event that flows along Liverpool Street to the west of the railway line were too deep to walk through, with water at the Guernsey Street intersection extending north from Liverpool Street half way to St Aubins Street.

5.3.2.6 Kingdon Street

Residents in Kingdon Street near the Figtree Gully causeway crossing who were present in the 1992 flood, observed that floodwaters stayed within the causeway (and did not get high enough to overtop the western edge of the causeway).

5.3.3 Summary of Flooded Properties

A summary of the properties flooded is provided in **Table 6**, based on modelling of various flood events and the information provided by the local community.

TABLE 6: ESTIMATED NUMBER OF PROPERTIES FLOODED ALONG FIGTREE GULLY

Average Recurrence Interval (years)	RESIDENTIAL		NON-RESIDENTIAL		TOTAL	
	Above Ground Level	Above Floor Level	Above Ground Level	Above Floor Level	Above Ground Level	Above Floor Level
5	0	0	0	0	0	0
10	0	0	5	1	5	1
20	50	0	11	9	61	9
100	146	20	42	35	188	55
PMF	228	196	49	46	277	242

The modelling indicates that above floor level flooding of residential properties is not expected until events of the 20 ARI year and greater are experienced, however due to

the variable nature of overland flow paths (streets, driveways, fence obstructions, in between buildings), limited freeboard between ground and floor levels, and possible local drainage problem, above floor level inundation may be worse than indicated.
In the central business district (CBD) around Main Street, Kelly Street and Liverpool Street, above floor level inundation is significantly greater than for the residential areas in the 10 year ARI to 100 year ARI events. Again, due to the variable nature of overland flow paths, limited freeboard between ground and floor levels, and possible local drainage problem, above floor level inundation may be worse than that defined.

Flow velocities will vary greatly, with velocities in the steeper open road areas possibly as high as 3m/s to 4m/s in the 100 year ARI storm while velocities behind fencelines may be very small.

In the PMF, flood levels are predicted to be about 1m above the 100 year ARI storm levels in the CBD, but generally less in the residential areas.

5.4 EXTENTS OF FLOOD INUNDATION

Figure 5 shows the extent of the 20 year ARI flood, 100 year ARI flood and the PMF from Kingdon Ponds, Middle Brook and Parsons Gully (under existing conditions).

Figure 6 shows the extent of the 100 year ARI flood and an extreme event from Figtree Gully. Due to the nature of overland flows, these extents of inundation are approximate and do not include for local stormwater inadequacies which may result in flooding beyond the extents shown.

5.5 FLOOD HAZARD CLASSIFICATION

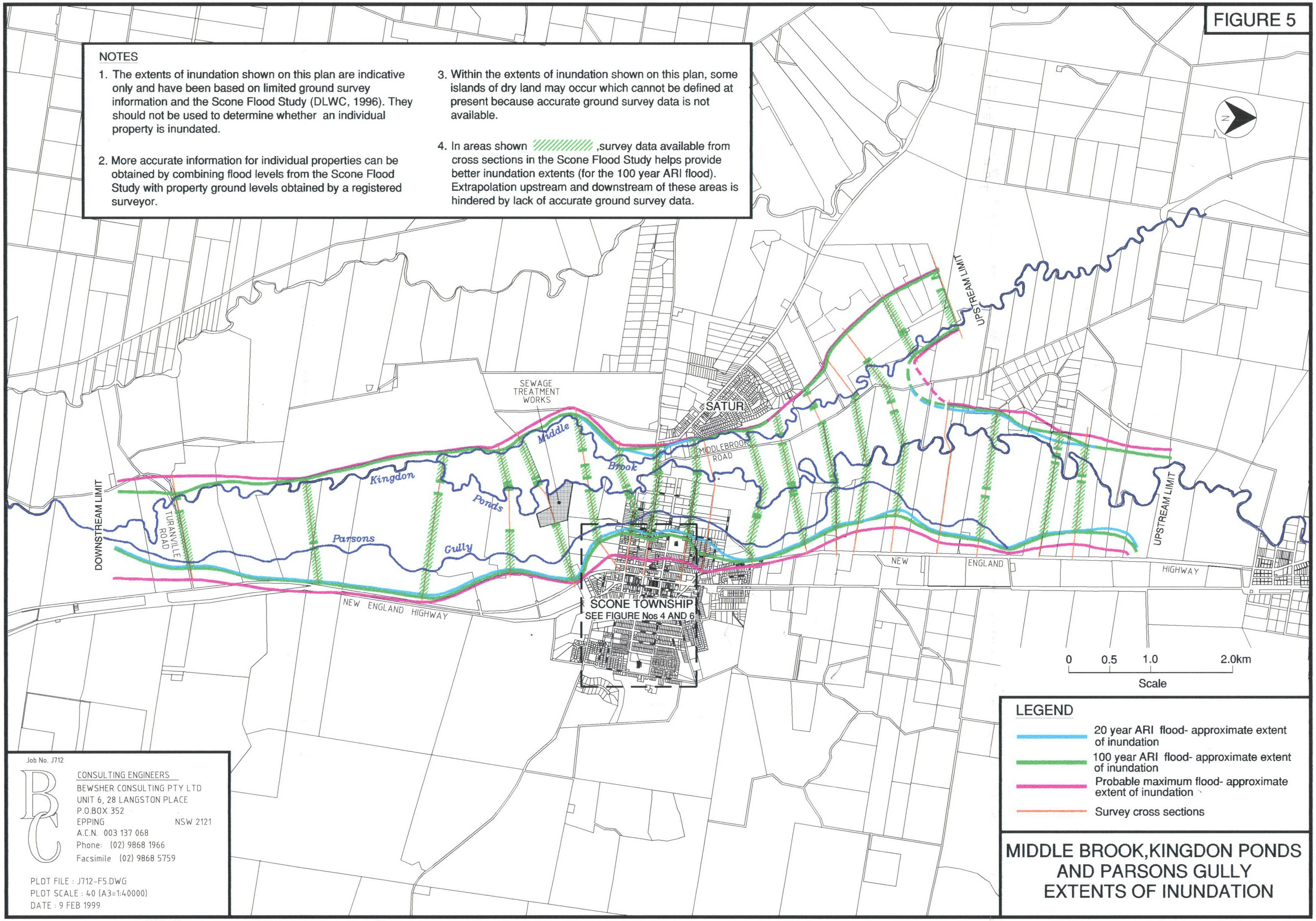
The term 'flood hazard' refers to the potential for damage to property or risk to persons during a flood. The categorisation of the floodplain into 'low hazard' and 'high hazard' areas, provides useful input to the floodplain management process.

'Low hazard' defines conditions of low flood depth and flow velocities. In a low hazard area, should it be necessary, people and their possessions could be evacuated and able-bodied adults would have little difficulty wading in such conditions.

In 'high-hazard' conditions, either flow velocities or flood depths, or other factors present a significant danger. Under these conditions, evacuation may be difficult and there is potential for structural damage to buildings and property. Significant social disruption may also occur and financial losses may be high.

The western fringe of Scone township that is subject to flooding from Parsons Gully has been classified into low, or high hazard, based on 100 year ARI flood levels and velocities, in accordance with the guidelines for 'provisional hazard' presented in **Reference 1**. The line between high and low flood hazard areas has been plotted in **Figure 6**. The number of properties in each hazard category is shown in **Table 7**.

FIGURE 5



NOTES

1. The extents of inundation shown on this plan are indicative only and have been based on limited ground survey information and the Scone Flood Study (DLWC, 1996). They should not be used to determine whether an individual property is inundated.

2. More accurate information for individual properties can be obtained by combining flood levels from the Scone Flood Study with property ground levels obtained by a registered surveyor.

3. Within the extents of inundation shown on this plan, some islands of dry land may occur which cannot be defined at present because accurate ground survey data is not available.

4. In areas shown ////////, survey data available from cross sections in the Scone Flood Study helps provide better inundation extents (for the 100 year ARI flood). Extrapolation upstream and downstream of these areas is hindered by lack of accurate ground survey data.

LEGEND

- 20 year ARI flood- approximate extent of inundation
- 100 year ARI flood- approximate extent of inundation
- Probable maximum flood- approximate extent of inundation
- Survey cross sections

MIDDLE BROOK, KINGDON PONDS AND PARSONS GULLY EXTENTS OF INUNDATION

Job No. J712
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PLOT FILE : J712-F5.DWG
PLOT SCALE : 40 (A3=1:40000)
DATE : 9 FEB 1999

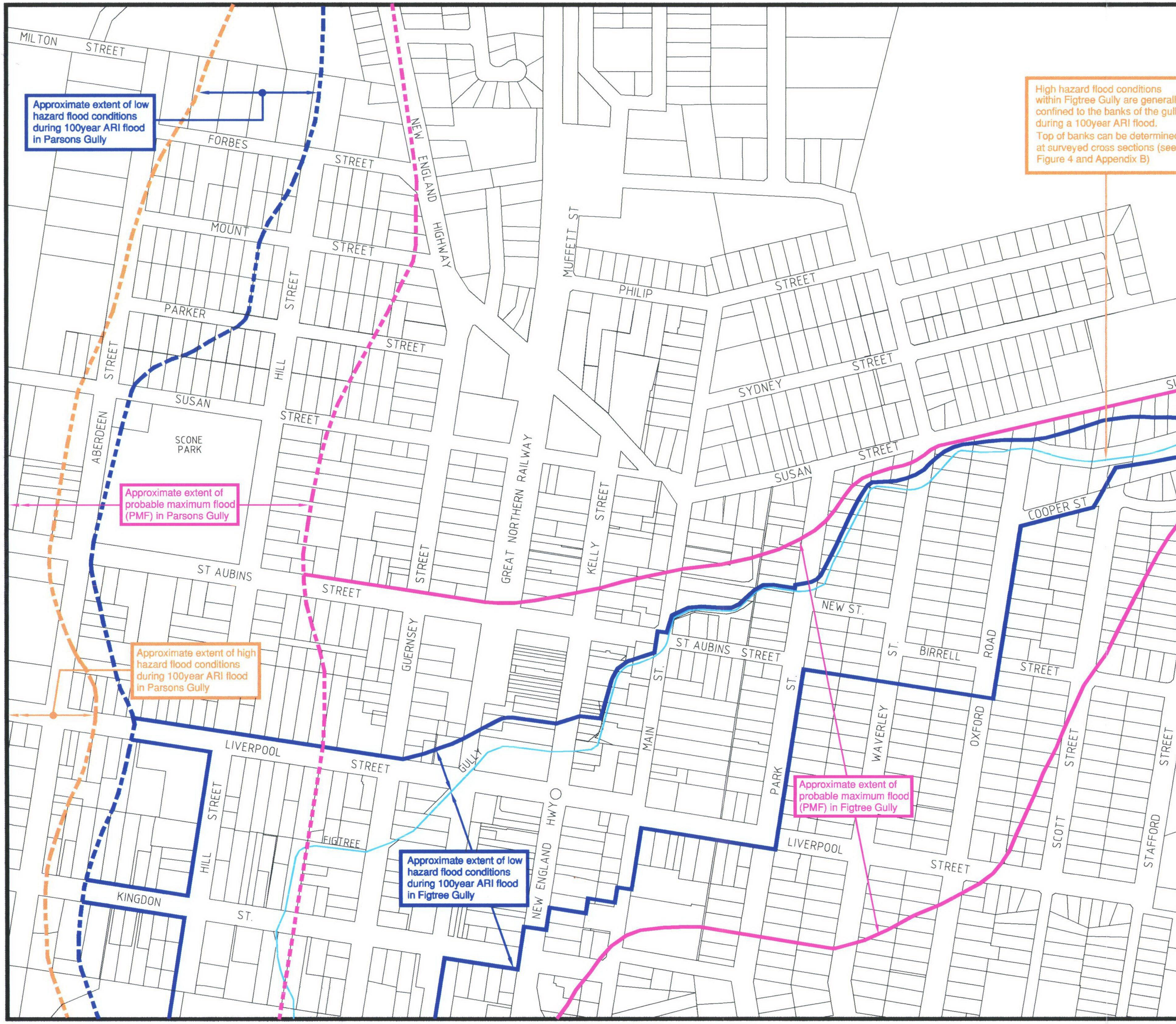

FIGURE 6

JOB No. J712

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PLOT FILE : J712-F6.DWG
PLOT SCALE : 5 (A3=1:5000)
DATE OF PLOT : 9 FEB 1999

LEGEND

- Low Hazard line (Parsons Gully)
- High Hazard line (Parsons Gully)
- PMF Line (Parsons Gully)
- Low Hazard line (Figtree Gully)
- PMF Line (Figtree Gully)

Note : Figtree Gully High Hazard areas are limited to within the waterway banks and are not shown on plan

SCONE TOWNSHIP HAZARD DEFINITION

Given the lack of detailed topographic data over the remainder of the Parsons Gully floodplain, and the Middle Brook and Kingdon Ponds floodplains, it has not been possible to prepare any meaningful hazard categorisation in these areas.

For the Scone CBD and residential areas subject to flooding from Figtree Gully, the high and low flood hazard areas have been plotted in **Figure 6**. For Figtree Gully, high hazard conditions exist only within the formal channel. Therefore all properties inundated within the 100 year ARI flood limit are classified as in low flood hazard areas.

TABLE 7: WESTERN FRINGE OF SCONE TOWNSHIP — NUMBER OF FLOODED PROPERTIES BY HAZARD CATEGORY FOR 100 YEAR ARI FLOOD#

LAND USE	LOW HAZARD	HIGH HAZARD
Commercial	0	3
Residential	36	19
TOTAL	**36**	**22**

\# Excludes properties subject to catchment flows from the east of the New England Highway.

5.6 FLOOD DAMAGES

The assessment of flood damages is generally the method used to quantify the cost of flooding to a community in a particular flood prone area.

Flood damages in this study have been calculated using the flood damages data base (described in detail in **Section 3.3**) for that area of Scone township to the west of Hill Street.

No formal flood damages data base was prepared for the Scone CBD and the residential areas affected by Figtree Gully flooding, due to the uncertainty of overland depths and paths (discussed in **Section 4**). Instead, the number of properties flooded and associated damages were approximated using Council's rates mailing list, surveyed floor levels, historic flood information, the estimated flood depths determined from the Figtree Gully flood assessment (see **Section 4**) and the flood damage curves as for the Parsons Gully flood damages data base (presented in **Appendix F**).

For the rural areas, damage estimates have been extrapolated from the flood questionnaire responses received as part of this study.

5.6.1 Calculation of Flood Damages

The total potential damage bill for a particular sized flood is divided into a number of components. The definitions and methodologies used in estimating flood damage have been established by a number of previous investigations. **Figure 7** summarises the types of flood damages that have been considered in this study.

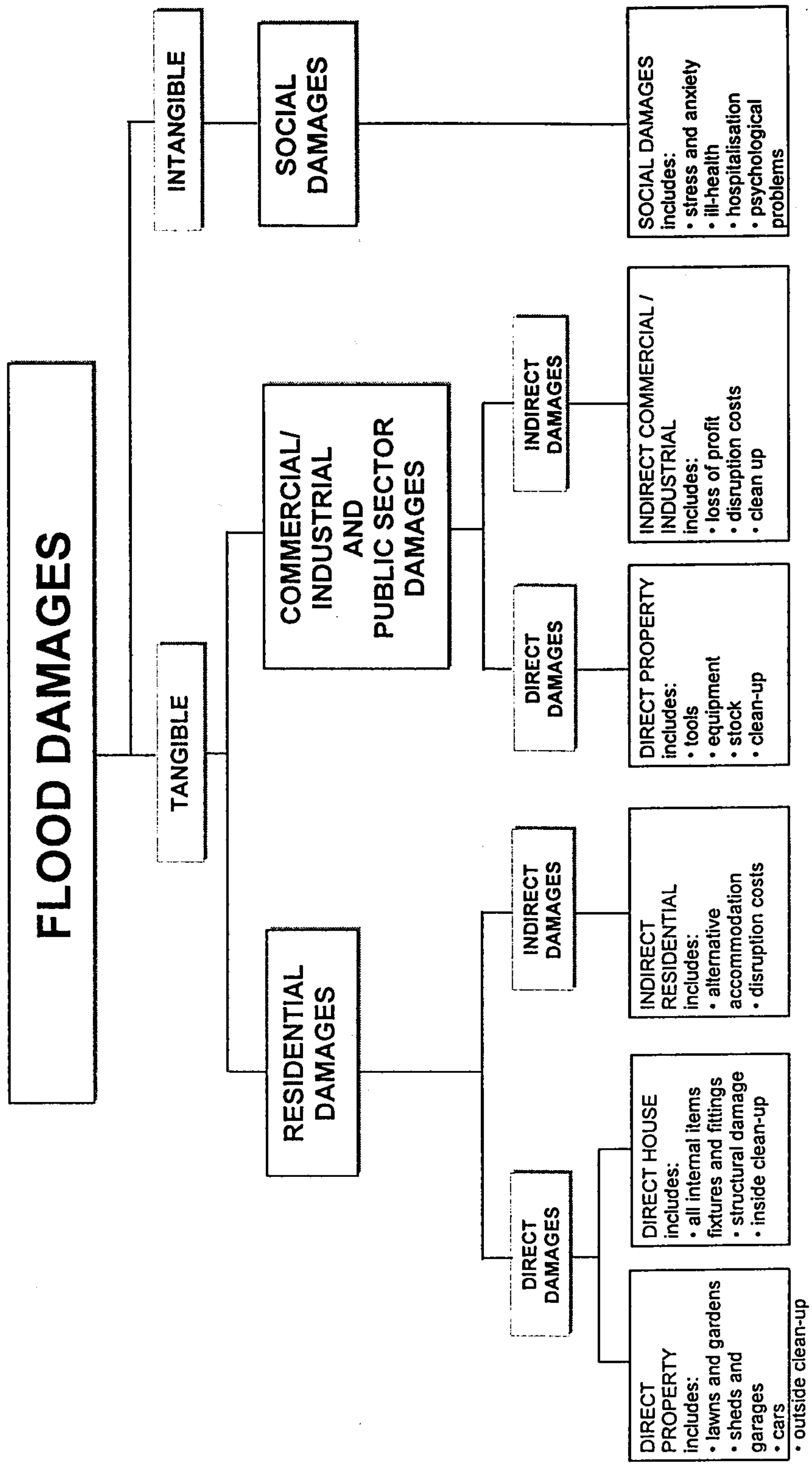

FIGURE 7
TYPES OF FLOOD DAMAGES

The two main categories are 'tangible' and 'intangible' 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 hence are much more difficult to quantify.

Appendix F describes the methodology used in this study for the calculation of flood damages, including:

- description of types of flood damage;
- adopted stage–damage curves for residential and business properties;
- all other assumptions used including sources of information.

The damages tabulated in this report are 'predicted actual' damages. 'Actual' damages will always be less than potential damages if the community takes action to reduce damage (e.g. raising goods, moving cars, etc.). **Reference 11** shows that even with a very short warning time, 'actual' damages are less than 'potential' damages.

5.6.2 Summary of Calculated Flood Damages

Table 5 and **Table 6** show the number of residential and non-residential properties that would be inundated in a 5, 20 and 100 year ARI flood and the PMF for Parsons Gully and Figtree Gully respectively. **Table 8** and **Table 9** provide a summary of the total flood damage bill (for Parsons Gully and Figtree Gully respectively) that could be expected in the Scone township area for this range of flood events. Average annual damage (i.e. the average cost of damage per year) and the present value of damage (assuming discount rates of 4%, 7% and 10%, and a period of 20 years, as recommended in **References 12** and **13**) have also been included.

5.6.3 Rural Area Flood Damages

Fifteen rural land holders responded to the questionnaire, representing approximately 70% of the rural areas subject to flooding within the study area along the Middle Brook, Kingdon Ponds and Parsons Gully waterways. None of the respondents had experienced flooding above house floor level. Nine of the respondents (representing approximately 50% of the rural areas subject to flooding within the study area along the Middle Brook, Kingdon Ponds and Parsons Gully waterways) had experienced flood damages in the 1992 flood event, totalling approximately $100,000.

TABLE 8: VALUE OF FLOOD DAMAGES ALONG THE WESTERN FRINGE OF SCONE TOWNSHIP DUE TO PARSONS GULLY FLOWS

ITEM	RESIDENTIAL	NON-RESIDENTIAL	TOTAL*
5 year ARI flood	$8,000	-	$8,300
10 year ARI flood	$58,000	$5,000	$64,000
20 year ARI flood	$297,000	$46,000	$350,000
100 year ARI flood	$909,000	$97,000	$1,025,000
PMF	$3,722,000	$540,000	$4,346,000
Average Annual Damage	$65,000	$6,000	$72,000
Present Value (7%)	$683,000	$61,000	$759,000
Present Value (4%)	$876,000	$78,000	$973,000
Present Value (10%)	$549,000	$49,000	$610,000

* Total damage includes residential, non-residential plus infrastructure.

TABLE 9: VALUE OF FLOOD DAMAGES ALONG FIGTREE GULLY CATCHMENT

ITEM	RESIDENTIAL	NON-RESIDENTIAL	TOTAL*
5 year ARI flood	-	-	-
10 year ARI flood	-	$13,000	$13,300
20 year ARI flood	$88,000	$117,000	$209,000
100 year ARI flood	$491,000	$805,000	$1,322,000
PMF	$3,075,000	$2,520,000	$5,707,000
Average Annual Damage	$31,600	$39,000	$72,000
Present Value (7%)	$335,000	$412,800	$763,000
Present Value (4%)	$430,000	$530,000	$979,000
Present Value (10%)	$270,000	$332,000	$613,000

* Total damage includes residential, non-residential plus infrastructure.

6. OVERVIEW OF FLOODPLAIN MANAGEMENT

Key items discussed in this Section include:

- *existing floodplain management measures* ***(Section 6.1)****;*
- *the proposed approach to setting a flood planning level (FPL). This is to be based on a 'graded' set of controls defined in a 'planning matrix' (rather than the traditional approach of using controls based on a single FPL). Refer to* ***Section 6.2****;*
- *sources of floodplain management funding and how to apply for it* ***(Section 6.3)****. A funding application pro forma is provided in* ***Appendix G****. Applications are to be submitted to the DLWC before April each year ;*
- *assessment criteria used for the evaluation of floodplain management options* ***(Section 6.5)****; and*
- *community perceptions of the various options (see* ***Tables 11*** *and* ***12****).*

6.1 EXISTING FLOODPLAIN MANAGEMENT MEASURES

6.1.1 Planning and Development Controls

Existing planning instruments and background documents which apply to the study area are listed below. Many of these are reviewed in **Appendix A**. Not all will be immediately applicable to flooding issues.

- State Environmental Planning Policies (SEPP's);
- Regional Environmental Plans (REP's);
- Section 117 Directions covering the rezoning of land;
- Environmental Planning Instruments (LEP's);
- Development Control Plans (DCP'S);

- Council Policies including a Floodplain Management Plan and any interim flood policies; and

- Development Application Assessment.

6.1.2 On-Site Stormwater Detention (OSD)

Council currently does not have any OSD requirements.

6.1.3 Flood Warning

The Figtree Gully catchment response time is too short for an effective flood warning system to have been established.

The much larger Parsons Gully catchment has a flooding warning system in place. The system utilises water level markers located in the upper reaches of Middle Brook, Dry Creek and Kingdon Ponds. Residents nearby to the markers are relied upon to be contactable (by telephone) by the Scone State Emergency Service (SES). If communications are operable at the time, the flood warning time for Scone township is up to approximately seven hours. However past experience, such as in the February 1992 flood event, saw the telephone communication system fail, and as a result no flood warning was available by this means.

There is also a stream gauging station on Kingdon Ponds near Parkville, however from this location the flood warning time for Scone township is limited to less than 4 hours.

6.1.4 House Raising

On the western fringe of Scone township approximately eight houses within Parsons Gully have been raised. Discussions with the residents indicated that the house raising was carried out some time ago (as early as 1974) and at the owners' expense.

6.1.5 Temporary Flood Proofing

A number of commercial property owners in the central business district near the intersection of Kelly Street and Liverpool Street use temporary barricading to try and prevent flood waters entering their properties.

6.2 SELECTION OF THE FLOOD PLANNING LEVEL

The flood planning level (FPL) (previously known as the 'designated flood' level or 'flood standard') is the flood level selected for planning purposes, and will directly determine the area of land that should be subject to flood-related building and development controls (**Reference 1**).

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

Selection of the FPL needs to balance short-term gains against long-term problems, for example:

- if the FPL is too low — large numbers of properties may suffer quite frequent inundation with corresponding high flood damage bills. As more and more development occurs, damage bills will get higher and higher over time;
- if the FPL is too high — properties that would be rarely flooded may be subjected to unnecessarily restrictive development and building controls.

The 100 year ARI flood was adopted as a mandatory FPL in New South Wales in 1977 after a series of major floods occurred in Australia during the early and mid-1970s and caused considerable devastation. The majority of these floods had recurrence intervals between 50 and 100 years. The 100 year ARI flood was therefore seen as indicative of a 'big flood' with a potentially high damage bill. However, in late 1984, the NSW Government abandoned the policy that the 100 year ARI flood should be the mandatory FPL. At that time it became the responsibility of local councils to determine a FPL appropriate to local conditions and the local community (**Reference 1**).

6.2.1 Issues Affecting Selection of a FPL

The issues affecting the selection of a FPL are numerous, with the implications often extending beyond the immediate floodplain area. Issues and factors that need to be considered include flood behaviour (including the consequences of extreme floods), the impact on existing and future development and environmental issues.

It should be noted that the selection of a particular FPL does not change anything in the past, only in the future. Regardless of the FPL adopted (and assuming no flood mitigation measures are undertaken), the existing flood risk and damage would not be reduced — only flood damage to future developments can be prevented. The amount of potential future flood damage is dependent on the amount of development potential there is between a particular FPL and the probable maximum flood (PMF).

6.2.2 Shortcomings of the Singular FPL Approach

The adoption of a singular FPL which is higher than the 100 year ARI level may be unduly restrictive for some types of land uses. For example, whilst it may be appropriate for some land uses, such as a hospital, to be located above a PMF flood, it could be argued that residential, agricultural or recreational land uses do not require such restrictive controls.

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

As a result, consideration has been given to a new approach which does not rely on the definition of a singular FPL.

6.2.3 Proposed Approach For The Study Area

To overcome the shortcomings noted above, a 'graded' set of controls which consider the variation of damage risk with flood frequency and land use, has been proposed for the study area. These are contained in a 'Planning Matrix' which is presented as part of **Section 7.2.4** and discussed further in **Appendix A**.

A description of these controls is also provided in **Appendix A**. The controls do not rely on the definition of a singular FPL. In essence, the approach makes use of a range of FPL's for various land uses within the flood prone land below the PMF, without specifically referring to this term.

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

- the procedures and philosophy espoused in the Government's Floodplain Development Manual (**Reference 1**);
- consideration of the social, economic and environmental impacts of flooding and the proposed controls;
- investigations carried out within the current study;
- community attitudes expressed during the current study;
- minimising Council's exposure to legal actions in relation to flooding;
- Council's existing interim flood policy and flood planning level;
- views expressed by the Floodplain Management Committee and various senior officers within Council and the DLWC; and
- experience gained from the development of planning controls and flood policies for various communities across NSW in recent years.

6.3 SOURCES OF FUNDING FOR FLOODPLAIN MANAGEMENT

6.3.1 Council's Funding

Table 10 shows Scone Council's budgeted expenditure on flood control in recent years. Based on these figures, it is anticipated that approximately $100,000 to $150,000 could be made available by Council in any one year for capital expenditure on flood mitigation works. However this expenditure may need to be shared with other catchments in the Scone Council area.

TABLE 10: SCONE COUNCIL'S EXPENDITURE ON FLOOD CONTROL

FINANCIAL YEAR	EXPENDITURE
1993	$75,000
1994 (Jan - Jun)	0
1994-95	0
1995-96	$120,000
1996-97	$90,000

Notes: Figures are actual expenditure

6.3.2 State and Federal Government Funding

The NSW Government provides subsidies to Council for the implementation of flood mitigation works and measures recommended in Councils' floodplain management plans through two sub-programs:

- the Commonwealth Subsidised Capital Sub-Program where the project is funded through a partnership agreement between the Commonwealth, State and Local Governments. Traditionally this has been on a 2:2:1 basis (Commonwealth: State: Council); and

- the State Only Capital Sub-Program where the project is funded through a partnership agreement between the State and Local Governments. Traditionally this has been on a 2:1 basis (State: Council).

The partnership agreement between the Commonwealth, State and Local Governments is subject to ongoing review and the traditional funding ratios outlined above along with the funding commitments can not be guaranteed into the future.

Investigation and implementation works may also be funded on a 2:1 (State: Council) basis through the Floodplain Management Program.

The annual contribution to flood mitigation programmes is limited and there is strong competition for these funds. Scone would have to compete for funding alongside all the other flood-affected local government areas.

When applying for funding for works recommended in floodplain management studies, councils have to complete a pro forma that describes the proposed project. The format of the pro forma changes slightly from year-to-year, however the basic assessment criteria tend to remain the same. The following information needs to be included in the pro forma:

- project identification, description and costs;
- benefit–cost ratio;
- flood hazard level;
- average annual damage;
- damage in the project design flood;
- community involvement;
- strategic planning implications;
- local contribution to funding;
- total catchment management compatibility;
- summary of benefits and costs associated with the works;
- method used for estimation of flood damages;
- project readiness.

A copy of the 1998 pro forma has been provided in **Appendix G**.

Completed pro formas are submitted to the DLWC before April each year. These are passed on to the Floodplain Management Authorities (FMA) working group who review and collate the information for all submitted projects. Prioritisation of the projects is undertaken at the annual FMA conference in May. The collation of all submissions then becomes part of the overall State bid for funding under the National Landcare Program.

6.4 RANGE OF FUTURE MANAGEMENT OPTIONS AVAILABLE

Floodplain management options can be divided into three categories:

- options which modify the way a flood behaves by reducing flows (e.g. flood retarding basins), increasing the conveyance of the channel and floodplain (e.g. channel widening and deepening), or restricting the flood extent (e.g. levees);

- options which minimise the damage at individual properties by modifying the properties (e.g. house raising or flood proofing); and

- options which reduce damages by improving the way that people and organisations respond to floods.

As part of this study, it has been necessary to consider whether the proposed measures might produce adverse effects upstream and/or downstream, and to consider modifications that should be incorporated to lessen or compensate for such effects. The study has attempted to consider all feasible options and to take account of physical, social, economic and environmental factors.

6.5 CRITERIA FOR EVALUATION OF OPTIONS

In evaluating potential floodplain management options within the study area, a range of assessment criteria have been used. These include:

- ***financial feasibility***

  Options proposed within the floodplain management plan must be capable of being funded. Sources of funds for implementation of the plan have been discussed in **Section 6.3**.

- ***economic merit***

  The ratio of the benefit divided by the cost (i.e. the benefit–cost ratio) is a common measure of assessing economic feasibility. Theoretically, no investment should be made on an option if the benefit/cost ratio does not exceed unity (i.e. if the benefits do not exceed the costs). However, traditionally many floodplain management options have been undertaken where this is not the case because the intangible benefits, (i.e. those not able to be quantified), are considerable. Benefit–cost ratios can also be useful in ranking competing options.

- ***community acceptance***

  Assessment of possible community attitudes towards any proposed floodplain management options is essential. If community attitudes are strongly negative, this is often enough to deter the implementation of the proposals which otherwise may have significant merit. The community's attitude to the various options are discussed in the following section.

- ***environmental impact***

  Floodplain management options involving structural works may often have significant environmental impacts. Impacts on vegetation, visual amenity and soil erosion/sedimentation, are issues which must commonly be addressed when evaluating works within watercourses.

- ***impact on flood behaviour***

  The impact on flood behaviour caused by the option needs to be considered for upstream and downstream locations. These impacts can include such things as changes in flood levels, changes in velocities or alteration of flow directions.

- ***performance during large floods***

  All options must be assessed in the knowledge that large floods, i.e. larger than the 100 year ARI flood, or larger than any known historical flood, will happen at some time in the future. It is therefore imperative that the options do not expose the community to unacceptable risks by providing a false sense of security.

- ***technical feasibility***

  If the proposed options involve structural works, these works must be able to be constructed and be free from major technical constraints.

- ***political/administrative impact***

  Any recommended option will have more chance of success if it involves little if any disruption to current political and administrative structures, attitudes and responsibilities.

  There are also various strategic objectives which Council and other authorities have concerning development within the study area.

6.6 COMMUNITY PERCEPTIONS OF THE FLOODPLAIN MANAGEMENT OPTIONS

Community attitudes have been assessed through:

- community representation on the Floodplain Management Committee;
- the community questionnaire;
- the afternoon display in the Bi-Lo shopping arcade;
- the public meeting; and
- discussions with individual business owners and residents.

6.6.1 Community Questionnaire

Part C of the community questionnaire asked people to indicate which floodplain management options they favoured. **Table 11** lists the options from the questionnaire which were most favoured by the community, while **Table 12** lists the least favoured options.

6.6.2 Public Meeting

A public meeting was held on 5 March 1998 at the Scone RSL Club, and was attended by eighteen residents and four others representing authorities or the Council.

The floodplain management process was explained and floodplain management options were described and feedback was sought on the community's attitudes to these options. The meeting's response showed a general appreciation of the flooding problems in the catchment and favoured most of the options presented. None of the options presented elicited a negative response, however it was questioned whether more could be done to improve the hydraulic efficiency in Parsons Gully to the south of Liverpool Street, and whether house raising could be a viable option in this area.

6.6.3 Drainage versus Flooding Problems

As well as flooding problems, a number of localised drainage problems exist within the Figtree Gully catchment, including at the corner of Birrell Street / Park Street, and Main Street and Kelly Street to the south of Liverpool Street downstream. Works to improve these localised drainage problems, such as improved stormwater pipelines leading to the main channel, are favoured by the whole community however they will not reduce flooding along the Gully.

Consideration of these localised drainage problems within the current study is beyond the scope of the study brief. However it is noted that within the Floodplain Management Plan, implementation of the recommended Option 1.9 (see **Section 7**) would facilitate the construction of local stormwater lines to alleviate these localised drainage problems within Figtree Gully.

TABLE 11: QUESTIONNAIRE OPTIONS MOST FAVOURED BY THE COMMUNITY

OPTION	PERCENTAGE OF RESPONDENTS IN FAVOUR
Removal of obstructions in the creeks	59%
Providing information about the potential risks of flooding to all residents and business owners	45%
Improvements to piped drainage systems	44%
Providing a certificate to all residents stating whether their property is flood affected	44%
Installation of flood marker poles	43%
Development of flood action plans by residents and business owners	43%

TABLE 12: QUESTIONNAIRE OPTIONS LEAST FAVOURED BY THE COMMUNITY

OPTION	PERCENTAGE OF RESPONDENTS AGAINST
Flood proofing of individual properties	13%
Council purchase of the most severely affected flood-liable land	13%
Construction of small retarding basins on existing properties	11%
Building of temporary levees during floods	10%

7. ASSESSMENT OF OPTIONS

Options to be included in the Floodplain Management Plan are identified in this Section.

*Options have been assessed against the evaluation criteria described in **Section 6.5** using a qualitative matrix assessment procedure. This assessment matrix is provided in **Tables 13a** and **13b** at the end of this Section.*

***Figure 9** shows all the floodplain management options which were examined.*

Estimates of the cost of each option are also provided. These are for construction only, and exclude any land acquisition costs.

A flood assessment of a new roundabout at the intersection of Liverpool Street and Middlebrook Road was made during the course of this study, and has been reported in a separate document to Council.

7.1 OPTIONS WHICH MODIFY FLOOD BEHAVIOUR

7.1.1 Construct a Large Retarding Basin(s) Upstream of Parsons Gully (Option 1.1)

Findings — Option 1.1 is not recommended for further consideration.

This option would involve the construction of a large flood retarding basin on Kingdon Ponds (and possibly a second on Middle Brook), to reduce the existing 100 year ARI flows in Parsons Gully ($840m^3/s$) to that of approximately the existing 10 year ARI flow ($240m^3/s$) to provide adequate downstream flood protection.

Implementation of this option would protect downstream rural areas, the western fringe of Scone township and Liverpool Street (at Parsons Gully) from flooding.

The total work for this option is estimated to cost in excess of \$200M.

A vast amount of land would need to be purchased upstream of Parsons Gully for the storage(s), and apart from potentially significant adverse environmental impacts, the cost of this option would be prohibitive. The required storage volume may exceed $1,000,000m^3$, and assuming an average depth of water of 1.0m, this would cover an area of approximately $1km^2$.

7.1.2 Construction of a Levee on the Eastern Side of Parsons Gully (Option 1.2)

Findings — Option 1.2 is not recommended for further consideration.

Levees are often used to prevent flooding of populated areas on the floodplain. However, in some circumstances they can make flooding worse for people outside or upstream of the levee and can also give a false sense of security as overtopping or a breach of a levee can occur in large floods.

On the eastern side of Parsons Gully a levee could be constructed from the New England Highway (north of Forbes Street), south westward (west of Aberdeen Street), to the south of Kingdon Street, then east to Hill Street. The total levee length would be approximately 2km.

Implementation of this option would protect most of the western residential fringe of Scone township.

A large amount of land would need to be purchased for the levee, a significant pump system would need to be installed behind the levee to manage local stormwater, and compensation would have to be provided for those to the west of the levee who would be adversely affected by the levee construction.

These requirements, and a cost estimate in excess of $10M make this option very unfavourable.

7.1.3 Construction of a Formal Channel in Parsons Gully (Option 1.3)

Findings — Option 1.3 is not recommended for further consideration.

This option involves the construction of a major channel in Parsons Gully to convey the 100 year ARI flows past the western residential fringe of Scone township, and provide 100 year ARI floor level protection to existing properties in this area.

The channel would extend from just south of Kingdon Street north for approximately 2km, and be of the order of say 2m deep with a width greater than 100m. Such a channel would require major culverts to be constructed at several street crossings (including upgrading of the Parsons Gully culvert), and changes to the geomorphology of the Gully would probably mean on going works to maintain the channel.

The need to purchase a significant amount of land for the channel and a cost estimate in excess of $20M, make this option very unfavourable.

7.1.4 Construct a Single Large Retarding Basin Upstream of Barton Street (Option 1.4)

Findings — Option 1.4 is not recommended for further consideration.

Most of the urban area flood problems experienced in the study area are on the Figtree Gully catchment downstream of Barton Street. There is opportunity to construct a retarding basin immediately upstream of Barton Street with the current land owner indicating that he is open to negotiation for such a construction.

Preliminary assessment of a retarding basin, to mitigate flows up to the 100 year ARI event, indicates that the basin would need to be a massive structure of similar dimensions to that outlined in **Reference 3**. The Council report indicates the basin wall would be up to 10m high and 1km long, with a spillway capacity for the half PMF (although if constructed it would probably need to convey the full PMF flow).

Since there is a significant urbanised catchment upstream of Scone CBD that would not be controlled by the basin, the basin itself would not fully attenuate the peak flood flows. Therefore the Scone CBD would not be fully protected from above floor level flooding. As a result some additional upgrading of the Figtree Gully system through the CBD would also be necessary.

With an estimated cost for the basin is in excess of $20M and the necessity for additional system upgrading works through the CBD, this option is not favoured.

7.1.5 Construct a Number of Smaller Retarding Basin Upstream of Park Street (Option 1.5)

Findings — Option 1.5 is not recommended for further consideration.

The construction of one or two storages along Figtree Gully upstream of Park Street would also require construction of a formal street drainage system to convey the 100 year ARI flows from the eastern residential area into the proposed storage(s). Purchase of existing residential land to accommodate the basin(s) would also be required.

Such storages would provide some additional flood protection against very short intense storm bursts (say up to half an hour duration) over the urbanised area, but would not offer any significant relief from the greater Figtree Gully flows.

These are not recommended given their limited benefit and high cost (estimated to be between $0.5M to $1M).

7.1.6 Reconstruct Figtree Gully from Downstream of Barton Street to Park Street as a Concrete Channel and Construct a Box Culvert System from Park Street to Parsons Gully (Option 1.6)

Findings — Option 1.6 is not recommended for further consideration.

This option involves reconstructing the existing Figtree Gully system from about 200m downstream of Barton Street through to Park Street as a concrete lined channel to convey flows up to the 20 year ARI. This section of land is not owned by Council, therefore approval from the various land owners to do the works would be necessary. The approval process (and negotiation of an easement) should be possible without cost to Council since such works should make additional flood free land available to property owners. This option would also involve the construction of culverts with 20 year ARI capacity at Oxford Road, Waverley Street and Park Street.

From Park Street a new box culvert system would be constructed via Park Street, Main Street, Kingdon Street and Guernsey Street through to Parsons Gully at the southern end of Guernsey. This alignment, although requiring relatively deep excavation at the intersection of Main Street/Kingdon Street, is considered more economic than following Liverpool Street and Kelly Street, which is through the CBD.

This option would provide:

- a below ground stormwater system with a 20 year ARI capacity;
- 100 year ARI above floor level flood protection for all existing properties in the Figtree Gully catchment apart from possibly the most severely flood prone commercial properties in the CBD which may still require some flood proofing to provide 100 year ARI floor protection; and
- opportunity for the construction of street stormwater systems to overcome existing local drainage problems.

The estimated cost of this option is $7.5M. Options 1.7 to 1.9 offer alternatives which provide similar flood protection, however are economically and/or environmentally more favourable than this option.

7.1.7 Reconstruct Figtree Gully from Downstream of Barton Street to Park Street as a Deeper and Wider Grass Lined Channel and Construct a Box Culvert System from Park Street to Parsons Gully (Option 1.7)

Findings — Option 1.7 is only recommended as an alternative to Option 1.9 should necessary land acquisition for 1.9 not be possible.

This option is similar to Option 1.6 except that the reconstruction of the open system upstream of Park Street would be wider and deeper to accommodate a more natural channel structure. This option would also require negotiation with the land owners adjacent to channel upstream of Park Street, so that the channel works could be carried out and an easement created where necessary.

The estimated cost of this option is $7.0M, which is a higher cost than for Option 1.9. Therefore Option 1.7 should only be considered if acquiring land (at the corner of Main Street and St Aubins Street) necessary for Option 1.9 is not possible.

7.1.8 Reconstruct Figtree Gully from Downstream of Barton Street to Park Street as a Concrete Channel and Construct a Box Culvert System from Main Street to Parsons Gully (Option 1.8)

Findings — Option 1.8 is not recommended.

This option is similar to Option 1.6 except that the length of the box culvert system would be reduced by connecting into the open channel Figtree Gully system at the intersection of Main Street and St Aubins Street. This option may require the purchase of at least one block of land on the north east of the Main Street and St Aubins Street intersection to accommodate the culvert inlet structure.

The estimated cost of this option is $7.0M, which is a higher cost and less environmentally favourable than Option 1.9.

7.1.9 Reconstruct Figtree Gully from Downstream of Barton Street to Park Street as a Deeper and Wider Grass Lined Channel and Construct a Box Culvert System from Main Street to Parsons Gully (Option 1.9)

Findings — Option 1.9 is recommended for further consideration. In particular we note that the works could be staged to suit available funding.

This option is similar to Option 1.7 except that the length of the box culvert system would be reduced by connecting into the open channel Figtree Gully system at the intersection of Main Street and St Aubins Street. This option may require the purchase of at least one block of land on the north east of the Main Street and St Aubins Street intersection.

The estimated cost of this option (assuming no land purchase) is $6.5M.

7.1.10 Construct a Permanent Levee Along the South Side of Figtree Gully from Downstream of Barton Street to Park Street and Construct a Box Culvert System from Main Street to Parsons Gully (Option 1.10)

Findings — Option 1.10 is not recommended.

This option is similar to Option 1.9 except that flood waters would be confined to the Figtree Gully open channel system upstream of Park Street by the construction of a levee along its southern bank. This option would also require the creation of an easement to accommodate the levee between Park Street and Oxford Road (and still require the construction of culvert crossings at Park Street, Waverley Street and Oxford Road).

Flooding of properties adjacent to the northern side of the levee would be increased, which is not an acceptable scenario.

The estimated cost of this option is $5.5M.

7.1.11 Remove Obstructions in the Channel (Option 1.11)

Findings — Option 1.11 is recommended for further consideration.

On the western side of Park Street, where Figtree Gully becomes a concrete lined channel, there is a trash rack which can potentially obstruct flows. Other obstructions along the length of the channel include overgrowth of vegetation and dumped materials.

On going maintenance of the channel and the removal of these obstructions is strongly favoured by the community but would result in only minor improvements in the capacity of the channel.

The cost to Council of removing (or modifying) the trash rack and clearing the drainage reserve of vegetation and rubbish is estimated to be less than $10,000.

Having relatively low cost, and high community support, such works are highly favoured.

7.1.12 On-Site Stormwater Detention (Option 1.12)

Findings — Option 1.12 is recommended for further consideration.

It is recommended that Council introduce an OSD policy for new development in Figtree Gully (and also other eastern catchments which impact on Scone township — excluding those areas flooded by Parsons Gully flows).

On-site stormwater detention (OSD) can collect and store stormwater runoff from roofs and other impervious surfaces. OSD storages delay the passage of runoff for short periods of time (say less than half an hour) thus reducing flow peaks entering stormwater drainage systems.

OSD is currently not required by Council when considering new developments.

It is proposed that an OSD policy be introduced by Council for all new developments and building works where the proposed increase in paved/roofed areas exceed 100m^2.

The OSD policy would only apply to new developments in Figtree Gully and other eastern catchments which impact on Scone township. The policy should exclude those areas flooded by Parsons Gully flows.

It should be noted that such a policy would not alleviate existing drainage and flooding problems in the catchment, rather it would protect against increased flood flows which may otherwise result from future development.

For this option to be effective, the OSD facilities would need to be maintained regularly to prevent blockages and to ensure their efficient operation. The scope of the OSD policy could be similar to that recently developed for Gosford (**Reference 30**) which may overcome some of the problems experienced by Sydney councils in implementing effective OSD systems.

7.2 PROPERTY MODIFICATION OPTIONS

7.2.1 Voluntary Purchase by Council (Option 2.1)

Findings — Option 2.1 is not recommended for further consideration.

Under a voluntary purchase scheme, Council would offer to purchase flood liable properties if and when they became available for purchase, subject to the availability of funds at the time. Voluntary purchase is not compulsory acquisition and affected property owners can expect to receive market values, or higher than market values, for their properties (i.e. values assume no voluntary acquisition scheme is in place and assumes properties are not flood prone).

Voluntary purchase schemes, by their very nature, cannot be implemented immediately. To be successful, the majority of owners in the area need to take up the offer and a suitable allocation of funds must be available to purchase the properties. There needs to be an ongoing commitment from Council to continue to purchase properties into the future as they become available, in spite of changes to Council's elected officers and senior staff.

A possible purchase criteria could be to purchase houses with floors inundated in a 20 year ARI flood (i.e. 10 residential properties available for voluntary purchase in Parsons Gully on the western fringe of Scone township). Property purchase costs would be of the order of $100,000 each.

As well as residential properties, there are a number of commercial premises affected by flooding which could be considered for voluntary purchase. These include approximately four premises on Parsons Gully and nine premises in the central business district (on Figtree Gully). State and Federal Government funding is not available for voluntary purchase of commercial properties, so Council would have to meet the full cost of these purchases (**Table 13a** only includes for purchase of residential properties).

The cost of this option is high and does not address flooding problems elsewhere in the catchment. In addition the option was not favoured by respondents to the community questionnaire.

7.2.2 House Raising (Option 2.2)

Findings — Option 2.2 is recommended for further consideration.

The raising of timber and fibro houses has proved to be an effective floodplain management option in some locations in NSW. Recent experience has been with Fairfield Council adjacent to Prospect Creek (**Reference 31**) where approximately forty houses have been successfully raised. It is understood that one brick veneer house has also been raised at Fairfield. The DLWC has advised that house raising has also been carried out in the Lake Macquarie City Council area.

On the Parsons Gully catchment, raising floors by up to about 1.0m would lift most residences above the 100 year ARI flood level. However, for practical considerations, a house is best raised to one storey (i.e. 2.4m–2.7m) so that use can be made of the lower level.

It appears that all 10 residences flooded above floor level in the 20 year ARI event are of weather board/fibro construction, and could be raised with little difficulty, although new bathroom and laundry floors may be necessary and add to the cost. Also there may be various disadvantages associated with house raising, for example:

- steps to gain access to the house may not be suitable for older people or those with disabilities;
- other property damage within the property, e.g. damage to parked cars and equipment, may still occur;
- after raising, residents may 'close in' any downstairs area to create further habitable areas (without Council approval) and thus increase future damage potential;
- there may be aesthetic and town planning restrictions associated with raising some houses. For example, isolated raising of some properties in a street may not be appropriate, and it may be necessary to raise a group of properties in a street.

In addition, house raising in high hazard areas is generally not supported by the State Government.

The above problems aside, a number of Parsons Gully residences (neighbouring those that could be raised) have already been successfully raised. The **Table 13a** house raising cost estimate is based on $40K per house, however the Lake Macquarie experience suggests that the cost may be about 35% lower (advice from Mr Greg Bernard of DLWC, Newcastle, at the Floodplain Management Committee meeting on 23 March 1998), depending on individual property requirements.

Since there are no feasible options to adequately modify flood behaviour for the protection of existing residences in Parsons Gully, this is an option which should be considered.

7.2.3 Flood Proofing of Individual Properties (Option 2.3)

Findings — *Option 2.3 is recommended as interim protection prior to the recommended Option 1.9 works being completed.*

Individual properties can be modified to reduce the impacts of flooding by the construction of flood retaining walls outside the house (similar to levees in function), waterproofing walls of houses and by placing shutters across doors and other openings. This option would be most effective for short duration floods as extended periods of inundation would increase the likelihood and extent of leaks through the waterproofing measures.

Properties which may be suited to flood proofing are within Figtree Gully only (having short duration floods) and limited to the commercial properties in the Scone CBD. Measures which could be adopted here include waterproof barriers, doors and gates. Examples include the recently constructed flood shutters on some commercial properties in Inverell.

For such measures to be effective when the premises are unattended, it would be necessary for flood gates and similar structures to be erected. It is recognised that this may be a labour intensive process and therefore owners may only erect these structures when wet weather is imminent. As many flood events may occur in the night or on weekends, such measures could not be relied upon to provide total protection for commercial properties.

The works could be at no cost to Council, or with some Council contribution.

7.2.4 Building and Development Controls (Option 2.4)

Findings — Option 2.4 is recommended for further consideration.

Land use planning and development controls are key mechanisms by which Council can manage flood affected areas within the Scone district. Such mechanisms will influence future development (and redevelopment) and therefore the benefits will accrue gradually over time. Without comprehensive floodplain planning, existing problems may be exacerbated and opportunities to reduce flood risks may be lost.

The importance of land use planning and development controls has been given significant attention in this report and a separate document (**Appendix A**) has been prepared to summarise these investigations. A brief summary of the principal findings and recommended planning measures is provided below:

(a) a graded set of planning controls be applied to the study area (as proposed in the planning matrix in **Figure 8**) which are tailored to the proposed land use and flood level, and which recognise flood risks up to and including the PMF;

(a) the planning implications for each of the structural options recommended in the floodplain management plan (**Section 8**) be addressed further, having regard to the issues outlined within this report, during the detailed design of these options;

(b) future LEP's (in particular major consolidating planning instruments) applicable to the study area contain objectives to restrict development in high hazard areas, and control the form of development in the floodplain to ensure it is compatible with flood risk;

(c) a flood prone land policy be adopted for the study area outlining appropriate measures to be applied to development in the floodplain. In this regard, **Appendix A** provides a suggested draft Flood Prone Land Policy for Council's consideration. It is also recommended that this policy be adopted as a Development Control Plan in accordance with the EPA Act and Local Approvals Policy in accordance with the Local Government Act.

7.2.5 Raise Liverpool Street Across Parsons Gully Through to Middle Brook (Option 2.5)

Findings — Option 2.5 is not recommended.

To provide 100 year ARI vehicle access between Scone and Satur via Liverpool Street, without making upstream flooding worse, it would be necessary to bridge Parsons Gully and the road section between Kingdon Ponds and Middle Brook.

Under existing conditions the Parsons Gully culvert under Liverpool Street has about a 10 year ARI capacity before Liverpool Street would be overtopped. In the 100 year ARI flood the depth of water over Liverpool Street would be up to 1.2m. Access between Scone and Satur would be cut for up to about 6 hours (although considerably longer if there is structural failure of the waterway crossings) . Muswellbrook Road is an alternative route to the south from Satur, however this road may be flooded by Dart Brook at several locations.

In 100 year ARI flood events Scone itself would be isolated for a short period with the New England Highway being cut to the north and south of the town by flood waters from eastern catchments.

The implications of Satur being isolated for up to 6 hours in floods greater than the 10 year ARI does not warrant prioritising the raising of Liverpool Street ahead of works to protect Scone. However this issue may need to be considered by Council and the SES at a future date.

The estimated cost of this option is in excess of $10M.

7.2.6 Prepare a Vegetation Management Plan (Option 2.6)

Findings — Option 2.6 is recommended for further consideration.

As recommended in the **Appendix A**, the preparation and implementation of a vegetation plan would improve the ecological and aesthetic quality of creek corridors, and ensure inappropriate exotic species do not result in a future weed infestation problem.

Implementation of such a vegetation plan will also assist in the ongoing maintenance of existing over grown waterways such as in Parsons Gully south of Liverpool Street.

The estimated cost of the study to prepare the plan is approximately $30K.

FIGURE 8

SCONE FLOODPLAIN MANAGEMENT PLAN

PLANNING MATRIX CONTROLS

DEVELOPMENT CONTROL CONSIDERATION	GROUND LEVEL OF LAND																				
	OUTER FLOODPLAIN ABOVE 100YR ARI FLOOD (PLUS 0.5m FREEBOARD) TO EXF							FLOOD FRINGE BETWEEN HIGH HAZARD AREA TO 100 YEAR ARI FLOOD(PLUS 0.5m FREEBOARD)							FLOODWAY HIGH HAZARD AREA						
	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT
FLOOR LEVEL		3									2	2or 5	1	4						1	4
BUILDING COMPONENTS		2									1	1	1	1						1	1
STRUCTURAL SOUNDNESS		3								2	2	2	2	2						1	1
FLOOD AFFECTATION		2	2		2					1	2	2	2	2						1	1
EVACUATION/ACCESS		2	3		3					1,3	3	3	3							1,3	3
FLOOD AWARENESS		3	3	3	3	3	3			1,2,3	2,3	2,3	2,3	2,3						2,3	2,3
MANAGEMENT & DESIGN		1	4							4	1,2,3	1,2,3	1,2,3	1,3						1,2,3	1,2,3

NOTES

NOT RELEVANT

UNSUITABLE LAND USE

EXF REFERS TO THE EXTREME FLOOD AS DEFINED IN THE GLOSSARY

FLOOR LEVEL

1. ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 20 YEAR ARI FLOOD PLUS 0.5M (FREEBOARD)
2. FLOOR LEVELS (EXCLUDING NON-HABITABLE RESIDENTIAL FLOORSPACE) TO BE EQUAL TO OR GREATER THAN THE 100 YEAR ARI FLOOD PLUS 0.5M (FREEBOARD) AND OTHER FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 100YR ARI FLOOD (NO FREEBOARD)
3. ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE EXF PLUS 0.5M (FREEBOARD)
4. FLOOR LEVELS TO BE AS CLOSE TO THE DESIGN FLOOR LEVEL AS PRACTICAL & NO LOWER THAN THE EXISTING FLOOR LEVEL WHEN AN ADDITION TO AN EXISTING BUILDING
5. FLOOR LEVELS OF SHOPS & OFFICES TO BE AS CLOSE TO THE DESIGN FLOOR LEVEL AS PRACTICAL, OR MORE THAN 30% OF FLOOR AREA OR EQUIVALENT STORAGE SPACE TO BE ABOVE THE DESIGN FLOOR LEVEL, OR PREMISES TO BE FLOOD PROOFED (EG.FLOOD SHUTTERS FOR SHOPS) BELOW THE DESIGN FLOOR LEVEL

FLOOD COMPATIBLE BUILDING COMPONENTS

1. ALL STRUCTURES TO HAVE FLOOD COMPATIBLE BUILDING COMPONENTS BELOW OR AT THE 100 YEAR ARI FLOOD LEVEL PLUS 0.5M(FREEBOARD)
2. ALL STRUCTURES TO BE CONSTRUCTED OF FLOOD COMPATIBLE MATERIALS BELOW OR AT THE EXF LEVEL

STRUCTURAL SOUNDNESS

1. ENGINEERS REPORT TO PROVE ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 100 YR ARI FLOOD LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY
2. APPLICANT TO DEMONSTRATE THAT ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 100 YEAR ARI FLOOD SHOULD WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY
3. APPLICANT TO DEMONSTRATE THAT ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCLUDING THE EXF LEVEL SHOULD WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY

FLOOD EFFECT ON OTHERS

1. ENGINEERS REPORT REQUIRED TO PROVE THAT THE DEVELOPMENT OF AN EXISTING ALLOTMENT WILL NOT INCREASE FLOOD AFFECTATION ELSEWHERE
2. THE IMPACT OF THE DEVELOPMENT ON FLOOD AFFECTATION ELSEWHERE TO BE CONSIDERED

EVACUATION/ACCESS

1. RELIABLE ACCESS FOR PEDESTRIANS REQUIRED DURING A 100 YEAR ARI FLOOD
2. RELIABLE ACCESS FOR PEDESTRIANS & VEHICLES REQUIRED AT OR ABOVE THE EXF LEVEL
3. CONSIDERATION REQUIRED REGARDING AN APPROPIATE FLOOD EVACUATION STRATEGY & PEDESTRIAN /VEHICULAR ACCESS ROUTE FOR BOTH BEFORE & DURING A FLOOD

FLOOD AWARENESS

1. RESTRICTIONS TO BE PLACED ON TITLE ADVISING OF MINIMUM FLOOR LEVELS REQUIRED RELATIVE TO THE FLOOD LEVEL
2. S149(2) CERTIFICATES TO NOTIFY AFFECTATION BY THE 100 YEAR ARI FLOOD
3. S149(2) CERTIFICATES TO NOTIFY AFFECTATION BY THE EXF FLOOD

MANAGEMENT & DESIGN

1. FLOOD PLAN REQUIRED WHERE FLOOR LEVELS ARE BELOW THE DESIGN FLOOR LEVEL
2. APPLICANT TO DEMONSTRATE THAT THERE IS AN AREA WHERE GOODS MAY BE STORED ABOVE THE 100 YEAR ARI FLOOD LEVEL PLUS 0,5M(FREEBOARD) DURING FLOODS.
3. APPLICANT TO PROVIDE CONTROLS WHERE NECESSARY TO PREVENT THE DISCHARGE OF POLLUTION DURING FLOODS.
4. APPLICANT TO DEMONSTRATE THAT POTENTIAL DEVELOPMENT AS A CONSEQUENCE OF A SUBDIVISION PROPOSAL CAN BE UNDERTAKEN WITHOUT ANY SIGNIFICANT FLOOD EFFECT ELSEWHERE AND CAN ACCESS AN APPROPRIATE PEDESTRIAN/VEHICULAR ROUTE AS PART OF A FLOOD EVACUATION STRATEGY IF REQUIRED

7.3 OPTIONS WHICH MODIFY PEOPLE'S RESPONSES TO FLOODING

7.3.1 Issue Flood Certificates for all Properties (Option 3.1)

Findings — Option 3.1 is recommended for further consideration.

A flood certificate issued to individual property owners would inform them of the flood situation at their particular property (**Reference 14**). This certificate would contain vital information such as the expected flood levels in a range of storm events. When combined with ground levels and floor levels, depths of flooding over the property could be determined. It could be issued with Council rates notices on either a yearly or biennial basis.

This option was strongly favoured by respondents to the community questionnaire.

7.3.2 Improved Emergency Planning and Management (Option 3.2)

Findings — Option 3.2 is recommended for further consideration.

The State Emergency Service (SES) is the State's 'combat' agency for flooding and fulfils a vital role in emergency planning and management.

As part of the current study, the SES has been made aware of the existing flood problems in the study area and has participated in the public meeting held to discuss potential floodplain management options. In addition, details of the frequency and depth of inundation of streets in the Scone CBD (Figtree Gully) and Liverpool Street (Parsons Gully) have been provided to the SES, together with details of the most severely affected properties.

These measures have gone part way to assisting the SES develop an improved Local Flood Plan for Scone, comprising preparedness measures, the conduct of response operations, and the coordination of immediate recovery measures.

The SES has fulfilled an important role in the current study and been closely involved in identifying potential floodplain management options to be included within Scone's floodplain management plan. In particular, the SES has identified the need for a reliable flood warning system (which is discussed in **Section 7.3.4**). The SES has also advised that the grate across Figtree Gully at Park Street has blocked with debris in times of flooding. The design and function of this grate should be reviewed so as to alleviate the problem (see **Section 7.1.11**).

Continued and increased cooperation with the SES, such as that initiated during the current study, will have significant benefits to the study area.

7.3.3 Increased Community Education and Flood Awareness (Option 3.3)

Findings — Option 3.3 is recommended for further consideration

Actual flood damages can be reduced if community awareness of flood issues is raised. According to the results of the questionnaire, Scone residents have experienced low to moderate flooding in the recent past and should therefore be reasonably flood aware. Their awareness of the risks of larger floods is expected to be limited however.

The development and implementation of an effective flood awareness and education programme in the study area has the opportunity to improve the knowledge and experience of residents to mitigate flood hazards. A flood awareness and education programme could include various components:

- the use of local media. Regular reminders of past flood events help to maintain flood awareness. **Appendix H** contains an example of a newspaper feature about flooding and floodplain management which was published during the course of the current study;

- contact with local schools and community groups. This could include talks given by Council staff and handouts containing general flood information;

- notification on Section 149 certificates. The questionnaire responses indicate that very few people have obtained information about flooding at their property from Council. It is recommended that Council advise prospective property purchasers that a property is flood liable by notification on Section 149(2) certificates. In addition, the proposed flood certificate (Option 3.1) could be appended to the Section 149(2) certificate;

- public displays. Public displays on flooding could be set up in public buildings such as the Council chambers, library or shopping centre. Such displays could contain information about Council's Floodplain Management Plan as well as information from the SES;

- flood marker poles. The marking of past flood levels on telephone poles (or on specially constructed flood totem poles — see **Reference 15**) will also provide constant reminders of flooding risks. Liverpool Street in Parsons Gully, the western end of Forbes Street, the intersection of Liverpool Street and Kelly Street and the low point in Kingdon Street, may be suitable locations for such structures.

For the flood awareness program to be successful and cost-effective, it should be implemented by Council over the whole of the Scone district. To ensure the program is on-going, responsibilities need to be identified and allocated to key individuals within Council.

Such a program could cost approximately $100,000 to develop and implement, and about $10,000 per annum to maintain.

7.3.4 Improved Flood Warning Systems (Option 3.4)

Findings — Option 3.4 is recommended for further consideration.

Actual flood damages can be reduced if there is sufficient warning time for the community to take appropriate damage reduction measures.

As discussed in **Section 6.1.3**, the Figtree Gully catchment response time is too short to establish a formal flood warning system, however there is some response time for Parsons Gully and a limited flood warning system is already operating for this catchment.

To improve the operation and reliability of the Parsons Gully flood warning system, it is proposed that:

- three new automatic reporting stations be located in the in the upper reaches of Middle Brook, Dry Creek and Kingdon Ponds, such that up to 7 hours flood warning time is available;
- the stations would report stream height and rainfall, and would have minimal installation and maintenance costs;
- the stations be automated and installed with a radio communication system;
- the adopted system should be one which has been proven to be reliable and is acceptable to the SES.

To achieve this, two alternative systems are available:

- extending the existing DLWC monitoring system in the Hunter Valley. — The proposed new stations would be linked to the existing DLWC monitoring system in the Hunter Valley and the information made readily available to the Scone SES. (It is understood that the DLWC system is not yet fully operational, and that a repeater station located in Aberdeen may be necessary for radio communication to the north of Scone. In the interim, the stations could be set up for telephone communication).
- installing an "Alert" system which has been developed by the Bureau of Meteorology (BoM). — This system is currently being looked into by the SES as a preferred system for their operation within the State.

Further discussions between Council, SES, DLWC and BoM are necessary to establish which of the above two systems should be implemented. These discussions should be given a high priority.

It is recommended that Council encourage the State and Federal Governments to implement the flood warning system. Initially this should take the form of written approach to the NSW Flood Warning Consultative Committee in accordance with the Committee's procedures for assessing flood warning system proposals (as set out in **Appendix I**).

The cost estimate for the supply and installation of automated radio communication equipment and three stations is $100,000. The annual maintenance cost may be of the order of $6,000.

7.3.5 Preparation of Flood Action Plans (Option 3.5)

Findings — Option 3.5 is recommended for further consideration.

Flood action plans comprise instructions for people at individual properties telling them what they should do before, during and after a flood, where they should go and who they should contact if there is a flood. They may be formulated for single residential properties or may apply to groups of residences such as in the south western end of Aberdeen Street. They could also be developed for commercial properties such as those in Main Street, Kelly Street and Liverpool Street. The plans would be simple instructions, similar to those for fire emergencies or first aid, and would be posted at noticeable locations within buildings.

7.4 LIVERPOOL STREET ROUNDABOUT

The construction of a roundabout at the intersection of Liverpool Street and Middlebrook Road was assessed as part of this study. The proposed roundabout design was prepared by Council and its potential impacts on flooding was assessed by the Consultant and reported in a separate document to Council during the course of this study.

TABLE 13a SUMMARY OF FLOODPLAIN MANAGEMENT OPTIONS — QUALITATIVE ASSESSMENT MATRIX

OPTION NO.	DESCRIPTION OF OPTION	AIM OR CRITERIA OF OPTION	COMMENTS AND RELATIVE SCORE FOR EACH CRITERIA									RECOMMENDED FOR INCLUSION IN PLAN
			Financial feasibility	Economic merit	Community acceptance	Environmental impacts	Impacts on flood behaviour	Consequences in extreme flood	Reduction in number of homes / commercial buildings flooded in 100 yr ARI flood	Technical feasibility / difficulty	Administrative / political / legal impacts	
1	OPTIONS WHICH MODIFY FLOOD BEHAVIOUR											
	PARSONS GULLY											
1.1	Construct a large retarding basin(s) upstream of Parsons Gully.	To store water temporarily during floods thus reducing peak flood levels downstream	>$200M – –	< 0.1 – –	– –	–	+	O	46	–	–	no
1.2	Construct a levee on the east side of Parsons Gully.	To protect the western fringe of Scone township.	>$10M – –	< 0.1 – –	+	–	+	–	35	+	–	no
1.3	Construct a formal channel in Parsons Gully to convey 100 year flows past western fringe of Scone township.	To protect the western fringe of Scone township.	>$20M – –	< 0.1 – –	+	–	+	+	46	+	– –	no
	FIGTREE GULLY											
1.4	Construct a single large Council owned retarding basin upstream of Barton Street.	To store water temporarily during floods thus reducing peak flood levels downstream	$20M – –	B/C < 0.1 – –	+	–	+	O	20 to 30	–	O	no
1.5	Construct a number of smaller Council owned retarding storages upstream of Park Street.	To store water temporarily during floods thus reducing peak flood levels downstream	$0.5 to 1M +	B/C < 0.1 – –	+	O	O	O	O	O	O	no
1.6	Reconstruct Figtree Gully from downstream of Barton St to Park St, as a concrete lined channel; and Construct a box culvert system from Park Street to Parsons Gully at the southern end of Guernsey Street.	Increase system capacity to reduce flooding in the Scone CBD and nearby residential areas.	$7.5M –	B/C = 0.1 –	+ +	– –	+ +	O	55	+	O	no
1.7	Reconstruct Figtree Gully from downstream of Barton St to Park St, as a deeper and wider grass lined channel; and Construct a box culvert system from Park Street to Parsons Gully at the southern end of Guernsey Street.	Increase system capacity to reduce flooding in the Scone CBD and nearby residential areas.	$7.0M –	B/C= 0.11 –	+ +	–	+ +	O	55	O	O	no
1.8	Reconstruct Figtree Gully from downstream of Barton St to Park St, as a concrete lined channel; and Construct a box culvert system from Main Street / St Aubins Street to Parsons Gully at the southern end of Guernsey Street.	Increase system capacity to reduce flooding in the Scone CBD and nearby residential areas.	$7.0M –	B/C= 0.11 –	+ +	– –	+ +	O	55	+	O	no
1.9	Reconstruct Figtree Gully from downstream of Barton St to Park St, as a deeper and wider grass lined channel; and Construct a box culvert system from Main Street / St Aubins Street to Parsons Gully at the southern end of Guernsey Street.	Increase system capacity to reduce flooding in the Scone CBD and nearby residential areas.	$6.5M +	B/C= 0.12 –	+ +	–	+ +	O	55	O	O	yes
1.10	Construct a permanent levee along Figtree Gully from Barton Street to Park Street; and Construct a box culvert system from Main Street / St Aubins Street to Parsons Gully at the southern end of Guernsey Street.	Increase system capacity to reduce flooding in the Scone CBD and nearby residential areas.	$5.5M – –	B/C= 0.14 –	+	– –	+ +	– –	55	+	–	no
1.11	Remove obstructions in Figtree Gully channel	Increase the channel capacity	< $10K O	+ +	+ +	O	+	O	O	+ +	O	yes
1.12	On site detention (OSD) for future developments	To store water temporarily during floods thus reducing peak flood levels downstream	No cost to Council n.a.	O	–	O	+	O	O	–	–	yes

Notes: For description for relative scores for each criteria refer to Table 13b.
n.a. = not assessed, not available or not applicable.

TABLE 13a SUMMARY OF FLOODPLAIN MANAGEMENT OPTIONS — QUALITATIVE ASSESSMENT MATRIX

OPTION NO.	DESCRIPTION OF OPTION	AIM OR CRITERIA OF OPTION	COMMENTS AND RELATIVE SCORE FOR EACH CRITERIA									RECOMMENDED FOR INCLUSION IN PLAN
			Financial feasibility	Economic merit	Community acceptance	Environmental impacts	Impacts on flood behaviour	Consequences in extreme flood	Reduction in number of homes / commercial buildings flooded in 100 yr ARI flood	Technical feasibility / difficulty	Administrative / political / legal impacts	
2	OPTIONS WHICH MODIFY THE WAY EXISTING OR FUTURE PROPERTIES ARE AFFECTED BY FLOODING - PARSONS GULLY AND FIGTREE GULLY											
2.1	Voluntary purchase of severely flood affected properties by Council (Parsons Gully only)	Purchase & demolition of 10 residential properties which are known to have been flooded to above floor level	$1.0M –	B/C = 0.2 –	–	+	O	+ +	10	n.a.	O	no
2.2	House raising of severely flood affected properties (Parsons Gully only)	Modify 10 existing houses so that floor levels are raised to above the 100 year flood level	$0.4M +	B/C = 0.3 –	+	–	O	+	10	n.a.	O	yes
2.3	Flood proofing of individual properties (Figtree Gully Central Business District only)	Reducing the impacts of flooding on individual properties by waterproofing walls, putting shutters across doors and using materials that are relatively unaffected by submersion etc.	No cost to Council n.a.	n.a.	–	O	O	+	n.a.	n.a.	O	yes *
2.4	Building and development controls	Controlling future impacts, for example by setting minimum floor levels for future development and extensions to existing dwellings	No capital cost n.a.	n.a.	+ +	O	+	+ +	n.a.	+ +	–	yes
2.5	Raise Liverpool Street across Parsons Gully and between Kingdon Ponds and Middle Brook.	Provide 100 year road access between Satur and Scone.	>$10M – –	< 0.1 – –	+	O	O	–	O	+	–	no
2.6	Preparation of a Vegetation Management Plan.	Improve ecological & aesthetic values. Prevent weed infestation which may obstruct flood waters.	$30K +	n.a.	+ +	+ +	O	O	O	O	–	yes

3	OPTIONS WHICH MODIFY THE WAY PEOPLE RESPOND TO FLOODS - PARSONS GULLY AND FIGTREE GULLY											
3.1	Issue flood certificates for all properties	To raise flood awareness of property owners	No capital cost n.a.	n.a.	+ +	O	O	+	O	+	–	yes
3.2	Improved emergency planning and management	SES to upgrade current emergency assistance plans	No capital cost n.a.	n.a.	+ +	O	O	+	O	+	O	yes
3.3	Increased community education and flood awareness	To make the public more aware of flooding issues	$0.1M +	n.a.	+ +	O	O	+	O	+	O	yes
3.4	Improved flood warning systems (for Parsons Gully only)	To provide an indication to the SES, Council or the Police of conditions likely to cause flooding.	$0.1M +	n.a.	+ +	O	O	+	O	+	–	yes
3.5	Preparation of flood action plans for individual properties	To tell residents WHAT they should do, WHERE they should go and WHO they should contact if there is a flood	No capital cost n.a.	n.a.	+ +	O	O	+	O	+	O	yes

Notes: For description for relative scores for each criteria refer to Table 13b.
n.a. = not assessed, not available or not applicable.
** Option 2.3 is only applicable to commercial properties and only until Option 1.9 is implemented.*

TABLE 13b EXPLANATION OF ASSESSMENT SCORES FOR QUALITATIVE ASSESSMENT MATRIX

CRITERIA	– –	–	O	+	+ +
FINANCIAL FEASIBILITY	Very unlikely to receive funding	May not receive funding	Neutral	Would possibly receive funding	Very likely to receive funding
ECONOMIC MERIT	B/C less than 0.1	B/C = 0.1–0.3	B/C = 0.3–0.7	B/C = 0.7–1.0	B/C greater than 1.0
COMMUNITY ACCEPTANCE	Strongly against	Generally against	Neutral	Some support	Strongly supported
ENVIRONMENTAL IMPACT	Significant negative impact	Some negative impact	No impact	Some positive impact	Significant positive impact
IMPACT ON FLOOD BEHAVIOUR	Significantly increase flood levels and/or velocities	Some increase in flood levels and/or velocities	No change	Some reduction in flood levels and/or velocities	Significantly reduces flood levels and/or velocities
PERFORMANCE DURING LARGE FLOODS	Significantly increases risk	Some increase in risk	No change in risk	Some reduction in risk	Significant reduction in risk
TECHNICAL FEASIBILITY	Very difficult	Difficult	Neutral	Easy	Very easy and straight forward
POLITICAL/ ADMINISTRATIVE / LEGAL IMPACT	Significant changes required which are very unlikely to be supported	Some changes required which may not be supported	No changes or impact	Some changes required are likely to be supported	Significant changes required which are likely to be strongly supported

B/C = Benefit Cost Ratio

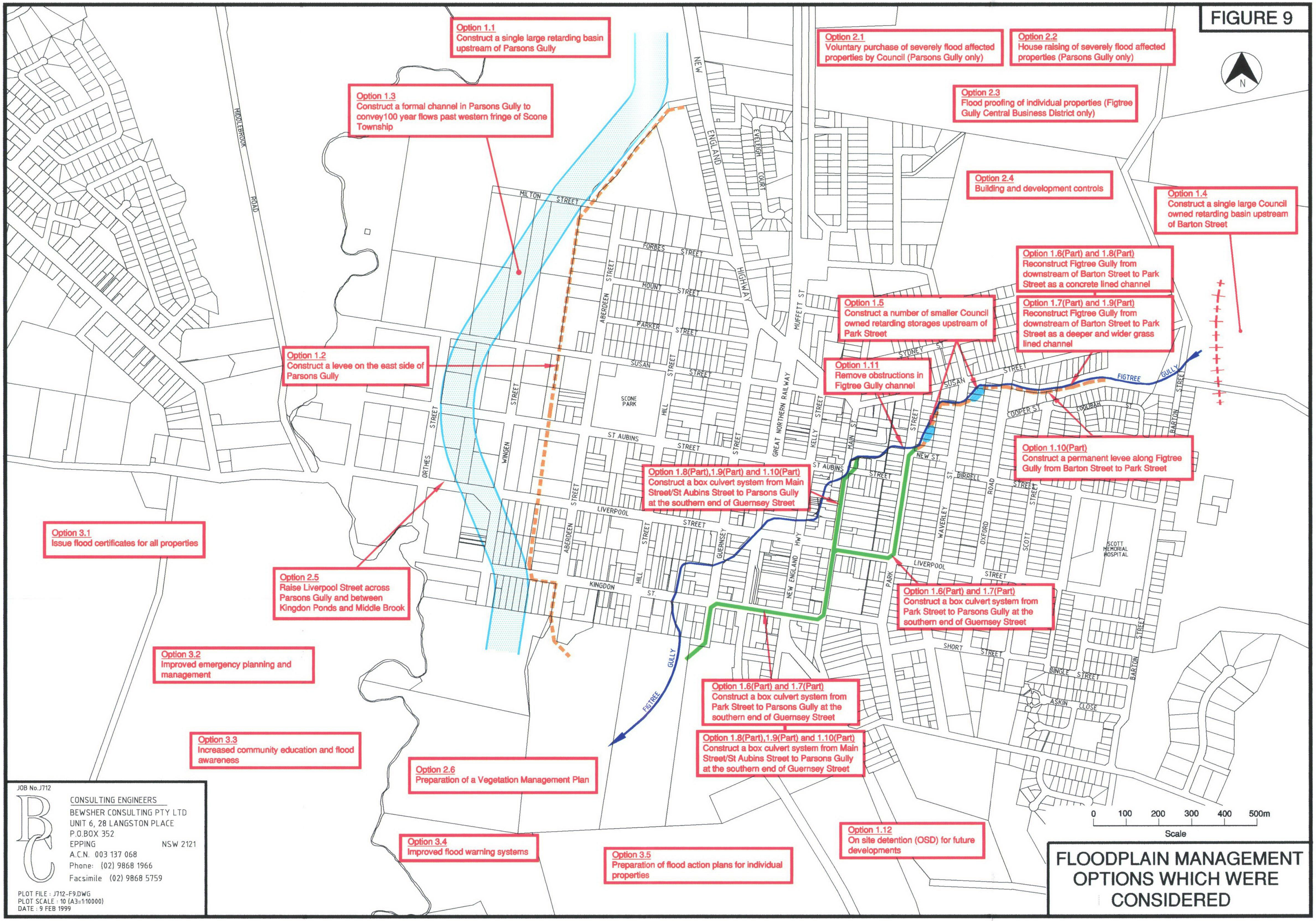

FIGURE 9

FLOODPLAIN MANAGEMENT OPTIONS WHICH WERE CONSIDERED

8. FLOODPLAIN MANAGEMENT PLAN

*A Floodplain Management Plan for the Scone district has been prepared and is presented in **Table 14.***

*The locations of the recommended options are shown on **Figure 10**.*

The principal components of the Plan are briefly discussed below under the three categories previously described in the report.

*Timing of the proposed works will depend on Council's overall budgetary commitments and hence is best decided by Council. The "priority" column in **Table 14** indicates a tentative order in which the works should be carried out having regard to the sensitivity of the flood problem and the cost-effectiveness of the work. It is likely that Council may modify the proposed order after other administrative, funding and local political issues have been considered.*

8.1 THE PLAN

8.1.1 Options which Modify Flood Behaviour (Options 1.9, 1.11 & 1.12)

Reconstruction of Figtree Gully (Option 1.9) is the only recommended option which significantly modifies the flood behaviour and is aimed at reducing flood levels throughout the Figtree Gully catchment such that above floor level flooding will only occur in events larger than a 100 year ARI event.

This option will particularly benefit the Scone CBD which currently experiences significant above floor level flooding. Implementation of Option 1.9 is critical to the success of the Plan. A "medium" priority has been allocated, given the high cost and the recognition that funding may take some time.

Removal of obstructions in Figtree Gully (Option 1.11) will give only a minor improvement to flooding however it is recommended due to its inexpensive cost.

The provision of on-site stormwater detention facilities within new developments (Option 1.12) is also an important component of the Plan since it will offset any increase in flows as a result of future development.

There is no recommended "hard engineering" option to modify flood behaviour in Parsons Gully since the magnitude of flows (being an order of magnitude greater than in Figtree Gully) results in such options being economically unfeasible.

8.1.2 Property Modification Options (Options 2.2, 2.3, 2.4 & 2.6)

The options described above improve flooding in Figtree Gully however may not be able to offer an immediate or complete level of protection expected by the community. For this reason a number of property modification options are proposed to provide the immediate/extra level of protection required in Figtree Gully and Parsons Gully.

The raising of ten houses (Option 2.2) is proposed for the residential properties in Parsons Gully on the western fringe of Scone township which would currently be flooded above floor level in the 20 year ARI event.

The flood proofing of individual buildings (Option 2.3) is considered as an interim protection option for commercial properties in the Scone CBD, until Option 1.9 is implemented.

Controls on new development and redevelopment at residential or industrial/commercial properties (Option 2.4) will ensure that the flooding problem is not made worse and that the development itself is not affected by flooding.

Preparation of a Vegetation Management Plan (Option 2.6) will lead to ecological and environmental benefits, and a reduction in ongoing maintenance of the waterways.

8.1.3 Options Which Modify People's Responses To Flooding (Options 3.1–3.5)

All the options which modify people's responses to flooding, are recommended in this Plan. These options involve public education and enable people to be more prepared for the likelihood of flooding and to be better able to deal with floods and their aftermath.

The issuance of a flood certificate to all property owners on a regular basis will be a principal means of raising and maintaining flood awareness (Option 3.1), and was strongly supported by members of the community who responded to the questionnaire.

Assistance and encouragement to the SES will improve the existing evacuation emergency management procedures (Option 3.2).

A community flood education program is proposed for the whole of the Scone district at a cost of $100,000 (Option 3.3). This will have benefits in many catchments outside of Figtree Gully and Parsons Gully. These costs are considered to be small compared to the potential benefits that would accrue.

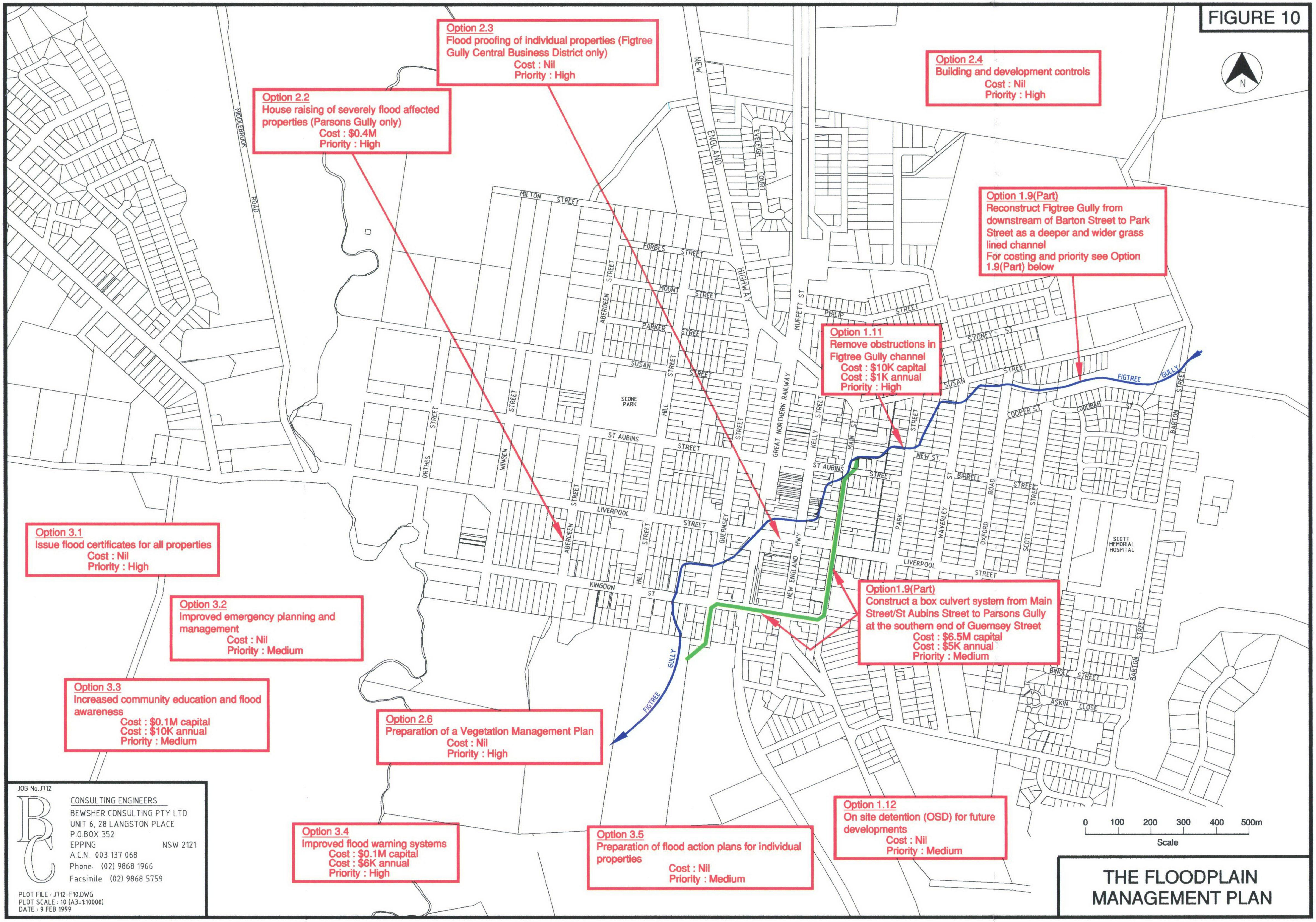
FIGURE 10
Option 2.3
Flood proofing of individual properties (Figtree Gully Central Business District only)
Cost : Nil
Priority : High
Option 2.4
Building and development controls
Cost : Nil
Priority : High
Option 2.2
House raising of severely flood affected properties (Parsons Gully only)
Cost : $0.4M
Priority : High
Option 1.9(Part)
Reconstruct Figtree Gully from downstream of Barton Street to Park Street as a deeper and wider grass lined channel
For costing and priority see Option 1.9(Part) below
Option 1.11
Remove obstructions in Figtree Gully channel
Cost : $10K capital
Cost : $1K annual
Priority : High
Option 3.1
Issue flood certificates for all properties
Cost : Nil
Priority : High
Option 3.2
Improved emergency planning and management
Cost : Nil
Priority : Medium
Option1.9(Part)
Construct a box culvert system from Main Street/St Aubins Street to Parsons Gully at the southern end of Guernsey Street
Cost : $6.5M capital
Cost : $5K annual
Priority : Medium
Option 3.3
Increased community education and flood awareness
Cost : $0.1M capital
Cost : $10K annual
Priority : Medium
Option 2.6
Preparation of a Vegetation Management Plan
Cost : Nil
Priority : High
Option 3.4
Improved flood warning systems
Cost : $0.1M capital
Cost : $6K annual
Priority : High
Option 3.5
Preparation of flood action plans for individual properties
Cost : Nil
Priority : Medium
Option 1.12
On site detention (OSD) for future developments
Cost : Nil
Priority : Medium
MIDDLEBROOK ROAD
NEW ENGLAND HIGHWAY
EVELEIGH COURT
MILTON STREET
FORBES STREET
MOUNT STREET
PARKER STREET
SUSAN STREET
ABERDEEN STREET
SCONE PARK
ST AUBINS STREET
HILL STREET
ORTHES STREET
WINGEN STREET
LIVERPOOL STREET
GUERNSEY STREET
KINGDON ST.
GREAT NORTHERN RAILWAY
MUFFETT ST
PHILIP STREET
KELLY STREET
MAIN ST
NEW ENGLAND HWY
SYDNEY ST
COOPER ST
COOLIBAH ST
NEW ST
PARK STREET
WAVERLEY ST
BIRRELL STREET
OXFORD ROAD
SCOTT STREET
BARTON STREET
SCOTT MEMORIAL HOSPITAL
BINGLE STREET
ASKIN CLOSE
FIGTREE GULLY
0 100 200 300 400 500m
Scale
N
THE FLOODPLAIN MANAGEMENT PLAN
JOB No.J712
CONSULTING ENGINEERS
BEWSHER CONSULTING PTY LTD
UNIT 6, 28 LANGSTON PLACE
P.O.BOX 352
EPPING NSW 2121
A.C.N. 003 137 068
Phone: (02) 9868 1966
Facsimile (02) 9868 5759
PLOT FILE : J712-F10.DWG
PLOT SCALE : 10 (A3=1:10000)
DATE : 9 FEB 1999

TABLE 14: THE FLOODPLAIN MANAGEMENT PLAN

OPTION NO.	DESCRIPTION	CAPITAL COST (to Council)	MAINTENANCE COST per annum	PRIORITY
MEASURES WHICH MODIFY FLOOD BEHAVIOUR				
1.9	Reconstruct Figtree Gully from downstream of Barton Street to Park Street as a deeper and wider grass lined channel; and construct a box culvert system from Main Street / St Aubins Street to Parsons Gully at the downstream end of Guernsey Street	$6.5M	$5K	Medium
1.11	Remove obstructions in the Figtree Gully channel	<$10K	<$1K	High
1.12	Introduce an on-site stormwater detention policy in Figtree Gully	Nil	Nil	Medium
MEASURES WHICH MODIFY PROPERTIES				
2.2	House Raising of 10 severely flood affected properties (Parsons Gully only)	$400K[(2)]	Nil	High
2.3	Flood proof individual commercial properties (Figtree Gully Central Business District only)	$100K[(2)]	Nil	High
2.4	Improve existing building and development controls	Nil	Nil	High
2.6	Prepare a Vegetation Management Plan for each floodplain	$30K	Nil	High
MEASURES WHICH MODIFY PEOPLE'S RESPONSES TO FLOODING				
3.1	Issue flood certificates to all property owners on a regular basis	Nil	Nil	High
3.2	Improve emergency planning and management	Nil	Nil	Medium
3.3	Increase community education and flood awareness	$100K[(1)]	$10K[(1)]	Medium
3.4	Improve flood warning systems	$100K	$6K	High
3.5	Prepare flood action plans for individual properties	Nil	Nil	Medium
TOTAL (rounded)		**$7.3 million**	**$22K**	

[(1)] Cost for whole of Scone local government area.
[(2)] These works could possibly be funded by local property owners (in part or full) as part of future redevelopment. If redevelopment is not imminent, funding by Council is recommended.

Lobbying of the State and Federal Governments will assist in implementation of the proposed flood warning system which is to be integrated within the existing Hunter Valley warning system established by the DLWC (Option 3.4).

The preparation of local flood action plans (Option 3.5) will ensure individual property owners or tenants in critically flood prone premises are adequately prepared for flooding.

8.2 FUNDING AND IMPLEMENTATION

Council could expect assistance with implementing parts of the Plan from the State Government and possibly the Federal Government. Funding assistance would normally be on a 2:1 basis (State:Local), i.e. Council contributes one third of the total capital costs, or a 2:2:1 basis (i.e. Commonwealth: State: Local). Special grant money may also be available in some cases.

For options to receive Government funding, they must be of significant benefit to the community. Funding of investigation and design activities as well as any works and ongoing programmes such as voluntary purchase, is normally available. Maintenance would be the responsibility of Council however.

Eligibility for funding does not guarantee that funding will be forthcoming. Funding is available on a competitive basis against other floodplain management projects elsewhere in the State.

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

- the Floodplain Management Committee considers the Study report and Plan and presents it to Council;
- Council resolves to put the Study report and Plan on public exhibition;
- the Floodplain Management Committee reviews the comments and submissions received and the Study and Plan are finalised. The Floodplain Management Committee presents the Study and Plan to Council for adoption;
- Council allocates priorities to components of the Plan, based on local considerations and budgetary constraints;
- Council submits an application for funding assistance to the DLWC;
- as funds become available from the DLWC and/or Council's own resources, Council commences to implement the Plan in accordance with the established priorities.

The absence of State and Federal Government funding for a particular option should not preclude Council from independently funding the work, if it has significant benefits for the community, and is cost effective.

8.3 ON-GOING REVIEW OF PLAN

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

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10. INDEX

APPENDIX A

TOWN PLANNING CONTEXT AND STRATEGY

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Appendix A

SCONE
FLOODPLAIN MANAGEMENT STUDY & PLAN
TOWN PLANNING CONTEXT & STRATEGY

Prepared for
BEWSHER CONSULTING PTY LTD

PROJECT NO: P3696

SEPTEMBER 1998
(FINALISED FEBRUARY 1999)

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1.0 INTRODUCTION

1.1 Background and Study Scope

Don Fox Planning Pty Ltd has been engaged by Bewsher Consulting Pty Ltd to form part of a consultant team to prepare a Floodplain Management Study (FPMS) and Plan (FPMP) for the Scone Township and rural hinterland. The Study has been commissioned and managed by the Scone Shire Council (Council) with overall direction from the Scone Floodplain Management Committee.

The purpose of this component of the study is to undertake the following tasks:

- Review existing landuses within the study area, having regard to the flood hazard.
- Discuss the role of planning in the preparation of the Floodplain Management Plan and the implications in the choice of an appropriate designated flood standard.
- Review the existing framework of planning and development controls which are relevant to the formulation of planning instruments and the assessment of building and development applications.
- Provide general comments in regard to a preferred approach to forming a Vegetation Management Strategy to address weed infestation and revegetation of the creek corridor and its impact upon flooding conditions.
- Analyse population changes and characteristics of the township to determine the need for urban expansion to provide a planning context and determine an appropriate planning response to the identified flood hazard.
- Discuss options and review strategic planning issues to guide the formulation of appropriate planning controls for inclusion within the Floodplain Management Plan.
- Make specific planning recommendations in regard to the above, including an outline of suggested planning controls.

It is noted that the flood hazard is one component for consideration in any town planning exercise. It is not considered appropriate to produce a variety of planning controls within the FPMP which responds to the planning hazard identified by hydraulics studies in isolation to the strategic planning context. Accordingly, this component of the FPMS reviews the strategic planning context for Scone as a prelude to formulating planning recommendations for the FPMP.

1.2 Study Area

Scone is located approximately 149 kilometres north-west of Newcastle and 25 kilometres north of Muswellbrook as depicted upon **Illustration 1**.

The study area as defined by the original study brief, covers the whole of the Scone Town, the satellite residential area known as Satur, and parts of the adjoining rural hinterland (refer to **Illustration 2**). The urban area of the Town within the floodplains is the primary focus of the Study.

There are basically 2 floodplains the subject of this FPMS and FPMP. The first is the primary floodplain of Middle Brook, Kingdon Ponds and Parsons Gully which extend in a north-south direction through the centre of the study area, dissecting the main Scone township from Satur. The second is a smaller floodplain (but more significant as it traverses the urban area of the town of Figtree Creek) which extends from the north-east of the town in a south-west direction to drain into the primary floodplain.

For the purposes of this study the term 'floodplain' is a reference to the area adjacent to the subject watercourses, which is potentially subject to inundation by all predicted floods. That is, the maximum extent of the floodplain is defined by the "probable maximum flood" (PMF), being the maximum flood likely to occur.

1.3 Consultations

In the process of preparing this report, the following organisations were consulted:

1. Scone Shire Council.

2. Scone Landcare.

ILLUSTRATION 1.

REGIONAL LOCATION

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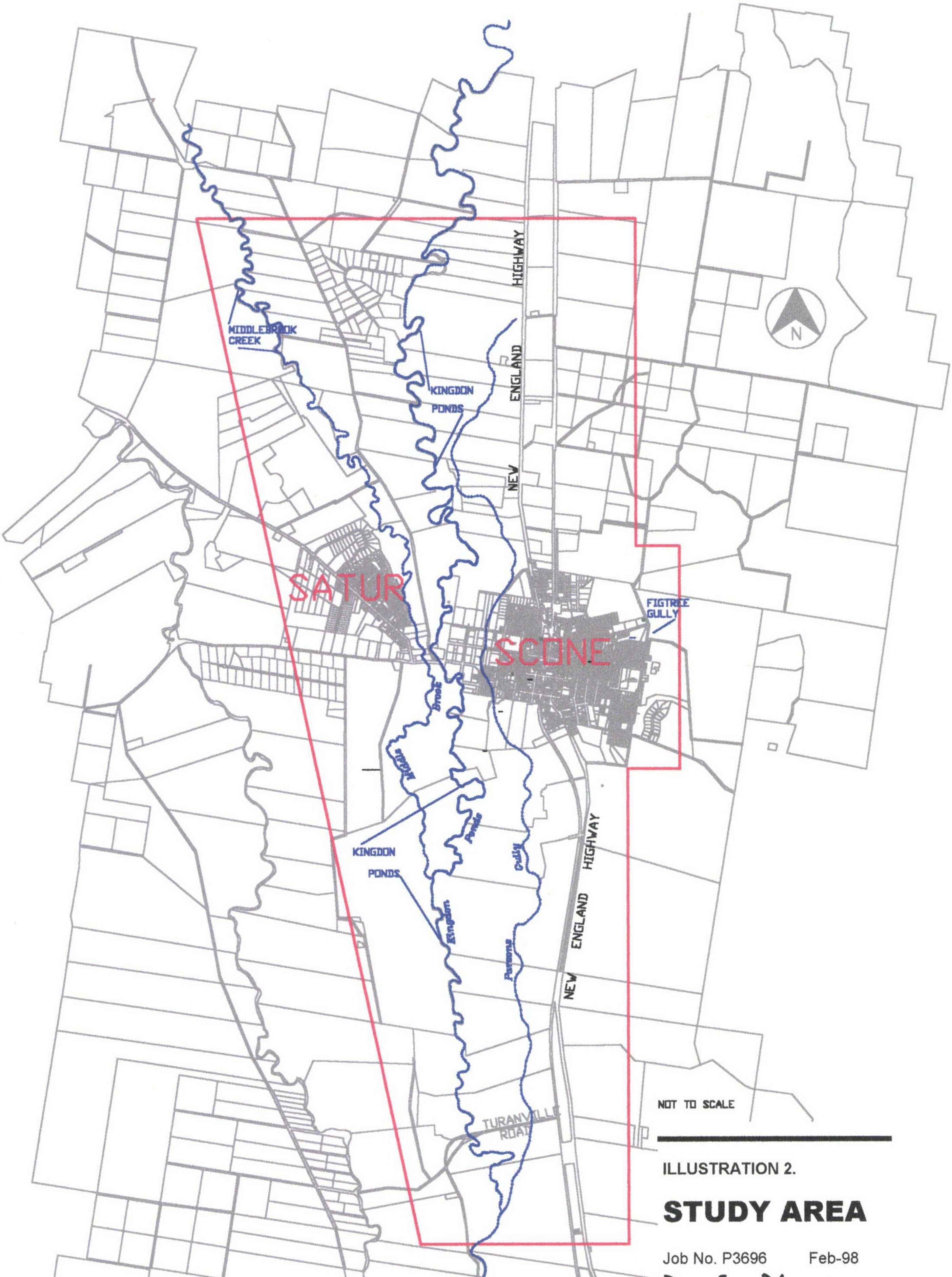

ILLUSTRATION 2.

STUDY AREA

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The advice and assistance provided by these organisations is acknowledged and gratefully appreciated.

2.0 THE PLANNING CONTEXT

2.1 Existing Landuse

The landuses within the study area of the Scone Floodplain can generally be categorised as urban within the zoned town boundaries and rural and rural residential beyond these boundaries. The general land use patterns within the Study area are depicted upon **Illustration 3**.

The Scone township comprises two major components being:

- The original Scone township area dissected by the New England Highway and railway line, which contains the main commercial centre, small industrial area to the north, various special uses such as the abattoir, sales yard and garbage depot to the far northern extent, and a major recreation area to the south. This component contains the older established areas of Scone plus new developing areas to the east.

- The satellite residential area known as Satur. This satellite residential area is adjacent to the Scone Aerodrome and new racecourse and research centre, but separated from the main Scone urban area by a distance of approximately 1 kilometre.

The separation between the main Scone urban area and Satur is basically in recognition of the flood hazard within this corridor of land due to the three major watercourses - Middle Brook, Kingdon Ponds and Parsons Gully. The Satur satellite residential area itself is substantially free from potential flooding with the exception of portions of some allotments on the eastern extent of this area.

The western extent of the main Scone urban residential area (including several residential allotments) and most of the main recreation area to the south, is potentially affected by flooding from the three main watercourses (Middle Brook, Kingdon Ponds and Parsons Gully). Part of the remaining main Scone township is partially affected from flooding of Figtree Creek, which enters the urban area at the north-eastern extent of the residential lands, traverses the residential area in a south-westerly direction within a

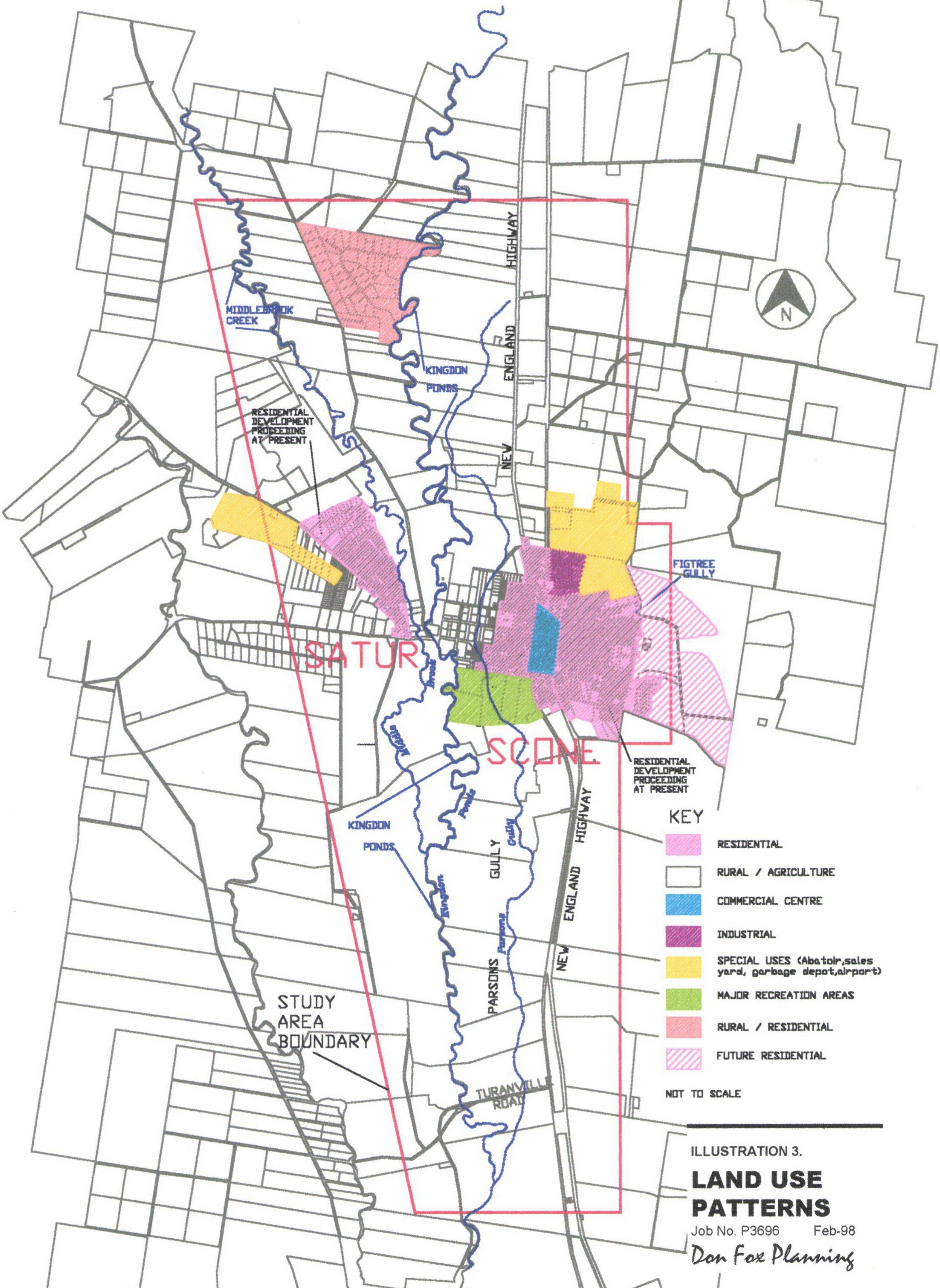

ILLUSTRATION 3.

LAND USE PATTERNS

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combination of open grass swales and pipes/culverts crossing the commercial area between approximately St Aubins and Liverpool Streets, continuing across the residential area west of the railway line and then south through the major recreation area. Flooding from Figtree Creek has implications in regard to risk to property and life, and the cause of potential inconvenience and disruption which may arise at the times of moderate to major floods.

The sewage treatment works is located to the south of the major recreation area, contained wholly within the main floodplain. Notwithstanding, the sewage works are protected by a bund at a height which exceeds the estimated 100 year ARI flood.

Substantial land has been identified for future residential development to the east of the existing main Scone urban area. The northern extent of this future residential area would be partially affected by flooding from Figtree Creek, however, the bulk of this future residential area is located to the south of the Figtree Creek catchment.

The existing landuses within the study area have developed in a manner which is substantially cognisant of the potential flood hazard in the area with the exception of development affected by localised flooding of the Figtree Creek watercourse. Flooding impacts from Figtree Creek would effect primarily immediately adjoining residential land and a portion of the commercial centre of the town.

2.2 Existing Planning and Development Controls

2.2.1 Introduction

This section of the report identifies and examines various forms of planning instruments which apply to the study area and may potentially be used for the purpose of implementing planning controls to guide future development within the study area. Not all of these planning instruments will be applicable, but are reviewed for the purpose of completeness and provides a general overview of the potential application of planning controls.

2.2.2 State Environmental Planning Policies (SEPP's)

A State Environmental Planning Policy (SEPP) is a planning document prepared in accordance with the Environmental Planning and Assessment Act by the Department of Urban Affairs and Planning and eventually approved by the Minister. A SEPP deals with matters of significance for environmental planning for the State. Examples of SEPP's that have been prepared include SEPP No. 19 - Bushland in Urban Areas, and SEPP No. 35 - Maintenance Dredging of Tidal Waterways, to name just a couple.

No State Environmental Planning Policy has been prepared dealing specifically with the issue of flooding.

2.2.3 Regional Environmental Plans (REP's)

A Regional Environmental Plan (REP) is prepared in accordance with the Environmental Planning and Assessment Act by the Department of urban Affairs and Planning and eventually approved by the Minister, which provides objectives and controls for environmental planning for a region or part of a region. The extent of a region will vary depending upon the issue to be addressed but normally refers to more than one local government area (LGA).

The Hunter Regional Environmental Plan, 1989 (Hunter REP) and accompanying Background Report is one such REP. The Scone LGA is located within the Northern Hunter Sub-region. The Hunter REP has the following implications in regard to the Scone FPMS.

(a) Flooding is identified as the prime natural hazard to development in the region, causing economic loss to both urban development and rural activity during major floods. The Background Report outlines that the prime responsibility for management of the floodplain rests with local government in accordance with the principles outlined by the Floodplain Development Manual of the State Government (FPDM).

(b) The REP recognises that Scone is located in proximity to important coal resources and prospective power station sites.

(c) The REP adopts a settlement strategy which basically aims at concentrating population growth in the main urban centres, and limiting growth in smaller villages and rural localities. This is directed to making the best use of existing private and public investment in the main centres. It is envisaged by the Plan that Scone will maintain modest growth and was estimated to have the capacity to develop 1000 residential lots/dwellings between the years 1986 to 2011. (Sch. 2 - Background Report).

(d) The first listed aim of the Hunter REP is consistent with the objectives of a Floodplain Management Plan being:

> "*2(1)(a)* *To promote the balanced development of the region, the improvement of its urban and rural environments and the orderly and economic development and optimum use of its land and other resources, consistent with conservation of natural and manmade features and so as to meet the needs and aspirations of the community*".

(e) Division 3 of Part 7 of the REP identifies various matters for consideration in the preparation of Local Environmental Plans (LEP's - rezoning plans) by individual Councils. The objective provided at Clause 52(b) is as follows:

> "*Control development on flood liable lands and encourage floodplain management which ensures maximum personal safety and appropriate landuses*".

(f) Clause 54(2) outlines principles to act on the above objective and includes a requirement that Council should prepare management plans and introduce appropriate planning controls for flood liable lands.

(G) Flood liable land is not defined by the REP, and accordingly could be considered in its wider sense to include the whole of the floodplain.

There are no other known REP's relevant to the area, or REP's which relate specifically to the issue of flooding.

2.2.4 Section 117 Directions

The rationalisation of landuse zonings in the Study Area, including any future urban releases within the study area will require the rezoning of land. As part of the rezoning process, the Council and Department of Urban Affairs & Planning are required to take into consideration any Directives issued by the Minister under Section 117 of the Environmental Planning & Assessment Act 1979 (as amended).

Section 117 Directive No. G25 (Flood Liable Land) applies to flood liable land, as defined in accordance with the principles contained in the FPDM (which refers to affectation by the designated flood) and states that:

"Except where the Council can satisfy the Director that any particular provision or area should be varied or excluded having regard to the provisions of Section 5 of the Environmental Planning & Assessment Act, 1979:

draft Local Environmental Plans shall not-

(a) Rezone flood liable land from a zone described as special uses - flood liable, rural, open space, scenic protection, conservation, environmental protection, water catchment or coastal land protection or by a similar description, to a zone described as residential, business, industrial, special use, village or by similar description."

Accordingly, any rezoning of the Rural lands within the study area to permit the residential/urban release of lands which are affected by the designated flood liable would need to address this Section 117 Directive.

Circular No. C9 which accompanied the introduction of the above Section 117 Directive, was issued by the then Department of Planning covering the introduction of the FPDM. This Circular generally advocates the principles of the FPDM and notes that assessment of proposals under the manual is in accordance with a merits based approach. In regard to rezonings, this Circular advises that Local Environmental Plans should not contain provisions applying to flood liable land which:

"(i) permit a significant increase in the development of that land;

(ii) are likely to result in a substantially increased requirement for Government spending on flood mitigation measures, on infrastructure or on services; or

(iii) permit development to be carried out without development consent except development for the purposes of agriculture (not including dams, drainage canals, levees, buildings or structures in floodways, high hazard flood fringe or high hazard flood storage areas) minor development and additions as defined in the Floodplain Development Manual."

Further, the Circular advises that land defined as high hazard flood liable or as floodway in accordance with the manual should be zoned as "*Special Uses - High Hazard Flood Liable or Special Uses - Floodway, Rural, Open Space, Scenic Protection, Conservation,* *Environmental Protection, Water Catchment, or Coastal Land Protection or a Zone having a similar description".*

2.2.5 Local Environmental Planning Instruments (LEP's)

Environmental Planning Instruments are a form of zoning plan which include instruments known as Local Environmental Plans (LEP's). These instruments define zones, permissible uses within these zones, specific development standards and other special matters for consideration with regard to use or development of land. The study area is subject to the provisions of Scone LEP 1986 (SLEP 1986).

The study area is zoned a variety of Rural, Residential, Business, Industrial, Special Uses, Open Space and Environmental Protection zones under the provisions of Scone LEP 1986 as depicted upon **Illustration 4**.

The LEP Map also identifies areas as "flood liable land". The extent of flood liable land is identified as that area of the Middle Brook, Kingdon Ponds and Parsons Gully floodplain understood to be within the extent of the 100 ARI flood at time of the preparation of the LEP (being the recorded extent of the 1955 flood). The LEP Map also shows (by way of a broken line) the extent of what was understood to be the 20 year ARI flood at the time of preparation of the LEP (being the known extent of the 1976 flood) within the same floodplain. Additionally, the LEP instrument provides the following definition:

> "*'Land within a floodprone area' means land identified as such on a map marked 'flood-prone Land Map' held in the office of Council".*

The main rural zones (1(a) and 1(b)) and the one Environmental Protection zone (7(a)) requires a minimum of 40 hectares per allotment. There is a small rural holdings zone (1(c)) which covers land occupied by a rural residential enclave within the northern extent of the study area. Within this 1(c) zone allotments are permissible with a minimum area of 4000m² where on-site disposal of sewage is required or 2000m² where allotments are served with a common sewage disposal system.

Within the urban residential zones (2(a), 2(b), 2(c) and 2(d)), standard residential allotments are permissible to a minimum area of 650m² or 1000m² in the case of battle axe shaped allotments. These residential zones also permit other forms of multi-unit housing varying from duplex flats, maisonettes and semi-detached cottages within the 2(a) zone, group houses, villa homes and townhouses in the 2(b) zone, and residential

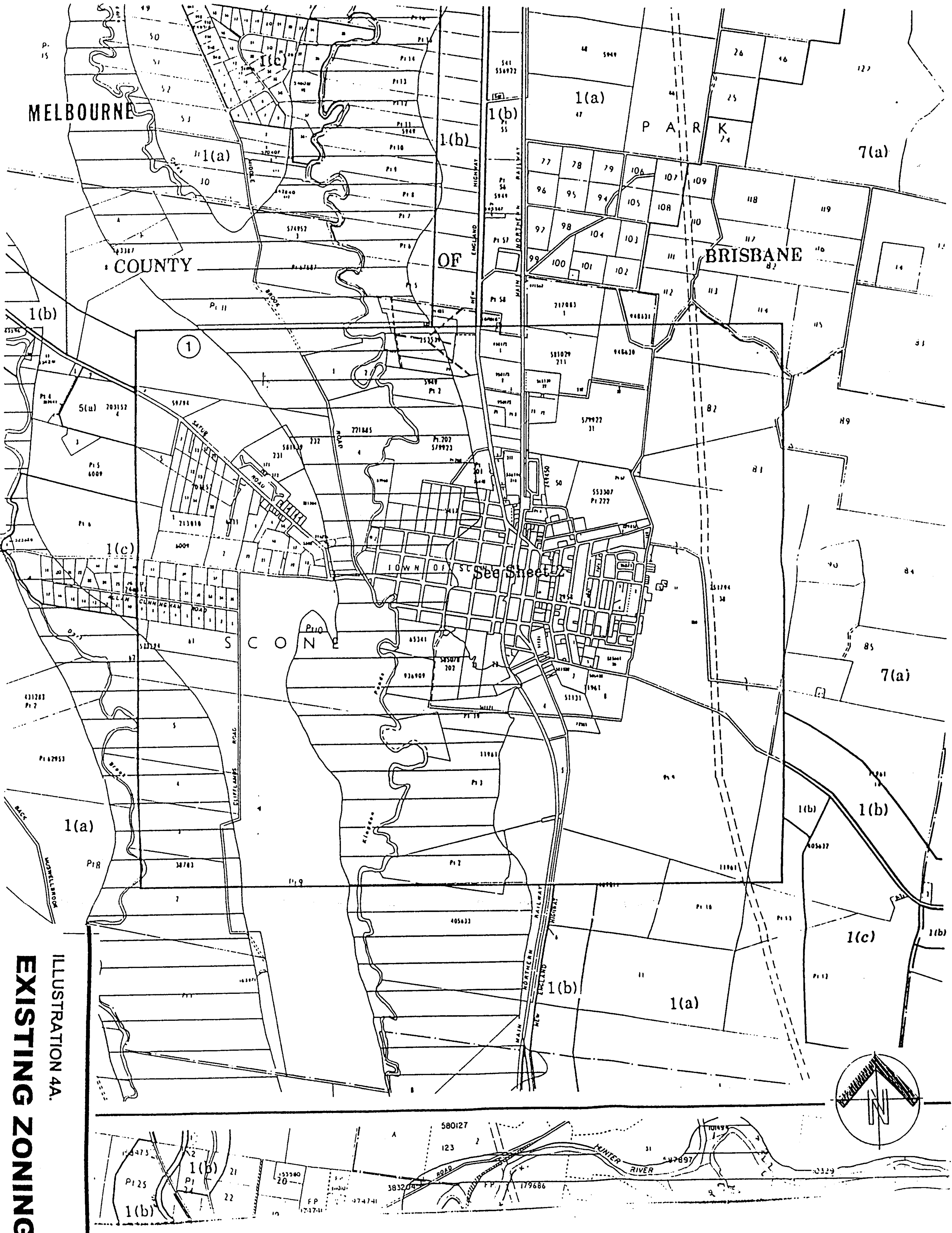

ILLUSTRATION 4A.

EXISTING ZONINGS

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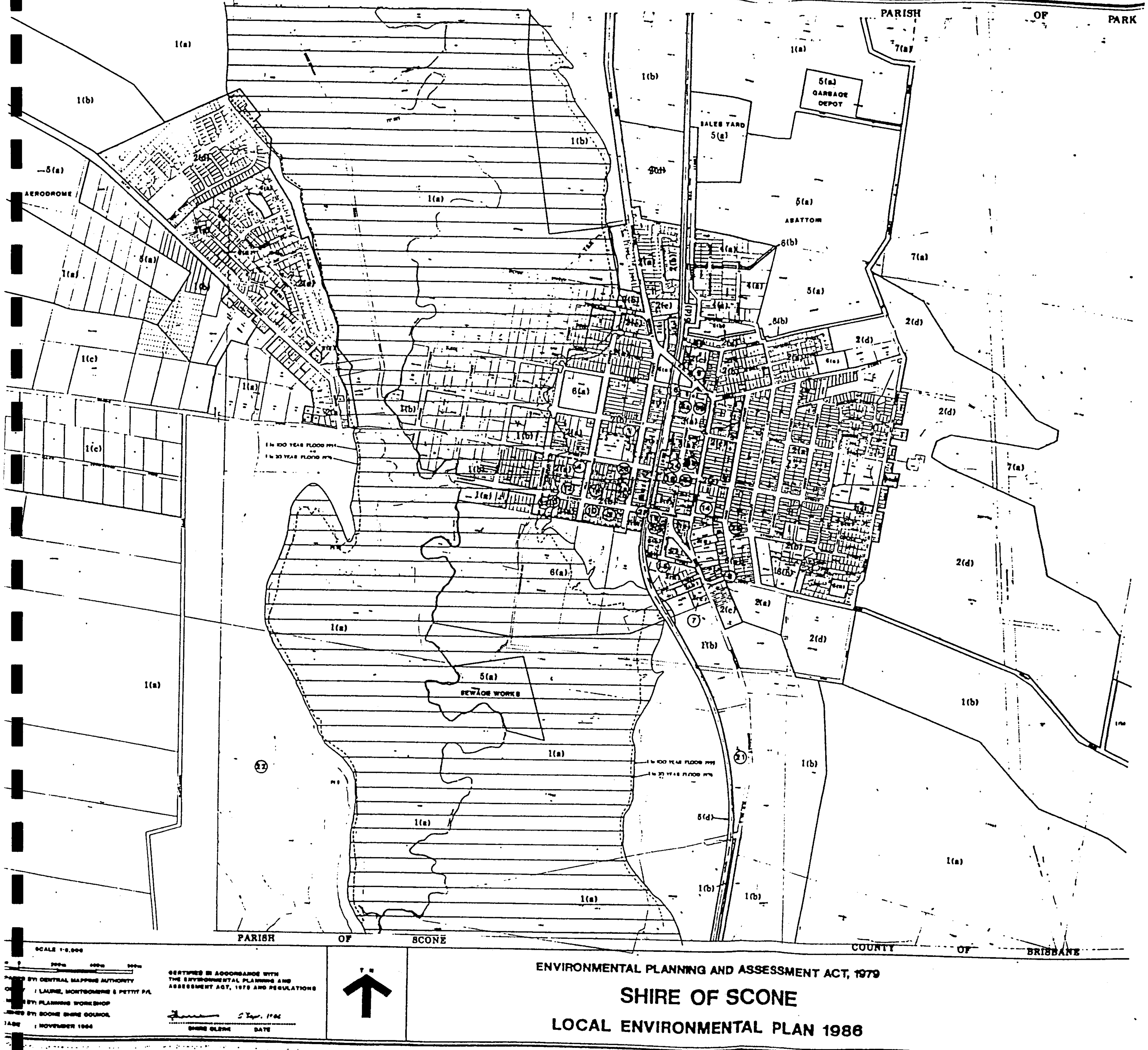

ZONE INDEX	
1. RURAL	
(a) RURAL 'A'	
(b) RURAL 'B'	
(c) RURAL 'C' (SMALLHOLDINGS)	
(d) RURAL 'D' (STATE FORESTS, TIMBER RESERVES)	
2. RESIDENTIAL	
(a) RESIDENTIAL 'A'	
(b) RESIDENTIAL 'B'	
(c) RESIDENTIAL 'C'	
(d) RESIDENTIAL 'D'	
(v) VILLAGE 'V'	
3. BUSINESS	
(a) GENERAL BUSINESS 'A'	
(b) SPECIAL BUSINESS 'B'	
(c) NEIGHBOURHOOD BUSINESS 'C'	
4. INDUSTRIAL	
(a) GENERAL INDUSTRIAL	
5. SPECIAL USES	
(a) SPECIAL USES 'A' (USE INDICATED IN BLACK NOTATION ON MAP)	
(b) SPECIAL USES 'B' (PROPOSED ARTERIAL ROAD)	
(c) SPECIAL USES 'C' (WATER CONSERVATION)	
(d) SPECIAL USES 'D' (RAILWAYS)	
(e) SPECIAL USES 'E' (PROPOSED LOCAL ROAD AND CAR PARKING)	
6. OPEN SPACE	
(a) OPEN SPACE 'A' (PUBLIC RECREATION)	
(b) OPEN SPACE 'B' (PRIVATE RECREATION)	
(c) OPEN SPACE 'C' (LOCAL OPEN SPACE RESERVATION)	
7. ENVIRONMENTAL PROTECTION	
(a) ENVIRONMENTAL PROTECTION 'A' (SCENIC)	
8. NATIONAL PARKS AND NATURE RESERVES	
(a) NATIONAL PARKS AND NATURE RESERVES 'A'	
FLOOD LIABLE LAND	
WESTERN SCONE URBAN CONSERVATION AREA	

SCHEDULE OF HISTORIC BUILDINGS AND STRUCTURES

1	FORMER HARPERS BOOT FACTORY	CNR. GUERNSEY STREET/AUBINS STREET
2a	FORMER SOORERS MILLS	GUERNSEY STREET
2b	MILL COTTAGE	GUERNSEY STREET
3	FORMER CATHOLIC CHURCH	KINGDON STREET
4	ST. LUKES CHURCH & RECTORY	CNR. LIVERPOOL STREET/HILL STREET
5a	SHOPS	96-97 KELLY STREET
5b	BELMORE HOTEL	98 KELLY STREET
6	CBC BANK	CNR. LIVERPOOL & KELLY STREET
7	ST. AUBINS ARMS (FORMER WOOL PACK INN)	145 KELLY STREET
8	MONUMENTS: THOMAS COOK MEMORIAL, ALLAN CUNNINGHAM MEMORIAL, JOHN GRAHAM MEMORIAL	ROTARY PARK
9	FORMER BELMORE HOUSE NOW "GERALDTON"	SHAW STREET
10	FORMER CONVENT OF SISTERS OF MERCY	61 KINGDON STREET
11	FORMER GRAMMAR SCHOOL, ORIGINALLY ST. LUKES (ANGLICAN) SCHOOL HOUSE 1846	KINGDON STREET
12	FORMER CONSTABLE QUARTERS AND LOCK UP, NOW HISTORICAL MUSEUM	KINGDON STREET
13	FORMER SCHOOL OF ARTS	KINGDON STREET
14	PRESBYTERIAN MANSE	MAIN STREET
15	FORMER HOSPITAL	SMITH STREET
16	SCONE RAILWAY STATION	SUSAN STREET
17	FORMER COURT HOUSE (NOW OLD COURT THEATRE) 1848-9 & 1882	KINGDON STREET
18	POST OFFICE 1879	KELLY STREET
19	FORMER PRESBYTERIAN CHURCH 1861, NOW MASONIC TEMPLE	KINGDON STREET
20	HOUSE C1858	KINGDON STREET
21	ST. AUBINS HOUSE, 1 KM SOUTH OF SCONE	NEW ENGLAND HIGHWAY
22	INVERMEIN	CLIFTLANDS ROAD
23	BANK OF NEW SOUTH WALES	170 KELLY STREET
24	CAMPBELLS CORNER	177-181 KELLY STREET
25	ST. MARYS ROMAN CATHOLIC CHURCH	CNR. PARK & SHORT STREET
26	FORMER WILLOW TREE HOTEL, NOW BUTCHER SHOP	CNR. GUERNSEY STREET & LIVERPOOL STREET
27	RAILWAY GATEKEEPERS COTTAGE 1875	KINGDON STREET, SCONE

ILLUSTRATION 4B.

EXISTINGS ZONINGS

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flat buildings within the 2(c) zone. The 2(d) zone applies to the future residential areas and is referred to as a "release area zone".

The LEP also identifies the "*Western Scone Urban Conservation Area*". This area is located immediately west of the railway line and south of Liverpool Street and includes a portion of the "flood liable land" identified on the LEP Map. This flood affected part of the Conservation Area also includes two heritage items located in Kingdon Street, being the former School of Arts and the former Court House (now Old Court Theatre circa 1848-1849 and 1882). These items of environmental heritage and all buildings within the conservation area require Council's consent prior to any modification works or demolition. The LEP provides specific criteria for the assessment of such proposals.

Clause 37 of the LEP provides specific provisions in regard to the development of "flood-prone land". The clause applies specifically to land within a "flood-prone area" being land defined on a map separately held in the office of the Council and not necessarily to "flood liable land" as identified on the LEP Map. This appears somewhat anomalous, and while the areas on the different maps may coincide it would be an appropriate exercise to relate the provisions of the LEP instrument, as contained within Clause 37, to that land identified as "flood liable" on the LEP Map.

Clause 37 requires the consent of Council for all development within a floodprone area. Applications must include the following:

- A survey plan;
- Measures to prevent flood damage;
- Measures to prevent pollution by any waste created by the development.

Additionally, Council must be satisfied of the following:

- Adequate measures will be undertaken to prevent flood damage;
- Adequate precautions will be taken to prevent waste pollution;
- The proposal will not increase the likelihood of flooding of existing development.

The extent of the 100 year ARI flood on the LEP Map is generally similar to the extent of the 100 year ARI flood depicted upon more recent flood mapping undertaken in 1996 by the Department of Land & Water Conservation for the Kingdon Ponds, Middle Brook and Parsons Gully Floodplain. The minor variations should preferably be rectified by an amendment to the LEP Map.

If available, it would also be a helpful educational mechanism to identify the extent of the PMF on the LEP Map, to signify that more extreme floods than the 100 year ARI flood are possible. This would also allow people to be aware of the risk within the area between the 100 year ARI flood extent and the PMF ("outer floodplain") and make decisions accordingly, albeit a substantially reduced risk. Similarly, as the LEP Map currently identifies the extent of the 20 year ARI flood, it is considered desirable to replace this with an identification of the high hazard flood area as determined by the recent flood mapping. For the purposes of floodplain management in this case, the extent of the high hazard flood would be effectively the extent of what was traditionally referred to as the "floodway" and an area where more stringent floodplain management controls should be applied in accordance with Government policy.

Generally, it is recommended that Council consider reviewing the zoning provisions within the extent of the floodway, so that this area includes only rural, open space and environmental protection zones as a means to prohibiting any further development in this area. That is, the floodway area is that which is considered too hazardous for the location of buildings or people to reside within. Council could consider retaining existing residential zonings over allotments where they have good evacuation access and emergency response procedures in place, which would accord with the principles of the FPDM.

The greatest discrepancies between the extent of the currently determined floodway and areas zoned for urban purposes occurs within the vicinity of Aberdeen and Liverpool Streets. The floodway (or high hazard classification) in this area arises primarily due to the depth of water, with velocities being minimal and floodwaters residing within half a days time. Some dwellings within this area have been raised and additional house raising is recommended. Provided that evacuation from dwellings could be made potentially available, then it is not considered critical that any existing urban zoned land be "back zoned" to a rural or similar zoning to reflect the currently determined extent of the floodway (high hazard classification).

At present, the LEP Map does not identify the extent of flooding originating within the Figtree Creek Gully. While part of this flooding overlaps with what is potentially referred to as stormwater drainage problems, the management of the issue is similarly dealt with. Accordingly, it is considered desirable that the flood mapping now available be used to show the extent of the PMF (floodplain), 100 year ARI and high hazard flood areas (floodway) within the Figtree Creek Gully catchment, upon the LEP Map.

2.2.6 Development Control Plans (DCP'S)

A Development Control Plan (DCP) is a plan prepared in accordance with Section 72 of the Environmental Planning and Assessment Act which provides detailed guidelines for the assessment of development applications.

We are advised that Council has not adopted any specific DCP relating to flooding. Council has a number of area specific DCP's, none of which have any particular implications in regard to this study.

2.2.7 Council Policies

In addition to formal regulations such as a Development Control Plan or an Environmental Planning Instrument, Councils may from time to time adopt specific policies with regard to their long term vision for development within the floodplain or to deal with specific matters. Normally, such policies are translated to Development Control Plans if they are considered relevant to the consideration of development applications, or to Local Approvals Policies if relevant to building applications.

Council has two current policy documents relevant to the control of development within the floodplains. The first document is that referred to as the *"Scone Shire Council Floodplain Management Plan, 1990 (FPMP 1990)"* and the second is a document recently adopted by Council as referred to as the *"Floodplain Development - Interim Policy"*.

The FPMP 1990 is a stand-alone document which is accompanied by the Scone Shire Council Floodplain Management Study (SFPMS), also prepared in 1990. This study reiterates the principles of the FPDM and provides descriptions of flood behaviour within all the floodplains contained within the Scone Shire. The Plan also identifies that the major social and economic costs associated within the Scone Shire results are due to disruptions to road access. Flood damage to property is relatively minimal.

The 1990 SFPMS recognises that zoning and planning controls remain an appropriate measure to reduce flood damage for the Scone Shire. The minimisation of development potential within the floodway and imposing appropriate controls on the form of development which is otherwise permissible within the floodplain is recognised as providing appropriate measures to minimise the impacts associated with flooding. The outcomes of this FPMS will primarily provide for a refinement of controls to deal more comprehensively with potential development in the floodplain and to address issues that have arisen since the preparation of the 1990 FPMF.

The 1990 Scone FPMP acknowledges Council's adoption of the "1% flood" (100 year ARI flood) as the flood standard and the "5% flood" (20 year ARI flood) as the definition of the limit of floodway areas. The 1990 FPMP also identifies Council's policies in regard to flood awareness and education, flood warning, evacuation and contingency planning, and planning and development standards. The development standards primarily have the following implications:

- Prohibition of any development involving new buildings and structures, major refurbishment or major alterations to existing buildings within the floodway.

- Development on land between the extent of 100 year ARI flood and the floodway to only be permitted where it is demonstrated that the free flow of floodwaters will not be affected and buildings will be constructed from flood compatible materials.

Discussions with Council Officers indicate that there have been occasional difficulties with the application of the FPMP in regard to restricting new buildings within the floodway. This would be partly due to both the inaccuracies in the original mapping and interpretation on a site to site basis as to an understanding of the actual flood hazard as opposed to just the flood extent.

In 1993, the Land & Environment Court heard an appeal against Council's refusal of a development application for the erection of four houses on "flood liable land" in Scone which in this case was also located within the "floodway" *(Alan J Stafford -v- Scone Council,* Appeal No 10578 of 1993, Assessor Hussey). In his judgement, Assessor Hussey made a number of points which are of particular relevance:

- Council had recognised that their existing FPMP was inadequate since 1992, however, knowledge of the potential flood impacts has not given sufficient priority to warrant review of the 1990 FPMP.

- While Council maps identified that the subject site was within the "floodway", further detailed analysis concluded that it is not in a high hazard floodway, having a depth to velocity ratio during a 100 year ARI flood of between 0.2 to

0.75. Therefore, the main considerations listed in Clause 37 of the Scone LEP could be reasonably satisfied.

- The existence of a sealed access road would enable orderly evacuation with the assistance of current flood warning controls, to higher ground to the east.

- Council had previously approved developments within the floodplain or in areas more severely effected by potential flooding.

Council's more recent Floodplain Development - Interim Policy basically provides a list of criteria for consideration in the determination of applications within the floodplain. These criteria now include a need to classify the land based on its hydraulic, hazard and landuse category in accordance with the classifications provided by the FPDM. This Interim Policy also notes "minor" alterations and additions are to relate to situations where the additional floor area is less than 20% of the existing building or $30m^2$, whichever is the lesser. The Interim Policy then requires an assessment be made of the proposal having regard to the principles outlined within the FPDM. We understand from discussions with Council Officers that this is the procedure currently pursued in regard to the assessment of applications within the floodplain, with primary reliance placed on the provisions of the FPDM.

The FPDM provides a basis for the preparation of area specific FPMS's and FPMP's. Having regard to the comments made within the abovementioned judgement of the Land & Environment Court and the intent of the FPDM, this study and resultant FPMP will provide an important basis for Council's ongoing management of the Scone floodplain.

2.2.8 Development Application Assessment

Development Applications for proposals which are permissible with consent must have regard to the relevant provisions contained in SLEP 1986 and the 'Matters for Consideration' contained in Section 79C of the Environmental Planning & Assessment Act, 1979.

Section 79C(1)(a)(i) of the Act requires the consent authority to take into consideration, when determining a development application, the provisions of any environmental planning instrument. Accordingly Council is required to have regard to the provisions of Clause 37 of SLEP 1986 which specifies various matters to consider with respect to flood liable land.

Section 79C(1)(a)(iii) requires that Council also consider any Development Control Plan in force. While no DCP is presently in force which deals with the issue of flooding, such an instrument would provide a desirable mechanism for Council to comprehensively assess development applications with respect to the issue of flooding.

The Environmental Planning & Assessment Act and accompanying Regulations 1994 also identify certain developments which are deemed to be "designated development". Designated developments are generally large scale developments which have been identified as potentially causing greater impacts on the environment. Hence designated development proposals require the preparation of an Environmental Impact Statement and more specialised assessment procedures including statutory notification of the development application with third party rights of appeal for any objectors.

Schedule 3 of the Environmental Planning & Assessment Regulation 1994 identifies those developments which are designated development by virtue of their processing capacity, site requirements or location near environmentally sensitive features. Developments such as "agricultural produce industries, aquaculture or mariculture, artificial water bodies, extractive industries, large stock processing industries, turf farms and the like are permissible in the zoning of the study area and adjoining land. Some of these developments may be regarded as designated development when located within a certain distance of a natural water body or wetlands or on flood prone land or a floodplain.

Schedule 3 of the EPA Regulation 1994 defines floodplain as follows:-

> "*Floodplain means the floodplain level nominated in a Local Environmental Plan or those areas inundated as a result of a 100 year flood event if no level has been nominated.*"

Accordingly, there are a number of potential outcomes of the FPMP process which may have implications in regard to the manner in which Development Applications are dealt with.

2.3 Population Growth and Development Trends

A review of population growth and development trends has been undertaken in order to determine the likely future demands for urban land, whether sufficient areas have been allocated to accommodate future growth requirements, and whether these areas or other areas that may be required need to impinge upon the floodplain. It is important to determine whether there are any social and economic issues which would justify further development within the floodplain, or whether development in the floodplain would be appropriate having regard to ensuring orderly and economic development proceeds for the township.

In order to undertake this assessment, we have reviewed building and development application statistics obtained from Council, population census data produced by the Australian Bureau of Statistics, and the *"Scone Urban Study"* prepared for Council by Hill Top Planners in July 1996. The Scone Urban Study provides an up to date basis for the assessment of future development and land requirements for the Scone township and recommended strategic directions for the growth of the town.

2.3.1 Building Activity

Between the years 1989 and 1997, Council approved building applications for a total of 597 new dwellings, of which 511 (86%) were single dwellings and 86 (14%) were multi-unit dwellings. This represented an average per yearly development of 66 new dwellings per year of which 57 were for new single dwellings and 9 were for multi-unit dwellings.

The above data was compiled by Council for the whole of the Scone LGA, and a more detailed analysis for Scone and Satur was undertaken by analysis of census data for the years 1986, 1991 and 1996 (refer to Summary Census Data at **Appendices A, B** and **C**). The census data for the last 10 years indicates a minor decrease in separate houses and other dwelling structures within the Scone urban area, and a minor increase in separate houses and multi-unit dwellings in Satur and the immediately adjoining rural areas.

The census data appears potentially in conflict with Council's building approvals for dwellings, but it should be noted that building approvals do not always compensate for the loss of existing dwelling stock through demolitions. Notwithstanding, it is clear that the rate of new dwelling growth in the study area has been minimal over the past 10 years.

The Scone Urban Study showed that within the 14 year period between 1982 and 1995, Council issued building approvals in the Scone Urban Area averaging 40 new dwelling houses and 9 new multi-unit dwellings on average per annum. Again, there would appear to be some conflict between Council's building approval statistics and the census data. Notwithstanding, it could be reasonably expected that the Council building approvals would not take into consideration loss of dwelling stocks through demolition and accordingly total new dwellings per annum would be on average over the last 10 years somewhat less than 50 dwellings per annum within the study area.

2.3.2 Subdivision Development

The Scone Urban Study notes that the production rate for new residential lots within the Scone urban area between the years 1981 and 1996 was estimated at 25 to 30 lots per annum. It is noted that the majority of these lots were larger than 1500m² and would, therefore, often be rural residential allotments outside of the urban area.

2.3.3 Population Growth and Development Trends

Appendix A1, A2 and A3 provides a summary of relevant census data from the 1986, 1991 and 1996 census of population and housing undertaken by the Australian Bureau of Statistics, applicable to the main Scone urban area, Satur and the adjoining rural hinterland. **Appendix A4** provides similar data for New South Wales, for comparison purposes. The census boundary for the adjoining rural hinterland extends beyond the study area and, therefore, should not be considered to reflect total numbers of persons but only to indicate general trends. It is emphasised that due to the criteria for definition of census collector districts, the Satur area was not distinguishable from the Scone urban area during the 1986 census, while during the 1991 and 1996 census there was some overlap or discrepancies in census collector district boundaries which creates comparison difficulties. Notwithstanding, adjusting for these discrepancies, the following points can be drawn from this data.

- The combined population of Scone and Satur increased between 1986 to 1996 from a population of 4,272 to 4,581 persons. The adjoining rural lands experienced a minor increase in population between the years 1986 and 1996. In comparison, NSW experienced an annual compound growth rate of 1% between 1991 and 1996.

- Scone experienced decreasing household sizes reflected by a fall in the dwelling occupancy ratio from 2.71 in 1986 to 2.37 in 1996. In comparison, Satur experienced an increase in dwelling occupancy ratio (ie. household sizes) from 3.03 persons per dwelling in 1986 to 3.24 persons per dwelling in 1996. The occupancy ratio of dwellings in the adjoining rural land also fell, from 3.21 in 1986 to 2.06 in 1996.

- The age structure for Scone indicates a slight increase in the number of older persons (ie. 55 or greater), a slight increase in the proportion of the middle aged population, a decrease in the proportion of school aged children and a slight increase in the proportion of infants. Almost conversely, the Satur area experienced a decrease in the proportion of older persons (ie. 55 or over), a slight increase in the proportion of middle aged persons, a significant increase in the proportion of school aged children and a slight decrease in the proportion of infants. The rural area experienced a definite aging of the population in all age groups above 25 years of age and decreases in the proportion of the population within the lower age groups - consistent with, but not as pronounced as the trend for NSW overall.

- Standardised and adjusted (CPI) median income levels revealed that the census period 1986 to 1996 saw a reduction in the family household income levels in Scone (but with a slight increase in individual incomes - consistent with the trend for NSW overall), increases in income levels within Satur and slight increases in individual and family income levels in the adjoining rural lands (although, a slight decrease in the household income for this area).

Generally, the census data indicates that the main Scone urban area is undergoing a stage within the population cycle where the population is beginning to age, there is a reduced number of people in the labour force (assumingly a higher retiree level), reduced income levels and substantially reduced household sizes. Conversely, the Satur area is entering a stage of its population cycle which comprises predominantly families with school aged children, higher individual and family income levels and larger household sizes, reflective of the fact that this is a relatively newly developed area, with the majority of growth occurring over the last 10 to 15 years. The surrounding rural area is also experiencing a gradual aging of the population, decreasing household sizes, but relatively stable income levels.

2.3.4 Vacant Land Supply

An evaluation of existing vacant supply within the township of Scone and the adjoining area of Satur has been made with the use of aerial photography and site inspections and a review of data contained within the Scone Urban Study.

The Scone Urban Study indicated that at March 1996 there 46 vacant allotments in Scone and 13 vacant allotments in Satur (a total of 53 vacant allotments). In addition to this, the study indicated that at that time there were approximately 56 allotments under construction. The analysis of aerial photography (November 1996) and site inspections indicated that this volume of vacant land supply would be about the same today.

The majority of these allotments would be within the zoned urban areas and, therefore, outside the main floodplain (Middle Brook, Kingdon Ponds and Parsons Gully) although some are located within the Figtree Gully Creek area. Vacant allotments within the Figtree Creek Gully area are primarily within the upper reaches of the creek within the zoned urban area in the vicinity of Park Street, Susan Street, Waverley Street and Oxford Road. It would appear that the drainage/flooding constraint would impose a major impediment to the development of these lands.

2.3.5 Strategic Planning Issues

It is considered important that an appreciation of the growth and development characteristics be obtained in order to ensure that any proposed planning and development controls do not have an unreasonable social and economic impact upon the town.

The Scone Urban Study identified that there were some 719 potential urban and rural residential lots within zoned areas in and around the Scone township. The majority of these potential lots exist within the future residential release area zone to be east of the township. The Scone Urban Study also identified potential for 170 lots within areas which may be investigated for future urban release, mostly located to the north-west and south of Satur, with one area to the east of the Scone township immediately south of Gundy Road.

All the zoned and potential urban areas are located outside of the main Middle Brook, Kingdon Ponds and Parsons Gully floodplain. However, a small portion of the release area 2(d) zone would be affected by flooding from Figtree Creek. The extent of the future urban area within the Figtree Creek floodplain would be minimal and would not have a significant impact upon the availability of land for urban development within Scone. Accordingly, it is considered relevant that the extent of the floodplain within this release area be identified upon the LEP map. The part of this area affected by the high hazard flood extent should be rezoned Rural, Open Space or Environmental Protection to clearly note that development of buildings would not be permitted in this area.

As previously outlined, it is recommended that both the extent of the 100 year ARI flood and the PMF should be shown on the LEP Map as both a public awareness initiative and to provide a mechanism to ensure greater consideration of the flooding issue at the development application stage.

With the exclusion of portions of the Figtree Creek Gully being available for future urban development, there would still remain in the order of 1000 potential lots on zoned land or within areas with potential for further investigation for urban development, and outside of the floodplains. Having regard to the above analysis of population growth, dwelling and lot construction, there would remain a minimum estimated 20 years supply of available land, after which there would appear to be adequate potential areas for expansion of the town away from the floodplain.

The Scone Urban Study also indicated that there was sufficient commercial and industrial land to meet the short to medium term needs of the Scone township. Should any additional industrial land be required in the medium to long term, this would best be satisfied by the rezoning of appropriately located residentially zoned land, in particular that area located opposite the sale yards.

Accordingly, it is clear that the constraint of flooding would not impose a significant impediment to the orderly and efficient growth of the township and there is no necessity for consideration of more intensive use of the floodplain for urban purposes. This study, however, does provide a mechanism to identify the necessity for refinement to the urban release residential area to the east of the township, to have regard to the flooding constraints associated with Figtree Creek Gully.

Council also has an obligation to ensure that when development in existing zoned areas and redevelopment occurs it takes into consideration the flood hazard to minimise risk to life and property and to promote orderly and economic development. This can be achieved with regard to new development with the imposition of appropriate development and building controls, and this is discussed further within later sections of this report.

3.0 ROLE OF PLANNING

Flooding is a significant naturally occurring hazard to the utilisation of land, which affects development generally, and in this case within the study area. As recognised by the FPDM (NSW Govt. 1986), each floodplain exhibits its own characteristics which require individual assessment and tailored management plans. The study and management plan need to identify and address the issues associated with competing objectives with the utilisation of land within the floodplain which can generally be narrowed to the following two opposing forces.

- A desire to minimise the impact, through planning or control of the nature processing of flooding within the floodplain to reduce the adverse effects upon the environment, economic impact to development and social disruption and danger to life and limb arising from flood events.

- The need to maximise the efficient utilisation of land so as to not unnecessarily hinder expectations for the utilisation of land and deprive a region of economic input or to constrain the orderly development of an area.

As outlined within previous sections of this report the Scone Floodplain within this study area is mostly undeveloped but partially developed and subject to zoning controls which would permit development. New development in the township should desirably be avoided within the floodway and preferably not be undertaken in the floodplain unless in accordance with appropriate management and development controls.

Generally, the management of a floodplain is approached by the imposition of either structural or non-structural measures. Traditionally in NSW, structural measures have played a major role, but non-structural measures (which include, but are not limited to town planning matters) are providing an increasingly important role. Non-structural measures, other than town planning, may include increased public awareness, land acquisition, establishment of evacuation procedures, and so on.

There are a number of mechanisms within current statutes which provide a requirement for Council to take into consideration the issue of flooding in the preparation of specific types of planning instruments and the assessment of individual development projects. These include the following:

- The provisions of the **Environmental Planning & Assessment Act** and its specific aims and objectives;

- Council **Environmental Planning Instruments** (zoning plans);

- **Section 117(2) Directions** relevant to the preparation of Environmental Planning Instruments;

- **Circular No. C9 of the then Department of Planning** dealing with planning in the floodplain;

- Council's current **Development Control Plans**;

- **Section 79C of the Environmental Planning & Assessment Act**, dealing with matters to be taken into consideration in the determination of applications.

- **Section 94 Plans** which may encompass drainage and flood mitigation works.

Accordingly, there are a number of statutory requirements in regard to the issue of flooding, which necessitates having a comprehensive and well thought out basis for reviewing individual proposals and in the formulation of planning strategies from a local to a regional level. The above statutory framework also provides a basis on which the floodplain management plan can manifest itself to form a legitimate legal basis to implement the planning objectives of the floodplain management study and plan. In general, this provides a basis for the output recommendations of this town planning component of the study, as evaluated and discussed at Section 6.0 and 7.0 of this report.

It has been recognised (see NSW Public Works, 1994) that planning measures provide the greatest opportunity to control and limit any increase in future hazard and damage in the floodplain. Planning measures are a long term proposition which should be directed to long term timeframes (refer to NSW Public Works, 1994, P.14) as follows:

- A long term planning horizon of 50 to 100 years to identify and realise opportunities for correcting historical problems (e.g. by improving accessibility of evacuation routes) and through a sustained long term program for property purchase in especially hazardous areas.

- A definite floodplain management plan needs to be adopted to cater for development over the next 20 to 30 years.

Controls and conditions placed on future development on flood affected land will reduce growth in flood related risks and damage and improve evacuation response. Appropriate measures are outlined within the Sections 6.0 and 7.0 of this report.

The planning framework in general also provides a basis for the assessment of various structural flood mitigation options identified within other working papers. Section 5.0

of this working paper reviews the potential flood mitigation options and provides comments from a town planning perspective.

4.0 CHOOSING A DESIGNATED FLOOD STANDARD

The choice of a designated flood for the study area is a fundamental component in the preparation of the floodplain management plan.

The glossary within the FPDM (NSW Govt, 1986) clarifies the "flood standard (or designated flood)" as follows:

> *"The flood selected for planning purposes. The selection should be based on an understanding of flood behaviour and the associated flood risk. It should also take into account social, economic and ecological considerations."*

The designated flood in effect determines the area of land which will be subject to specific building and development controls and the design criteria on certain aspects of development (e.g. minimum floor levels of habitable dwellings).

The FPDM recommends a merit approach in the selection of a designated flood. That is, various factors such as social, economic and ecological considerations need to be balanced against the consequences of floods to determine a designated flood. The choice of the designated flood must flow from an assessment of the various factors which in effect provides the best results for the community having regard to the two opposing forces referred to previously - that is, the need to maximise the efficient utilisation of land versus a desire to minimise the impact of flooding. While the 100 year ARI flood is the most commonly adopted designated flood in New South Wales, and it is the designated flood currently applicable to the study area, it is incumbent upon any floodplain management study to review the issues associated with the choice of a designated flood and to make appropriate recommendations.

Normally, the 100 year ARI flood is adopted as it has been considered to provide a balance between the two opposing forces of minimising impact and maximising efficient utilisation of land. The choice of a designated flood should be based on the potential achievement of specific multiple objectives including:

1. Economic efficiency (such as the cost of mitigation structure, sterilisation of land, additional costs associated with development, etc).

2. Avoidance of loss of life.

3. Avoidance of injury.

4. Promotion of social well being by minimising disruption to daily activities caused by flood events.

5. Preservation of natural environments (ecological considerations).

6. Minimising damage to property and public infrastructure.

The PMF extent has been mapped for the main floodplain (Middle Brook, Kingdon Ponds and Parsons Gully) and the Figtree Creek floodplain. The main floodplain affected by the 100 year flood represents a corridor of land between Scone and Satur. The extent of the whole of the floodplain (up to the PMF) extends outwards from the 100 year floodplain about an additional 300 metres to the east affecting both zoned and developed residential land and substantially vacant rural land. In the consideration of whether to recognise and apply any controls or management policies to the area between the 100 year floodplain and the PMF (referred to in this study as the "outer floodplain"), various factors need to be considered such as the implications of restricting development upon the viability of the town or the increase in cost of development of housing, commercial and industrial development uses.

These factors, together with other data, provide a basis for the consideration of the achievement of the multiple objectives outlined above. The consideration of these objectives requires input from various members of the study team, and relevant discussion from a town planning perspective is provided as outlined below.

4.1 Economic Efficiency

The choice of a designated flood greater than the 100 year ARI flood could have a proportional impact in regard to additional costs associated with the development of land, and opportunity costs associated with the sterilisation of land. These implications include:

- Additional construction costs associated with the raising of the level of buildings to appropriate flood design heights and flood proofing;

- Additional costs associated with the preparation of applications for development and their assessment and in the supervision of construction; and

- The loss of property values associated with additional properties previously considered to be notionally "flood free" as now being flood affected;

On the opposing side of the scale, the economic costs associated with flood damage associated with the various potential floods need to be considered.

4.2 Loss of Life

The risks associated with loss of life arising from floods would undoubtedly increase with the severity of the flood. However, the increased risks associated with increased flood events is difficult to quantify as no definitive research has been identified.

The level of risk of death associated with floods will vary depending upon a number of factors as outlined at Appendix A2 of the FPDM including the following factors:

* Size of flood
* Effective warning time
* Flood awareness
* Rate of rise of flood waters
* Depth and velocity of flood waters
* Duration of flooding
* Obstructions
* Evacuation problems
* Access

In general, the chance of fatality associated with cataclysmic storms and storm floods has been calculated at 1 in 5 million per year for individuals in New South Wales (refer to DOP, 1992, Page 11). For comparison purposes we note that a fatality risk level of 1 in one million is adopted as the risk acceptability for residential exposure to hazardous industries (DOP, 1992, P.4). No known statistics exist outlining the chance of fatality generally for occupants of land within floodplains, but significant numbers of deaths are not normally associated with floods in NSW.

The choice of a designated flood would have implications in regard to the extent of built up area within the floodplain, the height of floor levels in the floodplain, the extent of flood awareness (although this could be separately addressed), evacuation procedures and the like. The implications are significant in regard to the subject floodplains due to a relatively short warning time available in regard to floods in the main floodplain of about 3 hours (although this could be improved) and practically no warning time in Figtree Creek Gully.

An estimation of the potential risk to loss of life from the choice of alternate designated floods would be a complicated exercise and would need to be based on a number of assumptions, and is beyond the scope of this study. Notwithstanding, it could be expected that there could be some potential increase in risk to life associated with adopting a lower designated flood as opposed to a higher one.

There may be alternate mechanisms by which to minimise the increased potential risk to life associated with adopting a lower designated flood. For example, if a 100 year ARI flood is chosen as the designated flood this could be applied for the purposes of planning and building controls, while a higher standard such as the PMF could be adopted for the purposes of establishing evacuation procedures, flood awareness programs and the like.

4.3 Avoidance of Injury

The same implications with regard to the loss of life would also apply in regard to the potential for injury although the chances of injury would be much greater than death.

4.4 Minimising Disruption to Daily Activities

A choice of a designated flood with a low flood frequency could result in development, redevelopment, evacuation procedures and infrastructure being designed to cater for large and rare floods. This would result in less likelihood of disruption to daily activities resulting from flooding, but at greater costs.

The subject flood waters subside within 24 hours after the ceasing of rain and, therefore, having regard to the infrequency of major floods occurring, would not cause a major disruption to daily activities in the township. The major disruptions are the flooding of some shops within the main commercial centre of Scone and the cutting off of road access between the main Scone urban area and Satur. It is understood that road access is cut at relatively low flood frequencies, however, some roadworks are currently proceeding to improve road access and reduce susceptibility to flooding.

4.5 Preservation of the Natural Environment

As flooding is a natural occurrence, it can be argued that the ecological impact on the natural environment resulting from flooding should not be a major concern. However. concern would arise when the impact of flooding results from man-influenced flooding or associated consequences such as the destruction of the natural environment associated with the construction of flood mitigation works.

The natural environment in the study area has been extensively modified by human intervention which has resulted in the removal of the majority of indigenous flora and, in parts, weed infestation of the creek corridor. As detailed later within this report, a Vegetation Management Strategy would be desirable, and would provide general improvements in the environment in regard to matters such as soil erosion improvement to the visual quality of the area and increasing fauna habitat.

4.6 Minimising Impact to Buildings & Infrastructure

The considerations in regard to this issue are similar to those outlined above at Item 4.5.

4.7 Summary

There is no clear solution to the choice of an appropriate designated flood which balances out all the above factors. The role of this report is to assist in outlining the consequences associated with the choice of alternate designated floods. As alluded to above, one approach in resolving this matter may be to chose alternate designated floods for different circumstances which has:

- A lower designated flood for agricultural, recreational and similar activities as opposed to residential development.

- The choice of a different designated flood for the establishment of flood awareness programs, evacuation procedures, etc.

- A choice of a higher designated flood for major and critical public infrastructure such as sewage pumping stations, major transport linkages (railway lines and major roads), hospitals, SES bases, etc (being those uses particularly necessary to remain unaffected during periods of major flood.

Accordingly, a range of designated floods would be appropriate for inclusion within the final FPMP, and a "planning matrix approach" is recommended for adoption for the purposes of forming planning controls. The planning matrix approach has been documented (refer to "*A New Approach to the Development of Floodplain Controls for Floodplains*" D Bewsher & P Grech, May 1997, paper presented to the 37th Annual Floodplain Management Conference - Maitland) and applied to many other Floodplain Management Plans, including the Hawkesbury Nepean Floodplain Management Strategy recently adopted by the State Government for public exhibition purposes. The approach identifies land use preferences within the floodplain and controls development to minimise the flood consequences. Using this approach, a matrix of development controls, based on the flood hazard and the land use, can be developed which balances the risk exposure across the floodplain.

The planning matrix approach is consistent with the conclusions reached above, providing different standards or criteria for assessment, based on the type of land use and its position within the floodplain. In this regard, it is not possible to categorically conclude that, for example, a 100 year ARI flood standard would be more appropriate for floor levels than, for example, a 150 year ARI flood standard for residential dwelling houses. Notwithstanding, floor level criteria and other assessment criteria are to be adopted based on what is considered reasonable and practical having regard to the experience of the consultants, current practice by Council, comments received from the community, environmental, social and economic factors identified during the study and an overall planning outcome which provides for the orderly and efficient development of the whole of the floodplain in a manner which minimises the community exposure to flood damages and risk to life and limb.

5.0 REVIEW OF POTENTIAL FLOOD MITIGATION MEASURES

The following provides some comment in regard to the planning implications associated with potential structural flood mitigation options identified within the FPMS prepared by Bewsher Consulting.

Option No.	Option	Comment
1	OPTIONS WHICH MODIFY FLOOD BEHAVIOUR	
	PARSONS GULLY	
1.1	Construct a large retarding basin(s) upstream of Parsons Gully.	This would likely benefit only existing development, and accordingly restrict Council's ability to fund its construction through the application of Section 94. Council would need to acquire land and undertake appropriate environmental studies, which may include preparation of an REF and, if necessary, an EIS for the proposed work.
1.2	Construct a levee on the east side of Parsons Gully.	The environmental impact of the levee, particularly the visual impact, would need to be reviewed. A substantial portion of the land likely to be acquired would be in private ownership and, therefore, Council will need to acquire land or easements.
1.3	Construct a formal channel in Parsons Gully to convey 100 year flows past western fringe of Scone township.	The environmental impact would need to be reviewed carefully. It is likely that significant tree removal would result in addition to changes to the natural landform.
	FIGTREE GULLY	
1.4	Construct a single large Council owned retarding basin upstream of Barton Street.	The area where this basin would be situated is currently substantially zoned 2(d) Residential and is identified for future urban residential purposes. The basin would likely sterilise land beyond that which would otherwise be constrained as a result of flooding. The environmental impact of the basin would also need to be reviewed and may likely require an EIS to be prepared dependant upon the size and capacity of the basin.

Option No.	Option	Comment
1.5	Construct a number of smaller Council owned retarding storages upstream of Park Street.	This would likely only benefit existing development and, therefore, could not be funded through Section 94. Ownership patterns are not known, but Council may need to acquire land. The basins would be located close to existing residents and, therefore, would need to be sympathetically designed to present as aesthetic water features within the landscape, and may preferably incorporate some areas of parkland.
1.6	Reconstruct Figtree Gully from downstream of Barton St to Park St, as a concrete lined channel; and Construct a box culvert system from Park Street to Parsons Gully at the southern end of Guernsey Street.	The visual and environmental impact of removing the existing semi-natural watercourse would need to be reviewed carefully. The proposal would undoubtedly have a significant visual impact upon this corridor of land and may need to be ameliorated with landscaping.
1.7	Reconstruct Figtree Gully from downstream of Barton St to Park St, as a deeper and wider grass lined channel; and Construct a box culvert system from Park Street to Parsons Gully at the southern end of Guernsey Street.	This option would similarly require the potential acquisition of additional land and would likely result in the removal of existing vegetation along the semi-natural watercourse necessitating appropriate landscaping to mitigate its visual impact.
1.8	Reconstruct Figtree Gully from downstream of Barton St to Park St, as a concrete lined channel; and Construct a box culvert system from Main Street/St Aubins Street to Parsons Gully at the southern end of Guernsey Street.	Similar comments as to Option 1.6 would apply.
1.9	Reconstruct Figtree Gully from downstream of Barton St to Park St, as a deeper and wider grass lined channel; and Construct a box culvert system from Main Street/St Aubins Street to Parsons Gully at the southern end of Guernsey Street.	Similar comments as to Option 1.7 would apply.

Option No.	Option	Comment
1.10	Construct a permanent levee along Figtree Gully from Barton Street to Park Street; and Construct a box culvert system from Main Street/St Aubins Street to Parsons Gully at the southern end of Guernsey Street.	The visual impact of the levee would need to be carefully considered and would likely require mitigative measures such as appropriate landscaping.
1.11	Remove obstructions in Figtree Gully channel.	No applicable planning comments.
1.12	On site detention (OSD) for future developments.	This would be an appropriate planning requirement, to ensure that new development does not exacerbate existing conditions. This requirement should be incorporated within relevant DCP's of Council.
2	OPTIONS WHICH MODIFY THE WAY EXISTING OR FUTURE PROPERTIES ARE AFFECTED BY FLOODING - PARSONS GULLY AND FIGTREE GULLY	
2.1	Voluntary purchase of severely flood affected properties by Council (Parsons Gully only)	Consideration should be given to the alternate use of the land subsequent to voluntary purchase (eg. parks, rural use, etc).
2.2	House raising of severely flood affected properties (Parsons Gully only)	The visual impact of the raised dwellings should be considered, and the undercroft areas should be required to be appropriately treated to minimise any impact upon the streetscape and character of an area.
2.3	Flood proofing of individual properties (Figtree Gully Central Business District only)	No applicable planning comments.
2.4	Building and development controls	This is considered an appropriate means to minimise the exposure of new development to the flooding hazard, and a DCP/LAP in addition to refinements to Council's LEP are recommended as part of this report.
2.5	Raise Liverpool Street across Parsons Gully and between Kingdon Ponds and Middle Brook.	The environmental impact of the raised road would need to be considered, but would relate primarily only to its visual impact and is likely to be a major constraint should this option be pursued.

Option No.	Option	Comment
2.6	Preparation of a Vegetation Management Plan.	This option is recommended as part of this report.
3	**OPTIONS WHICH MODIFY THE WAY PEOPLE RESPOND TO FLOODS - PARSONS GULLY AND FIGTREE GULLY**	
3.1	Issue flood certificates for all properties	This option is supported and could be incorporated within Section 149 Certificates as well as generally made available.
3.2	Improved emergency planning and management.	Generally desirable but no specific planning comments.
3.3	Increased community education and flood awareness.	Desirable, and planning documents which appropriately incorporate information about flooding would assist.
3.4	Improved flood warning systems (for Parsons Gully only).	No applicable planning comments.
3.5	Preparation of flood action plans for individual properties.	This may be desirable for major new development and appropriate requirements are recommended within the proposed DCP/LAP referred to later in this report.

6.0 REVIEW OF PLANNING OPTIONS

6.1 General

There are a number of alternate mechanisms by which town planning may have a role in implementing non-structural measures for the control of development within the floodplain. These measures may vary from a fairly broad strategic overview of future and intended development or detailed building and development controls applicable to various forms of development in different zones.

Town planning can also have an input in regard to providing appropriate mechanisms for the implementation of structural measures, such as the adoption of a Section 94 contributions plan to provide developer funding towards broader scale flood mitigation works. Town planning can also assist in regard to flood awareness initiatives through notations on Section 149 Certificates (zoning information certificates).

The above measures and options for control of development and implementation of other associated measures are outlined and discussed below.

6.2 State Environmental Planning Policies (SEPP's)

As the State Government'S FPDM is aimed at encouraging a merit based approach to floodplain planning for individual areas, it is unlikely to be desirable to establish a global policy for floodplain development though the application of a SEPP. Accordingly, the pursuance of this option is not discussed further.

6.3 Regional Environmental Plans (REP's)

Potential would exist to refine the provisions of the Hunter REP to provide more definite guidelines and objectives in regard to the management of the floodplain having regard to the findings of this study. This may have substantial benefit in ensuring a more consistent regional approach to planning within the floodplain (which could include all the floodplains in the Hunter Valley, depending on the availability of similar studies), particularly as the plan currently has some flood control measures.

Controls at the REP level would be particularly relevant if a flood standard greater than the 100 year ARI flood was pursued as the adoption of a different standard within the floodplains could produce inconsistencies in standards for development, conflict between development potential over local government boundaries and potential confusion and uncertainty in evacuation needs and flood awareness programmes.

Specific matters that could be addressed within an amendment of the Hunter REP may include the following:

(a) A recognition that the management of the floodplain needs to extend to the whole of the floodplain as recognised by the PMF.

(b) Objectives for the management of the floodplain which could be common to the whole area.

(c) Specific matters for consideration for rezoning of land within the floodplain (which in part is discussed later in this report).

(d) Specific matters for consideration in the assessment of development applications (refer also to guidelines outlined later in this report).

These options would need to be pursued by the Department of Urban Affairs & Planning in consultation with relevant government authorities and local Councils. Council could refer this FPMS to the Department to initiate consideration of the above recommendations.

6.4 Local Environmental Plans (LEP's)

There are various aspects of Council's current LEP and other potential applications of the LEP which can be appropriately structured to form a component in the application of the FPMP. It is noted that the structure of the LEP should be such that it provides the necessary flexibility for the adoption of other FPMP's and their associated planning recommendations which may be prepared from time to time elsewhere within the Shire. In this regard, the importance of the LEP can be summarised as follows.

- To provide objectives for the application of Floodplain Management principles in the assessment of development applications.

- To appropriately identify areas subject to flooding in order that development applications in such areas may be specially considered and that Council has a basis for notifying the public of the potential for flooding on individual parcels of land in accordance with Section 149 Certificates issued under the Act.

- To outline general matters for consideration with more detailed controls being the subject of a Development Control Plan (DCP) in accordance with common and accepted practice.

- To ensure that the permissibility and prohibition of uses is consistent with the Floodplain Management Plan, in order that flood sensitive land uses are clearly prohibited within areas subject to significant and hazardous levels of flooding. In this regard we note that the prohibition of land uses is a matter which must be clearly outlined within LEP's as this function cannot legally be transferred to a DCP.

Having regard to the above potential applications for an LEP, the following comments are provided.

Objectives

At present, Council's LEP 1986 does not provide a structure which would logically allow for the introduction of objectives relating to floodplain management. However, it would be desirable to provide objectives within any future Shire LEP to provide for the application of floodplain management principles in the assessment of the development applications. Such objectives could include the following:-

- *To reduce the incidence of damage and level of risk to areas subject to flooding by restricting development in the floodplain and in the floodways.*

- *To allow for more detailed controls on development in the floodplain and in the floodways to be implemented within the development control plan."*

Definitions

As a general principle, it is considered preferable that the consideration of the flood hazard be a manner applicable to the whole of the floodplain (i.e. up to the PMF) albeit that the considerations will vary considerably across the floodplain depended upon the sensitivity of individual land uses and the extent of the flood hazard in any particular area. Accordingly, it is considered appropriate that a definition of flood prone land similar to that within the Draft Floodplain Management Manual be adopted.

As previously outlined, it is considered that the definition of 'flood prone land' currently contained within the LEP should be amended to refer to the identification of the floodplain extent on the LEP map, as opposed to a separate set of maps held in the office of Council. This would avoid confusion, particularly as the LEP maps do currently identify flood extents. The key on the LEP map should also be amended to reflect similar terminology (ie. flood prone land instead of what is currently shown as flood liable land) to similarly avoid any confusion.

Identifying the whole of the floodplain (ie, up to the PMF) would allow the acknowledgement of flood risks within the whole of the floodplain. This does not mean that it is proposed to reduce development potential in the floodplain. A detailed DCP will provide a gradation of planning controls relative to position of land in the floodplain and consequent flood risk. Three "bands" are to be identified in the floodplain, being:

- **Floodway** - High Hazard within the 100 year ARI flood extent (plus 0.5m freeboard) provide a gradation of planning controls relative to position of land in the floodplain and consequent flood risk. Three "bands" are to be identified in the floodplain, being:

- **Floodway** - High Hazard within the 100 year ARI flood extent (plus 0.5m freeboard)
- **Flood Fringe** - Floodway to 100 year ARI flood extent (plus 0.5m freeboard)
- **Outer Floodplain** - 100 year ARI flood extent (plus 0.5m freeboard) to PMF.

Accordingly, it would be appropriate to identify the PMF, 100 year ARI flood extent (plus 0.5m freeboard) and floodway on the LEP map.

It is also considered desirable that the component of flood prone land which is clearly unsuitable to specific uses due to the extent of the hazard, be identified and defined in order to provide a basis to prohibit inappropriate land uses from this area. This hazardous component of flood prone land may be defined under various terms depended upon the contents of the FPMS and local area, but in the case of Scone the "floodway" would appear to be the most appropriate term. Accordingly, it is recommended that a definition of floodway be adopted.

In the case of Scone, only minor adjustments will be required to Council's zone map to reflect the high hazard flood extent determined by recent flood mapping of the Middle Brook, Kingdon Ponds and Parsons Gully floodplain, associated with this FPMS, however, no flood extent or flood hazard mapping has been undertaken for that portion of Figtree Creek Gully east of Barton Street. As this area is currently zoned for residential development (2(d) Residential Release Area) it would be desirable to extend flood mapping to identify the flood extent, including the floodway on the LEP map consistent with the main floodplain. Due to the nature of the flood, and consequent mapping, of the Figtree Creek Gully area east of Barton Street, it is understood that it may be impractical to include the flood extents of all this portion of the floodplain upon the LEP map. This is not a major concern as the majority of this area is substantially undeveloped but where definitive mapping is not possible, a general notation may be desirable.

In the consideration of adopting appropriate definitions regard must be made to other FPMP's which may be undertaken in the same Shire in the future. That is, the structure of the definitions must allow for the logical application of two or more FPMP's and must not complicate Council's duties in regard to areas which are not covered by a FPMP.

Floodways

At present, Council identifies the extent of the flood liable land (approximately being the 100 year ARI floodplain) and provides specific matters for consideration for development applications within this area. However, for the area of the floodplain which is high hazard (that is the floodway in this case) no specific restriction on landuse is provided. However, consistent with the Departmental Circular outlined previously, the principle of restricting any further development within the floodway is supported, due to the danger of locating within the floodway and the possible effect on the flow of floodwaters.

To avoid any potential future uncertainty or conflict, it is considered desirable that Clause 37 of the LEP be amended to specifically prohibit further buildings being constructed within the floodway which is to be identified on the LEP Map. Such a prohibition could be exclusive of recreational and agricultural buildings, and public utilities protected from flooding such as the sewage works.

Summary

Accordingly, the following amendments to LEP 1991 are recommended.

1. The objectives of any future Shire LEP to include the following, where consistent with the structure of the LEP:

   "... to reduce the incidence of damage and level of hazard to areas subject to flooding by restricting development in the floodplain and in the floodways."

   "... to allow for more detail controls on development in the floodplain and in the floodways to be implemented within a Development Control Plan."

2. Amend Clause 5 of the LEP to delete the definition of "flood liable land" and to insert the following definitions for flood prone land, floodways, the flood fringe and the probable maximum flood (PMF).

   > *"**Flood prone land or floodplain**" means the portion of a river valley, adjacent to the river channel which is covered with water when the river overflows during floods and may include the area affected up to the PMF as distinctively identified and shown diagonally hatched with black lines on the map.*

"Outer Floodplain" means that part of the floodplain situated between the 100 year ARI flood and the PMF.

"The extreme flood (PMF)" means the flood estimated to be the maximum likely to occur.

It is noted that some amendments to individual maps may be required where they currently refer to "flood liable land" to ensure that the term flood prone land is used. The LEP map would show the floodplain up to the PMF only where this is known, and therefore not in every case.

5. Amend the LEP Map for Scone (and other areas as appropriate) to delineate and refine the extent of flood prone lands, the 100 year ARI flood and floodways as determined by Council with the assistance of recent flood mapping.

4. Amend Clause 37 to include an additional sub-clause to restrict more intensive development within the floodways. It is suggested that the additional sub-clause could be as follows:

   "(5) Notwithstanding the provisions of clause 8, Council shall not permit development on floodways except for agriculture, animal boarding, breeding or training establishments, extractive industry, forestry, mines, recreation establishment, recreation facility or a retail plant nursery, - designed to minimise the impacts associated with the flooding hazard."

6.5 Development Control Plans

The appropriate mechanism for specifying detail controls to be applied for new development would be a DCP. This document could form an overall comprehensive flood management policy of Council and a suggested draft Policy is contained within **Appendix A5** while the main areas of control are discussed below.

There are seven areas of development control consideration relevant to floodplain planning which may be applied to development in the study area. These seven areas of consideration are as follows:

1. Flood levels.

2. Building components.

3. Structural soundness.

4. External flood affectation.

5. Evacuation/access.

6. Flood awareness.

7. Management and design.

The following provides a discussion of the controls that would be appropriately considered under each of these headings.

Floor Level

All habitable floor levels of dwellings should be no lower than the 100 year flood level plus a 0.5 metre freeboard. Additionally, where practical, extended habitable floors associated with minor additions to existing development should be provided at the 100 year flood level plus 0.5 metres but should never be at a level lower than the existing floor level where that does not comply with the standard.

Less "flood sensitive" landuses such as recreation or agriculture could have buildings located with floor levels at the 1 in 20 year flood level sufficient to avoid nuisance flooding. Critical utilities should have floor levels above the PMF as these will be essential to ensuring minimal disruption to the community during major floods. Essential community facilities (such as hospitals and public halls, etc) should be located outside of the floodplain to provide for potential refuge during major floods and minimal impact to the community.

Flood Compatible Building Components

All structures below the designated flood for individual landuses should be constructed of flood compatible materials. With regard to the identification of appropriate flood compatible materials, an appropriate general list of materials and fittings is provided within the recommended DCP. However, we note that the Department of Land & Water Conservation is currently having a detailed study undertaken by the CSIRO which will identify appropriate flood compatible materials, (including methods of construction) applicable to Australian conditions. The CSIRO study is understood to not yet be completed but is expected to be completed some time during this year. It is recommended that the DCP be reviewed upon completion and availability of this CSIRO study.

Structural Soundness

An engineer's report is considered to be appropriate to ensure structures located within the floodway are capable of withstanding the forces of floods including debris and buoyancy factors. The issue of structural soundness should be considered elsewhere within the floodplain, but it is not considered that an engineering report would be necessary in each case.

External Flood Effects

An appropriate principle in floodplain management is to ensure that development within the floodplain does not increase the flood affectation or hazard upon other properties or persons. Hence, it is recommended that an engineer's report is provided for any development within the floodway or for any subdivision and filling in the 100 year floodplain to prove that the development will not increase flood affectation elsewhere. This matter will also need to be considered with regard to other landuses in the floodplain but an engineering report may not be necessary in each case.

Evacuation/Access

Having regard to the short warning time (less than 3 hours) and the isolated nature of parts of the study area careful consideration of evacuation measures and available access to existing and new development is important. Accordingly, a number of controls regarding the provision of reliable access and the preparation of flood evacuation strategies is recommended.

Flood Awareness

The planning mechanisms available to assist in increasing flood awareness include the provision of notations upon Section 149(2) Certificates (zoning certificates) and imposition of restrictions on titles of new allotments created through subdivision advising of minimum floor levels relative to the flood level and of Council's flood prone land policy. Such mechanisms are recommended as outlined later in this report.

Management and Design

Special consideration of the design and management of individual proposals can also reduce the flood risk and potential damage to property and persons. These measures may involve the provision of a flood plan for individual sites which ensures that individuals consider and plan means to minimise the likelihood of flood damage, including providing for the movement of goods above the flood level within the likely available flood warning time. Other specific considerations are for the storage of certain goods above the designated flood level and requiring the implementation of mitigating measures to prevent pollution of the floodplain potentially occurring during floods.

6.6 Policies

In addition to formal regulations such as the DCP, Council may wish to identify and adopt specific policies with regard to their long term vision for development within the floodplain. This may be a stand along document or form a component of the DCP for the purposes of providing one comprehensive document, may include matters such as Council's policy in regard to dealing with rezoning applications on flood affected land.

6.7 Section 94 Contributions Plans

A Section 94 Contributions Plan includes detail in regard to anticipated increase of demand for public services and amenities arising from projected new development and provides calculations for developer contributions in order to fund the additional public services and amenities in accordance with an identified schedule of works. Section 94 Contributions Plans have an implication in regard to the Floodplain Management Study, where it is necessary or appropriate to fund flood mitigation works through such plans.

Having regard to the minimal expected further development in the floodplain, the option of using a Section 94 Contributions Plan to fund or partially fund any flood mitigation works is unlikely to be viable.

7.0 VEGETATION ISSUES

The majority of the floodplain within the study area is cleared pasture land with minimal existing indigenous flora.

Native vegetation within the main floodplain (Middle Brook, Kingdon Ponds and Parsons Gully) is restricted to mainly the tree species of *Casuarina cunninghamiana* (She Oak) and *Eucalyptus sp.* (Gum Tree). Minimal indigenous understorey flora remains.

There are extensive exotic plant species in the main floodplain, including various noxious weeds, particularly adjacent to the fringe of the urban areas and along roadways. Exotic tree species include *Populus alba* (Silver Poplar), *Populus nigra 'Italica'* (Lombardy Poplar), *Salix babylonica* (Weeping Willow), *Schinus molle* (Pepper Tree), *Fraxinus sp.* (Claret and Golden Ash) and *Prunus sp.* (Wild Peach/Plum). Within the main recreation area of the town immediately south of Kingdon Street recent plantings include *Fraxinus sp.*, *Grevillea robusta* (Silky Oak), and a minimal proportion of indigenous species.

Weed species along the creek corridors and road corridors in the main floodplain, in particular, include primarily exotic grass species such as Kikuyu (*Pennistum clandestinum)*, Paspalum (*Paspalum dilatatum)* with Fennel (*Foeniculum vulgare*) primarily along the road reserves.

As the Figtree Creek Gully floodplain (west of Barton Street) is substantially developed, the majority of native flora has been removed and existing vegetation comprises predominantly domesticated exotic plants. Species observed within the Figtree Creek corridor east of the New England Highway include *Fraxinus sp.*, *Schinus molle, Banksia integrifolia* (Coast Banksia), *Vibunum tinus, Szyagrus romanzoffianum* (Cocos Palm), *Phoenix canariensis* (Canary Island Date Palm), *Eucalyptus sp., Ligustrum sinensis* (Large Leafed Privet), and *Cotoneaster sp.* Some portions of the creek gully in this area (particularly that part adjoining Main Street) have some weed species such as Bamboo and Caster Oil Plant immediately along the formalised creek corridor. Further upstream the creek corridor exists within grass swales with minimal tree cover.

That portion of the Figtree Creek Gully floodplain to the west of the New England Highway similarly contains a number of domesticated exotic plant species including *Acer negundo* (Box Elder), *Ulmus parvifolia* (Chinese Weeping Elm), *Salix babylonica, Pinus radiata* (Radiata Pine), *Fraxinus sp.*, and *Cinnamomum camphora* (Camphor Laurel). As with the other areas of the floodplain there is minimal understorey, with ground cover comprising predominately exotic grass species including Kikuyu and Paspalum.

It is considered desirable to discourage non-indigenous plant species from the primary creek corridors as they can develop unnaturally as a weed problem causing congestion to the flow of flood waters and possible additional flooding problems, as well as general degradation to the ecological environment of the creek corridors. While not an apparent problem within the subject floodplains at present, other inland areas of NSW have had a developing problem associated with the spread of Poplars and Salix species as well as various noxious weeds within creek corridors causing both a degradation to the indigenous flora community and exacerbating flooding problems.

The majority of the floodplain, including the immediate creek corridors, are within private ownership. Indeed, that area of Figtree Creek which traverses through smaller residential allotments is not contained within individual drainage easements. Accordingly, at present Council has minimal ability to implement a vegetation strategy along the creek corridors as a single and comprehensive exercise. However, it is recommended that Council take whatever opportunities are available to them to secure the immediate creek corridors within easements or open space zonings (public reserves), particularly as part of the requirements of approvals issued for individual developments.

The Scone Landcare Group have recently formed and have as their main objective the revegetation of the creek corridors. Council's support of this group's objectives would be desirable, but this should be in the context of a predefined vegetation strategy which adopts the following specific principles:

(i) Species must be indigenous to the area;

(ii) Species must be suited to a creek environment;

(iii) Density of planting must be appropriate for a creek prone to flooding; and

(iv) Density of structure should ensure a healthy upper, middle and ground level vegetation cover which encourages a greater diversity of fauna.

Overall, the implementation of a vegetation strategy will provide primarily a mechanism to improve the ecological and aesthetic quality of the creek corridors but also a means to ensure that inappropriate exotic species do not result in a future weed infestation problem and the potential for the obstruction of floodwaters. Such a strategy will necessarily involve a long term and ongoing program involving maintenance on a regular basis to guarantee the sustainability of such an environment, and must be approached in a planned and coordinated manner.

8.0 RECOMMENDED PLANNING MEASURES

Having regard to the above discussion, the following planning measures are recommended:

(a) That consideration be given to the application of a graded set of planning controls for different landuses relative to different predicted flood levels within the study area.

(b) That the planning implications for each of the structural mitigation matters be addressed, having regard to the issues outlined within this report, prior to proceeding.

(c) That Council amend Scone LEP 1986 in the following manner:-

1. The objectives of any future Shire LEP to include the following, where consistent with the structure of the LEP:

   "... to reduce the incidence of damage and level of hazard to areas subject to flooding by restricting development in the floodplain and in the floodways."

   "... to allow for more detail controls on development in the floodplain and in the floodways to be implemented within a Development Control Plan."

2. Amend Clause 5 of the LEP to delete the definition of "flood liable land" and to insert the following definitions for flood prone land, floodways, the flood fringe and the extreme flood (PMF).

   "Flood prone land or floodplain" means the portion of a river valley, adjacent to the river channel which is covered with water when the river overflows during floods and may include the area affected up to the PMF as distinctively identified and shown diagonally hatched with black lines on the map.

   "Floodway" means a channel of a river or stream and those portions of the floodplain adjoining the channel which constitute the main flow path of flood waters and would pose a significant hazard to property and persons,

as distinctively identified and shown diagonally cross-hatched with black lines on the map.

"Outer Floodplain" means that part of the floodplain situated between the 100 year ARI flood and the PMF.

"The extreme flood (PMF)" means the flood estimated to be the maximum likely to occur.

It is noted that some amendments to individual maps may be required where they currently refer to "flood liable land" to ensure that the term flood prone land is used. The LEP map would show the floodplain up to the PMF only where this is known, and therefore not in every case.

5. Amend the LEP Map for Scone (and other areas as appropriate) to delineate and refine the extent of flood prone lands, the 100 year ARI flood and floodways as determined by Council with the assistance of recent flood mapping.

4. Amend Clause 37 to include an additional sub-clause to restrict more intensive development within the floodways. It is suggested that the additional sub-clause could be as follows:

   "(5) Notwithstanding the provisions of clause 8, Council shall not permit development on floodways except for agriculture, animal boarding, breeding or training establishments, extractive industry, forestry, mines, recreation establishment, recreation facility or a retail plant nursery."

(d) A Development Control Plan be adopted outlining appropriate measures to be applied to development in the floodplain. In this regard, **Appendix A5** provides a suggested Draft Development Control Plan for Council's consideration and adoption in accordance with the process required under the EPA Act.

(e) That Council consider revising Scone LEP 1986 to prohibit unsuitable landuses within areas subject to certain predicted flood levels, in a manner which is consistent with the suggested DCP provided at **Appendix A5**.

(f) That Council incorporate notations upon Section 149(2) Certificates which identify the affectation by projected floods up to the PMF flood. Additional notations regarding any affectation from a defined floodway would also need to be applied having regard to the recommendations above, and any further policies which arise from the recommendations of the overall FPMS and FPMP.

(g) That Council supports the preparation of a Vegetation Management Strategy and Plan for the creek corridors consistent with the principles outlined in this report.

It is considered that the above recommendations provide appropriate responses to the issues raised and evaluated within the context of the FPMS and the legislative framework associated with planning. The planning controls by their nature provide measures to address the flooding issue associated with new development, and other measures may be recommended elsewhere within the FPMP dealing with existing development.

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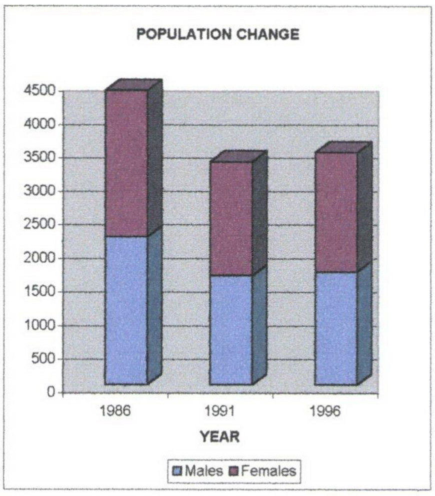
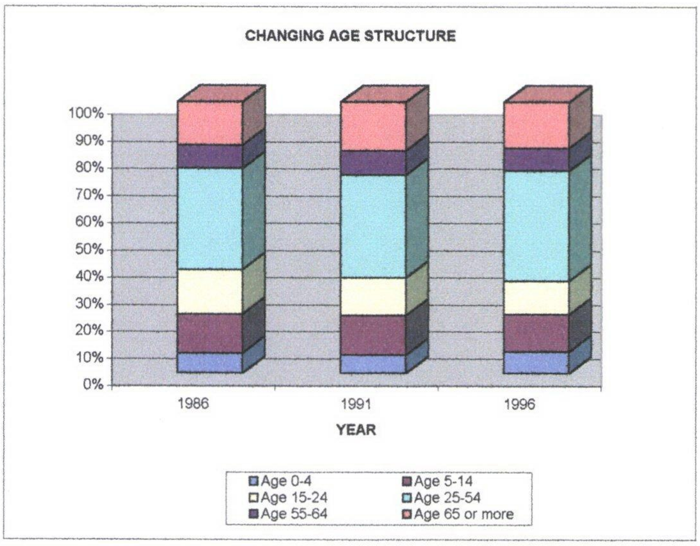
APPENDIX A1

ANALYSIS OF CENSUS INFORMATION : 1986 TO 1996

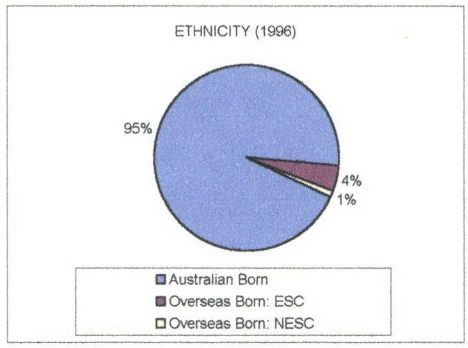
Table 1. Population and Selected Indicators

AREA: **Scone**	1986	1991	1996	Change 1986-96	%Change 1986-96	Compound Rate of Change 1986-91	1991-96
DEMOGRAPHIC SUMMARY							
Total persons							
Males	2202	1624	1684	-518	-24	-5.9%	0.7%
Females	2188	1704	1784	-404	-18	-4.9%	0.9%
Persons	4390	3328	3468	-922	-21	-5.4%	0.8%
Aged 15 years and over							
Males	1686	1283	1311	-375	-22	-5.3%	0.4%
Females	1742	1356	1403	-339	-19	-4.9%	0.7%
Persons	3428	2639	2714	-714	-21	-5.1%	0.6%
Aborig. & Torres St. Is.							
Males	20	37	40	20	100	13.1%	1.6%
Females	22	23	45	23	105	0.9%	14.4%
Persons	42	60	85	43	102	7.4%	7.2%
AGE SUMMARY							
Age 0-4	327	224	276	-51	-16	-7.3%	4.3%
Age 5-14	630	491	475	-155	-25	-4.9%	-0.7%
Age 15-24	726	469	430	-296	-41	-8.4%	-1.7%
Age 25-54	1628	1265	1397	-231	-14	-4.9%	2.0%
Age 55-64	375	294	291	-84	-22	-4.8%	-0.2%
Age 65 or more	699	601	583	-116	-17	-3.0%	-0.6%
Age Group as a Percentage of the Population							
Age 0-4	7	7	8	1	7	-2.0%	3.4%
Age 5-14	14	15	14	-1	-5	0.6%	-1.5%
Age 15-24	17	14	12	-4	-25	-3.1%	-2.5%
Age 25-54	37	38	40	3	9	0.5%	1.2%
Age 55-64	9	9	8	0	-2	0.7%	-1.0%
Age 65 or more	16	18	17	1	6	2.6%	-1.4%
Median Age							
Males	29	32	34	5	17		
Females	35	37	37	2	6		
Persons	32	35	35	3	9		

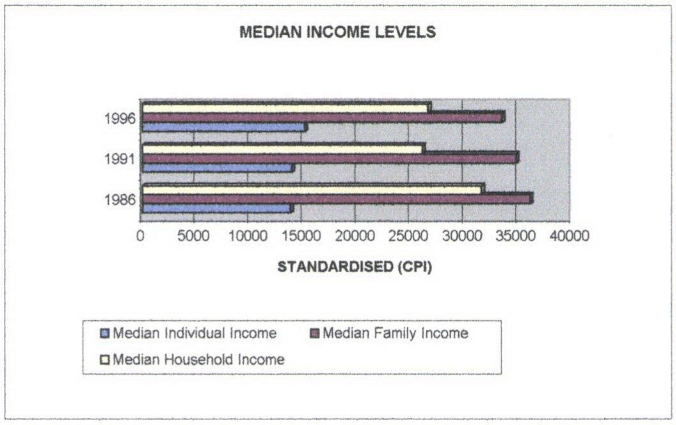




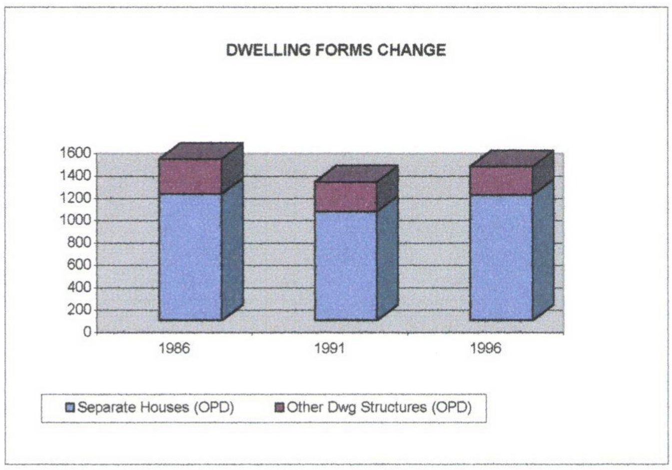
AREA: **Scone**				Change	%Change	of Change	
ETHNICITY SUMMARY	1986	1991	1996	1986-96	1986-96	1986-91	1991-96
Australian Born	4105	3070	3154	-951	-23	-5.6%	0.5%
Overseas Born: ESC	164	152	147	-17	-10	-1.5%	-0.7%
Overseas Born: NESC	70	49	36	-34	-49	-6.9%	-6.0%
Total Overseas Born	234	201	183	-51	-22	-3.0%	-1.9%
Birthplace Group as a Percentage of the Population							
Australian Born	94	92	91	-3	-3		
Overseas Born: ESC	4	5	4	1	13		
Overseas Born: NESC	2	1	1	-1	-35		
Total Overseas Born	5	6	5	0	-1		
OSB Poor English speakers	6	0	0	-6	-100		
OSB Poor Eng % of pop	0	0	0	0	-100		
OSB Poor Eng % of 5+ pop	0	0	0	0	-100		



LABOUR FORCE SUMMARY	1986	1991	1996	Change 1986-96	%Change 1986-96
Employed	1749	1338	1389	-360	-21
Unemployed	157	111	132	-25	-16
Not in the Labour Force	1488	1101	1132	-356	-24
Unemployment Rate	8	8	9	0	5
Participation Rate	56	55	56	1	1
INCOME SUMMARY					
Median Individual Income	8700	12300	15100	6400	74
Median Family Income	22800	30800	33500	10700	47
Median Household Income	20000	23100	26600	6600	33
Standardised Medians (CPI)					
Median Individual Income	13800	13900	15100	1300	9
Median Family Income	36100	34800	33500	-2600	-7
Median Household Income	31600	26100	26600	-5000	-16



AREA: **Scone**				Change	%Change
DWELLINGS SUMMARY	1986	1991	1996	1986-96	1986-96
Occupied Pvte Dwgs (OPD)	1444	1240	1376	-68	-5
Occupancy Ratio	2.71	2.46	2.37	0	-13
H'holds Owned/purch'g	766	738	804	38	5
H'holds Renting	610	440	482	-128	-21
% Hlds Owned/purch'g	53	60	58	5	10
% Hlds Renting	42	35	35	-7	-17
Average Number bedrooms	3	3	n/av	n/av	n/av
Average Number vehicles	1	1	1	0	-8
Separate Houses (OPD)	1133	972	1123	-10	-1
Other Dwg Structures (OPD)	311	268	253	-58	-19
% Separate Houses	78	78	82	3	4
% Other Dwg Structures	22	22	18	-3	-15
Median Mortgage	326	487	768	442	136
Median Rent	68	78	103	35	51
Standardised Medians (CPI)					
Median Mortgage	517	550	768	251	49
Median Rent	108	88	103	-5	-4



EXPLANATORY NOTES

OSB: ESC — Overseas born: Main English Speaking Countries. This is an approximation only, as Canada is not included for 1986.

OSB: NESC — Overseas born: Other than Main English Speaking Countries

OSB Poor English speakers — Overseas born people who speak English "Not well" or " Not at All" - Note 1986 measures OSB NESC only.

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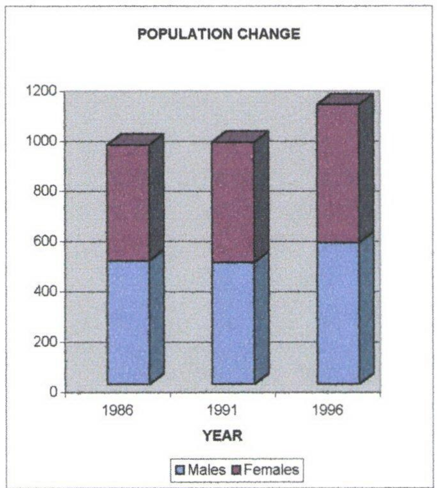
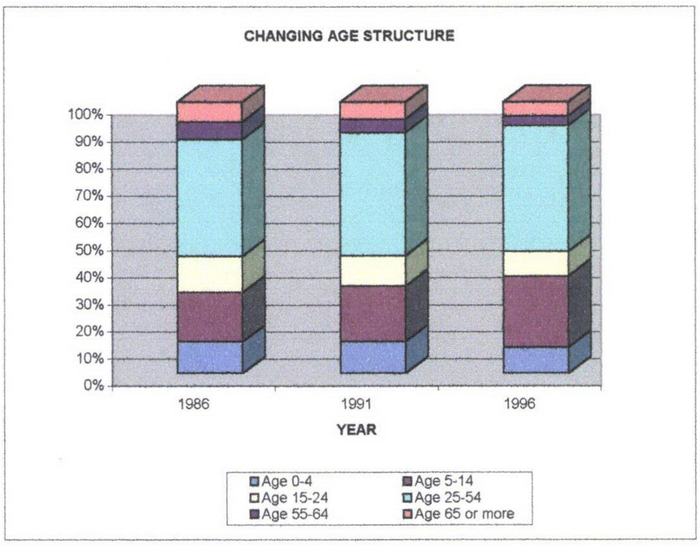
APPENDIX A2

ANALYSIS OF CENSUS INFORMATION : 1986 TO 1996

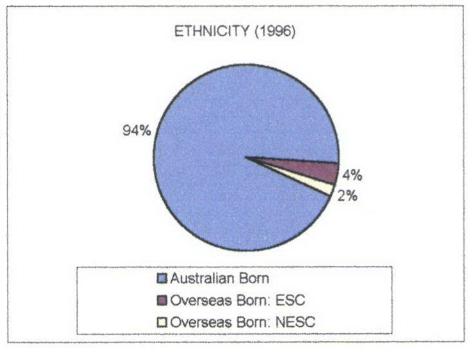
Table 1. Population and Selected Indicators

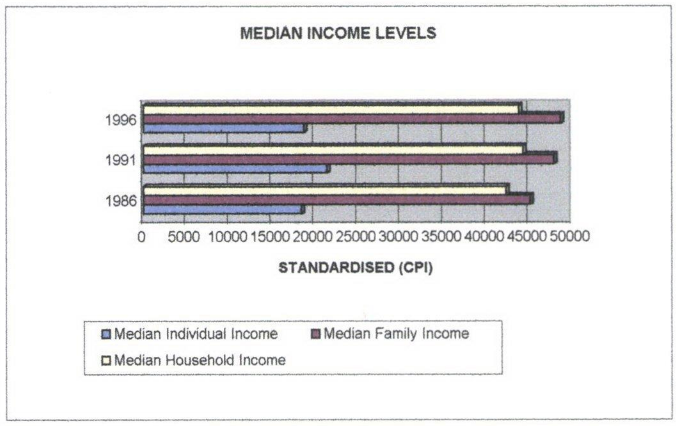
AREA: **Satur**	1986	1991	1996	Change 1986-96	%Change 1986-96	Compound Rate of Change 1986-91	Compound Rate of Change 1991-96
DEMOGRAPHIC SUMMARY							
Total persons							
Males	490	484	562	72	15	-0.2%	3.0%
Females	463	480	551	88	19	0.7%	2.8%
Persons	953	964	1113	160	17	0.2%	2.9%
Aged 15 years and over							
Males	342	330	349	7	2	-0.7%	1.1%
Females	326	328	362	36	11	0.1%	2.0%
Persons	668	658	711	43	6	-0.3%	1.6%
Aborig. & Torres St. Is.							
Males	2	6	3	1	50	24.6%	-12.9%
Females	2	3	3	1	50	8.4%	0.0%
Persons	4	9	6	2	50	17.6%	-7.8%
AGE SUMMARY							
Age 0-4	111	113	108	-3	-3	0.4%	-0.9%
Age 5-14	174	198	295	121	70	2.6%	8.3%
Age 15-24	127	108	101	-26	-20	-3.2%	-1.3%
Age 25-54	410	436	521	111	27	1.2%	3.6%
Age 55-64	62	48	40	-22	-35	-5.0%	-3.6%
Age 65 or more	69	60	57	-12	-17	-2.8%	-1.0%
Age Group as a Percentage of the Population							
Age 0-4	12	12	10	-2	-17	0.1%	-3.7%
Age 5-14	18	21	27	8	45	2.4%	5.2%
Age 15-24	13	11	9	-4	-32	-3.4%	-4.1%
Age 25-54	43	45	47	4	9	1.0%	0.7%
Age 55-64	7	5	4	-3	-45	-5.2%	-6.3%
Age 65 or more	7	6	5	-2	-29	-3.0%	-3.8%
Median Age							
Males	28	29	27	-1	-4		
Females	28	28	30	2	7		
Persons	28	29	28	0	0		



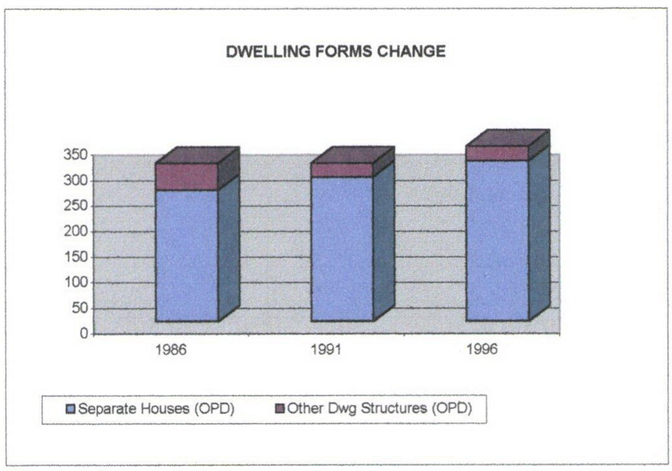


AREA: **Satur**				Change	%Change	of Change	
ETHNICITY SUMMARY	1986	1991	1996	1986-96	1986-96	1986-91	1991-96
Australian Born	877	897	1021	144	16	0.5%	2.6%
Overseas Born: ESC	49	28	40	-9	-18	-10.6%	7.4%
Overseas Born: NESC	16	13	23	7	44	-4.1%	12.1%
Total Overseas Born	65	41	63	-2	-3	-8.8%	9.0%
Birthplace Group as a Percentage of the Population							
Australian Born	92	93	92	0	0		
Overseas Born: ESC	5	3	4	-2	-30		
Overseas Born: NESC	2	1	2	0	23		
Total Overseas Born	7	4	6	-1	-17		
OSB Poor English speakers	0	6	9	9	#DIV/0!		
OSB Poor Eng % of pop	0	1	1	1	#DIV/0!		
OSB Poor Eng % of 5+ pop	0	1	1	1	#DIV/0!		
LABOUR FORCE SUMMARY							
Employed	407	443	451	44	11		
Unemployed	24	15	28	4	17		
Not in the Labour Force	217	186	217	0	0		
Unemployment Rate	6	3	6	0	5		
Participation Rate	65	70	67	2	3		
INCOME SUMMARY							
Median Individual Income	11600	18900	18700	7100	61		
Median Family Income	28500	42400	48700	20200	71		
Median Household Income	26700	39200	43800	17100	64		
Standardised Medians (CPI)							
Median Individual Income	18400	21400	18700	300	2		
Median Family Income	45100	47900	48700	3600	8		
Median Household Income	42300	44300	43800	1500	4		





AREA: **Satur**				Change	%Change
DWELLINGS SUMMARY	1986	1991	1996	1986-96	1986-96
Occupied Pvte Dwgs (OPD)	311	311	343	32	10
Occupancy Ratio	3.03	3.09	3.24	0	7
H'holds Owned/purch'g	213	243	255	42	20
H'holds Renting	84	58	79	-5	-6
% Hlds Owned/purch'g	68	78	74	6	9
% Hlds Renting	27	19	23	-4	-15
Average Number bedrooms	3	4	n/av	n/av	n/av
Average Number vehicles	2	2	2	0	0
Separate Houses (OPD)	258	284	315	57	22
Other Dwg Structures (OPD)	53	27	28	-25	-47
% Separate Houses	83	91	92	9	11
% Other Dwg Structures	17	9	8	-9	-52
Median Mortgage	433	555	809	376	87
Median Rent	89	118	134	45	51
Standardised Medians (CPI)					
Median Mortgage	686	627	809	123	18
Median Rent	141	133	134	-7	-5



EXPLANATORY NOTES

OSB: ESC — Overseas born: Main English Speaking Countries. This is an approximation only, as Canada is not included for 1986.

OSB: NESC — Overseas born: Other than Main English Speaking Countries

OSB Poor English speakers — Overseas born people who speak English "Not well" or " Not at All" - Note 1986 measures OSB NESC only.

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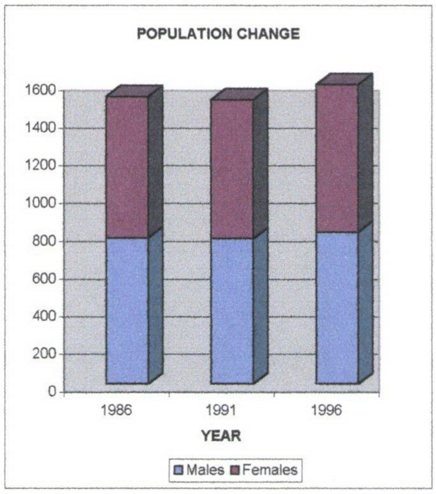
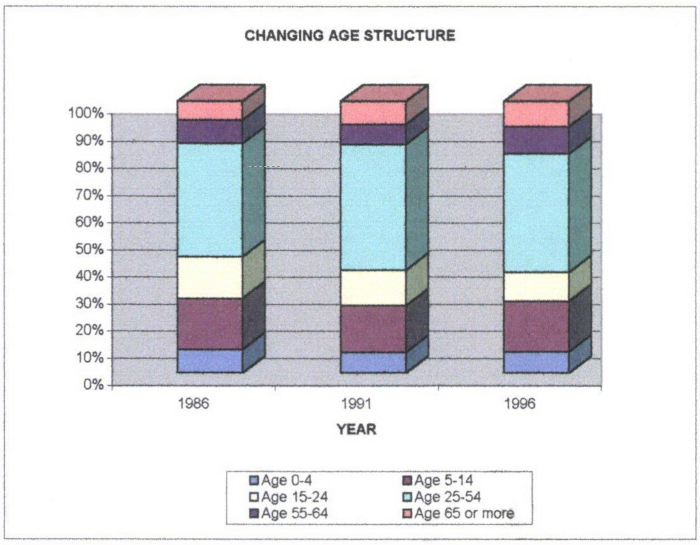
APPENDIX A3

ANALYSIS OF CENSUS INFORMATION : 1986 TO 1996

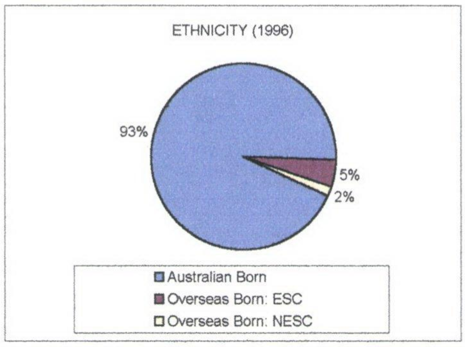
Table 1. Population and Selected Indicators

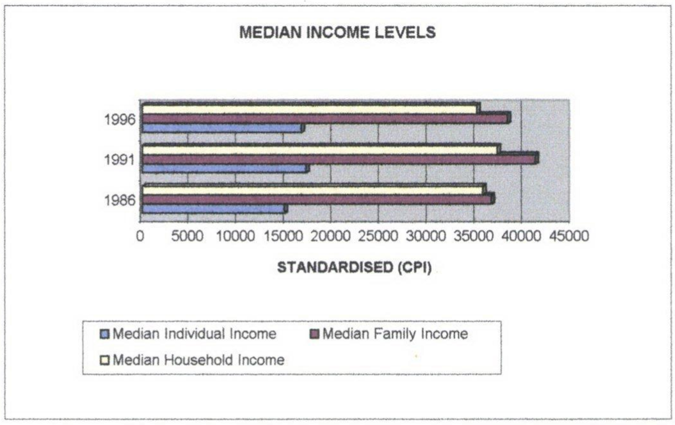
AREA: **Rural**	1986	1991	1996	Change 1986-96	%Change 1986-96	Compound Rate of Change 1986-91	Compound Rate of Change 1991-96
DEMOGRAPHIC SUMMARY							
Total persons							
Males	776	772	807	31	4	-0.1%	0.9%
Females	749	735	782	33	4	-0.4%	1.2%
Persons	1525	1507	1589	64	4	-0.2%	1.1%
Aged 15 years and over							
Males	569	580	592	23	4	0.4%	0.4%
Females	543	548	579	36	7	0.2%	1.1%
Persons	1112	1128	1171	59	5	0.3%	0.8%
Aborig. & Torres St. Is.							
Males	2	6	3	1	50	24.6%	-12.9%
Females	0	0	7	7	#DIV/0!	#DIV/0!	#DIV/0!
Persons	2	6	10	8	400	24.6%	10.8%
AGE SUMMARY							
Age 0-4	132	115	124	-8	-6	-2.7%	1.5%
Age 5-14	287	259	294	7	2	-2.0%	2.6%
Age 15-24	237	199	169	-68	-29	-3.4%	-3.2%
Age 25-54	639	702	692	53	8	1.9%	-0.3%
Age 55-64	132	111	158	26	20	-3.4%	7.3%
Age 65 or more	104	127	146	42	40	4.1%	2.8%
Age Group as a Percentage of the Population							
Age 0-4	9	8	8	-1	-10	-2.5%	0.4%
Age 5-14	19	17	19	0	-2	-1.8%	1.5%
Age 15-24	16	13	11	-5	-32	-3.2%	-4.2%
Age 25-54	42	47	44	2	4	2.1%	-1.3%
Age 55-64	9	7	10	1	15	-3.2%	6.2%
Age 65 or more	7	8	9	2	35	4.3%	1.7%
Median Age							
Males	29	31	35	6	21		
Females	29	33	35	6	21		
Persons	29	32	35	6	21		



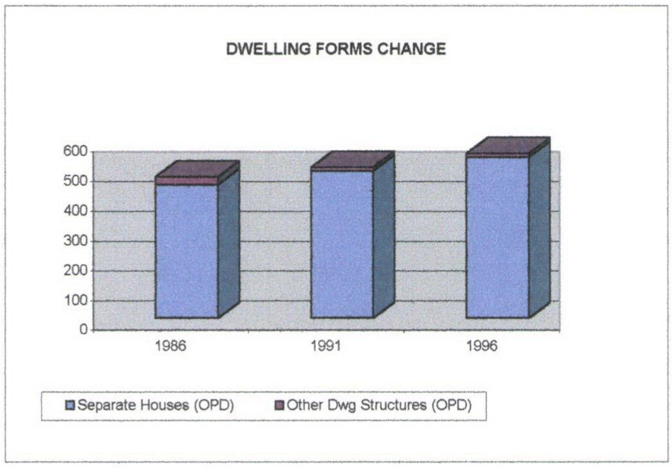


AREA: **Rural**				Change	%Change	of Change	
ETHNICITY SUMMARY	1986	1991	1996	1986-96	1986-96	1986-91	1991-96
Australian Born	1420	1391	1441	21	1	-0.4%	0.7%
Overseas Born: ESC	68	84	73	5	7	4.3%	-2.8%
Overseas Born: NESC	29	26	27	-2	-7	-2.2%	0.8%
Total Overseas Born	97	110	100	3	3	2.5%	-1.9%
Birthplace Group as a Percentage of the Population							
Australian Born	93	92	91	-2	-3		
Overseas Born: ESC	4	6	5	0	3		
Overseas Born: NESC	2	2	2	0	-11		
Total Overseas Born	6	7	6	0	-1		
OSB Poor English speakers	4	3	6	2	50		
OSB Poor Eng % of pop	0	0	0	0	44		
OSB Poor Eng % of 5+ pop	0	0	0	0	43		
LABOUR FORCE SUMMARY							
Employed	748	785	756	8	1		
Unemployed	25	42	38	13	52		
Not in the Labour Force	312	305	347	35	11		
Unemployment Rate	3	5	5	2	48		
Participation Rate	70	73	68	-1	-2		
INCOME SUMMARY							
Median Individual Income	9400	15200	16700	7300	78		
Median Family Income	23100	36400	38300	15200	66		
Median Household Income	22600	32900	35100	12500	55		
Standardised Medians (CPI)							
Median Individual Income	14900	17200	16700	1800	12		
Median Family Income	36600	41200	38300	1700	5		
Median Household Income	35700	37200	35100	-600	-2		





AREA: **Rural**				Change	%Change
DWELLINGS SUMMARY	1986	1991	1996	1986-96	1986-96
Occupied Pvte Dwgs (OPD)	475	508	554	79	17
Occupancy Ratio	3.21	2.97	2.86	0	-11
H'holds Owned/purch'g	294	315	375	81	28
H'holds Renting	98	125	101	3	3
% Hlds Owned/purch'g	62	62	68	6	9
% Hlds Renting	21	25	18	-2	-12
Average Number bedrooms	3	3	n/av	n/av	n/av
Average Number vehicles	2	2	2	0	-2
Separate Houses (OPD)	449	495	542	93	21
Other Dwg Structures (OPD)	26	13	12	-14	-54
% Separate Houses	95	97	98	3	3
% Other Dwg Structures	5	3	2	-3	-60
Median Mortgage	500	590	921	421	84
Median Rent	83	84	100	17	20
Standardised Medians (CPI)					
Median Mortgage	792	667	921	129	16
Median Rent	132	95	100	-32	-24



EXPLANATORY NOTES

OSB: ESC — Overseas born: Main English Speaking Countries. This is an approximation only, as Canada is not included for 1986.
OSB: NESC — Overseas born: Other than Main English Speaking Countries
OSB Poor English speakers — Overseas born people who speak English "Not well" or " Not at All" - Note 1986 measures OSB NESC only.

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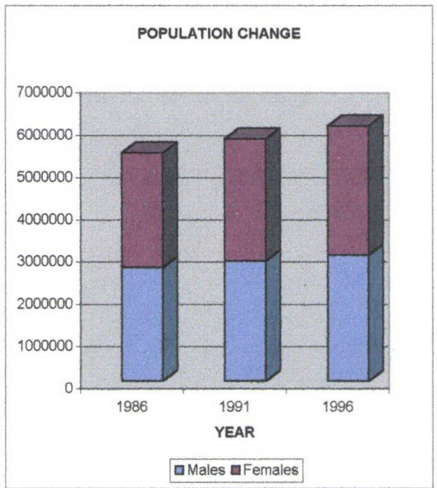
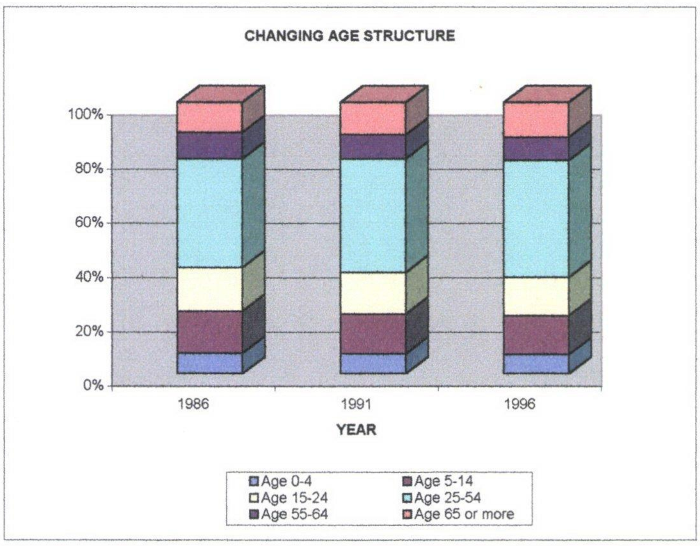
APPENDIX A4

ANALYSIS OF CENSUS INFORMATION : 1986 TO 1996

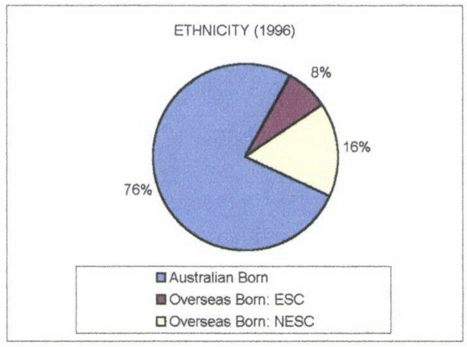
Table 1. Population and Selected Indicators

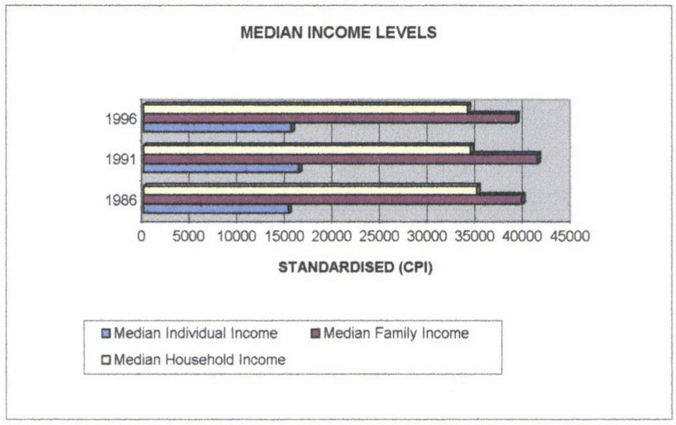
AREA: **New South Wales**	1986	1991	1996	Change 1986-96	%Change 1986-96	Compound Rate of Change 1986-91	Compound Rate of Change 1991-96
DEMOGRAPHIC SUMMARY							
Total persons							
Males	2684570	2844438	2983447	298877	11	1.2%	1.0%
Females	2717311	2887468	3055249	337938	12	1.2%	1.1%
Persons	5401881	5731906	6038696	636815	12	1.2%	1.0%
Aged 15 years and over							
Males	2047002	2196532	2322781	275779	13	1.4%	1.1%
Females	2110389	2271597	2425997	315608	15	1.5%	1.3%
Persons	4157391	4468129	4748778	591387	14	1.5%	1.2%
Aborig. & Torres St. Is.							
Males	29270	34647	50065	20795	71	3.4%	7.6%
Females	29748	35267	51420	21672	73	3.5%	7.8%
Persons	59018	69914	101485	42467	72	3.4%	7.7%
AGE SUMMARY							
Age 0-4	408322	427053	427690	19368	5	0.9%	0.0%
Age 5-14	836168	835997	857902	21734	3	0.0%	0.5%
Age 15-24	867217	878855	848425	-18792	-2	0.3%	-0.7%
Age 25-54	2176326	2408375	2586411	410085	19	2.0%	1.4%
Age 55-64	518976	500615	512215	-6761	-1	-0.7%	0.5%
Age 65 or more	594872	681179	762902	168030	28	2.7%	2.3%
Age Group as a Percentage of the Population							
Age 0-4	8	7	7	0	-6	-0.3%	-1.0%
Age 5-14	15	15	14	-1	-8	-1.2%	-0.5%
Age 15-24	16	15	14	-2	-12	-0.9%	-1.7%
Age 25-54	40	42	43	3	6	0.8%	0.4%
Age 55-64	10	9	8	-1	-12	-1.9%	-0.6%
Age 65 or more	11	12	13	2	15	1.5%	1.2%
Median Age							
Males	30	32	33	3	10		
Females	32	33	35	3	9		
Persons	31	32	34	3	10		



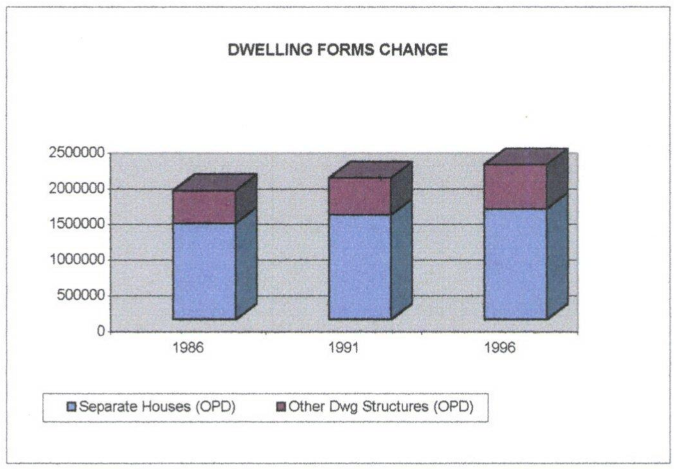


AREA: **New South Wales**				Change	%Change	of Change	
ETHNICITY SUMMARY	1986	1991	1996	1986-96	1986-96	1986-91	1991-96
Australian Born	4191998	4286879	4394218	202220	5	0.4%	0.5%
Overseas Born: ESC	411769	451841	441012	29243	7	1.9%	-0.5%
Overseas Born: NESC	714493	854851	947945	233452	33	3.7%	2.1%
Total Overseas Born	1126262	1306692	1388957	262695	23	3.0%	1.2%
Birthplace Group as a Percentage of the Population							
Australian Born	78	75	73	-5	-6		
Overseas Born: ESC	8	8	7	0	-4		
Overseas Born: NESC	13	15	16	2	19		
Total Overseas Born	21	23	23	2	10		
OSB Poor English speakers	139140	171027	179199	40059	29		
OSB Poor Eng % of pop	3	3	3	0	15		
OSB Poor Eng % of 5+ pop	3	3	3	0	15		
LABOUR FORCE SUMMARY							
Employed	2220666	2406798	2558875	338209	15		
Unemployed	249135	304618	247669	-1466	-1		
Not in the Labour Force	1601172	1637482	1785967	184795	12		
Unemployment Rate	10	11	9	-1	-13		
Participation Rate	59	61	60	0	0		
INCOME SUMMARY							
Median Individual Income	9600	14400	15500	5900	61		
Median Family Income	25100	36500	39100	14000	56		
Median Household Income	22100	30300	34000	11900	54		
Standardised Medians (CPI)							
Median Individual Income	15200	16300	15500	300	2		
Median Family Income	39700	41300	39100	-600	-2		
Median Household Income	35000	34300	34000	-1000	-3		





AREA: **New South Wales**				Change	%Change
DWELLINGS SUMMARY	1986	1991	1996	1986-96	1986-96
Occupied Pvte Dwgs (OPD)	1810726	1987342	2174917	364191	20
Occupancy Ratio	2.86	2.76	2.69	0	-6
H'holds Owned/purch'g	1226450	1317301	1413619	187169	15
H'holds Renting	489573	537580	606851	117278	24
% Hlds Owned/purch'g	68	66	65	-3	-4
% Hlds Renting	27	27	28	1	3
Average Number bedrooms	3	3	n/av	n/av	n/av
Average Number vehicles	1	1	1	0	1
Separate Houses (OPD)	1351542	1470690	1553847	202305	15
Other Dwg Structures (OPD)	459184	516652	621070	161886	35
% Separate Houses	75	74	71	-3	-4
% Other Dwg Structures	25	26	29	3	13
Median Mortgage	391	619	906	515	132
Median Rent	80	127	143	63	79
Standardised Medians (CPI)					
Median Mortgage	620	700	906	286	46
Median Rent	127	144	143	16	13



EXPLANATORY NOTES

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APPENDIX A5

SCONE
FLOOD PRONE
LAND POLICY

DCP No. ....
Environmental Planning and Assessment Act, 1979

APPENDIX A5

1.0 GENERAL

1.1 What is the Policy?

This DCP is to be known as the "Scone Flood Prone Land Policy". This Policy has been adopted by Council at its meeting of .... in accordance with Section 72 of the Environmental Planning and Assessment Act, 1979 (Development Control Plans).

1.2 What Applications does the Policy Apply to?

Council will take into consideration this policy when determining development applications received in accordance with the Environmental Planning and Assessment Act, 1979. This Policy does not propose to exempt any applications from the necessity to obtain a particular approval of the Council, where such a requirement would otherwise exist.

1.3 Where Does the Policy Apply?

The Policy applies to flood prone land in the Town of Scone and surrounding lands as depicted upon the Policy Map.

1.4 How does the Policy relate to Other Legislation and Regulations?

This Policy should be read in conjunction with the relevant provisions of the NSW Government Floodplain Development Manual, the Environmental Planning and Assessment Act, 1979, and Regulations thereto, Scone LEP .... and other relevant Development Control Plans adopted by Council.

1.5 What are the Aims and Objectives of the Policy?

This Policy aims to:-

(a) To provide more detailed controls for the assessment of applications on land affected by potential floods in accordance with the provisions of Scone LEP 1986 (as amended).

(b) To alert the community to the hazard and extent of land affected by potential floods.

(c) To inform the community of Council's policy in relation to the use and development of land affected by the potential floods in Scone.

(d) Reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods.

(e) Deal consistently with applications for development on land affected by potential floods, generally in accordance with the Floodplain Development Manual issued by the New South Wales Government.

(f) To increase public awareness of the potential of floods greater than the 100 year flood and to ensure essential services and landuses are planned in recognition of all potential floods.

(g) Encourage the development and use of land which is compatible with the indicated flood hazard.

(h) To provide different guidelines, for the use and development of land subject to all potential floods in the floodplain, which reflect the probability of the flood occurring and the potential hazard within different areas.

1.6 GLOSSARY

For the purpose of this DCP the following definitions have been adopted:

Australian Height Datum (AHD) is a common national plain of level corresponding approximately to mean sea level.

Design floor level means the floor level specified in this Policy which applies to the relevant land use type and the location and existing ground level of the site.

Designated flood is the flood adopted for planning purposes relative to the sensitivity of different land uses and the flood risk, as specified by Schedule 3.

Designated flood level represents the maximum level of water reached measured as a height above Australian Height datum, during a designated flood.

Effective warning time is equal to the available warning time, less the time taken to alert flood-effected people (by radio, television, loud-hailer or word of mouth) and have them commence effective evacuation procedures.

Flood awareness is an appreciation of the likely effects of flooding an a knowledge of the relevant flood warning and evacuation procedures.

Flood compatible building components means a combination of measures incorporated in the design and/or construction and alteration of individual buildings or structures subject to flooding, and the use of flood compatible materials for the reduction or elimination of flood damage as indicated in the Floodplain Development Manual.

Flood compatible materials include those materials used in building which are resistant to damage when inundated. A list of flood compatible materials is attached in **Schedule 1**.

Flood evacuation strategy means the proposed strategy for the evacuation of areas during periods of flood as specified within any policy of Council, the Floodplain Management Plan, by advices received from the State Emergency Services or as determined in the assessment of individual proposals.

Flood fringe means that part of the floodplain between the floodway and the 100 year ARI flood extent (plus 0.5m freeboard).

Flood prone land or *Floodplain* means the portion of a river valley, adjacent to the river channel, which is covered with water when the river overflows during floods, (includes the area affected up to the PMF).

Flood Plan is a management plan prepared in consultation with the State Emergency Services (SES) which demonstrates the means to minimise the likelihood of flood damage, including demonstrated ability to move goods above flood level within the likely available flood warning time and a requirement for flood drills for larger commercial/industrial premises. This could be in the form of an individual Flood Plan.

Floodway means the channel of a river or stream and those portions of the floodplain adjoining the channel which constitute the main flow path of floodwaters, and is considered to be highly hazardous to persons and property during floods, as identified on a map held within the offices of Council.

Freeboard is a factor of safety usually expressed as a height above the designated flood. Freeboard tends to compensate for factors such as wave action, localised hydraulic effects, etc.

Habitable floor area refers to a room (other than a bathroom, laundry, W.C. or the like) that is constructed or adapted for domestic living such as a lounge room, dining room, rumpus room, kitchen, bedroom.

Outer floodplain refers to that part of the floodplain between the 100 year ARI flood (plus 0.5m freeboard) and PMF extents.

The probable maximum flood (PMF) means the flood estimated to be the maximum likely to occur.

Reliable access during a flood means the ability for people to safely evacuate an area subject to imminent flooding within effective warning time and without a need to travel through areas where water depths increase.

Survey plan is a plan prepared by a registered surveyor which shows the information required for the assessment of an application in accordance with the provisions of this DCP.

2.0 WHAT ARE THE CRITERIA FOR DETERMINING APPLICATIONS?

2.1 General

The criteria for determining applications for proposals potentially affected by flooding are structured in recognition that different controls are applicable to different land uses and levels of potential flood inundation and hazard.

2.2 Land Use Categories

Seven major land use categories have been adopted. The specific uses, as defined by Scone LEP 1986, which may be included in each category, are listed in **Schedule 2**.

2.3 What Controls Apply to Proposed Developments?

The development controls apply to all flood prone land (that is up to the PMF flood). The type of controls have been graded relative to the severity and frequency of potential floods, having regard to the three following applicable categories:

(a) Outer floodplain.

(b) Flood fringe.

(c) Floodway.

Schedule 3 outlines the controls relevant to the area to which this Policy applies for each of the above categories.

2.4 Fencing

2.4.1 Other forms of fencing will be considered by Council on merit.

2.4.2 Council will require an Application for all new fences above 0.6m high.

2.4.3 Fencing within the floodway will generally not be permissible, except for stock fences of a type approved by Council.

2.4.4 An applicant will need to demonstrate that the fence would create no impediment to the flow of floodwaters. Appropriate fences may include:-

(a) An open collapsible hinged fence structure;

(b) Brick or other masonry type fence will generally not be permitted; or

(c) A fence type and siting criteria as prescribed by Council.

2.5 Other Uses and Works

All other development, building or other works on land affected by the designated flood which require Council's consent will be considered on their merits. In consideration of such applications Council must determine that the proposed development is in compliance with the objectives of this policy.

3.0 WHAT INFORMATION IS REQUIRED WITH AN APPLICATION TO ADDRESS THIS POLICY?

3.1 Applications must include information which addresses all relevant controls listed above, and the following matters as applicable.

3.2 Building applications for minor additions to an existing dwelling on land affected by the designated flood shall be accompanied by documentation from a registered surveyor confirming existing floor levels.

3.3 Development, subdivision and building applications for land which is affected by the designated flood shall be accompanied by a survey plan showing:-

(a) The position of the building;

(b) The existing ground levels to Australian height datum around the perimeter of the building; and

(c) The existing or proposed floor levels to Australian height datum.

3.4 Applications for earthworks, filling of land and subdivision shall be accompanied by a survey plan (with a contour interval of 0.25m) showing relative levels to Australian height datum.

3.5 In addition to Council's normal advertising and notification processes for applications for approval, Council shall notify all persons of applications received which, in the opinion of Council, may affect the flow of floodwaters or drainage upon their properties.

Council shall make such applications available for inspection for a period of a minimum of 14 days, during which period any person may make a submission for the consideration of Council when determining the application.

SCHEDULE 1
FLOOD COMPATIBLE MATERIALS

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL	BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL
Flooring and Sub-floor Structure	o concrete slab-on-ground monolith construction note: clay filling is not permitted beneath slab-on-ground construction, which could be inundated o suspension reinforced concrete slab.	**Doors**	o solid panel with water proof adhesives o flush door with marine ply filled with closed cell foam o painted metal construction o aluminium or galvanised steel frame
Floor Covering	o clay tiles o concrete, precast or in situ o concrete tiles o epoxy, formed-in-place o mastic flooring, formed-in-place o rubber sheets or tiles with chemical-set adhesives o silicone floors formed-in-place o vinyl sheets or tiles with chemical-set adhesive o ceramic tiles, fixed with mortar or chemical-set adhesive o asphalt tiles, fixed with water resistant adhesive	**Wall and Ceiling Linings**	o asbestos-cement board o brick, face or glazed o clay tile glazed in waterproof mortar o concrete o concrete block o steel with waterproof applications o stone, natural solid or veneer, waterproof grout o glass blocks o glass o plastic sheeting or wall with waterproof adhesive

BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL	BUILDING COMPONENT	FLOOD COMPATIBLE MATERIAL
Wall Structure	o solid brickwork, blockwork, reinforced, concrete or mass concrete	**Insulation** **Windows**	o foam or closed cell types o aluminium frame with stainless steel or brass rollers
Roofing Structure (for Situations Where the Relevant Flood Level is Above the Ceiling)	o reinforced concrete construction o galvanised metal construction	**Nails, Bolts, Hinges and Fittings**	o brass, nylon or stainless steel o removable pin hinges

Electrical and Mechanical Equipment For dwellings constructed on land to which this Policy applies, the electrical and mechanical materials, equipment and installation should conform to the following requirements.	**Heating and Air Conditioning Systems** Heating and air conditioning systems should, to the maximum extent possible, be installed in areas and spaces of the house above the relevant flood level. When this is not feasible every precaution should be taken to minimise the damage caused by submersion according to the following guidelines.
Main power supply - Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant flood level. Means shall be available to easily disconnect the dwelling from the main power supply.	**Fuel -** Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.

Wiring - All wiring, power outlets, switches, etc., should, to the maximum extent possible, be located above the relevant flood level. All electrical wiring installed below the relevant flood level should be suitable for continuous submergence in water and should contain no fibrous components. Only submersible-type splices should be used below the relevant flood level. All conduits located below the relevant flood level should be so installed that they will be self-draining if subjected to flooding.	**Installation -** The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to an elevation of 600 millimetres above the relevant flood level.
Equipment - All equipment installed below or partially below the relevant flood level should be capable of disconnection by a single plug and socket assembly.	**Ducting -** All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the relevant flood level, the ductwork should be protected by a closure assembly operated from above relevant flood level.
Reconnection - Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.	

SCHEDULE 2
LAND USE CATEGORIES

Essential Community Facilities	Critical Utilities	Subdivision and Filling	Residential	Commercial or Industrial	Recreation or General Agriculture	Minor Development
Commercial premises, Place of Assembly, or Public building which may provide an important contribution to the notification and evacuation of the community during flood events and Hospital.	Generating works, Public Utility Undertakings or Utility Installation Undertakings which may cause pollution of waterways during flooding, are essential to evacuation during periods of flood or if affected during flood events would unreasonably affect the ability of the community to return to normal activities after flood events	Subdivision of land which involves the creation of new allotments for any particular purpose and earthworks or filling operations covering 100m² or more than 0.3m deep.	Boarding house; Caravan park; Child care centre; Cluster development; Dwellings; Dwelling house; Group home; Home industry; Home occupation; Housing for aged or disabled persons; Professional consulting rooms; Public utility undertakings (other than critical utilities); Recreation Establishment; Residential flat building; Rural workers dwelling; Units for aged persons; and Utility installation undertakings (other than critical utilities).	Airline Terminal, Bulk store; Bus depot; Bus station; Car repair stations; Club; Commercial premises (other than where referred to elsewhere); Education establishment; Feed lot; General store; Health care professional; Helipad; Heliport; Hotel; Industry; Institution; Junk yard; Light industry; Liquid fuel depot; Motel; Motor showroom; Offensive or hazardous industry; Offensive storage; Place of assembly (other than essential community facilities); Place of public worship; Public building (other than essential community facilities; Recreation Facility; Refreshment Room; Road transport terminal; Rural industry; Sawmill; Service station; Shop; Tourist facilities; Transport terminal; Warehouse.	Agriculture; Extractive industry; Forestry; Irrigated agriculture; Mine; Mineral sand mine; Retail plant nursery; Recreation area; Roadside stall; and Stock and Sale Yard;	(a) In the case of residential development: (i) an addition to an existing dwelling of not more than 20% or 30m² (whichever is the lesser) of the habitable floor area which existed at the date of commencement of this policy; or (ii) the construction of an outbuilding with a maximum floor area of 20m². (b) In the case of shops & offices: (i) New shops with a total floor area less than 50m²; or (ii) change of use which involves no building. (c) In the case of other development an addition to existing premises of not more than 10% of the floor area which existed at the date of commencement of this policy.

SCHEDULE 3

SCONE FLOODPLAIN MANAGEMENT PLAN

PLANNING MATRIX CONTROLS

DEVELOPMENT CONTROL CONSIDERATION	GROUND LEVEL OF LAND: OUTER FLOODPLAIN ABOVE 100YR ARI FLOOD (PLUS 0.5m FREEBOARD) TO EXF							FLOOD FRINGE BETWEEN HIGH HAZARD AREA TO 100 YEAR ARI FLOOD(PLUS 0.5m FREEBOARD)							FLOODWAY HIGH HAZARD AREA						
	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT	ESSENTIAL COMM FACILITIES	CRITICAL UTILITIES	SUBDIVISION & FILLING	RESIDENTIAL	COMMERCIAL OR IND.	RECREATION OR AGRIC	MINOR DEVELOPMENT
FLOOR LEVEL		3									2	2or 5	1	4						1	4
BUILDING COMPONENTS		2									1	1	1	1						1	1
STRUCTURAL SOUNDNESS		3								2	2	2	2	2						1	1
FLOOD AFFECTATION		2	2		2					1	2	2	2	2						1	1
EVACUATION/ACCESS		2	3		3					1,3	3	3	3							1,3	3
FLOOD AWARENESS		3	3	3	3	3	3			1,2,3	2,3	2,3	2,3	2,3						2,3	2,3
MANAGEMENT & DESIGN		1	4							4	1,2,3	1,2,3	1,2,3	1,3						1,2,3	1,2,3

NOTES

NOT RELEVANT

UNSUITABLE LAND USE

EXF REFERS TO THE EXTREME FLOOD AS DEFINED IN THE GLOSSARY

FLOOR LEVEL

1 ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 20 YEAR ARI FLOOD PLUS 0.5M (FREEBOARD)

2 FLOOR LEVELS (EXCLUDING NON-HABITABLE RESIDENTIAL FLOORSPACE) TO BE EQUAL TO OR GREATER THAN THE 100 YEAR ARI FLOOD PLUS 0.5M (FREEBOARD) AND OTHER FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE 100YR ARI FLOOD (NO FREEBOARD)

3 ALL FLOOR LEVELS TO BE EQUAL TO OR GREATER THAN THE EXF PLUS 0.5M (FREEBOARD)

4 FLOOR LEVELS TO BE AS CLOSE TO THE DESIGN FLOOR LEVEL AS PRACTICAL & NO LOWER THAN THE EXISTING FLOOR LEVEL WHEN AN ADDITION TO AN EXISTING BUILDING

5 FLOOR LEVELS OF SHOPS & OFFICES TO BE AS CLOSE TO THE DESIGN FLOOR LEVEL AS PRACTICAL, OR MORE THAN 30% OF FLOOR AREA OR EQUIVALENT STORAGE SPACE TO BE ABOVE THE DESIGN FLOOR LEVEL, OR PREMISES TO BE FLOOD PROOFED (EG.FLOOD SHUTTERS FOR SHOPS) BELOW THE DESIGN FLOOR LEVEL

FLOOD COMPATIBLE BUILDING COMPONENTS

1 ALL STRUCTURES TO HAVE FLOOD COMPATIBLE BUILDING COMPONENTS BELOW OR AT THE 100 YEAR ARI FLOOD LEVEL PLUS 0.5M(FREEBOARD)

2 ALL STRUCTURES TO BE CONSTRUCTED OF FLOOD COMPATIBLE MATERIALS BELOW OR AT THE EXF LEVEL

STRUCTURAL SOUNDNESS

1 ENGINEERS REPORT TO PROVE ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 100 YR ARI FLOOD LEVEL CAN WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY

2 APPLICANT TO DEMONSTRATE THAT ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCL. THE 100 YEAR ARI FLOOD SHOULD WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY

3 APPLICANT TO DEMONSTRATE THAT ANY STRUCTURE SUBJECT TO A FLOOD UP TO & INCLUDING THE EXF LEVEL SHOULD WITHSTAND THE FORCE OF FLOODWATER, DEBRIS & BUOYANCY

FLOOD EFFECT ON OTHERS

1 ENGINEERS REPORT REQUIRED TO PROVE THAT THE DEVELOPMENT OF AN EXISTING ALLOTMENT WILL NOT INCREASE FLOOD AFFECTATION ELSEWHERE

2 THE IMPACT OF THE DEVELOPMENT ON FLOOD AFFECTATION ELSEWHERE TO BE CONSIDERED

EVACUATION/ACCESS

1 RELIABLE ACCESS FOR PEDESTRIANS REQUIRED DURING A 100 YEAR ARI FLOOD

2 RELIABLE ACCESS FOR PEDESTRIANS & VEHICLES REQUIRED AT OR ABOVE THE EXF LEVEL

3 CONSIDERATION REQUIRED REGARDING AN APPROPIATE FLOOD EVACUATION STRATEGY & PEDESTRIAN /VEHICULAR ACCESS ROUTE FOR BOTH BEFORE & DURING A FLOOD

FLOOD AWARENESS

1 RESTRICTIONS TO BE PLACED ON TITLE ADVISING OF MINIMUM FLOOR LEVELS REQUIRED RELATIVE TO THE FLOOD LEVEL

2 S149(2) CERTIFICATES TO NOTIFY AFFECTATION BY THE 100 YEAR ARI FLOOD

3 S149(2) CERTIFICATES TO NOTIFY AFFECTATION BY THE EXF FLOOD

MANAGEMENT & DESIGN

1 FLOOD PLAN REQUIRED WHERE FLOOR LEVELS ARE BELOW THE DESIGN FLOOR LEVEL

2 APPLICANT TO DEMONSTRATE THAT THERE IS AN AREA WHERE GOODS MAY BE STORED ABOVE THE 100 YEAR ARI FLOOD LEVEL PLUS 0,5M(FREEBOARD) DURING FLOODS.

3 APPLICANT TO PROVIDE CONTROLS WHERE NECESSARY TO PREVENT THE DISCHARGE OF POLLUTION DURING FLOODS.

4 APPLICANT TO DEMONSTRATE THAT POTENTIAL DEVELOPMENT AS A CONSEQUENCE OF A SUBDIVISION PROPOSAL CAN BE UNDERTAKEN WITHOUT ANY SIGNIFICANT FLOOD EFFECT ELSEWHERE AND CAN ACCESS AN APPROPRIATE PEDESTRIAN/VEHICULAR ROUTE AS PART OF A FLOOD EVACUATION STRATEGY IF REQUIRED

APPENDIX B

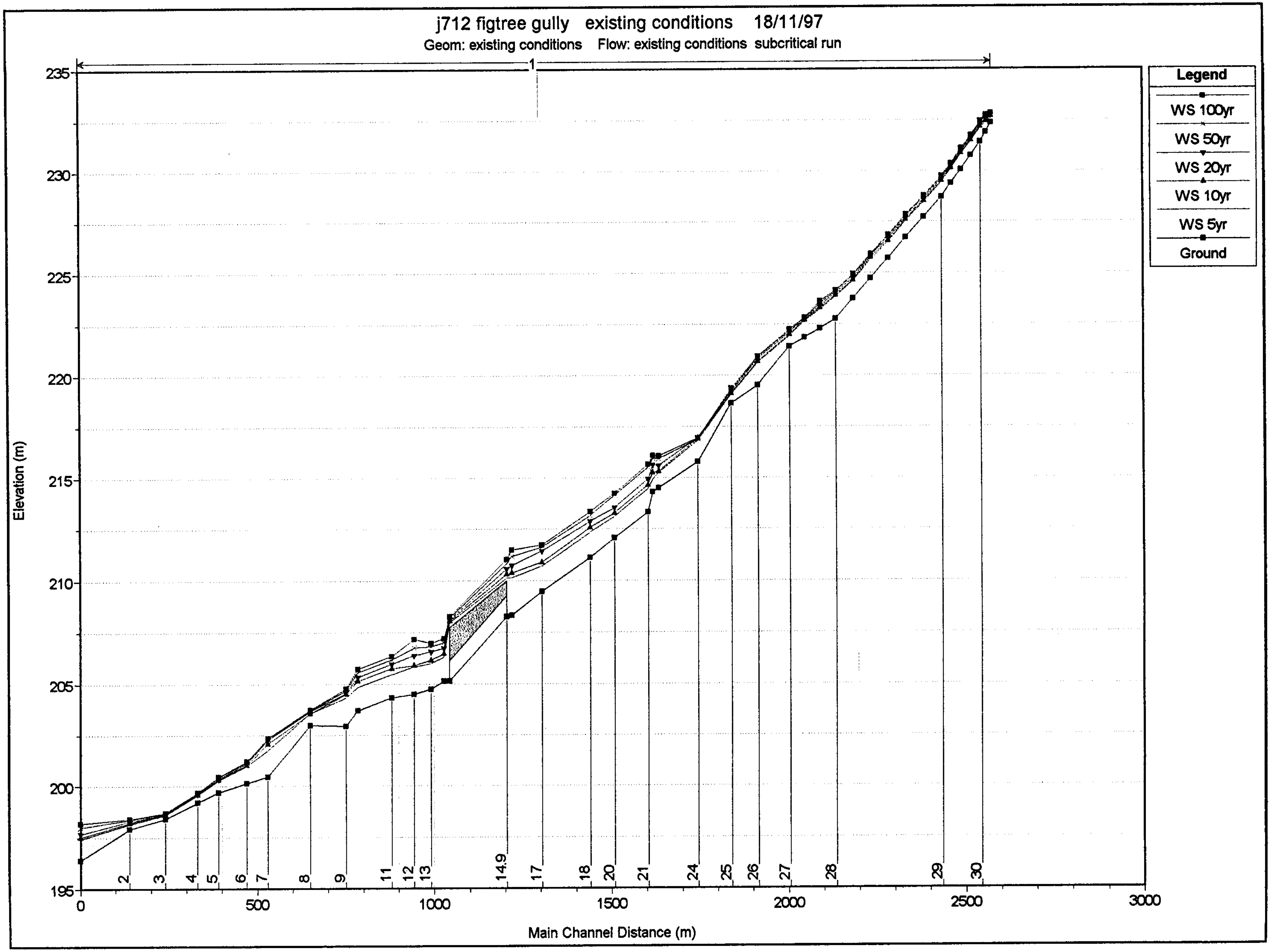
HEC-RAS MODEL
AND UNIFORM FLOW DETAILS

HEC-RAS Plan: existing River: Figtree Gully Reach: 1

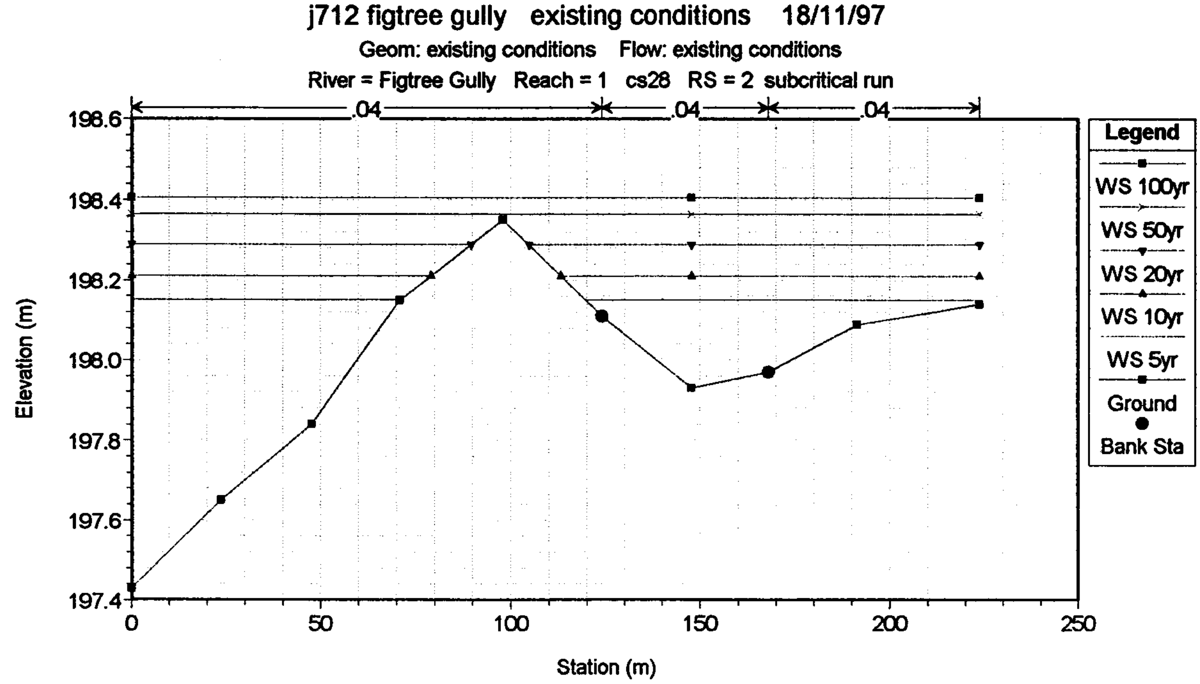
Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
1	31	5yr	11.5	232.34	232.65	232.65	232.74	0.0161	1.3	9	48	1.01
1	31	10yr	14.3	232.34	232.68	232.68	232.78	0.0154	1.4	10	50	1.01
1	31	20yr	18.9	232.34	232.72	232.72	232.84	0.0147	1.5	12	54	1.01
1	31	50yr	24.2	232.34	232.77	232.77	232.90	0.0138	1.6	15	57	1.00
1	31	100yr	28.7	232.34	232.81	232.81	232.95	0.0136	1.7	17	59	1.01
1	30	5yr	11.5	231.42	232.09		232.20	0.0217	1.4	8	17	0.68
1	30	10yr	14.3	231.42	232.16		232.28	0.0221	1.5	9	19	0.70
1	30	20yr	18.9	231.42	232.26		232.41	0.0228	1.7	11	20	0.72
1	30	50yr	24.2	231.42	232.36		232.53	0.0237	1.8	13	21	0.75
1	30	100yr	28.7	231.42	232.43		232.62	0.0241	1.9	15	22	0.76
1	29	5yr	11.5	228.71	229.45		229.51	0.0181	1.1	10	28	0.60
1	29	10yr	14.3	228.71	229.51		229.58	0.0180	1.2	12	30	0.61
1	29	20yr	18.9	228.71	229.60		229.68	0.0179	1.3	15	34	0.62
1	29	50yr	24.2	228.71	229.68		229.78	0.0185	1.4	18	37	0.64
1	29	100yr	28.7	228.71	229.74		229.85	0.0186	1.4	20	39	0.65
1	28	5yr	11.5	222.75	223.84		223.92	0.0107	1.3	11	43	0.51
1	28	10yr	14.3	222.75	223.91		223.99	0.0095	1.3	15	51	0.49
1	28	20yr	18.9	222.75	224.02		224.08	0.0084	1.3	21	61	0.46
1	28	50yr	24.2	222.75	224.11		224.17	0.0072	1.3	26	62	0.44
1	28	100yr	28.7	222.75	224.14		224.21	0.0083	1.4	28	63	0.47
1	27	5yr	11.5	221.40	221.93	221.87	222.02	0.0224	1.4	9	33	0.69
1	27	10yr	14.3	221.40	222.00	221.92	222.09	0.0202	1.5	12	42	0.67
1	27	20yr	18.9	221.40	222.09		222.19	0.0166	1.5	17	58	0.63
1	27	50yr	24.2	221.40	222.18		222.26	0.0131	1.5	22	63	0.57
1	27	100yr	28.7	221.40	222.26		222.33	0.0106	1.4	27	63	0.52
1	26	5yr	11.5	219.51	220.60	220.33	220.68	0.0107	1.2	9	15	0.50
1	26	10yr	14.3	219.51	220.68	220.41	220.77	0.0112	1.4	11	15	0.52
1	26	20yr	18.9	219.51	220.79	220.52	220.91	0.0123	1.5	12	15	0.55
1	26	50yr	24.2	219.51	220.89	220.62	221.05	0.0140	1.8	14	16	0.60
1	26	100yr	28.7	219.51	220.93	220.70	221.13	0.0173	2.0	14	16	0.67
1	25	5yr	11.5	218.63	219.06	219.06	219.21	0.0460	1.8	7	25	0.96
1	25	10yr	14.3	218.63	219.11	219.11	219.28	0.0437	1.9	8	27	0.96
1	25	20yr	18.9	218.63	219.19	219.19	219.37	0.0409	2.1	10	29	0.95
1	25	50yr	24.2	218.63	219.27	219.26	219.47	0.0348	2.1	13	30	0.90
1	25	100yr	28.7	218.63	219.37	219.31	219.55	0.0260	2.0	16	31	0.80
1	24	5yr	11.5	215.76	216.82		216.88	0.0059	1.0	11	16	0.38
1	24	10yr	14.3	215.76	216.93		216.99	0.0061	1.1	13	16	0.39
1	24	20yr	18.9	215.76	216.96		217.06	0.0095	1.4	14	17	0.49
1	24	50yr	24.2	215.76	216.89		217.08	0.0199	1.9	12	16	0.71
1	24	100yr	28.7	215.76	216.92		217.17	0.0250	2.2	13	16	0.80
1	23	5yr	11.5	214.49	215.24	215.24	215.42	0.0495	1.9	6	16	1.00
1	23	10yr	14.3	214.49	215.30	215.30	215.51	0.0492	2.0	7	18	1.01
1	23	20yr	18.9	214.49	215.58		215.69	0.0169	1.5	13	25	0.63
1	23	50yr	24.2	214.49	215.92		215.97	0.0057	1.1	23	35	0.39
1	23	100yr	28.7	214.49	216.06		216.12	0.0046	1.1	29	37	0.35
1	22	5yr	11.5	214.30	214.91		215.06	0.0018	1.9	8	22	0.82
1	22	10yr	14.3	214.30	215.25		215.30	0.0004	1.2	17	31	0.42
1	22	20yr	18.9	214.30	215.63		215.66	0.0002	1.0	31	41	0.27
1	22	50yr	24.2	214.30	215.94		215.96	0.0001	0.9	45	48	0.22
1	22	100yr	28.7	214.30	216.08		216.10	0.0001	0.9	52	50	0.22
1	21	5yr	11.5	213.31	214.45	214.45	214.99	0.0038	3.2	4	4	1.00
1	21	10yr	14.3	213.31	214.63	214.63	215.23	0.0035	3.4	4	5	0.98
1	21	20yr	18.9	213.31	214.92	214.92	215.59	0.0030	3.7	6	7	0.94
1	21	50yr	24.2	213.31	215.50	215.50	215.92	0.0014	3.0	17	34	0.67
1	21	100yr	28.7	213.31	215.64	215.64	216.06	0.0014	3.2	22	36	0.67
1	20	5yr	11.5	212.07	213.10	213.10	213.59	0.0038	3.1	4	4	1.00
1	20	10yr	14.3	212.07	213.26	213.26	213.83	0.0035	3.3	4	5	0.99
1	20	20yr	18.9	212.07	213.51	213.51	214.17	0.0031	3.6	6	6	0.97
1	20	50yr	24.2	212.07	214.12	214.12	214.41	0.0011	2.6	26	66	0.60
1	20	100yr	28.7	212.07	214.21		214.51	0.0011	2.8	32	69	0.61
1	18	5yr	12.8	211.11	212.34	212.34	212.96	0.0046	3.5	4	3	1.00
1	18	10yr	15.8	211.11	212.58	212.58	213.23	0.0042	3.6	5	5	0.95
1	18	20yr	20.5	211.11	212.86	212.86	213.59	0.0038	3.8	6	5	0.93
1	18	50yr	26.4	211.11	213.13	213.13	214.00	0.0037	4.2	7	5	0.94
1	18	100yr	31.3	211.11	213.34	213.34	214.31	0.0037	4.5	8	5	0.96
1	17	5yr	12.8	209.47	210.69	210.69	211.28	0.0042	3.4	4	3	1.00
1	17	10yr	15.8	209.47	210.89	210.89	211.54	0.0038	3.6	5	4	0.98
1	17	20yr	20.5	209.47	211.44	211.44	211.79	0.0016	2.9	13	27	0.66
1	17	50yr	26.4	209.47	211.63	211.63	211.97	0.0015	3.0	19	35	0.65
1	17	100yr	31.3	209.47	211.73	211.73	212.09	0.0015	3.1	22	39	0.67
1	16	5yr	12.8	208.32	210.16		210.32	0.0006	1.8	9	10	0.43
1	16	10yr	15.8	208.32	210.37		210.55	0.0006	1.9	11	19	0.43
1	16	20yr	20.5	208.32	210.73		210.88	0.0004	1.9	23	48	0.39
1	16	50yr	26.4	208.32	211.17		211.24	0.0002	1.5	51	70	0.28
1	16	100yr	31.3	208.32	211.49		211.53	0.0001	1.2	73	70	0.22
1	15	5yr	12.8	208.26	210.13	209.43	210.31	0.0007	1.9	8	5	0.45
1	15	10yr	15.8	208.26	210.32	209.60	210.54	0.0007	2.1	9	5	0.47

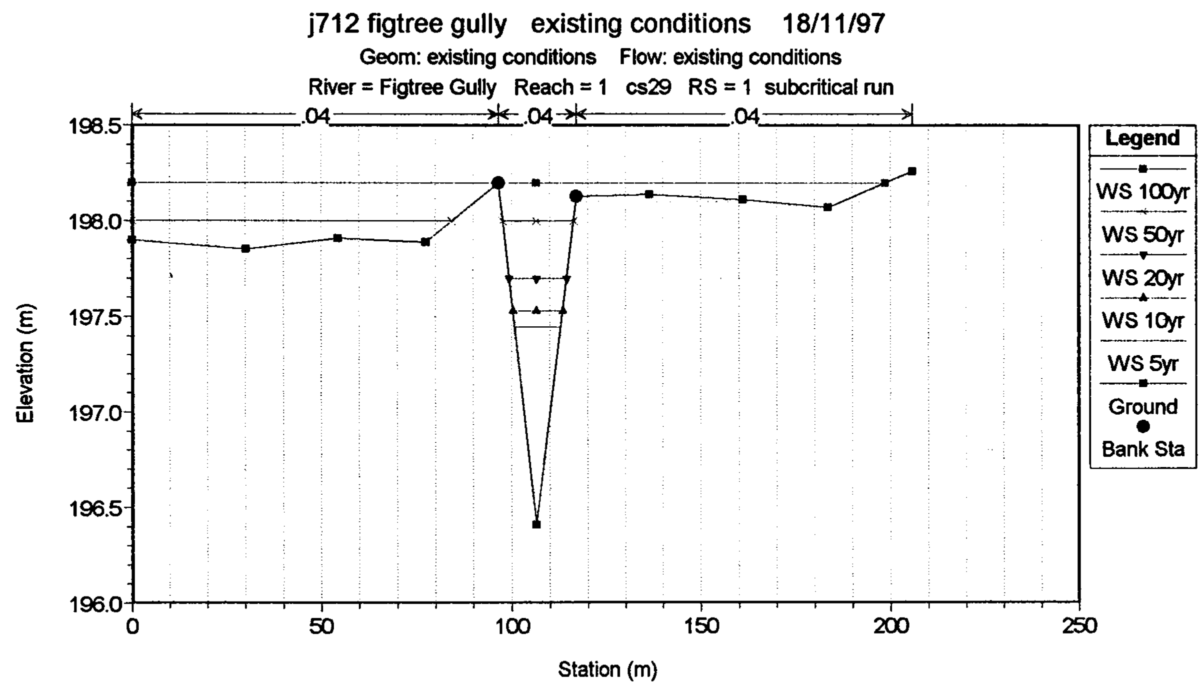
HEC-RAS Plan: existing River: Figtree Gully Reach: 1 (Continued)

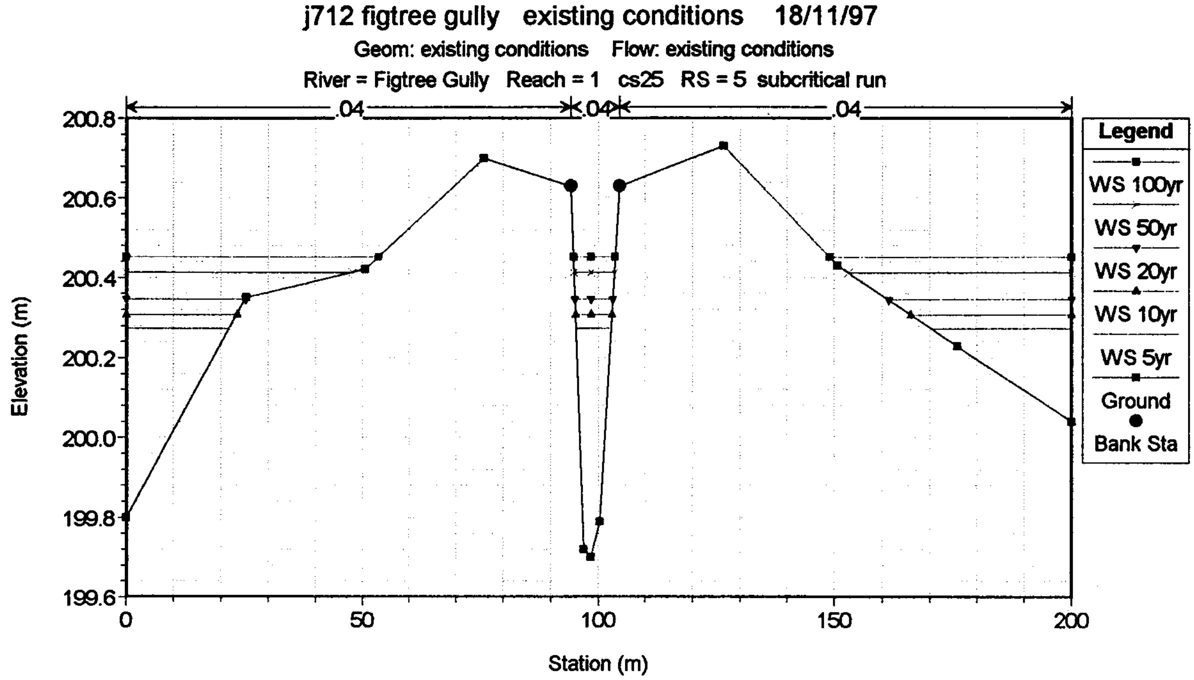
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	15	20yr	20.5	208.26	210.56	209.82	210.85	0.0008	2.5	10	5	0.52
1	15	50yr	26.4	208.26	210.82	210.06	211.20	0.0010	2.8	12	5	0.57
1	15	100yr	31.3	208.26	211.03	210.25	211.49	0.0010	3.1	13	5	0.60
1	14.9		Culvert									
1	14	5yr	12.8	205.14	206.32	206.32	206.83	0.0028	3.2	4	5	0.95
1	14	10yr	15.8	205.14	206.49	206.49	207.06	0.0026	3.4	5	5	0.94
1	14	20yr	20.5	205.14	206.73	206.73	207.38	0.0024	3.7	7	6	0.93
1	14	50yr	26.4	205.14	207.00	207.00	207.72	0.0022	3.9	8	7	0.92
1	14	100yr	31.3	205.14	207.20	207.20	207.98	0.0021	4.1	10	7	0.92
1	13	5yr	12.8	204.75	205.98	205.98	206.60	0.0082	3.5	4	3	1.00
1	13	10yr	15.8	204.75	206.16	206.16	206.88	0.0086	3.8	4	3	1.01
1	13	20yr	20.5	204.75	206.57	206.57	207.20	0.0058	3.6	6	5	0.85
1	13	50yr	26.4	204.75	206.81	206.81	207.55	0.0060	3.9	7	5	0.88
1	13	100yr	31.3	204.75	206.98	206.98	207.81	0.0061	4.2	8	5	0.90
1	12	5yr	12.8	204.48	205.84		206.27	0.0024	2.9	5	5	0.82
1	12	10yr	15.8	204.48	205.89	205.89	206.49	0.0032	3.4	5	5	0.95
1	12	20yr	20.5	204.48	206.38	206.38	206.81	0.0016	3.0	10	24	0.72
1	12	50yr	26.4	204.48	206.77	206.62	207.03	0.0009	2.6	23	41	0.56
1	12	100yr	31.3	204.48	207.15	206.76	207.28	0.0005	2.0	39	43	0.40
1	11	5yr	12.8	204.32	205.46	205.46	206.05	0.0044	3.4	4	3	1.02
1	11	10yr	15.8	204.32	205.75	205.75	206.27	0.0030	3.2	5	5	0.86
1	11	20yr	20.5	204.32	205.96	205.96	206.56	0.0030	3.5	6	5	0.88
1	11	50yr	26.4	204.32	206.18	206.18	206.89	0.0031	3.9	7	5	0.91
1	11	100yr	31.3	204.32	206.34	206.34	207.15	0.0031	4.2	8	5	0.93
1	10	5yr	12.8	203.70	204.84	204.84	205.43	0.0044	3.4	4	3	1.02
1	10	10yr	15.8	203.70	205.13	205.13	205.65	0.0030	3.2	5	5	0.86
1	10	20yr	20.5	203.70	205.34	205.34	205.94	0.0030	3.5	6	5	0.88
1	10	50yr	26.4	203.70	205.55	205.55	206.27	0.0031	3.9	7	5	0.91
1	10	100yr	31.3	203.70	205.72	205.72	206.53	0.0031	4.2	8	5	0.93
1	9	5yr	12.8	202.93	204.31	204.11	204.51	0.0078	2.1	7	8	0.65
1	9	10yr	15.8	202.93	204.51	204.23	204.70	0.0064	2.1	9	9	0.59
1	9	20yr	20.5	202.93	204.55	204.39	204.84	0.0097	2.6	9	10	0.73
1	9	50yr	26.4	202.93	204.68	204.57	205.05	0.0112	2.9	10	10	0.79
1	9	100yr	31.3	202.93	204.75	204.69	205.20	0.0128	3.2	11	10	0.84
1	8	5yr	14.1	202.98	203.57	203.49	203.66	0.0085	1.5	12	44	0.65
1	8	10yr	17.3	202.98	203.53		203.69	0.0167	1.9	11	36	0.91
1	8	20yr	22.1	202.98	203.65	203.65	203.78	0.0106	1.8	17	62	0.75
1	8	50yr	28.5	202.98	203.70	203.70	203.85	0.0115	2.0	20	63	0.79
1	8	100yr	33.9	202.98	203.74	203.74	203.90	0.0116	2.1	22	64	0.81
1	7	5yr	14.1	200.46	201.75	201.75	202.14	0.0195	2.8	5	6	1.00
1	7	10yr	17.3	200.46	202.07	202.07	202.29	0.0085	2.2	10	31	0.69
1	7	20yr	22.1	200.46	202.26	202.26	202.36	0.0044	1.7	24	138	0.51
1	7	50yr	28.5	200.46	202.31	202.31	202.41	0.0044	1.7	32	138	0.51
1	7	100yr	33.9	200.46	202.34	202.34	202.44	0.0048	1.8	36	138	0.53
1	6	5yr	14.1	200.14	200.98	200.85	201.02	0.0049	1.2	16	48	0.50
1	6	10yr	17.3	200.14	201.03	200.89	201.08	0.0051	1.2	18	52	0.51
1	6	20yr	22.1	200.14	201.10	200.93	201.15	0.0052	1.3	22	58	0.52
1	6	50yr	28.5	200.14	201.17	201.00	201.24	0.0054	1.4	27	64	0.54
1	6	100yr	33.9	200.14	201.22	201.05	201.29	0.0059	1.5	30	71	0.57
1	5	5yr	14.1	199.70	200.27	200.27	200.37	0.0169	1.7	12	59	0.88
1	5	10yr	17.3	199.70	200.31	200.31	200.41	0.0171	1.8	14	65	0.89
1	5	20yr	22.1	199.70	200.35	200.35	200.46	0.0184	1.9	16	72	0.93
1	5	50yr	28.5	199.70	200.41	200.41	200.52	0.0186	2.0	22	103	0.95
1	5	100yr	33.9	199.70	200.45	200.45	200.55	0.0170	2.0	26	113	0.91
1	4	5yr	14.1	199.20	199.56	199.47	199.57	0.0051	0.6	25	158	0.43
1	4	10yr	17.3	199.20	199.58	199.49	199.60	0.0052	0.6	29	167	0.43
1	4	20yr	22.1	199.20	199.62	199.52	199.64	0.0052	0.6	36	179	0.44
1	4	50yr	28.5	199.20	199.65		199.68	0.0054	0.7	42	187	0.46
1	4	100yr	33.9	199.20	199.69		199.71	0.0052	0.7	48	194	0.45
1	3	5yr	14.1	198.41	198.60	198.60	198.66	0.0298	0.9	13	105	0.93
1	3	10yr	17.3	198.41	198.62	198.62	198.69	0.0296	1.0	15	110	0.94
1	3	20yr	22.1	198.41	198.65	198.65	198.72	0.0285	1.0	18	117	0.94
1	3	50yr	28.5	198.41	198.69	198.69	198.77	0.0261	1.1	23	132	0.92
1	3	100yr	33.9	198.41	198.71	198.71	198.79	0.0287	1.2	26	154	0.98
1	2	5yr	14.1	197.93	198.15		198.16	0.0010	0.2	39	175	0.19
1	2	10yr	17.3	197.93	198.21		198.22	0.0009	0.3	50	190	0.19
1	2	20yr	22.1	197.93	198.29		198.29	0.0007	0.3	65	209	0.18
1	2	50yr	28.5	197.93	198.37		198.37	0.0007	0.4	82	224	0.18
1	2	100yr	33.9	197.93	198.41		198.41	0.0007	0.4	91	224	0.19
1	1	5yr	14.1	196.41	197.45	197.45	197.71	0.0200	2.3	6	12	1.00
1	1	10yr	17.3	196.41	197.53	197.53	197.82	0.0198	2.4	7	13	1.01
1	1	20yr	22.1	196.41	197.70	197.65	197.97	0.0153	2.3	10	15	0.91
1	1	50yr	28.5	196.41	198.00	197.78	198.12	0.0060	1.6	24	103	0.59
1	1	100yr	33.9	196.41	198.20	198.04	198.24	0.0020	1.0	52	199	0.35

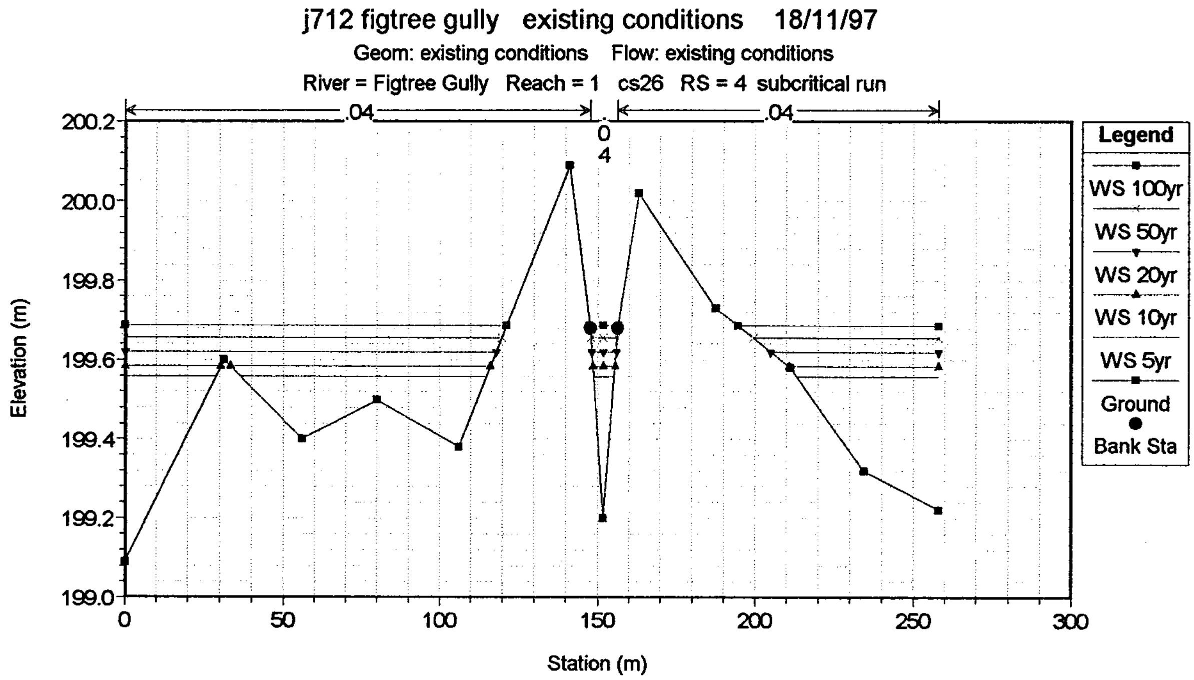


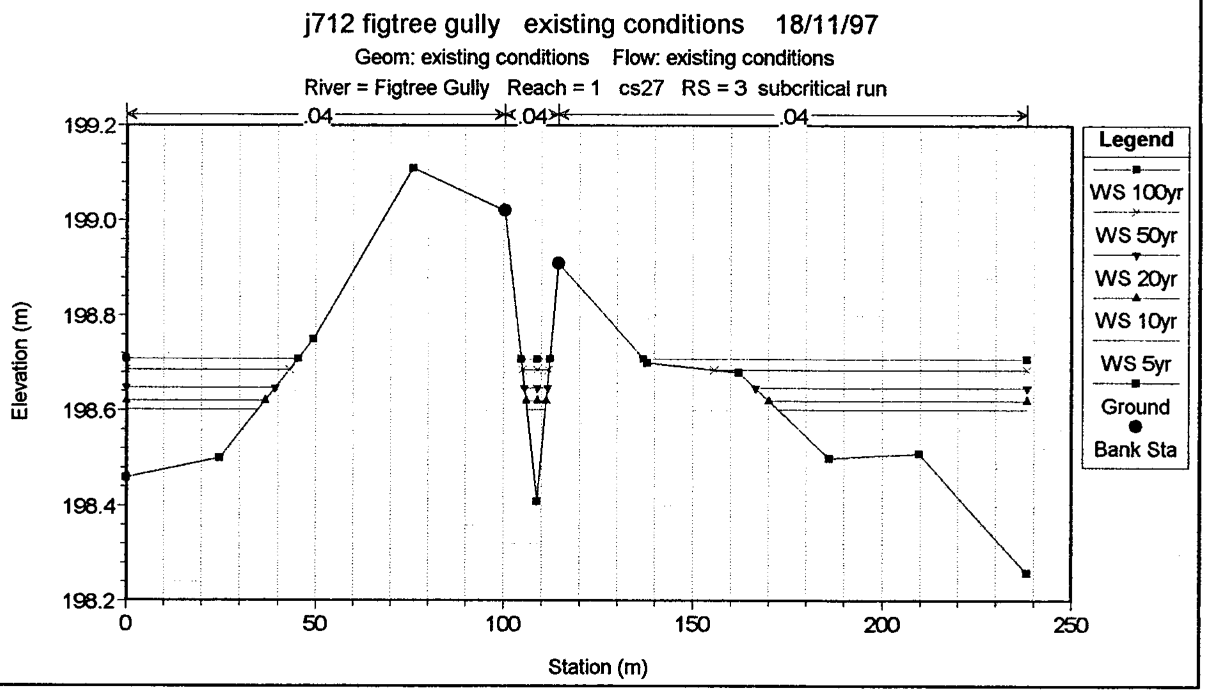
j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions subcritical run
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Elevation (m)
Main Channel Distance (m)
235
230
225
220
215
210
205
200
195
0
500
1000
1500
2000
2500
3000
1
2
3
4
5
6
7
8
9
11
12
13
14.9
17
18
20
21
24
25
26
27
28
29
30

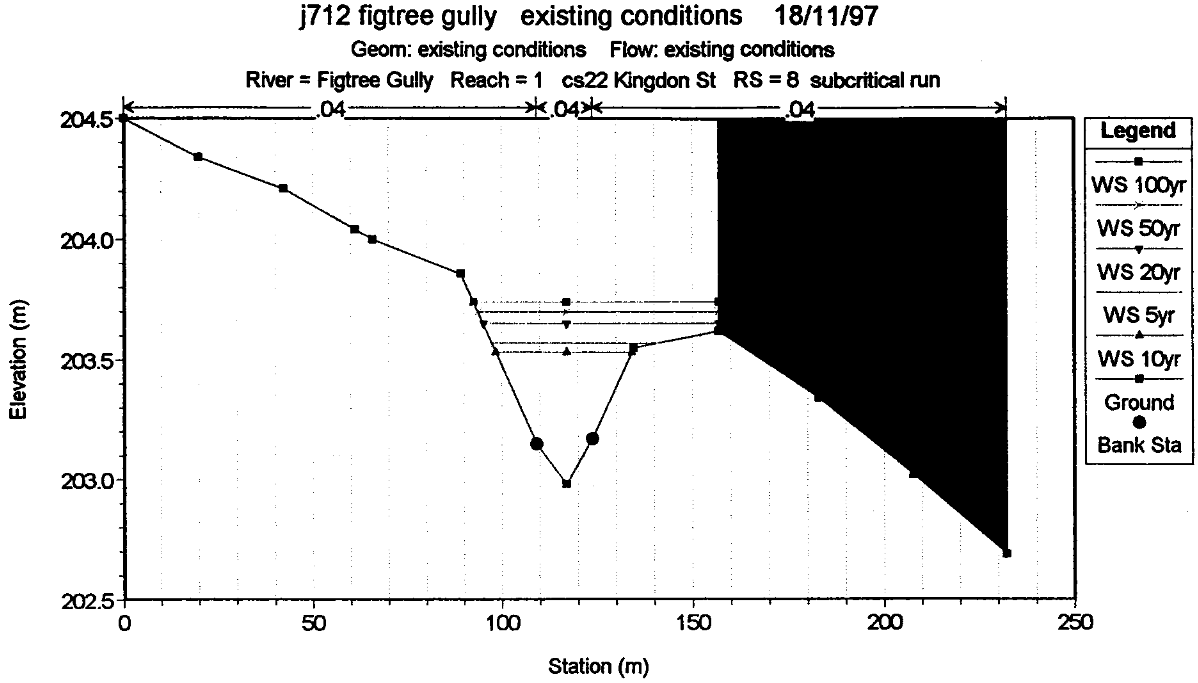

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs28 RS = 2 subcritical run
.04
.04
.04
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta
Elevation (m)
198.6
198.4
198.2
198.0
197.8
197.6
197.4
0
50
100
150
200
250
Station (m)

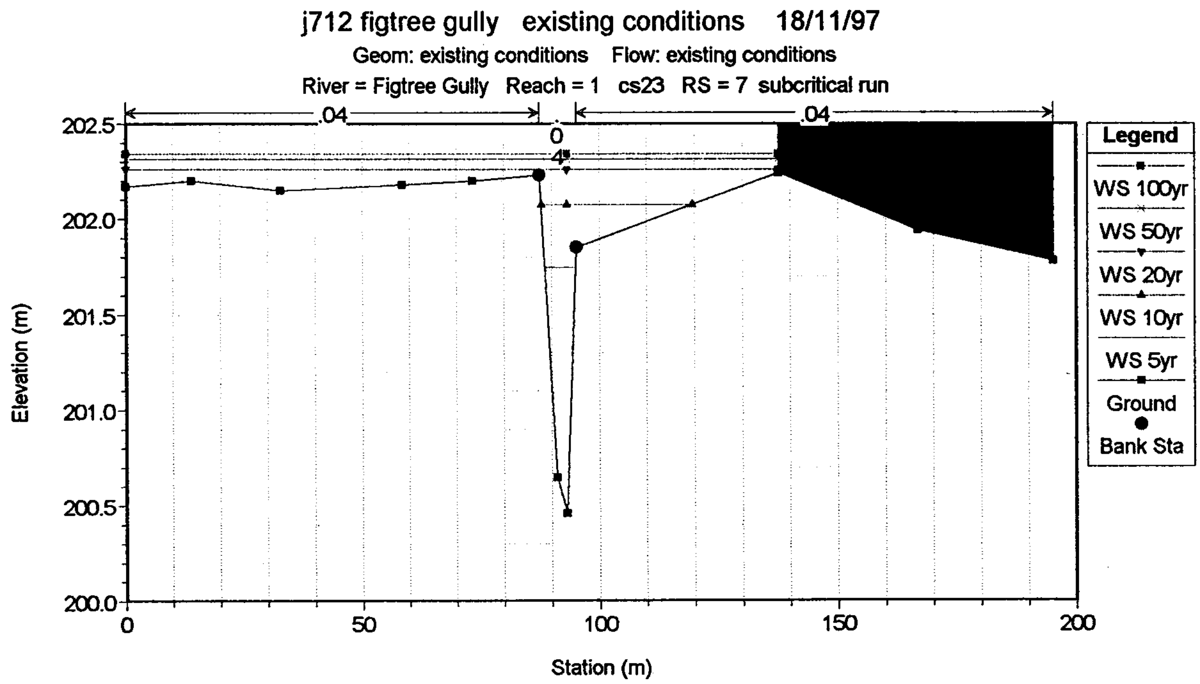

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs29 RS = 1 subcritical run
.04
.04
.04
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta
Elevation (m)
198.5
198.0
197.5
197.0
196.5
196.0
0
50
100
150
200
250
Station (m)

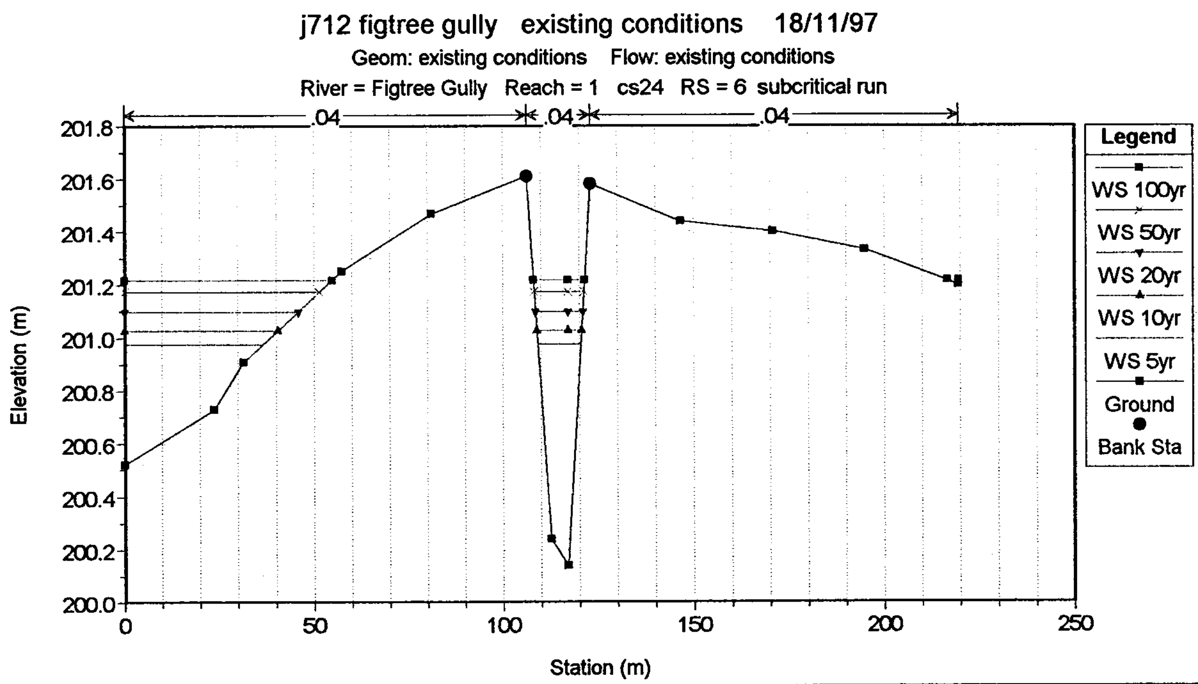

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs25 RS = 5 subcritical run
.04
.04
.04
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta

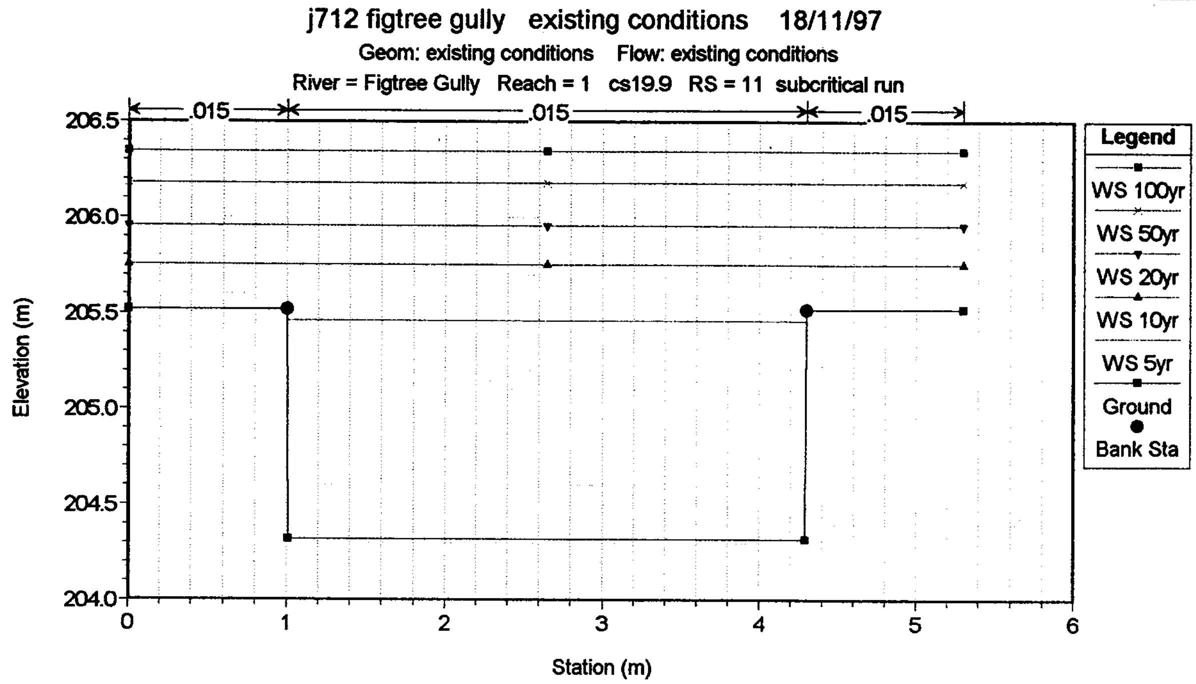

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs26 RS = 4 subcritical run
.04
0
4
.04
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta

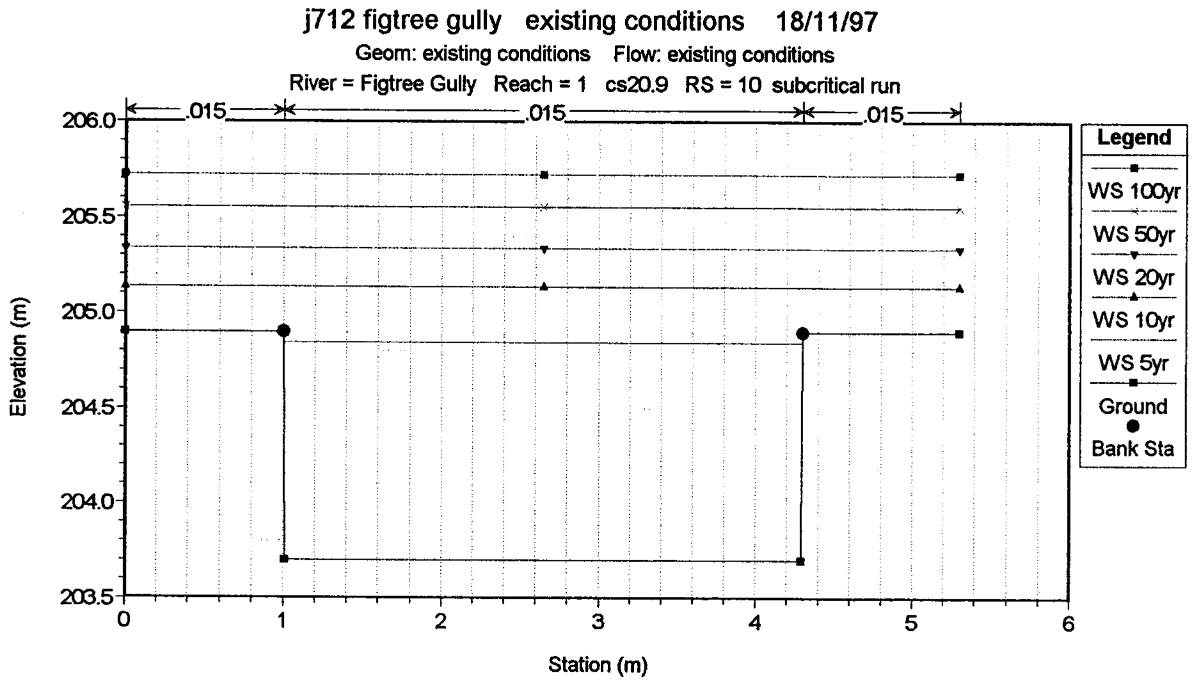

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs27 RS = 3 subcritical run
.04
.04
.04
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta

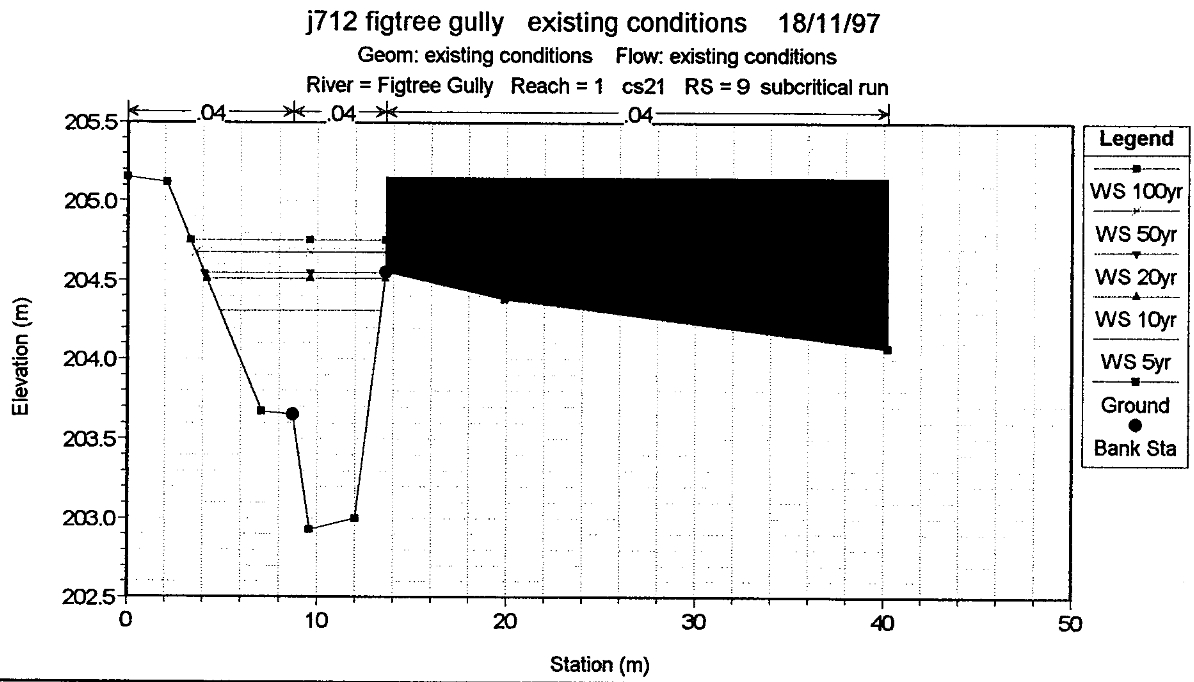

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs22 Kingdon St RS = 8 subcritical run
.04
.04
.04
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 5yr
WS 10yr
Ground
Bank Sta


j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs23 RS = 7 subcritical run
.04
.04
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta


j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs24 RS = 6 subcritical run
.04
.04
.04
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta


j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs19.9 RS = 11 subcritical run
.015
.015
.015
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta
Elevation (m)
Station (m)

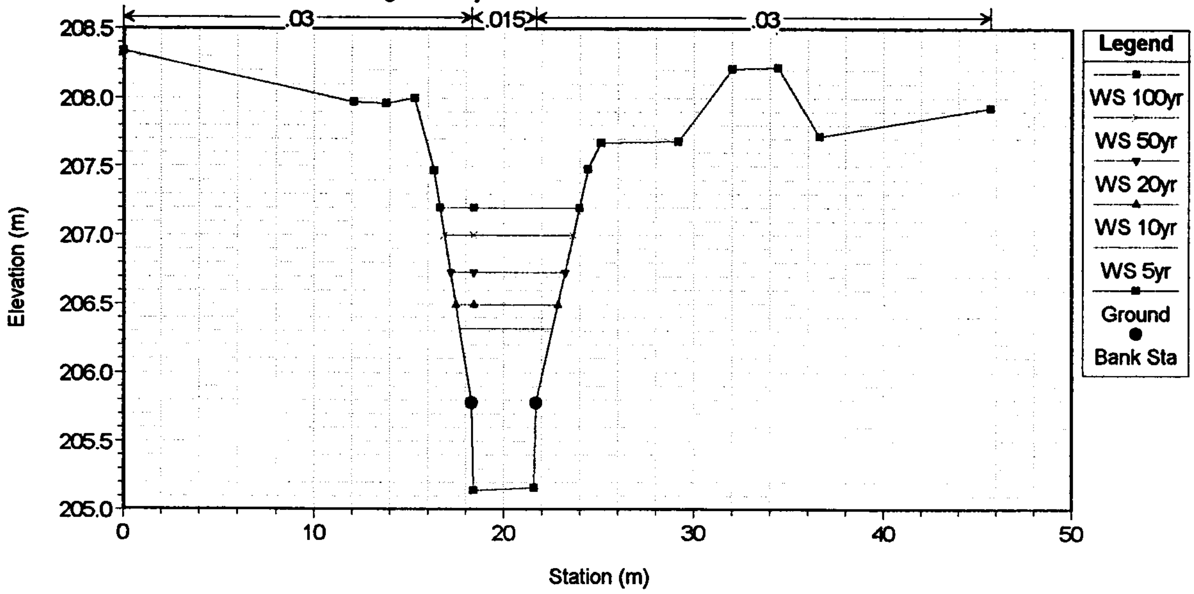

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs20.9 RS = 10 subcritical run
.015
.015
.015
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta
Elevation (m)
Station (m)


j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs21 RS = 9 subcritical run
.04
.04
.04
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta
Elevation (m)
Station (m)

j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

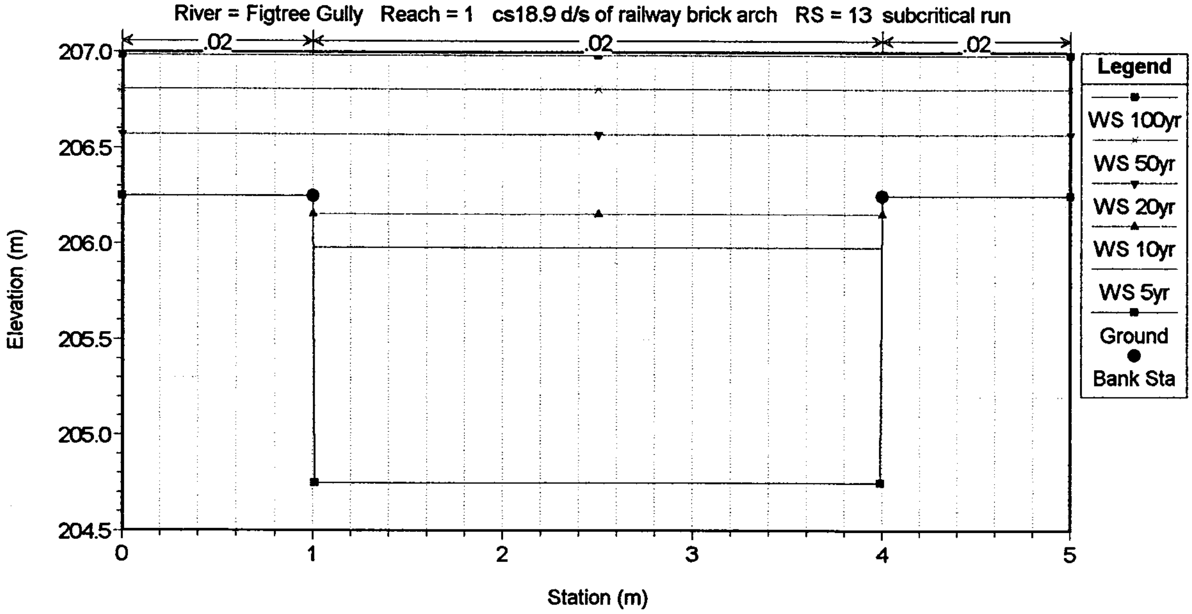
River = Figtree Gully Reach = 1 cs18 RS = 14 subcritical run



j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

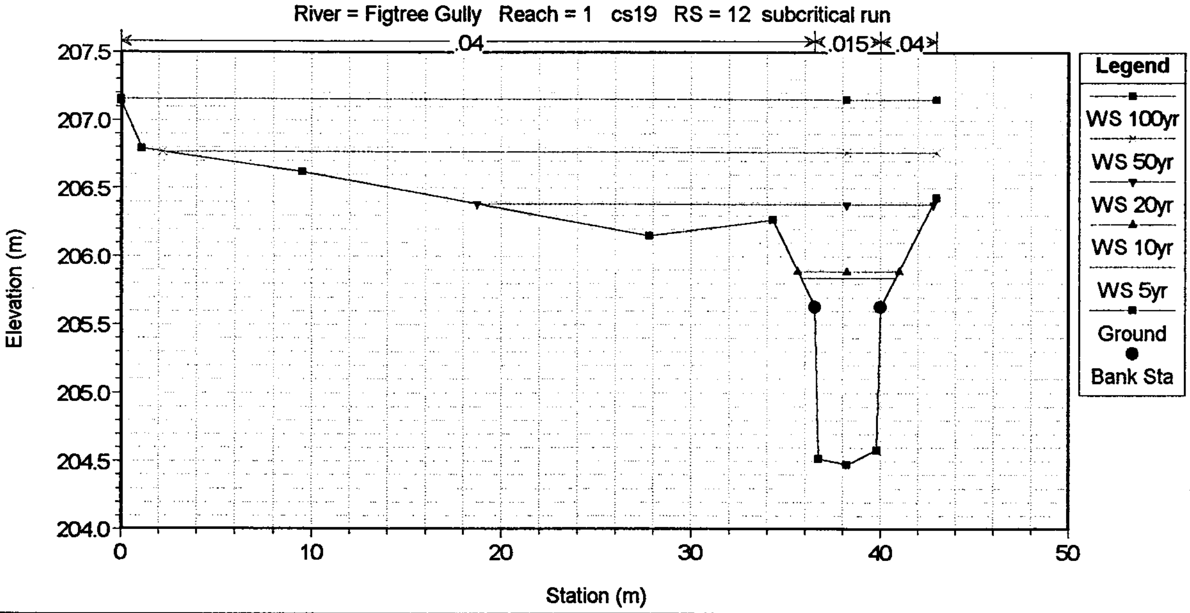
River = Figtree Gully Reach = 1 cs18.9 d/s of railway brick arch RS = 13 subcritical run

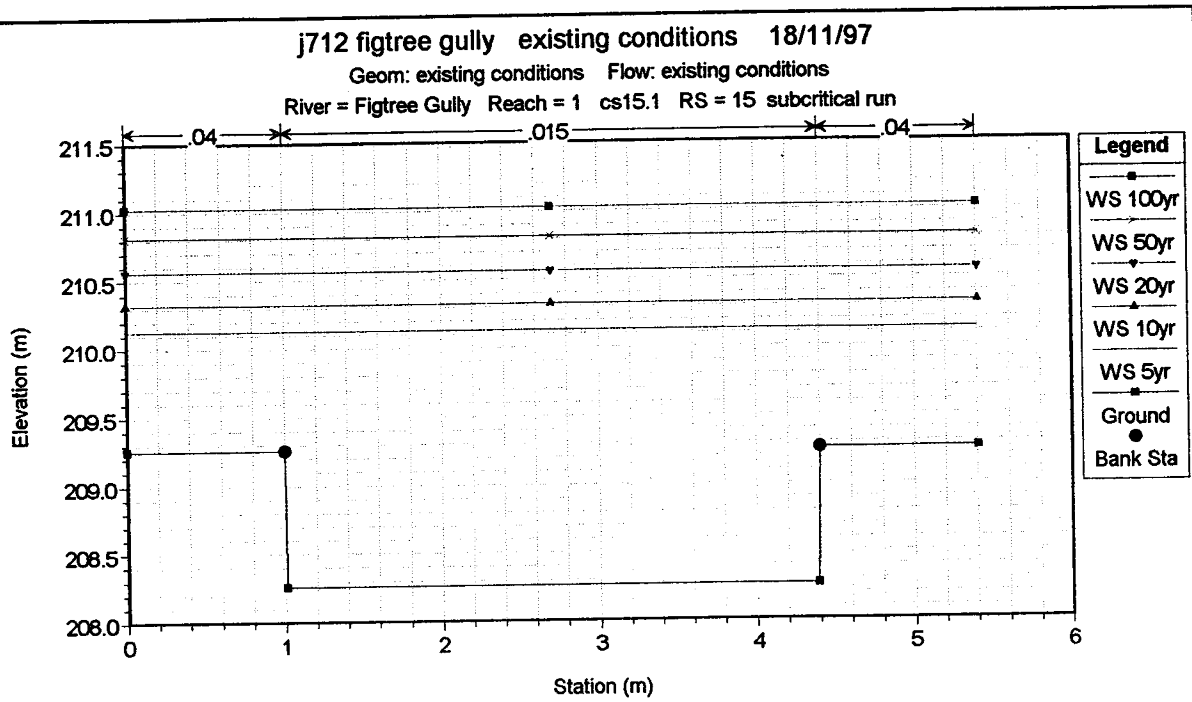


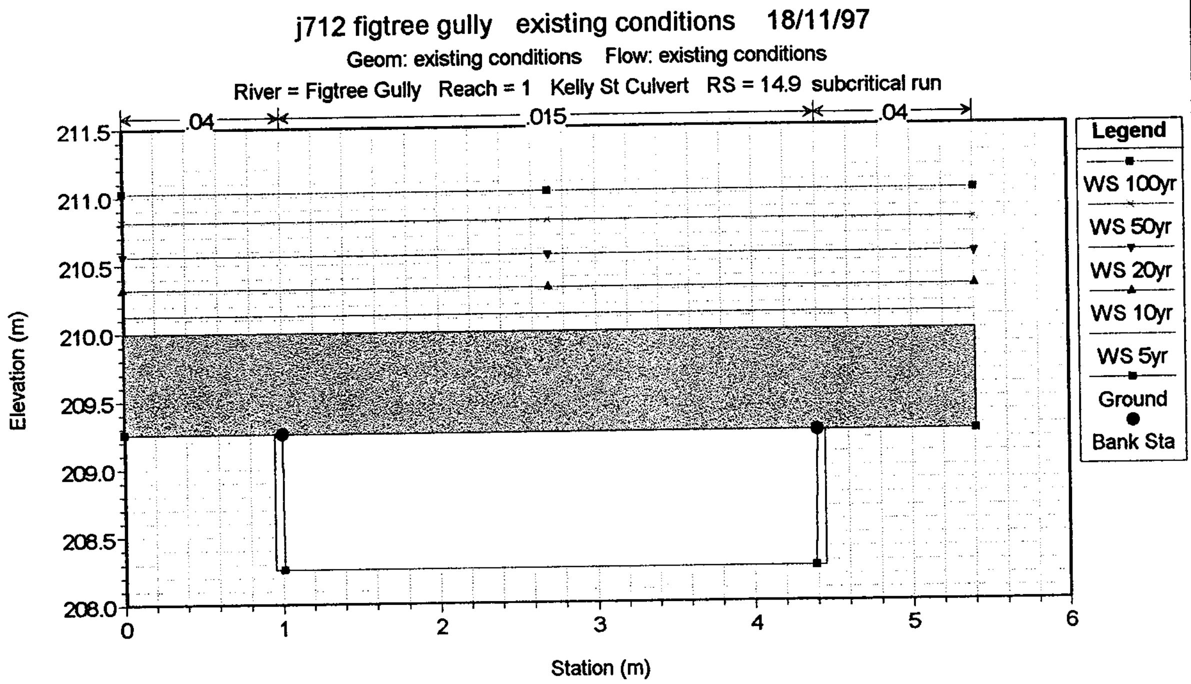
j712 figtree gully existing conditions 18/11/97

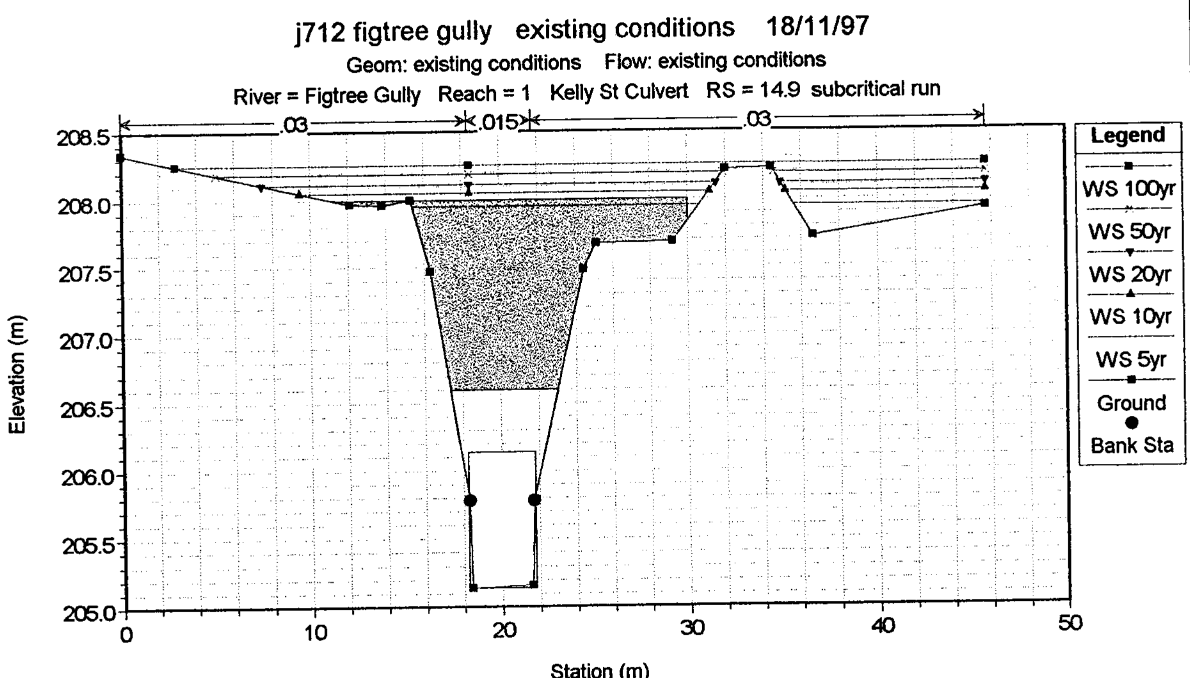
Geom: existing conditions Flow: existing conditions

River = Figtree Gully Reach = 1 cs19 RS = 12 subcritical run




j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs15.1 RS = 15 subcritical run
.04
.015
.04
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta

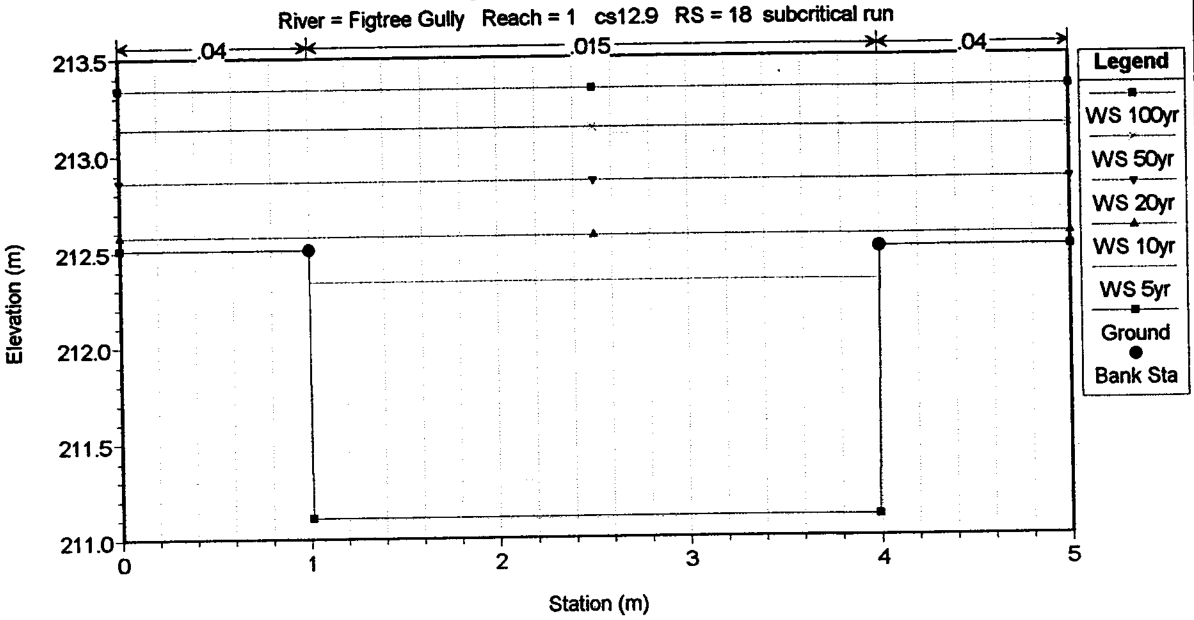

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 Kelly St Culvert RS = 14.9 subcritical run
.04
.015
.04
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta


j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 Kelly St Culvert RS = 14.9 subcritical run
.03
.015
.03
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta

j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

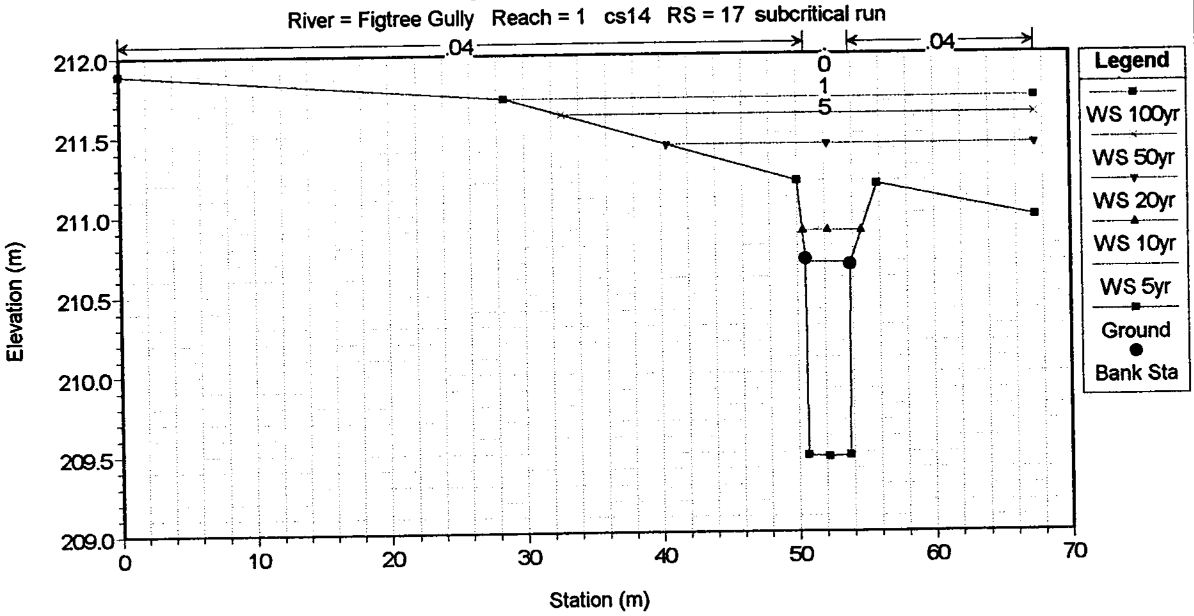
River = Figtree Gully Reach = 1 cs12.9 RS = 18 subcritical run



j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

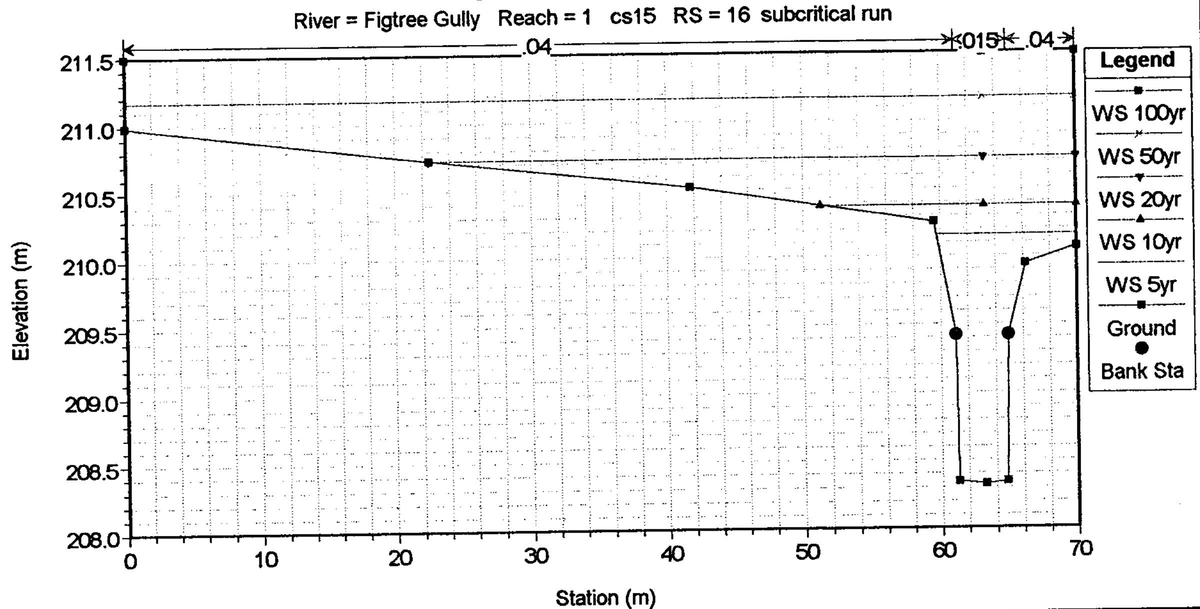
River = Figtree Gully Reach = 1 cs14 RS = 17 subcritical run

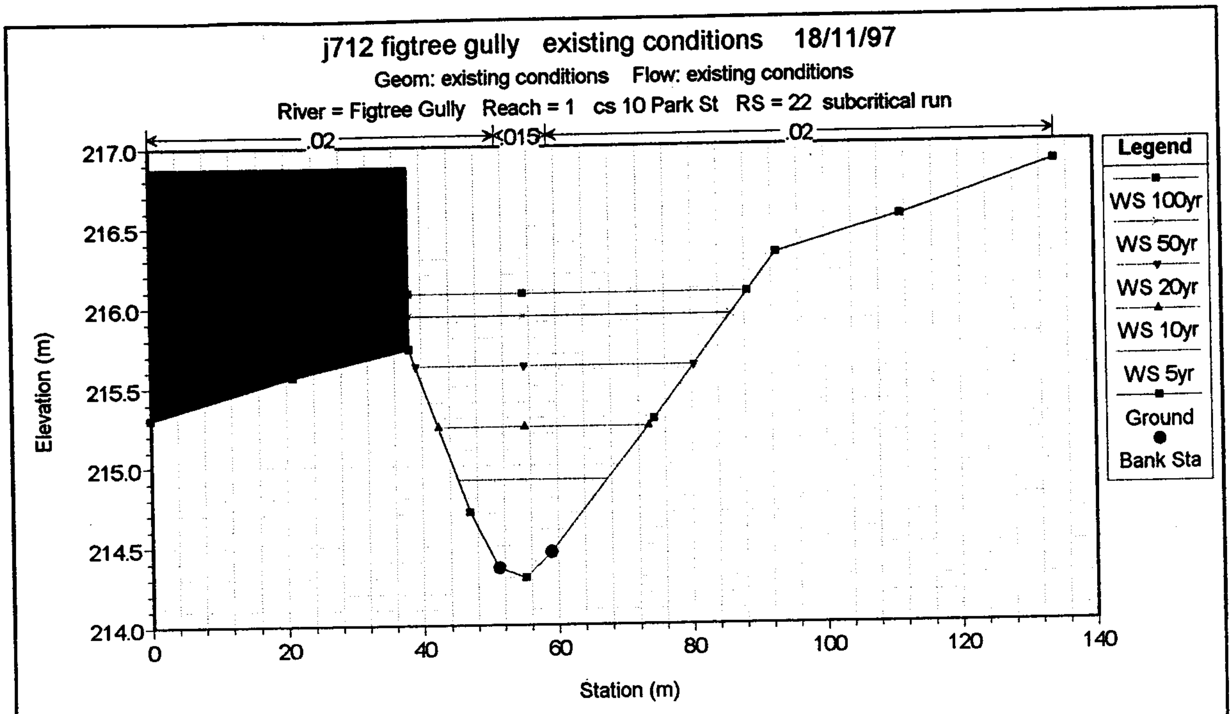


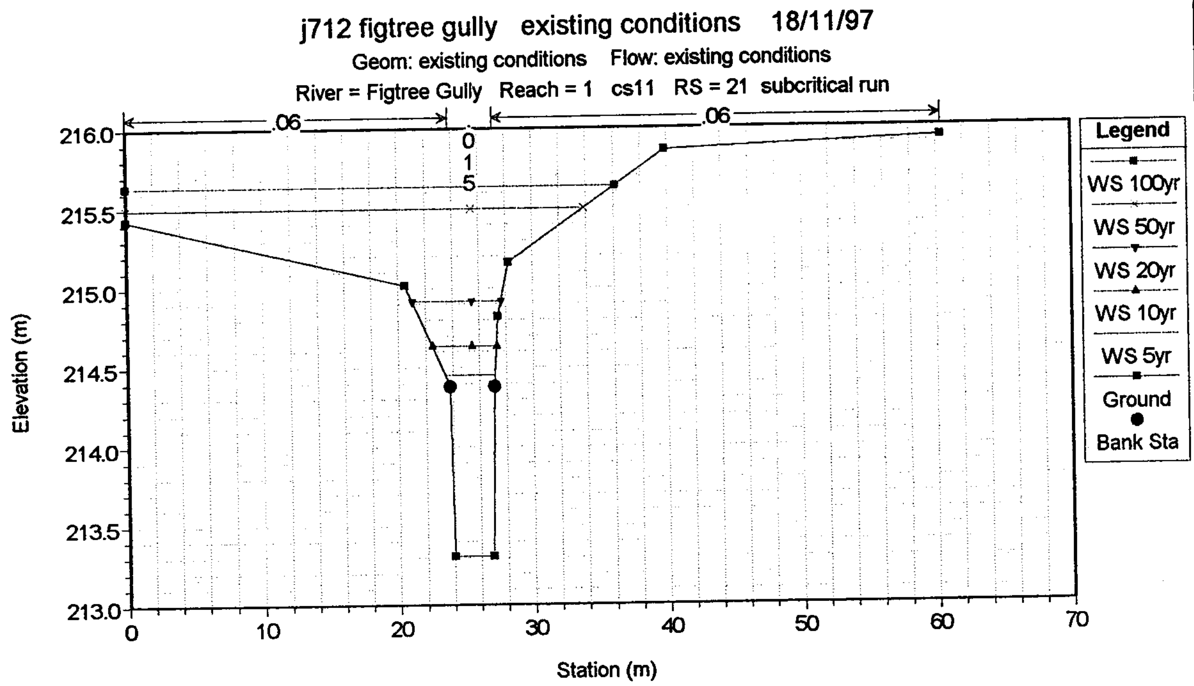
j712 figtree gully existing conditions 18/11/97

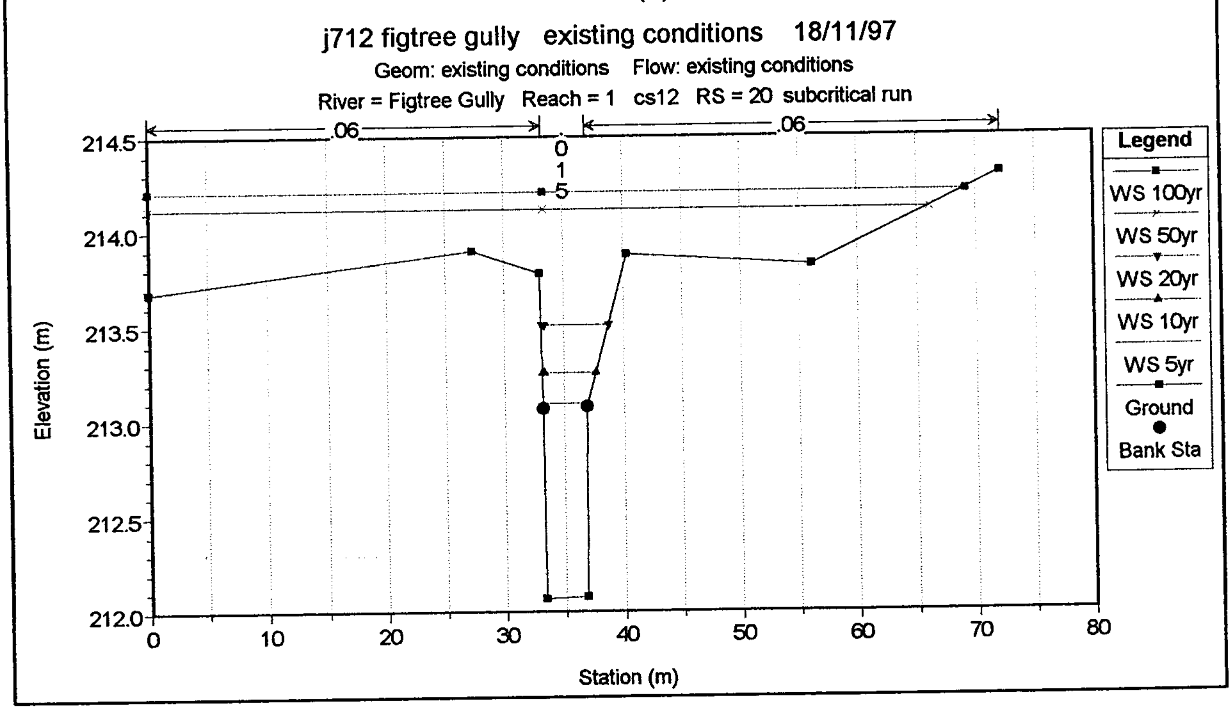
Geom: existing conditions Flow: existing conditions

River = Figtree Gully Reach = 1 cs15 RS = 16 subcritical run




j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs 10 Park St RS = 22 subcritical run
.02
.015
.02
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta

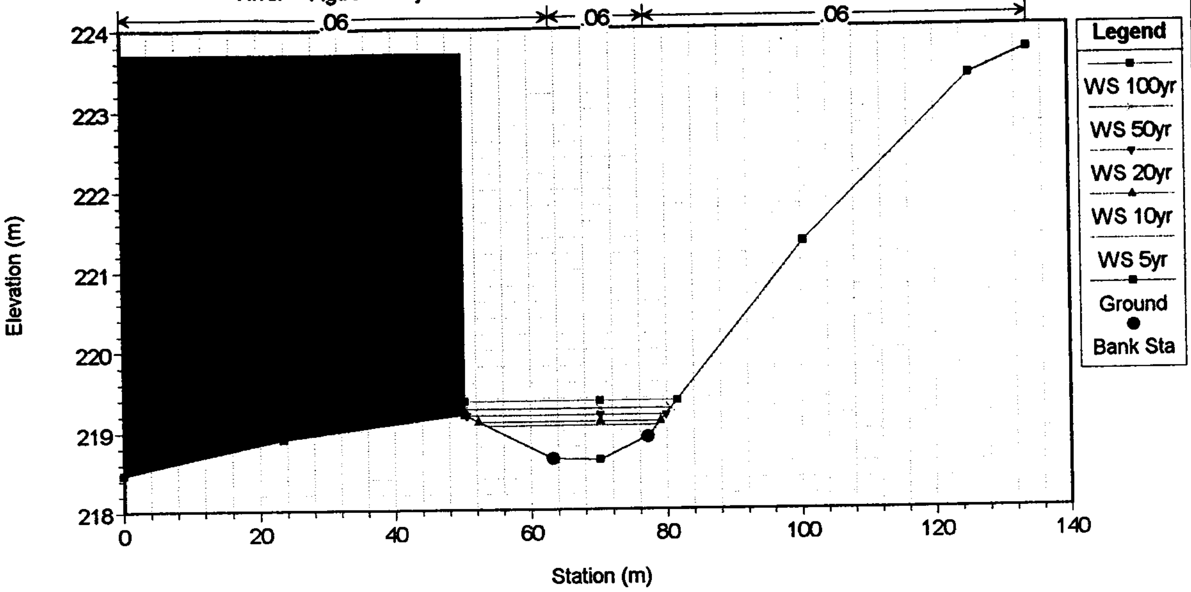

j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs11 RS = 21 subcritical run
.06
.06
0
1
5
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta


j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs12 RS = 20 subcritical run
.06
.06
0
1
5
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta

j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

River = Figtree Gully Reach = 1 cs7 Waverley St RS = 25 subcritical run

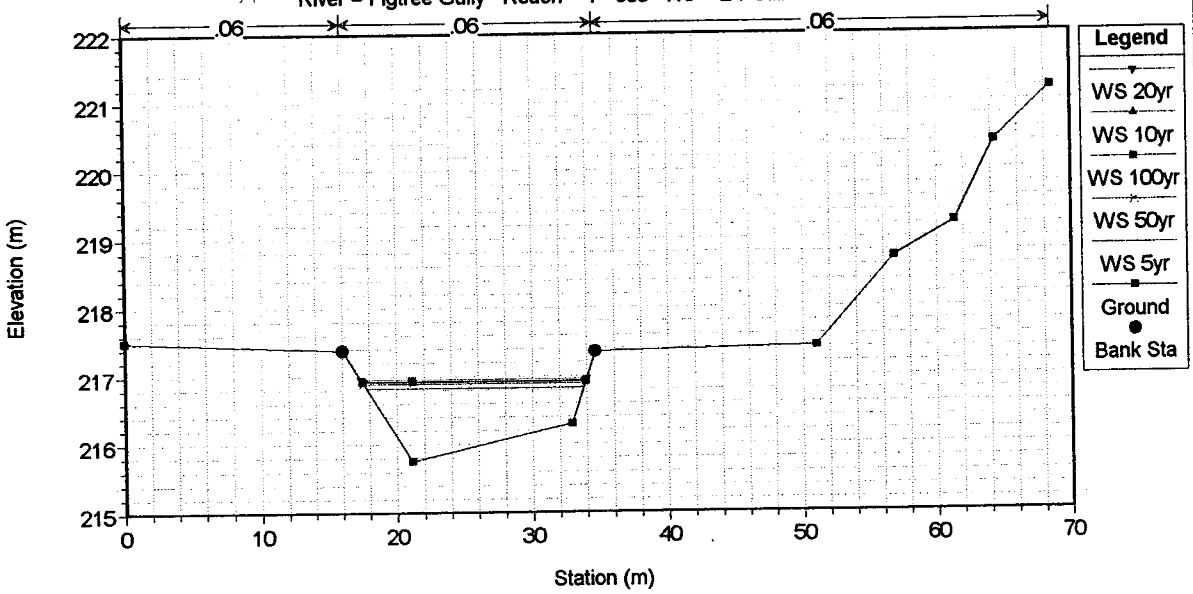


PARK ST

j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

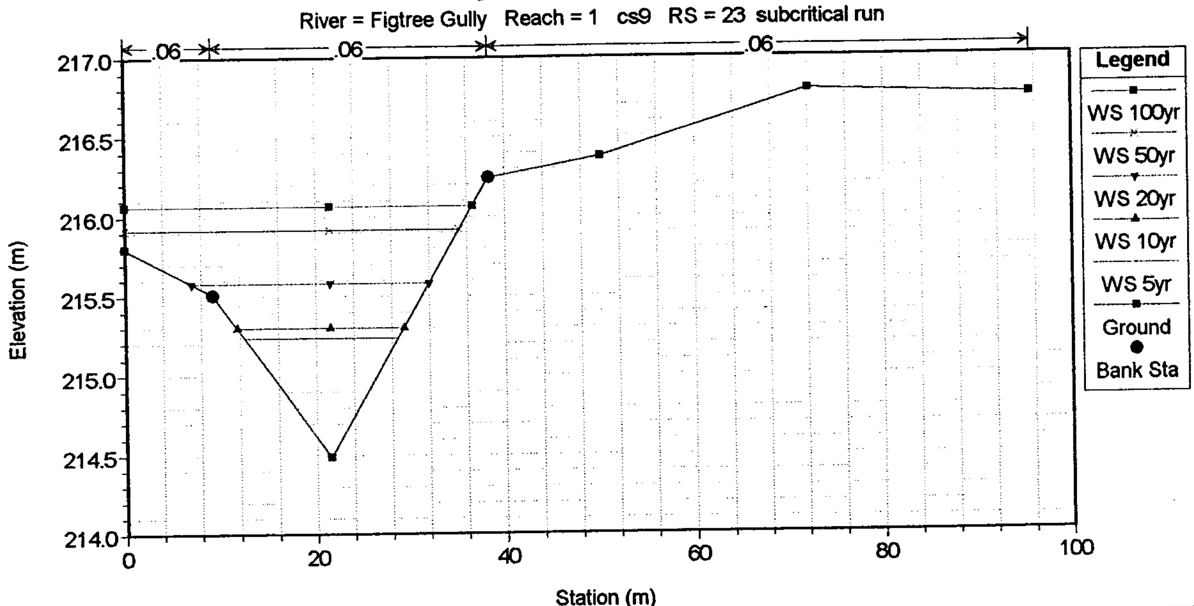
River = Figtree Gully Reach = 1 cs8 RS = 24 subcritical run



j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

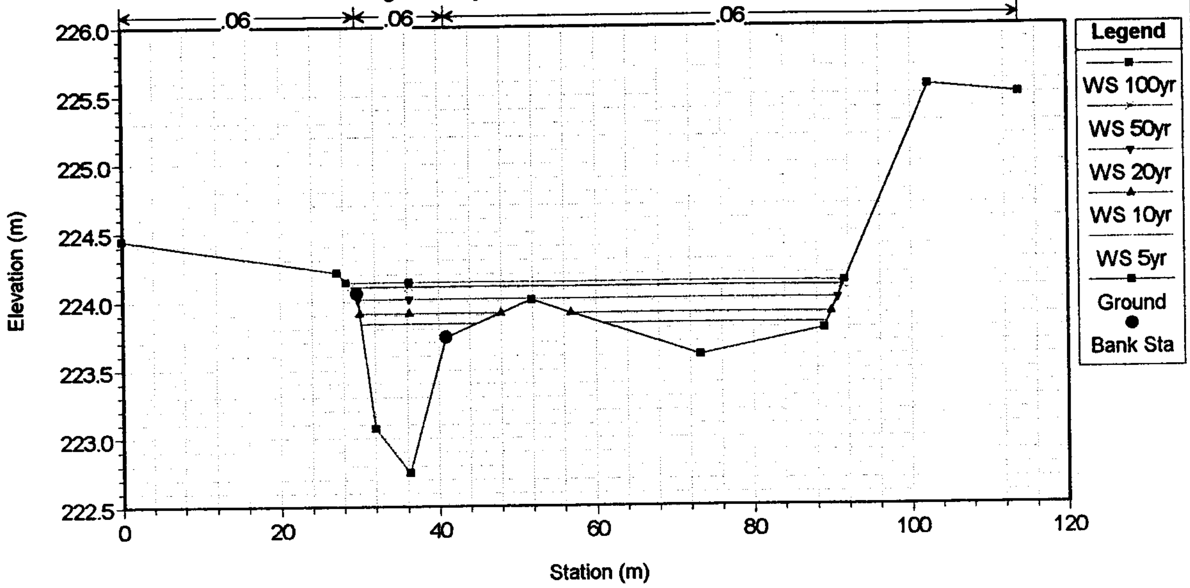
River = Figtree Gully Reach = 1 cs9 RS = 23 subcritical run



j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

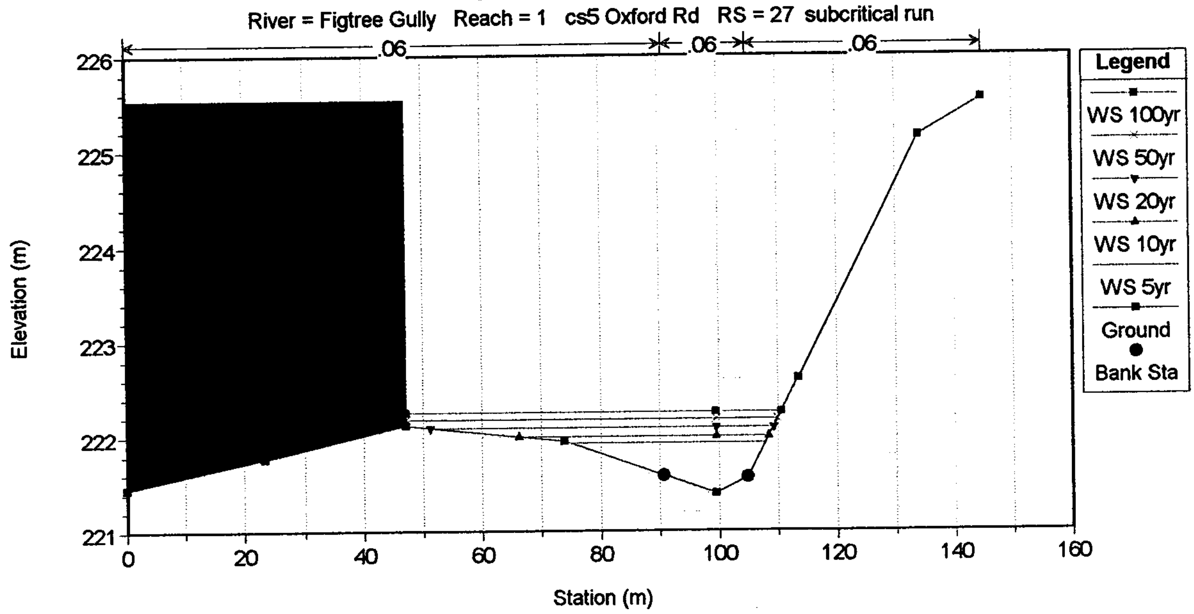
River = Figtree Gully Reach = 1 cs4 RS = 28 subcritical run



j712 figtree gully existing conditions 18/11/97

Geom: existing conditions Flow: existing conditions

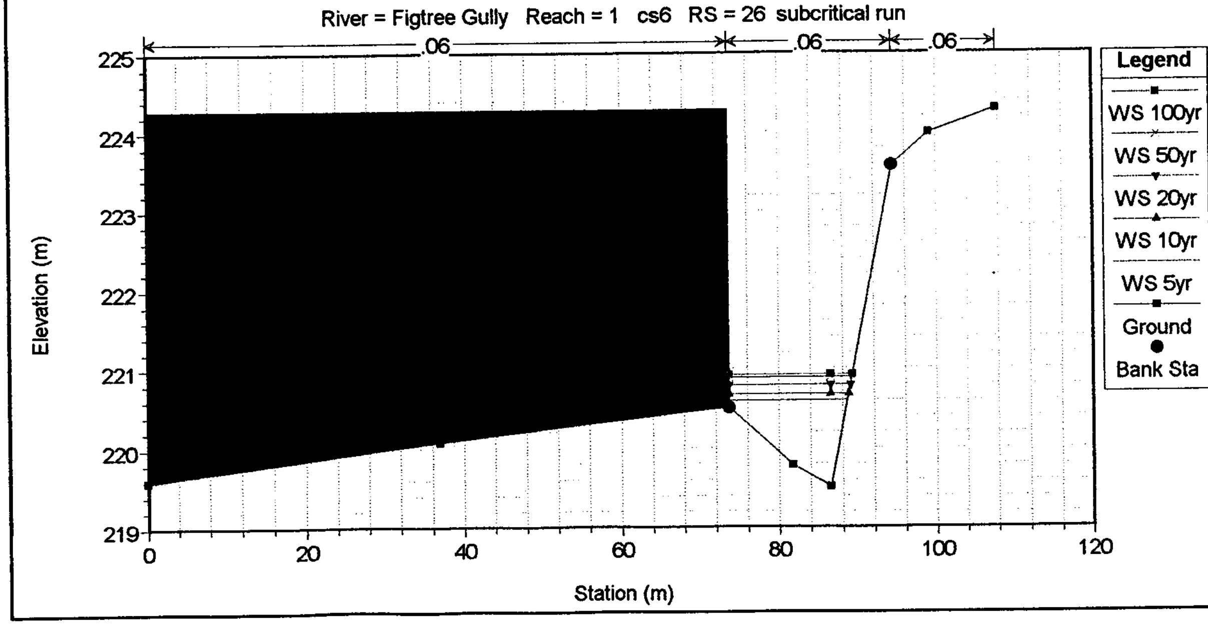
River = Figtree Gully Reach = 1 cs5 Oxford Rd RS = 27 subcritical run

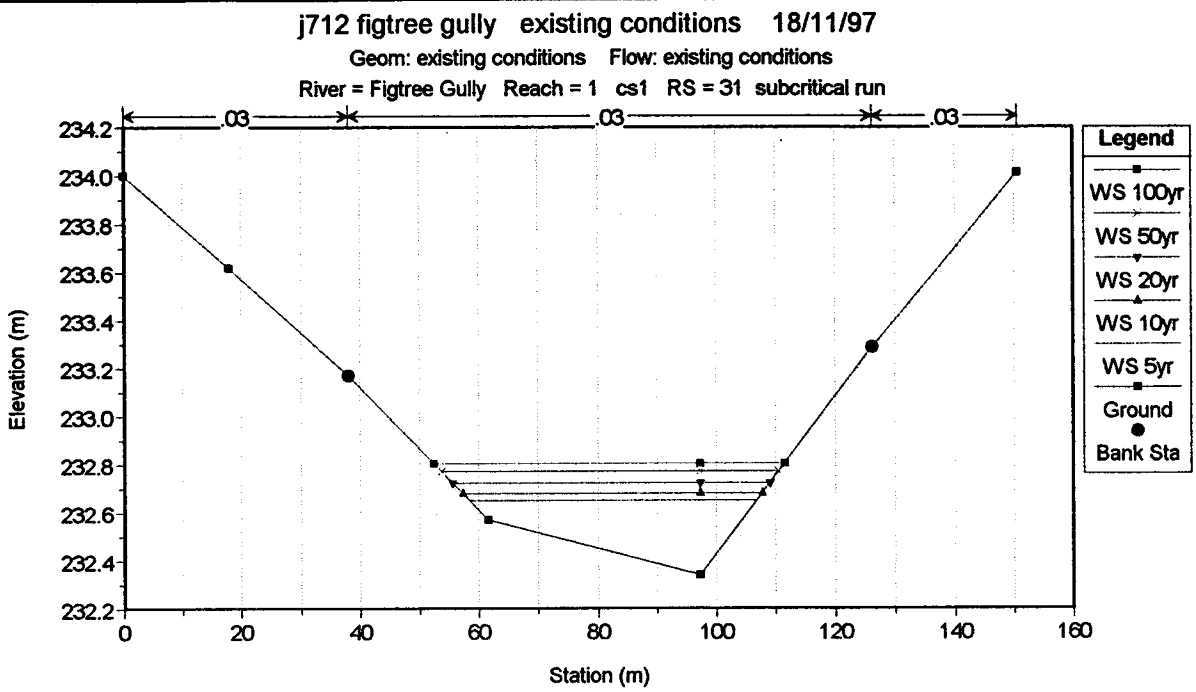


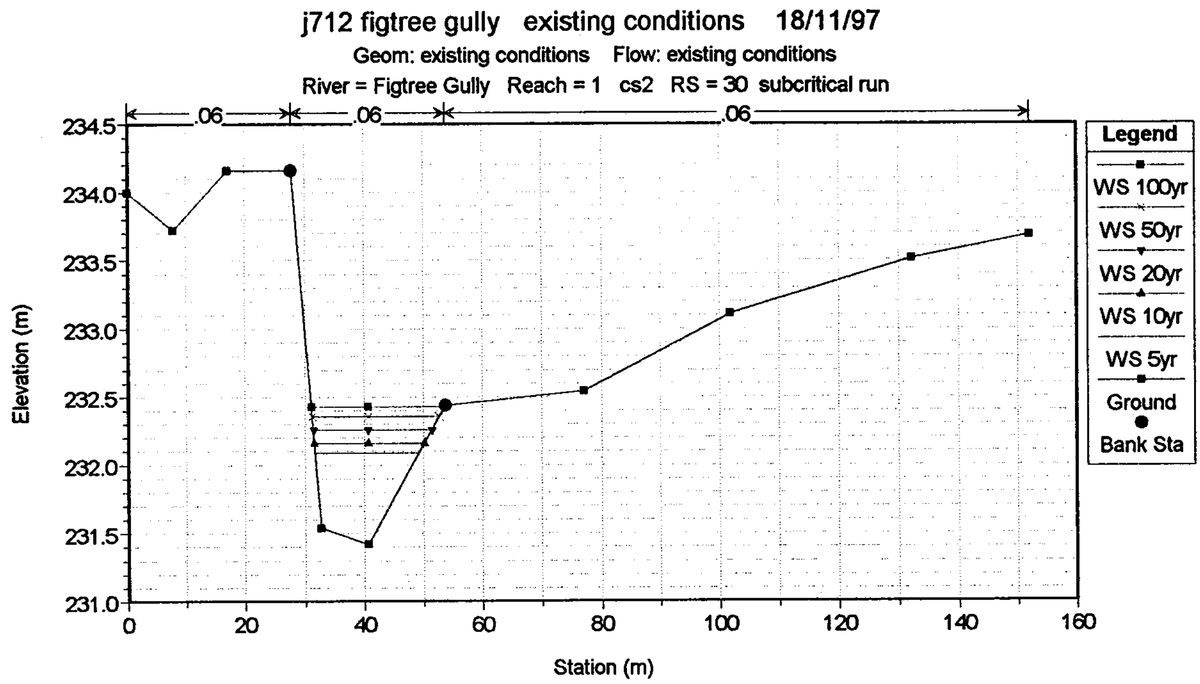
j712 figtree gully existing conditions 18/11/97

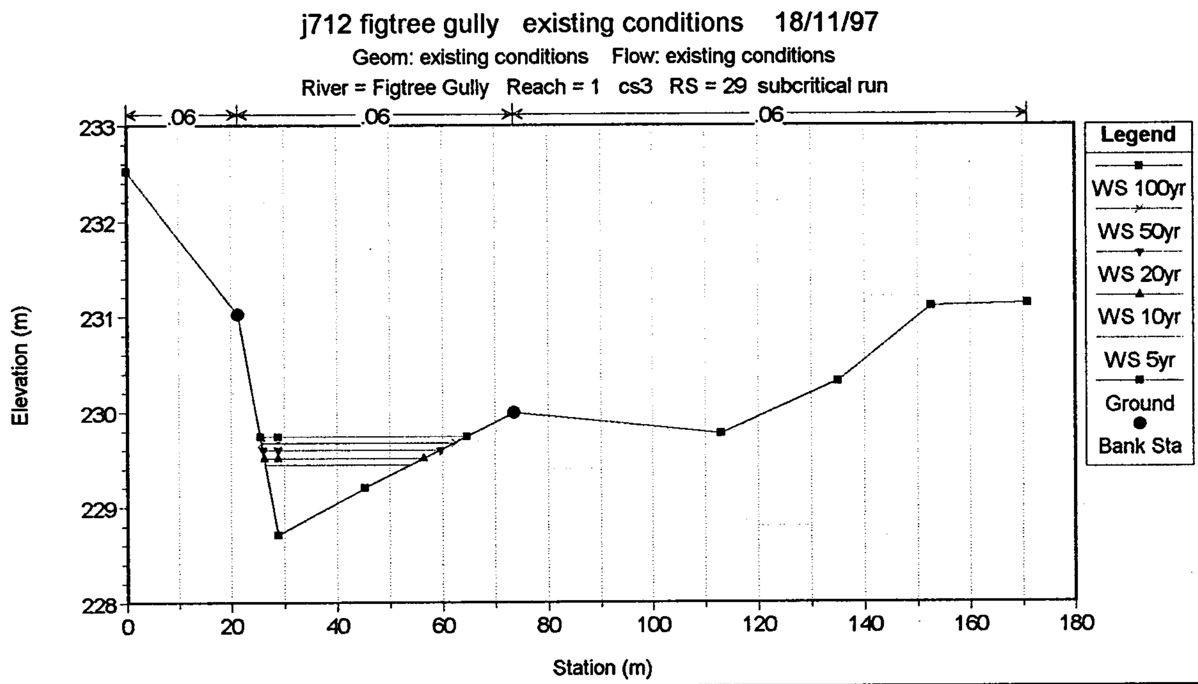
Geom: existing conditions Flow: existing conditions

River = Figtree Gully Reach = 1 cs6 RS = 26 subcritical run




j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs1 RS = 31 subcritical run
.03
.03
.03
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta


j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs2 RS = 30 subcritical run
.06
.06
.06
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta


j712 figtree gully existing conditions 18/11/97
Geom: existing conditions Flow: existing conditions
River = Figtree Gully Reach = 1 cs3 RS = 29 subcritical run
.06
.06
.06
Elevation (m)
Station (m)
Legend
WS 100yr
WS 50yr
WS 20yr
WS 10yr
WS 5yr
Ground
Bank Sta

HEC-RAS GEOMETRY FILE

```
Geom Title=existing conditions
Viewing Rectangle= .206687608941858 , .830030845388239 , .842210808383838 , .218867571937457

River Reach=Figtree Gully   ,1
Junct Up Dn=                ,
Reach XY= 2
       .8231293         .5517928         .2136054         .5099602
Rch Text X Y=0.6707483,0.5413347
Reverse River Text=-1

Type RM Length L Ch R = 1 ,31       ,10,15,10
BEGIN DESCRIPTION:
cs1
END DESCRIPTION:
#Sta/Elev= 7
       0     234    17.9  233.62    38.1  233.17    61.6  232.57    97.3  232.34
   126.2  233.29   150.6  234.01
#Mann= 3 , 0 , 0
       0     .03       0    38.1     .03       0   126.2     .03       0
Bank Sta=38.1,126.2
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,30.5*    ,10,15,10
#Sta/Elev= 13
       0     234   9.245 233.747   15.48 233.796  20.149  233.83   32.95 233.665
  46.923 232.062   47.26 232.054      69  231.88   89.95 232.865 104.492     233
  119.97 233.376  138.88 233.687   151.3 233.845
#Mann= 3 , 0 , 0
       0    .045       0   32.95    .045       0   89.95    .045       0
Bank Sta=32.95,89.95
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,30       ,27.5,27.5,27.5
BEGIN DESCRIPTION:
cs2
END DESCRIPTION:
#Sta/Elev= 11
       0     234     7.8  233.72      17  234.16    27.8  234.16    32.8  231.54
    40.7  231.42    53.7  232.44      77  232.54   101.8  233.11   132.1  233.51
     152  233.68
#Mann= 3 , 0 , 0
       0     .06       0    27.8     .06       0    53.7     .06       0
Bank Sta=27.8,53.7
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,29.75*   ,27.5,27.5,27.5
#Sta/Elev= 15
       0  233.63   7.351 233.315  16.022 233.521    26.2 233.375  30.667 231.186
  37.725 230.742  45.441 231.147  58.675 231.827  81.916  231.87  98.278  232.13
 106.653 232.327 120.548  232.55 136.876 232.892 138.284 232.917 156.725 233.042
#Mann= 3 , 0 , 0
       0     .06       0    26.2     .06       0  58.675     .06       0
Bank Sta=26.2,58.675
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,29.5*    ,27.5,27.5,27.5
#Sta/Elev= 15
       0  233.26   6.902  232.91  15.043 232.881    24.6  232.59  28.534 230.832
   34.75 230.065  45.394 230.498   63.65 231.215  86.831   231.2 103.152 231.344
 111.505 231.543 125.366 231.807 141.651 232.274 143.056 232.311  161.45 232.405
#Mann= 3 , 0 , 0
       0     .06       0    24.6     .06       0   63.65     .06       0
Bank Sta=24.6,63.65
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,29.25*   ,27.5,27.5,27.5
#Sta/Elev= 15
       0  232.89   6.453 232.504  14.065 232.242      23 231.805  26.401 230.478
  31.775 229.388  45.347 229.849  68.625 230.603  91.747 230.531 108.026 230.557
 116.358  230.76 130.183 231.063 146.427 231.656 147.828 231.706 166.175 231.768
#Mann= 3 , 0 , 0
```

```
       0     .06       0      23     .06       0  68.625     .06       0
Bank Sta=23,68.625
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,29      ,50,50,50
BEGIN DESCRIPTION:
cs3
END DESCRIPTION:
#Sta/Elev= 9
       0  232.52    21.4  231.02    28.8  228.71    45.3   229.2    73.6  229.99
   112.9  229.77     135  230.32   152.6   231.1   170.9  231.13
#Mann= 3 , 0 , 0
       0     .06       0    21.4     .06       0    73.6     .06       0
Bank Sta=21.4,73.6
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,28.8333*,50,50,50
#Sta/Elev= 15
       0 231.175  20.866  229.99  22.783  229.86  25.316 229.024   30.05 227.717
  44.082 228.186   68.15 228.948  82.074 228.926 105.814 228.751  109.41 228.819
 126.994 229.228 129.465 229.327 143.862  230.13 146.582 230.181   161.4 230.192
#Mann= 3 , 0 , 0
       0     .06       0  22.783     .06       0   68.15     .06       0
Bank Sta=22.783,68.15
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,28.6666*,50,50,50
#Sta/Elev= 15
       0  229.83  22.132 228.834  24.167   228.7  26.653 227.833    31.3 226.723
  42.865 227.172    62.7 227.907  76.019 227.942  98.728 227.731 102.168 227.776
 118.989 228.136 121.352  228.22 135.123  229.16 137.726 229.256   151.9 229.253
#Mann= 3 , 0 , 0
       0     .06       0  24.167     .06       0    62.7     .06       0
Bank Sta=24.167,62.7
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,28.5*   ,50,50,50
#Sta/Elev= 15
       0 228.485  23.399 227.678   25.55  227.54  27.989 226.643   32.55  225.73
  41.647 226.157   57.25 226.865  69.964 226.959  91.643 226.712  94.926 226.732
 110.983 227.043 113.239 227.112 126.385 228.189 128.869 228.332   142.4 228.315
#Mann= 3 , 0 , 0
       0     .06       0   25.55     .06       0   57.25     .06       0
Bank Sta=25.55,57.25
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,28.3333*,50,50,50
#Sta/Elev= 15
       0  227.14  24.666 226.522  26.933  226.38  29.326 225.452    33.8 224.737
  40.429 225.143    51.8 225.823  63.909 225.976  84.557 225.693  87.684 225.688
 102.977 225.951 105.126 226.005 117.647 227.219 120.013 227.408   132.9 227.377
#Mann= 3 , 0 , 0
       0     .06       0  26.933     .06       0    51.8     .06       0
Bank Sta=26.933,51.8
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,28.1666*,50,50,50
#Sta/Elev= 15
       0 225.795  25.933 225.366  28.317  225.22  30.663 224.261   35.05 223.743
  39.212 224.129   46.35 224.782  57.855 224.993  77.471 224.673  80.442 224.644
  94.971 224.859  97.013 224.897 108.909 226.249 111.156 226.484   123.4 226.438
#Mann= 3 , 0 , 0
       0     .06       0  28.317     .06       0   46.35     .06       0
Bank Sta=28.317,46.35
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,28      ,43.333,43.333,43.333
BEGIN DESCRIPTION:
cs4
END DESCRIPTION:
#Sta/Elev= 11
       0  224.45    27.2  224.21    29.7  224.06      32  223.07    36.3  222.75
    40.9  223.74    51.8  224.01    73.2   223.6    88.9  223.79   102.3  225.56
```

```
   113.9   225.5
#Mann= 3 , 0 , 0
       0     .06       0    29.7     .06       0    40.9     .06       0
Bank Sta=29.7,40.9
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,27.6666*,43.333,43.333,43.333
#Sta/Elev= 16
       0  223.45  12.853 223.512  25.982 223.583  40.766 223.474  45.822 223.391
  50.033 223.237  52.589 222.555  57.367   222.3    62.2 223.017  71.458 223.435
  75.685  223.48  89.633 223.642 102.967 224.124  107.46 224.709 114.348 225.477
   124.2 225.513
#Mann= 3 , 0 , 0
       0     .06       0  50.033     .06       0    62.2     .06       0
Bank Sta=50.033,62.2
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,27.3333*,43.333,43.333,43.333
#Sta/Elev= 16
       0  222.45  18.077 222.641  36.541 222.851  57.333 222.712  64.444 222.572
  70.367 222.413  73.178 222.039  78.433  221.85    83.5 222.293  91.115 222.859
  94.592 223.045 106.066 223.683 117.034 224.457  120.73  224.93 126.396 225.394
   134.5 225.527
#Mann= 3 , 0 , 0
       0     .06       0  70.367     .06       0    83.5     .06       0
Bank Sta=70.367,83.5
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,27      ,85,90,95
BEGIN DESCRIPTION:
cs5 Oxford Rd
END DESCRIPTION:
#Sta/Elev= 10
       0  221.45    23.3  221.77    47.1  222.12    73.9  221.95    90.7  221.59
    99.5   221.4   104.8  221.57   113.5  222.61     134  225.15   144.8  225.54
#Mann= 3 , 0 , 0
       0     .06       0    90.7     .06       0   104.8     .06       0
#Block Obstruct= 2 , 0
       0    47.1               0
Bank Sta=90.7,104.8
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,26      ,75,75,75
BEGIN DESCRIPTION:
cs6
END DESCRIPTION:
#Sta/Elev= 8
       0  219.59    36.9  220.08    73.6  220.51    81.7  219.79    86.5  219.51
    94.4  223.57    99.1  223.99   107.7  224.29
#Mann= 3 , 0 , 0
       0     .06       0    73.6     .06       0    94.4     .06       0
#Block Obstruct= 2 , 0
       0    73.6               0
Bank Sta=73.6,94.4
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,25      ,80,95,105
BEGIN DESCRIPTION:
cs7 Waverley St
END DESCRIPTION:
#Sta/Elev= 9
       0  218.47    23.4   218.9    50.3   219.2    63.2  218.65    70.1  218.63
    77.2  218.92   100.4  221.33   125.3   223.4   133.9  223.71
#Mann= 3 , 0 , 0
       0     .06       0    63.2     .06       0    77.2     .06       0
#Block Obstruct= 2 , 0
       0    50.3               0
Bank Sta=63.2,77.2
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,24      ,120,110,100
BEGIN DESCRIPTION:
cs8
```

Park
51

```
END DESCRIPTION:
#Sta/Elev= 10
       0  217.51      16  217.38     21.1  215.76     32.9   216.3     34.6  217.36
      51  217.42    56.8  218.72     61.3  219.23     64.3   220.4     68.5  221.19
#Mann= 3 , 0 , 0
       0     .06       0      16      .06       0     34.6     .06        0
Bank Sta=16,34.6
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,23       ,17,17,17
BEGIN DESCRIPTION:
cs9
END DESCRIPTION:
#Sta/Elev= 7
       0   215.8     9.2  215.51     21.5  214.49     38.3  216.24       50  216.37
    72.1  216.79    95.5  216.75
#Mann= 3 , 0 , 0
       0     .06       0     9.2      .06       0     38.3     .06        0
Bank Sta=9.2,38.3
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,22       ,13,13,13
BEGIN DESCRIPTION:
cs 10 Park St
END DESCRIPTION:
#Sta/Elev= 11
       0   215.3      21  215.56     38.2  215.73     46.9  214.71     51.2  214.36
    55.1   214.3    58.9  214.46     74.3  215.29     92.7  216.32    111.3  216.55
   134.2  216.88
#Mann= 3 , 0 , 0
       0     .02       0    51.2     .015       0     58.9     .02        0
#Block Obstruct= 2 , 0
       0    38.2                        0
Bank Sta=51.2,58.9
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,21       ,95,95,95
BEGIN DESCRIPTION:
cs11
END DESCRIPTION:
#Sta/Elev= 10
       0  215.43    20.5  215.02     23.8  214.38       24  213.31     26.9  213.31
    27.1  214.38    27.4  214.82     28.2  215.16     39.8  215.86     60.3  215.93
#Mann= 3 , 0 , 0
       0     .06       0    23.8     .015       0     27.1     .06        0
Bank Sta=23.8,27.1
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,20       ,70,70,70
BEGIN DESCRIPTION:
cs12
END DESCRIPTION:
#Sta/Elev= 10
       0  213.68    27.3   213.9       33  213.78     33.2  213.07     33.3  212.07
    36.8  212.08    36.9  213.08     40.3  213.88     56.1  213.82     72.1   214.3
#Mann= 3 , 0 , 0
       0     .06       0    33.2     .015       0     36.9     .06        0
Bank Sta=33.2,36.9
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,18       ,135,135,135
BEGIN DESCRIPTION:
cs12.9
END DESCRIPTION:
#Sta/Elev= 6
       0  212.51       1  212.51     1.01  211.11     3.99  211.11        4  212.51
       5  212.51
#Mann= 3 , 0 , 0
       0     .04       0       1     .015       0        4     .04        0
Bank Sta=1,4
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,17       ,85,85,85
```

```
BEGIN DESCRIPTION:
cs14
END DESCRIPTION:
#Sta/Elev= 10
       0  211.89     28.5  211.73       50   211.2     50.6  210.71     50.7  209.48
    52.2  209.47     53.7  209.48     53.8  210.68     55.8  211.18     67.4  210.98
#Mann= 3 , 0 , 0
       0     .04        0     50.6     .015        0     53.8      .04        0
Bank Sta=50.6,53.8
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,16      ,15,15,15
BEGIN DESCRIPTION:
cs15
END DESCRIPTION:
#Sta/Elev= 11
       0  210.99     22.5  210.73     41.7  210.52     59.5  210.25     61.1  209.42
    61.2  208.34     63.2  208.32     64.8  208.34     64.9  209.42     66.2  209.94
      70  210.06
#Mann= 3 , 0 , 0
       0     .04        0     61.1     .015        0     64.9      .04        0
Bank Sta=61.1,64.9
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,15      ,178,178,178
BEGIN DESCRIPTION:
cs15.1
END DESCRIPTION:
#Sta/Elev= 6
       0  209.26        1  209.26     1.01  208.26     4.39  208.26      4.4  209.26
     5.4  209.26
#Mann= 3 , 0 , 0
       0     .04        0        1     .015        0      4.4      .04        0
Bank Sta=1,4.4
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 2 ,14.9    ,,,
BEGIN DESCRIPTION:
Kelly St Culvert
END DESCRIPTION:
Bridge Culvert--1,0,-1,-1
Deck Dist Width WeirC Skew NumUp NumDn MinLoCord MaxHiCord MaxSubmerge Is_Ogee
0,161.1,1.6,,2,2,,,0.95,0,0,0,,
       0      30
     210     210
     208     208
       0      30
     208     208
   206.6   206.6
Culvert=2,1,3.5,161.1,0.015,0.7,1,8,1,208.26,2.7,205.14,20,Culvert #1  , 0 ,0

Type RM Length L Ch R = 1 ,14      ,36,36,36
BEGIN DESCRIPTION:
cs18
END DESCRIPTION:
#Sta/Elev= 16
       0  208.34     12.1  207.97     13.8  207.96     15.3     208     16.3  207.47
    18.3  205.78     18.4  205.14     21.6  205.16     21.7  205.78     24.4  207.48
    25.1  207.67     29.2  207.68       32  208.21     34.4  208.22     36.6  207.72
    45.7  207.93
#Mann= 3 , 0 , 0
       0     .03        0     18.3     .015        0     21.7      .03        0
Bank Sta=18.3,21.7
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,13      ,47,47,47
BEGIN DESCRIPTION:
cs18.9 d/s of railway brick arch
END DESCRIPTION:
#Sta/Elev= 6
       0  206.25        1  206.25     1.01  204.75     3.99  204.75        4  206.25
       5  206.25
#Mann= 3 , 0 , 0
```

```
       0     .02        0        1      .02        0        4      .02        0
Bank Sta=1,4
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,12       ,63,63,63
BEGIN DESCRIPTION:
cs19
END DESCRIPTION:
#Sta/Elev= 11
       0  207.14      1.1  206.79      9.5  206.62     27.8  206.15     34.3  206.27
    36.5  205.63     36.7  204.52     38.2  204.48     39.8  204.58       40  205.63
      43  206.43
#Mann= 3 , 0 , 0
       0     .04        0     36.5     .015        0       40      .04        0
Bank Sta=36.5,40
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,11       ,96,96,96
BEGIN DESCRIPTION:
cs19.9
END DESCRIPTION:
#Sta/Elev= 6
       0  205.52        1  205.52     1.01  204.32     4.29  204.32      4.3  205.52
     5.3  205.52
#Mann= 3 , 0 , 0
       0    .015        0        1     .015        0      4.3     .015        0
Bank Sta=1,4.3
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,10       ,35,35,35
BEGIN DESCRIPTION:
cs20.9
END DESCRIPTION:
#Sta/Elev= 6
       0   204.9        1    204.9     1.01    203.7     4.29    203.7      4.3    204.9
     5.3   204.9
#Mann= 3 , 0 , 0
       0    .015        0        1     .015        0      4.3     .015        0
Bank Sta=1,4.3
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,9        ,100,100,100
BEGIN DESCRIPTION:
cs21
END DESCRIPTION:
#Sta/Elev= 9
       0  205.15      2.1  205.12      7.1  203.67      8.7  203.65      9.6  202.93
      12     203     13.6  204.55     19.9  204.38     40.2  204.07
#Mann= 3 , 0 , 0
       0     .04        0      8.7      .04        0     13.6      .04        0
#Block Obstruct= 2 , 0
       0                      13.6        0
Bank Sta=8.7,13.6
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,8        ,120,120,120
BEGIN DESCRIPTION:
cs22 Kingdon St
END DESCRIPTION:
#Sta/Elev= 14
       0   204.5     19.9  204.34     42.2  204.21     61.2  204.04     65.7      204
    89.2  203.86    109.1  203.15      117  202.98    123.7  203.17    134.5  203.55
   156.7  203.62    182.9  203.34    207.8  203.02    232.2  202.69
#Mann= 3 , 0 , 0
       0     .04        0    109.1      .04        0    123.7      .04        0
#Block Obstruct= 2 , 0
       0                     156.7        0
Bank Sta=109.1,123.7
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,7        ,65,60,50
BEGIN DESCRIPTION:
cs23
```

```
END DESCRIPTION:
#Sta/Elev= 12
       0  202.17     13.9   202.2     32.7  202.15     58.5  202.18     73.4   202.2
    87.5  202.23     91.1  200.65     93.2  200.46     95.2  201.85    137.5  202.24
   166.8  201.94    195.1  201.78
#Mann= 3 , 0 , 0
       0     .04        0    87.5      .04        0    95.2      .04        0
#Block Obstruct= 2 , 0
       0                  137.5        0   202.5
Bank Sta=87.5,95.2
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,6        ,75,80,85
BEGIN DESCRIPTION:
cs24
END DESCRIPTION:
#Sta/Elev= 13
       0  200.52     23.7  200.73     31.5  200.91     57.3  201.25       81  201.47
   106.2  201.61    112.5  200.24    116.9  200.14    122.8  201.58    146.6  201.44
   170.7   201.4    194.7  201.33    219.5   201.2
#Mann= 3 , 0 , 0
       0     .04        0   106.2      .04        0   122.8      .04        0
Bank Sta=106.2,122.8
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,5        ,60,60,60
BEGIN DESCRIPTION:
cs25
END DESCRIPTION:
#Sta/Elev= 13
       0   199.8     25.4  200.35     50.6  200.42     75.9   200.7     94.2  200.63
    96.9  199.72     98.4   199.7    100.4  199.79    104.5  200.63    126.5  200.73
   150.7  200.43    175.8  200.23      200  200.04
#Mann= 3 , 0 , 0
       0     .04        0    94.2      .04        0   104.5      .04        0
Bank Sta=94.2,104.5
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,4        ,100,90,80
BEGIN DESCRIPTION:
cs26
END DESCRIPTION:
#Sta/Elev= 14
       0  199.09     31.4   199.6     55.9   199.4       80   199.5    106.2  199.38
   141.2  200.09    147.6  199.68    151.8   199.2    156.5  199.68    163.1  200.02
   187.6  199.73    211.2  199.58    234.5  199.32    257.9  199.22
#Mann= 3 , 0 , 0
       0     .04        0   147.6      .04        0   156.5      .04        0
Bank Sta=147.6,156.5
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,3        ,100,100,100
BEGIN DESCRIPTION:
cs27
END DESCRIPTION:
#Sta/Elev= 12
       0  198.46     24.8   198.5     49.4  198.75     75.9  199.11    100.3  199.02
   108.8  198.41    114.4  198.91      138   198.7      162  198.68    186.1   198.5
   209.6  198.51    238.1  198.26
#Mann= 3 , 0 , 0
       0     .04        0   100.3      .04        0   114.4      .04        0
Bank Sta=100.3,114.4
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,2        ,180,140,100
BEGIN DESCRIPTION:
cs28
END DESCRIPTION:
#Sta/Elev= 10
       0  197.43     23.8  197.65     47.6  197.84     70.9  198.15       98  198.35
   123.9  198.11    147.8  197.93    167.9  197.97    191.3  198.09    223.8  198.14
#Mann= 3 , 0 , 0
       0     .04        0   123.9      .04        0   167.9      .04        0
```

```
Bank Sta=123.9,167.9
Exp/Cntr=0.3,0.1

Type RM Length L Ch R = 1 ,1        ,0,0,0
BEGIN DESCRIPTION:
cs29
END DESCRIPTION:
#Sta/Elev= 11
       0   197.9    30.2  197.85    54.4  197.91    77.4  197.89    96.6   198.2
   106.5  196.41     117  198.13   136.5  198.14     161  198.11   183.6  198.07
   205.8  198.26
#Mann= 3 , 0 , 0
       0     .04       0    96.6     .04       0     117     .04       0
Bank Sta=96.6,117
Exp/Cntr=0.3,0.1

Chan Stop Cuts=-1
```

TABLE B1: TYPICAL ROAD RESERVE DEPTHS, FLOWS AND VELOCITIES

Depth (m)	Flow (m^3/s)	Average Velocity (m/s)
0.15	2	1.2
0.20 *	4	1.7
0.25 *	7	2.1
0.30 *	11	2.5
0.35 *	15	2.8
0.40 *	20	3.2

* indicates flows would be over top of kerb, and flows beyond road reserve have not been assessed.

APPENDIX C

COMMUNITY NEWSLETTER

SCONE FLOODPLAIN MANAGEMENT STUDY

COMMUNITY NEWSLETTER No. 1

AUGUST 1997

FLOOD PROBLEMS IN SCONE

The western areas of Scone township are located on the common floodplain of Kingdon Ponds, Middle Brook and Parsons Gully. The township is also affected by smaller creek systems which drain the steeper country to the east of the town. The most significant of these creek systems is Figtree Creek.

Major flood events recorded in the Scone region include those of February 1955, January/February 1971, January 1976, March 1977, February 1992 and January 1997.

During such events flows down the Kingdon Ponds, Middle Brook and Parsons Gully systems have resulted in the western areas of Scone township being flooded, isolation of the satellite area of Satur and significant rural areas to the north and south of Scone being inundated. Flows in the Figtree Creek system have caused significant inundation through the north eastern residential area and central business area of Scone.

The people of Scone need to be prepared for future flood events which may be similar or indeed larger than past flood events.

HOW IS COUNCIL GOING TO TACKLE THE FLOOD PROBLEM?

To deal with flooding problems in Scone, Council has commenced implementing the guidelines set out in the New South Wales Government's 'Floodplain Development Manual', under the guidance of the Department of Land and Water Conservation (formerly the Department of Water Resources).

Council has now received funding from the Department of Land and Water Conservation to undertake **THE SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN.**

Council's Floodplain Management Committee has appointed Bewsher Consulting Pty Ltd to undertake the study — an independent company specialising in flooding and environmental issues. Bewsher Consulting will be assisted by planning consultants, Don Fox Planning; and environmental consultants, Nelson Consulting.

WHAT ARE THE OBJECTIVES OF THE FLOODPLAIN MANAGEMENT STUDY?

The Floodplain Management Study will assess options for reducing the danger to life and property during flooding. An extensive community consultation program is proposed to ensure that all practical options are looked at and that your views on each option are considered.

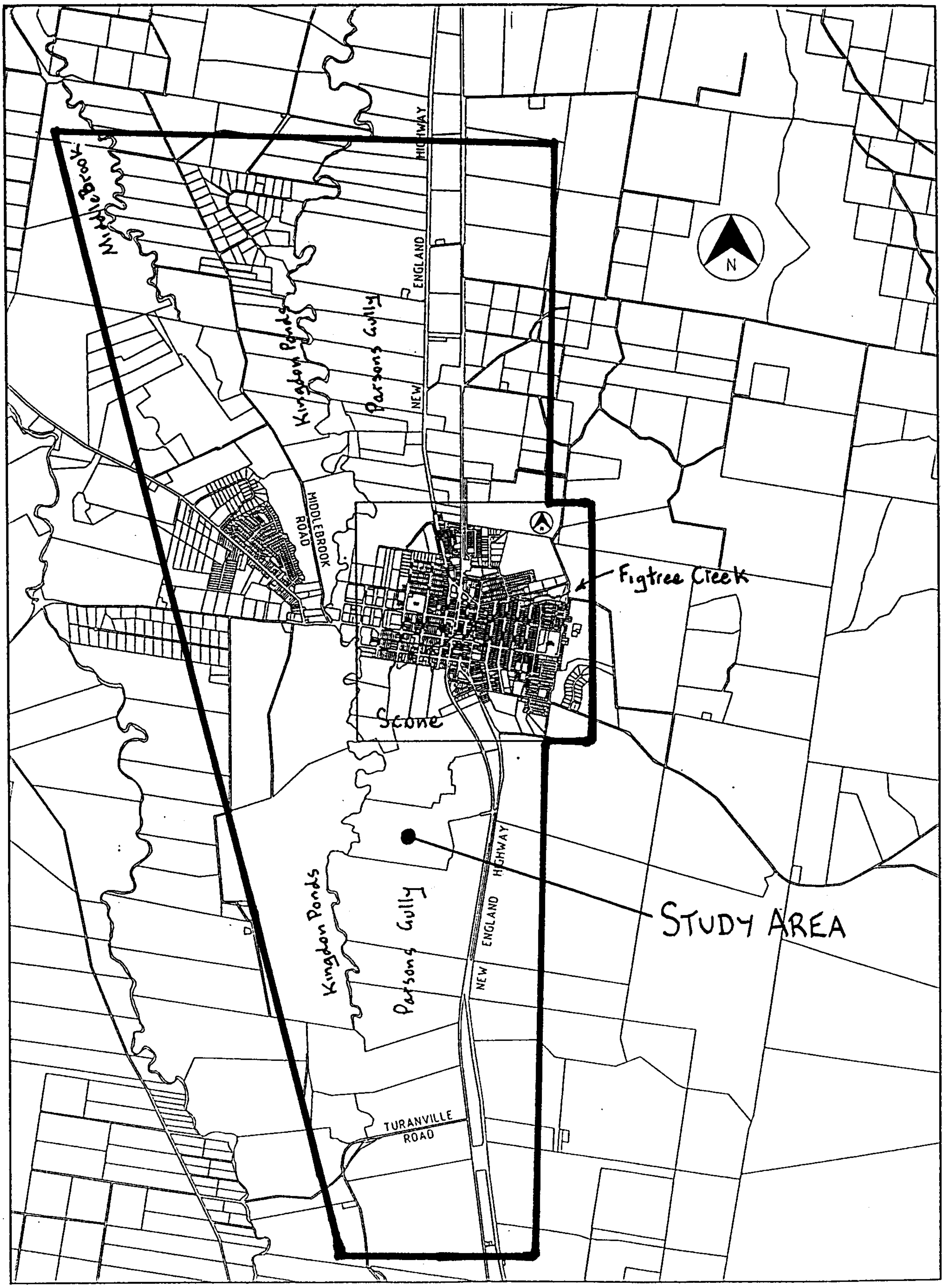
The ultimate objective of the Floodplain Management Study is to develop a Floodplain Management Plan for the Scone area which is fully endorsed by local residents. This plan will outline the best possible measures to reduce flood damage in the most equitable way. Environmental, social, economic, financial and engineering considerations will be all included in the ultimate plan.

Once Council has a formally adopted Floodplain Management Plan, it can apply to the Department of Land and Water Conservation for funding so that the recommended works can be carried out.

HOW WILL LOCAL RESIDENTS BE REPRESENTED DURING THE STUDY?

Council's Floodplain Management Committee is the vital link between the Consultant, Scone Shire Council, the Department of Land and Water Conservation and the local residents. The Floodplain Management Committee will overview the study as well as represent 'the community voices' for the more localised flooding problems within the catchment. Currently, members of the Floodplain Management Committee include:

- Scone Shire Councillors and Council officers;
- Community representatives*;
- Department of Land and Water Conservation;
- State Emergency Service;


Middle Brook
Kingdon Ponds
Parsons Gully
NEW ENGLAND HIGHWAY
MIDDLEBROOK ROAD
Figtree Creek
Scone
N
STUDY AREA
Kingdon Ponds
Parsons Gully
NEW ENGLAND HIGHWAY
TURANVILLE ROAD

* Council is looking for local residents to join the committee. If you are interested in contributing to the development of the Scone Floodplain Management Study by becoming a member of the committee, please contact David Casson of Council (ph 401 136) before Tuesday 12 August 1997.

WHAT IS THE EXTENT OF FLOODING BEING DETERMINED?

Flooding along Kingdon Ponds, Middle Brook and Parsons Gully was studied as part of the 1996 Scone Flood Study prepared by the Department of Land and Water Conservation for Council. This study defined the location and extent of flooding along these creeks, but it did not examine Figtree Creek Flooding or investigate options to manage or reduce the existing problems.

A copy of the Scone Flood Study Report may be viewed at Council's offices and various details will be put on public display during the course of the current study.

The current study will also estimate the extent and nature of flooding along Figtree Creek and we are especially looking for local residents with knowledge of past flooding to come forward so that as much local information as possible can be considered during the study.

HOW CAN LOCAL RESIDENTS PARTICIPATE IN THE STUDY? ...WE NEED YOUR HELP

The success of any floodplain management plan hinges on your input and acceptance of the proposals. This can be achieved by getting involved at all stages of the decision-making process.

We will be contacting community groups early in the study to collect information about past floods and to make sure we understand all the local issues.

You can participate in the study by:

- completing and returning the questionnaire. A questionnaire, designed especially for this study, has been distributed to homes and businesses close to the major creeks;
- attending the community information day and one of the public meetings planned to be held to discuss all the floodplain management options that will have been examined. We will be again seeking community input to the study on these occasions so we can include feedback from local residents in the Floodplain Management Plan. You will be informed of meeting details at a future date;
- commenting on the draft Floodplain Management Plan when it is put on public display.

WHAT FLOOD MITIGATION OPTIONS WILL BE LOOKED AT?

The Floodplain Management Plan for the Scone area will outline all the possible measures to reduce flood damage in the most equitable way, taking into consideration environmental, social economic, financial and engineering issues. It is likely that the ultimate Floodplain Management Plan will involve a combination of options.

An extensive list of options has already been developed. These are listed in no specific order of importance, cost, etc:

a. Clearing waterways of rubbish, debris and exotic vegetation;

b. Stabilising creek banks to reduce erosion;

c. Enlarging waterways by widening or deepening;

d. Constructing bypass channels and/or floodways;

e. Straightening waterways and/or lining channels with rock or concrete;

f. Constructing upstream dams or detention storages (e.g. on Figtree Creek upstream of Barton Street);;

g. Enlarging bridges and/or culverts to allow more water to flow under them (e.g. along Figtree Creek, and at Liverpool Street);

h. Raising of roads to improve access and evacuation in times of flood;

i. Construction of permanent levees to protect property;

j. Government purchase of the most flood-liable houses — only if residents wish to sell — and conversion of land to open space. The price offered for the house assumes the house is not flood-affected and therefore can be above market price;

k. Raising of timber, fibro and 'hardiplank' houses above the 100 year flood level;

l. Flood-proofing of individual residential and business properties with small flood walls and/or deflector banks;

m. Moving of the most flood-affected houses to areas of higher ground;

n. In existing urban and rural areas, providing consistent and equitable controls on development in flood-liable areas, including the amount of filling allowed on these properties;

o. Providing consistent and equitable controls on development in flood-liable areas, including the amount of filling allowed on these properties;

p. Widening the area beside channels by acquiring private property and using this land as open space;

q. Improving flood warning both before and during a flood;

r. Improving evacuation procedures and emergency assistance;

s. Making sure all information about the potential risks of flooding is available to all residents and business owners;

t. Providing a certificate to all residents stating whether their property is flood-affected;

u. Making sure residents and business owners have Flood Action Plans — these outline WHAT people should do, WHERE they should go and WHO they should contact if there is a flood;

v. Installing some flood markers (for example, on telegraph poles) to act as constant reminders of the heights of previous floods;

w. Promoting public education, community participation and flood awareness programs.

This list is by no means exhaustive and we need your input to get your opinions and ideas to make sure all options are considered. It is hoped that responses to the questionnaires and feed back from talking to local community groups will also give us your ideas for reducing the effects of flooding in the Scone area.

WHAT OTHER ENVIRONMENTAL ISSUES WILL BE CONSIDERED?

Floodplain management issues not only relate to reducing the effects of floods. They also relate to environmental issues such as:

- water quality in channels;
- vegetation along creeks;
- scenic or visual qualities of channels;
- illegal dumping, filling and littering;
- recreation opportunities;
- safety of the creek environment;
- education such as Landcare and Streamwatch programs;
- importance of the riverine corridor for preserving native bushland and wildlife habitats;
- stormwater pollution control and litter trapping devices.

WHO SHOULD I CONTACT FOR MORE INFORMATION?

For additional questionnaires or further information about the Scone Floodplain Management Study, please contact:

Mr David Casson
Scone Shire Council
Phone: 401-136

or

Mr Bruce Caldwell
Bewsher Consulting
Phone (02) 9868-1966

Thank you again for being part of this study

APPENDIX D

COMMUNITY QUESTIONNAIRE AND SUMMARY OF RESULTS

IMPORTANT COMMUNITY QUESTIONNAIRE

Concerning Flooding from Middle Brook, Kingdon Ponds, Parsons Gully and Figtree Creek

Please complete the questionnaire for the property in the Scone catchment in which you have an interest. Please fill in the details below:

House No ___ Street Name ______________________________

Name of Business/Organisation (if applicable) ____________________

PART A—GENERAL INFORMATION ON THE COMMUNITY

1. **Type of development.**

   (Tick one or more boxes)

   a. House ☐
   b. Business. Please indicate type: _______
   c. Farm or rural activities ___________
   d. Vacant land ☐
   e. Other. Please specify ___________

2. **Your residential status with regard to the property.**

   a. Owner residing or conducting business at property ☐
   b. Tenant only ☐
   c. Owner not residing nor conducting business at property ☐
   d. Other. Please specify ___________

3. **How long have you owned, lived at or conducted business at the property?**

   a. Less than 1 year ☐
   b. 1 year to 5 years ☐
   c. 5 years to 20 years ☐
   d. More than 20 years ☐
   If more than 20 years, how long? ____ years

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

   a. 1 ☐
   b. 2 ☐
   c. 3 ☐
   d. 4 ☐
   e. More than 4 ☐
   f. Not applicable ☐
   If more than 4, how many? ____

5. **If there is a business at the property how many people work there?**

   a. 1 to 3 ☐
   b. 4 to 6 ☐
   c. 7 to 10 ☐
   d. 11 to 20 ☐
   e. More than 20 ☐
   f. Not applicable ☐
   If more than 20, how many? ____

6. **If you are a resident, is your mobility (for example your ability to walk up the street) limited because of your age or a disability?**

   a. No ☐
   b. Yes ☐

19. Please mark the location of the property on the accompanying map. Please show the direction of floodwater flow, if applicable.

If you wish, please give further details of your ideas for reducing the effects of flooding in the Scone district. Attach a separate sheet if required. Any other comments about flooding in Scone that you may have are also welcome.

Please place your completed questionnaire in the postage paid envelope provided and return it before **Wednesday, 13 August 1997.**

No postage stamp is required. If you have misplaced the supplied envelope or wish to send an additional submission the address is:

Reply paid Permit Number 32
FLOOD STUDY QUESTIONNAIRE
Bewsher Consulting Pty Ltd
P.O. Box 352,
Epping NSW 2121

For additional questionnaires or further information about the Scone Floodplain Management Study and Plan, please contact:-

Mr David Casson
Acting Director, Environmental Services
Scone Council
P O Box 108,
SCONE NSW 2337
Phone: 401 136
Facsimile: 452 671

OR

Mr Bruce Caldwell
Bewsher Consulting Pty Ltd
PO Box 352
EPPING NSW 2121
Phone: (02)9868 1966
Facsimile: (02)9868 5759.
E-mail: bewsher@ozemail.com.au

THANK YOU AGAIN FOR BEING PART OF THIS STUDY

"Rural Area" location map (see over for urban area location map)

"Urban Area" area location map

IMPORTANT COMMUNITY QUESTIONNAIRE

Concerning Flooding from Middle Brook, Kingdon Ponds, Parsons Gully and Figtree Creek

Please complete the questionnaire for the property in the Scone catchment in which you have an interest. Please fill in the details below:

House No ___ Street Name ______________________________

Name of Business/Organisation (if applicable) ______________________

AS AT 13 JANUARY 1998 280 RESPONSES (870 QUESTIONNAIRES SENT OUT)

PART A—GENERAL INFORMATION ON THE COMMUNITY

1. Type of development.

(Tick one or more boxes)

		%
a.	House	73
b.	Business. Please indicate type:	14
c.	Farm or rural activities	5
d.	Vacant land	4
e.	Other. Please specify	19

2. Your residential status with regard to the property.

		%
a.	Owner residing or conducting business at property	71
b.	Tenant only	9
c.	Owner not residing nor conducting business at property	14
d.	Other. Please specify	4

3. How long have you owned, lived at or conducted business at the property?

		%
a.	Less than 1 year	6
b.	1 year to 5 years	16
c.	5 years to 20 years	49
d.	More than 20 years	28
	If more than 20 years, how long?	24

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

		%
a.	1	20
b.	2	28
c.	3	10
d.	4	12
e.	More than 4	14
f.	Not applicable	19
	If more than 4, how many? ____	5

5. If there is a business at the property how many people work there?

		%
a.	1 to 3	9
b.	4 to 6	6
c.	7 to 10	3
d.	11 to 20	2
e.	More than 20	3
f.	Not applicable	33
	If more than 20, how many? ____	0

6. If you are a resident, is your mobility (for example your ability to walk up the street) limited because of your age or a disability?

		%
a.	No	71
b.	Yes	11

PART B—FLOOD EXPERIENCE

7. What information about flooding have you received about the property?

(Tick one or more boxes)

	%
a. No information whatsoever	60
b. Flood levels from Council	6
c. Information from Real Estate Agent	7
d. Information from relatives, neighbours, friends or the previous owner	21
e. Viewed a Council Planning Certificate	1
f. Other	4

If other, please give the information you received

____

8. Have you ever experienced a flood at the property?

		%
a. No	☐ (go to Part C)	59
b. Yes	☐	27

If yes, which floods?

a. February 1955	6
b. January 1976	9
c. March 1977	10
d. February 1992	24
e. January 1997	16
f. Other	6

If other, please specify 3

9. In the biggest flood you have experienced, was the property flooded to above floor level?

	%
a. No	35
b. Yes	8

If yes, what was the depth of the water over the floor? ____________

10. In this biggest flood, what was the maximum depth of water in the backyard? (as best you can remember) % 26

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

	%
a. Less than 10 minutes	8
b. 10 minutes to half an hour	3
c. Half an hour to 2 hours	8
d. More than 2 hours	3
If more than 2 hours, how long?	3

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

a. No warning whatsoever	12
b. Witnessed with own eyes	16
c. Police	0
d. State Emergency Service (SES)	6
e. Radio	5
f. TV	0
g. Neighbours, relatives or friends	5
h. Other	1

If other, please give source of warning

____

13. In this biggest flood were you evacuated from the property?

	%
a. No	1
b. Yes	1

If yes, for how long?

a. Less than 12 hours	1
b. 12 to 24 hours	1
c. 24 to 48 hours	0
d. More than 2 days	0

Where did you stay?

a. With friends or relatives	2
b. In a motel/hotel paid for by Government Authorities	0
c. In a motel/hotel paid for by yourself	0
d. In community facilities	0
e. Other	0

If other, where did you stay? ____________

____

14. In this biggest flood what was the approximate cost (at the time) of the damage caused by the flood?

Outside building	%	Inside building	%
☐ \$0–\$1,000	14	☐ \$0–\$1,000	10
☐ \$1,000–\$2,000	3	☐ \$1,000–\$2,000	1
☐ \$2,000–\$5,000	2	☐ \$2,000–\$5,000	1
☐ \$5,000–\$10,000	0	☐ \$5,000–\$10,000	0
☐ \$10,000–\$20,000	1	☐ \$10,000–\$20,000	0
☐ Over \$20,000	0	☐ Over \$20,000	0

15. Figtree Creek Flooding
If you are affected by flooding from Figtree Creek (i.e. located in the eastern and central Scone residential and business areas, see attached map), are you able to identify specific marks or locations representing the peak water level in any of the floods you have experienced?

	%
a. Yes. (If "yes", please provide your phone number at Q. 18 so that we may contact you.	18
b. No.	8

16. __Figtree Creek Flooding__
Are you able to describe past flooding in parts of Figtree Creek (e.g. depth, velocities, locations, etc)?

		%
a.	Yes. (If "yes", please provide your phone number at Q. 18 so that we may contact you.	19
b.	No.	8

PART C—ATTITUDES TO FLOOD-PLAIN MANAGEMENT OPTIONS

17. **Below is a list of __possible options__ that may be looked at to try to minimise the effects of flooding in the Scone district.**

This list is not exhaustive and is in no specific order of importance. Please indicate (__Yes or No__) __which options you favour or think should be investigated in detail__.

Leave the boxes blank if undecided.

		Y %	N %
a.	Enlargement of Figtree Creek culvert under:		
	Kingdon Street	21	4
	Guernsey Street	13	4
	Great Northern Railway	11	5
	New England Highway	13	4
	St Aubins Street/Main Street	12	4
	Park Street	13	4
	Waverley Street	11	4
	Oxford Road	11	4
	Barton Street	11	3
	All the above culverts	28	3
b.	Enlargement of Parsons Creek culvert under Liverpool Street	24	5
c.	Construction of permanent levees	24	5
d.	Building of temporary levees during flood times by sand-bagging	12	10
e.	Removal of obstructions from the creek(s)	59	1
f.	Widening and/or deepening of the existing creek(s)	38	3
g.	Improvements to piped systems draining to the creeks	44	2
h.	Construction of a large Council owned retarding basin on Figtree Creek upstream of Barton Street	25	8
i.	Construction of small retarding basins/facilities on private properties	9	11
j.	Use of stormwater infiltration trenches and rainwater tanks in the catchment	30	1
k.	Council purchase of the most severely affected flood-liable properties	11	13
l.	Raising of houses above the 100 year flood level	19	4
m.	Flood proofing of individual properties by waterproofing walls, putting shutters across doors, etc	10	13
n.	Controls on future development in flood-liable areas (e.g. minimum floor levels, controls on extent of filling allowed on property etc.)	39	3
o.	Improvements to flood warning both before and during a flood	33	2
p.	Better evacuation and emergency assistance plans	22	4
q.	Public education, community participation and flood awareness programs	28	3
r.	Making sure all information about the potential risks of flooding is available to all residents and business owners	45	1
s.	Providing a certificate to all residents stating whether their property is flood affected	44	1
t.	Making sure residents and business owners have Flood Action Plans — these outline WHAT people should do, WHERE they should go and WHO they should contact in a flood	43	1
u.	Installing some flood markers (for example, on telegraph poles) to act as constant reminders of the heights of previous floods	43	3

18. **If you have answered "yes" in Questions 15 or 16, or if you have any other information which you think would be relevant, please provide your telephone number so that we may contact you.**

Work Phone: . . . . (Ask for . . . .)

Best time to call is . . . .

Home Phone: . . . . (Ask for . . . .)

Best time to call is . . . .

APPENDIX E

FIGTREE GULLY RAFTS-XP MODEL DETAILS AND PROBABILISTIC RATIONAL METHOD ASSESSMENT DETAILS

```
! Rafts 4.00 data file generated by RaftsXP 5.00
 1  1  1      400
DESIGN RUN
  4.   1  2  0    1.6       6009710 1 0 0000
! --- STACKED STORM DATA - Storm no.8
! --- STORM DATA
    540.    100.    12.93      1 0     0     3    60001    1
1
! --- LINK DEFINITION DATA
1  1.000     120          0     00     00U/S FIG  1      U/S FIG
1  1.001     120          0     00     00D/S FIG  1      D/S FIG
0
! --- LINK    1.000
! ------ FIRST SUBCATCHMENT DATA
    590.     0.     8.4             20.     2.50 0.07 0
   99999

! ------ LAG DATA
 19.
! --- LINK    1.001
! ------ FIRST SUBCATCHMENT DATA
    72.      5.     3.2             20.     2.510.025 0
   99999

! ------ SECOND SUBCATCHMENT DATA
    48.    100.     3.2              2.       000.015 0
   99999

! ------ Outlet node dummy link
 0.0
```

J712 SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN
FIGTREE GULLY - PROBABILISTIC RATIONAL METHOD

* From ARR(1987) Chapter 5 : Qy = 0.278* Cy * Iy * A

where:

Tc = 0.76*A**0.38 , Cy = C10 * FFy

Volume 2 Figure 5.1: C10 0.30

Zone B, elevation above 500m :	FF5	=	0.88
	FF10	=	1.00
	FF20	=	1.12
	FF50	=	1.26
	FF100	=	1.40

Note: Rainfall intensities from Council

5 YEAR ARI

Area	**Tc** (h)	**C5**	**I** (mm/h)	**A** (km2)	**Q** (m3/s)
U/S FIG	1.49	0.26	23.4	5.90	10.1

10 YEAR ARI

Area	**Tc** (h)	**C10**	**I** (mm/h)	**A** (km2)	**Q** (m3/s)
U/S FIG	1.49	0.30	26.5	5.90	13.0

20 YEAR ARI

Area	**Tc** (h)	**C20**	**I** (mm/h)	**A** (km2)	**Q** (m3/s)
U/S FIG	1.49	0.34	30.7	5.90	16.9

50 YEAR ARI

Area	**Tc** (h)	**C50**	**I** (mm/h)	**A** (km2)	**Q** (m3/s)
U/S FIG	1.49	0.38	36.5	5.90	22.6

100 YEAR ARI

Area	**Tc** (h)	**C100**	**I** (mm/h)	**A** (km2)	**Q** (m3/s)
U/S FIG	1.49	0.42	41.0	5.90	28.2

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF (1987)

Site name: Sconé.

Site latitude = 32.04 degrees S
longitude = 150.87 degrees E
skewness = .26

2-year ARI, 1 hour intensity = 24.00 mm/hr
12 hour intensity = 4.90 mm/hr
72 hour intensity = 1.48 mm/hr

50-year ARI, 1 hour intensity = 44.40 mm/hr
12 hour intensity = 9.10 mm/hr
72 hour intensity = 2.80 mm/hr

IFD Table for Various ARIs and Durations

Duration	1 yr	2 yr	5 yr	10 yr	20 yr	50 yr	100 yr	200 yr	500 yr
5 min	62.28	79.41	105.55	122.48	144.98	176.32	201.63	228.55	266.92
6 min	58.29	74.26	98.46	114.09	134.88	163.82	187.15	211.95	247.26
10 min	47.50	60.36	79.41	91.62	107.92	130.51	148.66	167.90	195.21
12 min	43.85	55.67	73.01	84.09	98.91	119.41	135.86	153.28	177.97
15 min	39.56	50.16	65.53	75.31	88.41	106.51	121.01	136.33	158.02
18 min	36.23	45.89	59.74	68.53	80.33	96.60	109.60	123.34	142.75
20 min	34.38	43.52	56.54	64.79	75.87	91.13	103.33	116.20	134.37
24 min	31.32	39.60	51.27	58.63	68.54	82.17	93.04	104.49	120.65
30 min	27.82	35.13	45.28	51.65	60.25	72.06	81.45	91.33	105.25
45 min	22.21	27.97	35.74	40.58	47.14	56.11	63.22	70.68	81.14
1.0 hr	18.80	23.63	30.00	33.94	39.32	46.63	52.42	58.47	66.94
1.5 hr	14.61	18.36	23.31	26.38	30.56	36.25	40.75	45.46	52.05
2.0 hr	12.16	15.29	19.42	21.98	25.46	30.21	33.96	37.89	43.39
3.0 hr	9.37	11.78	14.97	16.94	19.63	23.29	26.19	29.22	33.46
4.5 hr	7.21	9.07	11.52	13.04	15.12	17.94	20.17	22.51	25.78
6.0 hr	5.99	7.53	9.57	10.84	12.56	14.91	16.76	18.71	21.43
9.0 hr	4.62	5.80	7.38	8.35	9.68	11.49	12.93	14.43	16.53
12.0 hr	3.84	4.82	6.13	6.95	8.05	9.56	10.75	12.00	13.75
18.0 hr	2.97	3.74	4.76	5.40	6.26	7.44	8.38	9.36	10.73
24.0 hr	2.47	3.11	3.97	4.51	5.23	6.22	7.00	7.82	8.97
30.0 hr	2.14	2.70	3.44	3.90	4.53	5.39	6.08	6.79	7.79
36.0 hr	1.90	2.39	3.05	3.46	4.03	4.79	5.40	6.03	6.93
48.0 hr	1.56	1.96	2.51	2.85	3.31	3.95	4.45	4.98	5.71
72.0 hr	1.16	1.46	1.87	2.12	2.47	2.95	3.32	3.72	4.27

CALCULATION OF PROBABLE MAXIMUM PRECIPITATION (PMP) USING BULLETIN 53 PROCEDURE
— GENERALISED SHORT-DURATION METHOD (GSDM)
— DESIGN SPATIAL DISTRIBUTION

J712 SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN

TABLE A
PMP values (mm) FROM FIGURE 4 BULLETIN 53

CATCHMENT AREA: 7.1 km²

Duration (hr)	SMOOTH Depth from Fig. 4 (mm)	ROUGH Depth from Fig. 4 (mm)	Estimated depth (mm)
0.25	217	217	150
0.50	318	318	220
0.75	405	405	280
1.00	472	472	330
1.50	538	605	420
2.00	604	709	500
2.50	641	780	550
3.00	675	855	600
4.00	741	980	690
5.00	798	1077	750
6.00	845	1145	800

MAX. APPLICABLE DUR. (FIG. 2): 6 hours
TERRAIN CATEGORY: SMOOTH: 0.00
ROUGH: 1.00
ELEVATION ADJUSTMENT FACTOR: 1.00
MOISTURE ADJUSTMENT FACTOR (FIGURE 3): 0.70

DESIGN SPATIAL DISTRIBUTION

SUMMARY TABLE

DURATION (hour)		TOTAL RAINFALL AND AVERAGE RAINFALL INTENSITIES FOR ISOHYETAL LINES									
		A	B	C	D	E	F	G	H	I	J
1	mm:	340	260	180	130	110	70	50	30	0	0
	mm/hr:	340	260	180	130	110	70	50	30	0	0
2	mm:	510	400	310	240	200	130	90	50	10	0
	mm/hr:	255	200	155	120	100	65	45	25	5	0
3	mm:	610	490	390	310	250	180	120	80	20	0
	mm/hr:	203	163	130	103	83	60	40	27	7	0
4	mm:	700	570	460	370	310	220	160	100	40	0
	mm/hr:	175	143	115	93	78	55	40	25	10	0
5	mm:	760	630	510	420	340	240	180	120	50	0
	mm/hr:	152	126	102	84	68	48	36	24	10	0
6	mm:	810	670	550	450	380	270	200	140	70	0
	mm/hr:	135	112	92	75	63	45	33	23	12	0

CALCULATION OF PROBABLE MAXIMUM PRECIPITATION (PMP) USING BULLETIN 53 PROCEDURE
— GENERALISED SHORT-DURATION METHOD (GSDM)
— DESIGN SPATIAL DISTRIBUTION

J712 SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN

TABLE 1 (BULLETIN 53): DESIGN TEMPORAL DISTRIBUTION OF SHORT-DURATION PMP
For all duration storms: No. points on temporal points = 20

% OF TIME	% OF PMP	FRACTION PER TIME INTERVAL
0	0	
		0.040
5	4	
		0.060
10	10	
		0.080
15	18	
		0.070
20	25	
		0.070
25	32	
		0.070
30	39	
		0.070
35	46	
		0.060
40	52	
		0.070
45	59	
		0.050
50	64	
		0.060
55	70	
		0.050
60	75	
		0.050
65	80	
		0.050
70	85	
		0.040
75	89	
		0.030
80	92	
		0.030
85	95	
		0.020
90	97	
		0.020
95	99	
		0.010
100	100	
TOTAL		100.00%

TABLE 2 (BULLETIN 53)
Isohyetal labels for design spatial distribution of PMP (as hourly increments in per cent of one hour, 2.6 km² PMP)

Isohyet label	Area enclosed	Hourly Increment of PMP (%)					
		1st	2nd	3rd	4th	5th	6th
A	2.6	100	19	10	6	5	4
B	16	76	19	10	6	5	4
C	65	54	19	10	6	5	4
D	153	40	17	9	6	5	4
E	280	32	14	8	5	4	4
F	433	21	10	7	4	3	3
G	635	14	7	5	4	3	3
H	847	8	4	4	3	3	3
I	1,114	1	2	2	2	2	3
J	1,396	0	0	0	0	1	3

CALCULATION OF PROBABLE MAXIMUM PRECIPITATION (PMP) USING BULLETIN 53 PROCEDURE
— GENERALISED SHORT-DURATION METHOD (GSDM)
— DESIGN SPATIAL DISTRIBUTION
J712 SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN

ONE HOUR PMP SPATIAL DISTRIBUTION

a	b	c	d	e	f	g	h	i	j	k	l
Label	Area (Table 2) (km²)	Percent (Table 2) (%)	Initial isohyet value (Tb.2*Tb.A) (mm)	Area between isohyets (Col.b) (km²)	Catchment area between isohyets (measured) (km²)	Initial mean areal rainfall depth (wt. Av.d) (mm)	Total rainfall between isohyets (f x g) (mm km²)	Mean areal rainfall depth (g * SF) (mm)	Final isohyet value (d x SF) (mm)	Rounded final isohyet value (to 10mm) (mm)	Areal Weighting Factor (Col.f/Col.e)
A	2.6	100	330	2.6	2.6	337	875	343	336	340	1.00
A-B				13.4	4.5	317	1,425	323			0.34
B	16	76	251						255	260	
B-C				49	0	251	0	255			0.00
C	65	54	178						182	180	
C-D				88	0	178	0	182			0.00
D	153	40	132						134	130	
D-E				127	0	132	0	134			0.00
E	280	32	106						108	110	
E-F				153	0	106	0	108			0.00
F	433	21	69						71	70	
F-G				202	0	69	0	71			0.00
G	635	14	46						47	50	
G-H				212	0	46	0	47			0.00
H	847	8	26						27	30	
H-I				267	0	26	0	27			0.00
I	1,114	1	3						3	0	
I-J				282	0	3	0	3			0.00
J	1,396	0	0						0	0	
Total				1,396	7		2,300				
					Mean catchment rainfall:			324			
					Scaling factor:			1.02			

TWO HOUR PMP SPATIAL DISTRIBUTION

a	b	c	d	e	f	g	h	i	j	k	l
Label	Area (Table 2) (km²)	Percent (Table 2) (%)	Initial isohyet value (Tb.2*Tb.A) (mm)	Area between isohyets (Col.b) (km²)	Catchment area between isohyets (measured) (km²)	Initial mean areal rainfall depth (wt. Av.d) (mm)	Total rainfall between isohyets (f x g) (mm km²)	Mean areal rainfall depth (g * SF) (mm)	Final isohyet value (d x SF) (mm)	Rounded final isohyet value (to 10mm) (mm)	Areal Weighting Factor (Col.f/Col.e)
A	2.6	119	595	2.6	2.6	607	1,578	517	507	510	1.00
A-B				13.4	4.5	575	2,587	490			0.34
B	16	95	475						405	400	
B-C				49	0	475	0	405			0.00
C	65	73	365						311	310	
C-D				88	0	365	0	311			0.00
D	153	57	285						243	240	
D-E				127	0	285	0	243			0.00
E	280	46	230						196	200	
E-F				153	0	230	0	196			0.00
F	433	31	155						132	130	
F-G				202	0	155	0	132			0.00
G	635	21	105						90	90	
G-H				212	0	105	0	90			0.00
H	847	12	60						51	50	
H-I				267	0	60	0	51			0.00
I	1,114	3	15						13	10	
I-J				282	0	15	0	13			0.00
J	1,396	0	0						0	0	
Total				1,396	7		4,165				
					Mean catchment rainfall:			587			
					Scaling factor:			0.85			

CALCULATION OF PROBABLE MAXIMUM PRECIPITATION (PMP) USING BULLETIN 53 PROCEDURE
— GENERALISED SHORT-DURATION METHOD (GSDM)
— DESIGN SPATIAL DISTRIBUTION

J712 SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN

THREE HOUR PMP SPATIAL DISTRIBUTION

a	b	c	d	e	f	g	h	i	j	k	l
Label	Area (Table 2) (km²)	Percent (Table 2) (%)	Initial isohyet value (Tb.2*Tb.A) (mm)	Area between isohyets (Col.b) (km²)	Catchment area between isohyets (measured) (km²)	Initial mean areal rainfall depth (wt. Av.d) (mm)	Total rainfall between isohyets (f x g) (mm km²)	Mean areal rainfall depth (g * SF) (mm)	Final isohyet value (d x SF) (mm)	Rounded final isohyet value (to 10mm) (mm)	Areal Weighting Factor (Col.f/Col.e)
				2.6	2.6	789	2,053	620			1.00
A	2.6	129	774						608	610	
A-B				13.4	4.5	750	3,374	589			0.34
B	16	105	630						495	490	
B-C				49	0	630	0	495			0.00
C	65	83	498						391	390	
C-D				88	0	498	0	391			0.00
D	153	66	396						311	310	
D-E				127	0	396	0	311			0.00
E	280	54	324						254	250	
E-F				153	0	324	0	254			0.00
F	433	38	228						179	180	
F-G				202	0	228	0	179			0.00
G	635	26	156						122	120	
G-H				212	0	156	0	122			0.00
H	847	16	96						75	80	
H-I				267	0	96	0	75			0.00
I	1,114	5	30						24	20	
I-J				282	0	30	0	24			0.00
J	1,396	0	0						0	0	
Total				1,396	7		5,427				
					Mean catchment rainfall:			764			
					Scaling factor:			0.78			

FOUR HOUR PMP SPATIAL DISTRIBUTION

a	b	c	d	e	f	g	h	i	j	k	l
Label	Area (Table 2) (km²)	Percent (Table 2) (%)	Initial isohyet value (Tb.2*Tb.A) (mm)	Area between isohyets (Col.b) (km²)	Catchment area between isohyets (measured) (km²)	Initial mean areal rainfall depth (wt. Av.d) (mm)	Total rainfall between isohyets (f x g) (mm km²)	Mean areal rainfall depth (g * SF) (mm)	Final isohyet value (d x SF) (mm)	Rounded final isohyet value (to 10mm) (mm)	Areal Weighting Factor (Col.f/Col.e)
				2.6	2.6	950	2,470	712			1.00
A	2.6	135	932						698	700	
A-B				13.4	4.5	904	4,067	677			0.34
B	16	111	766						574	570	
B-C				49	0	766	0	574			0.00
C	65	89	614						460	460	
C-D				88	0	614	0	460			0.00
D	153	72	497						372	370	
D-E				127	0	497	0	372			0.00
E	280	59	407						305	310	
E-F				153	0	407	0	305			0.00
F	433	42	290						217	220	
F-G				202	0	290	0	217			0.00
G	635	30	207						155	160	
G-H				212	0	207	0	155			0.00
H	847	19	131						98	100	
H-I				267	0	131	0	98			0.00
I	1,114	7	48						36	40	
I-J				282	0	48	0	36			0.00
J	1,396	0	0						0	0	
Total				1,396	7		6,537				
					Mean catchment rainfall:			921			
					Scaling factor:			0.75			

CALCULATION OF PROBABLE MAXIMUM PRECIPITATION (PMP) USING BULLETIN 53 PROCEDURE
— GENERALISED SHORT-DURATION METHOD (GSDM)
— DESIGN SPATIAL DISTRIBUTION
J712 SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN

FIVE HOUR PMP SPATIAL DISTRIBUTION

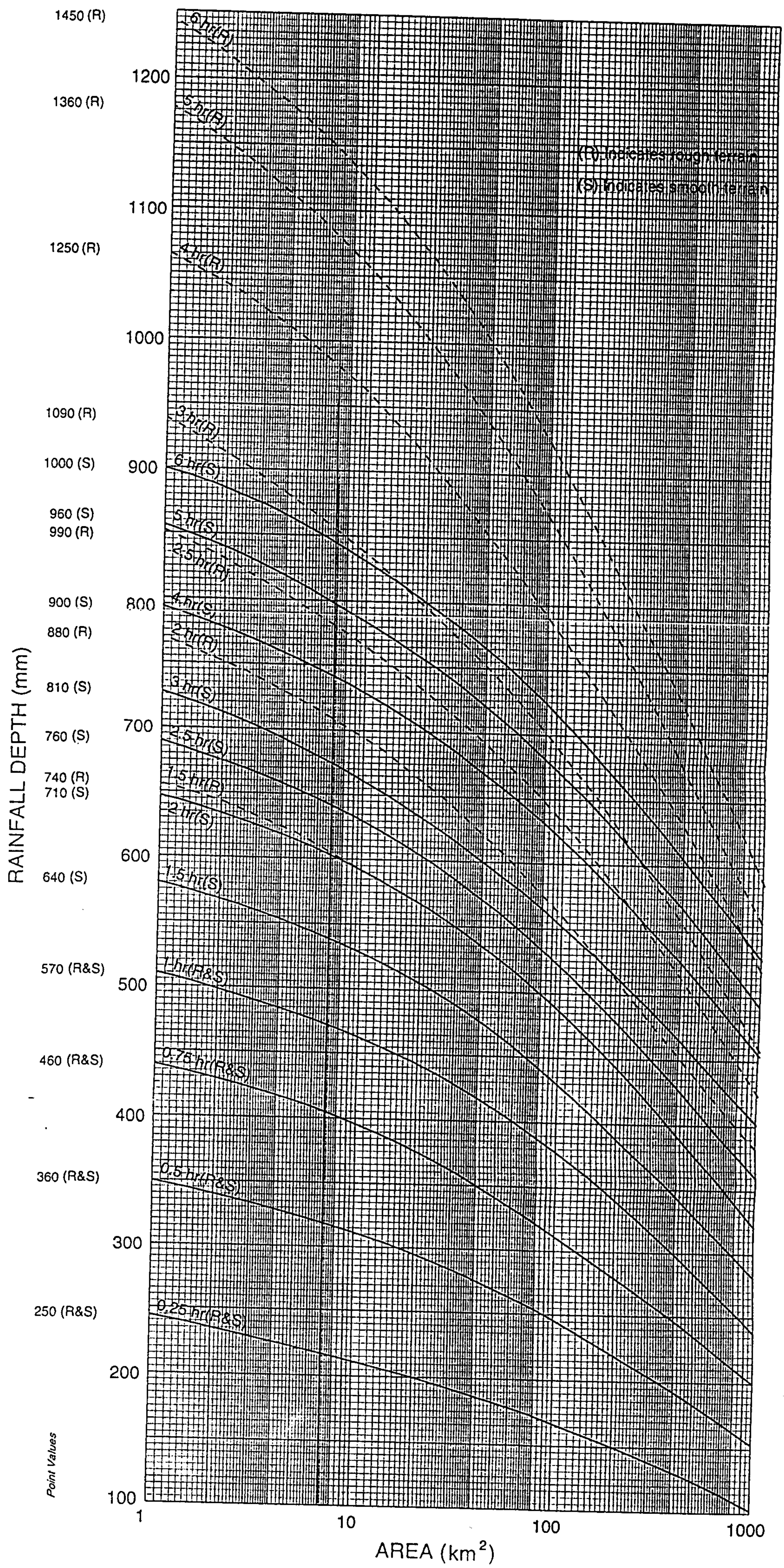
a	b	c	d	e	f	g	h	i	j	k	l
Label	Area (Table 2) (km²)	Percent (Table 2) (%)	Initial Isohyet value (Tb.2*Tb.A) (mm)	Area between Isohyets (Col.b) (km²)	Catchment area between Isohyets (measured) (km²)	Initial mean areal rainfall depth (wt. Av.d) (mm)	Total rainfall between Isohyets (f x g) (mm km²)	Mean areal rainfall depth (g * SF) (mm)	Final Isohyet value (d x SF) (mm)	Rounded final Isohyet value (to 10mm) (mm)	Areal Weighting Factor (Col.f/Col.e)
				2.6	2.6	1,071	2,785	773			1.00
A	2.6	140	1,050						758	760	
A-B				13.4	4.5	1,020	4,589	736			0.34
B	16	116	870						628	630	
B-C				49	0	870	0	628			0.00
C	65	94	705						509	510	
C-D				88	0	705	0	509			0.00
D	153	77	578						417	420	
D-E				127	0	578	0	417			0.00
E	280	63	473						341	340	
E-F				153	0	473	0	341			0.00
F	433	45	338						244	240	
F-G				202	0	338	0	244			0.00
G	635	33	248						179	180	
G-H				212	0	248	0	179			0.00
H	847	22	165						119	120	
H-I				267	0	165	0	119			0.00
I	1,114	9	68						49	50	
I-J				282	0	68	0	49			0.00
J	1,396	1	8						5	0	
Total				1,396	7		7,374				

Mean catchment rainfall: 1039
Scaling factor: 0.72

SIX HOUR PMP SPATIAL DISTRIBUTION

a	b	c	d	e	f	g	h	i	j	k	l
Label	Area (Table 2) (km²)	Percent (Table 2) (%)	Initial Isohyet value (Tb.2*Tb.A) (mm)	Area between Isohyets (Col.b) (km²)	Catchment area between Isohyets (measured) (km²)	Initial mean areal rainfall depth (wt. Av.d) (mm)	Total rainfall between Isohyets (f x g) (mm km²)	Mean areal rainfall depth (g * SF) (mm)	Final Isohyet value (d x SF) (mm)	Rounded final Isohyet value (to 10mm) (mm)	Areal Weighting Factor (Col.f/Col.e)
				2.6	2.6	1,175	3,055	825			1.00
A	2.6	144	1,152						808	810	
A-B				13.4	4.5	1,120	5,039	786			0.34
B	16	120	960						674	670	
B-C				49	0	960	0	674			0.00
C	65	98	784						550	550	
C-D				88	0	784	0	550			0.00
D	153	81	648						455	450	
D-E				127	0	648	0	455			0.00
E	280	67	536						376	380	
E-F				153	0	536	0	376			0.00
F	433	48	384						269	270	
F-G				202	0	384	0	269			0.00
G	635	36	288						202	200	
G-H				212	0	288	0	202			0.00
H	847	25	200						140	140	
H-I				267	0	200	0	140			0.00
I	1,114	12	96						67	70	
I-J				282	0	96	0	67			0.00
J	1,396	4	32						22	0	
Total				1,396	7		8,094				

Mean catchment rainfall: 1140
Scaling factor: 0.70


1450 (R)
1360 (R)
1250 (R)
1090 (R)
1000 (S)
960 (S)
990 (R)
900 (S)
880 (R)
810 (S)
760 (S)
740 (R)
710 (S)
640 (S)
570 (R&S)
460 (R&S)
360 (R&S)
250 (R&S)
Point Values
RAINFALL DEPTH (mm)
1200
1100
1000
900
800
700
600
500
400
300
200
100
1
10
100
1000
AREA (km²)
(R) Indicates rough terrain
(S) Indicates smooth terrain
6 hr(R)
5 hr(R)
4 hr(R)
3 hr(R)
6 hr(S)
5 hr(S)
2.5 hr(R)
4 hr(S)
2 hr(R)
3 hr(S)
2.5 hr(S)
1.5 hr(R)
2 hr(S)
1.5 hr(S)
1 hr(R&S)
0.75 hr(R&S)
0.5 hr(R&S)
0.25 hr(R&S)

APPENDIX F

FLOOD DAMAGE ASSESSMENT

TABLE OF CONTENTS

FIGURES

TABLES

APPENDIX F — FLOOD DAMAGE ASSESSMENT

This appendix describes the methodology used in the Scone Floodplain Management Study and Plan for the calculation of flood damages. Each type of flood damage is described in detail in the subsequent sections.

F.1 TYPES OF FLOOD DAMAGE

The definitions and methodology used in estimating flood damage have been established by a number of previous investigations. The two main categories are `tangible' and `intangible' 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 hence are much more difficult to quantify.

F.2 DIRECT HOUSE DAMAGE

Direct house damage relates to the tangible damage caused to the residential structure and its contents from the direct action of flood waters. This type of damage can also result from sediment and debris entering the premises. In this study, the following components of damage have been included in this category:

- replacement of internal items such as white goods, floor coverings, cupboards, clothes, manchester, etc;
- structural damage relating to the repair of floors, walls, window, doors, decoration, fittings, electrical wiring, etc;
- clean up of the inside of the house and house itself.

Previous studies and investigations have recommended the `stage–damage curve' as the most reliable method of direct residential damage (both `house' and `property') estimation. Stage–damage curves relate the amount of potential flood damage to different depths of floodwaters, and can be constructed in two ways:

- from actual data collected from residents after a flood;
- synthetically, by utilising actual data collected for other localities.

There were no actual stage–damage data available for Scone, therefore the stage–damage relationships for potential damages used in this study were based on stage–damage curves used in the FLDAMAGE program (**Reference 11**) which are based on damage assessments for various towns such as Nyngan (**Reference 16**).

All stage–damage data collated were updated to reflect 1998 dollar values (**Reference 17**).

The adopted relationships for potential damage at residential properties are shown in **Figure F.1**.

F.3 DIRECT RESIDENTIAL PROPERTY DAMAGE

This type of tangible damage signifies the damage caused from flood waters entering the residential property, without necessarily inundating the floor of the house, and includes:

- damage external to the house, such as, lawns, driveways, landscaping, gardens, sheds, tennis courts, etc;
- damage to vehicles — potential damage estimates assume that no cars are moved out of the path of the floodwaters;
- clean-up costs for outside the house.

From research from previous studies and technical papers, particularly Joy and Porter (**Reference 27**) and Handmer et al. (**Reference 26**), direct residential property damage has been estimated to be in the following typical ranges (in 1998 dollar values):

- $1,000–$2,000 for external property damage;
- $1,500–$2,000 for vehicle damage if the depth of flooding is between about 0.3m–0.6m;
- about $3,000 for vehicle damage if the depth of flooding is more than about 0.6m;
- $500–$2,000 for clean up costs depending on the depth of flooding.

These damage costs relate to average sized residential blocks. The adopted stage damage curve for potential damage at residential properties is shown in **Figure F.1**. For this study, a vacant residential block has been assumed to incur no damage.

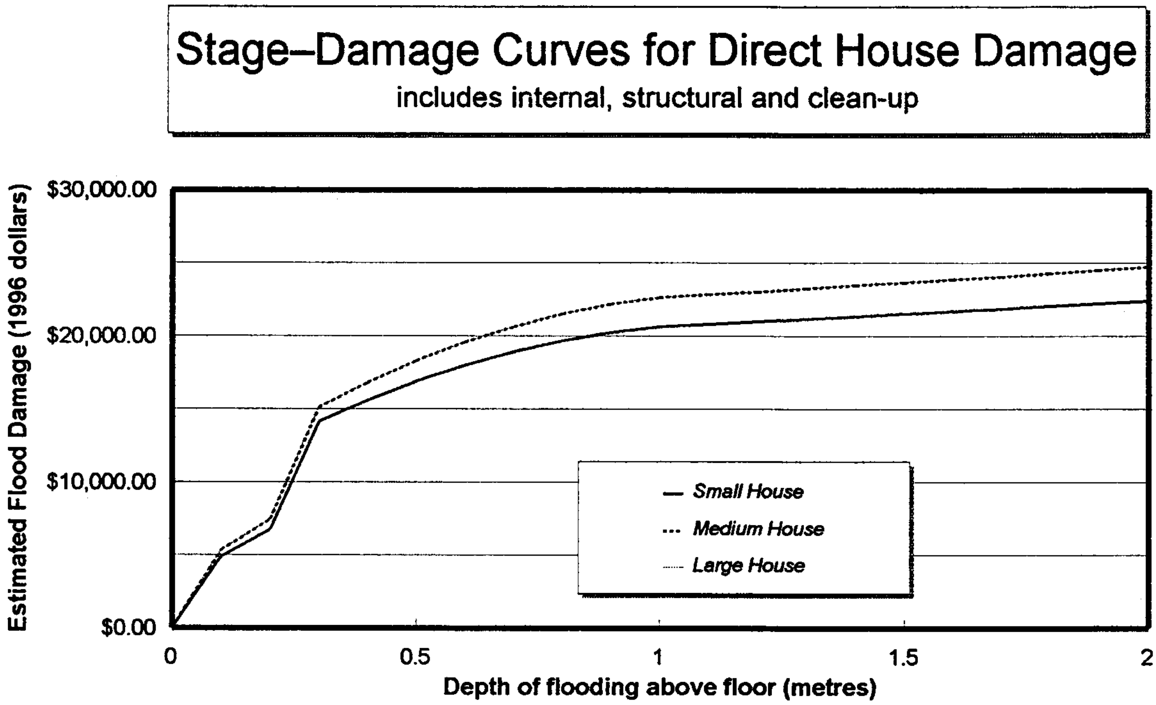
F.4 DIRECT COMMERCIAL AND INDUSTRIAL DAMAGES

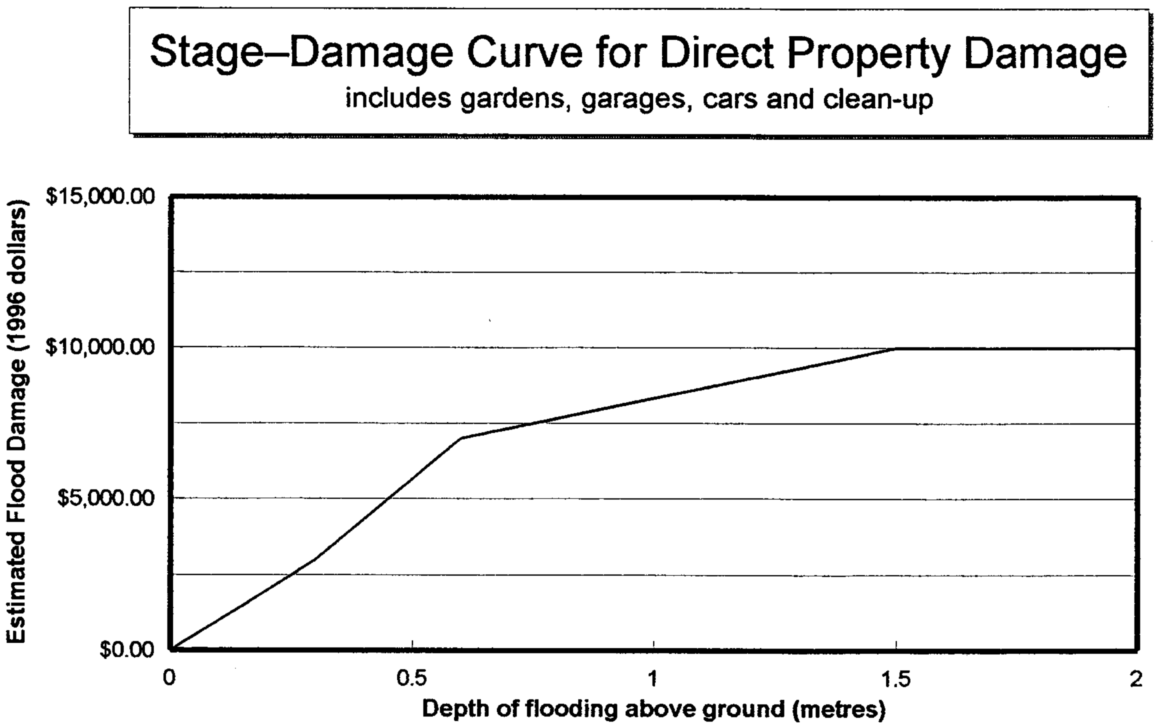
F.4.1 Methodology and Background Information

The types and sizes of businesses in any study area are generally extremely varied and is impractical to develop a stage-damage curve for each individual business in the study area. Therefore, the stage-damage curves for commercial and industrial properties developed for the Blacktown and Narrabri Floodplain Management Studies were adopted for Scone. These curves were developed from a detailed literature review including:

- *Cabramatta Creek Catchment Management Study* (**Reference 18**) — stage–damage curves for this study were based on previous studies, particularly Bathurst (**Reference 19**) and Lithgow (**Reference 20**) Floodplain Management Studies, where actual interviews were undertaken of about forty, mainly industrial, properties;
- *Losses and Lessons from the Sydney Floods of August 1986 — Volumes 1 & 2* (**Reference 21**);
- data from flood damage surveys from recent large floods in:
  - Inverell in February 1991 (**Reference 22**);
  - Forbes in August 1990 (**Reference 23**);
  - Nyngan in April 1990 (**Reference 16**);
- *ANUFLOOD Programmer's Guide and User's Manual* (**Reference 24**);
- *FLDAMAGE User Manual* (**Reference 11**).

Figure F.1
ADOPTED STAGE-DAMAGE CURVES FOR DIRECT DAMAGE TO RESIDENTIAL PROPERTIES





F.4.2 Categories for Commercial and Industrial Properties

Using all the information listed above, the following categories (or `business damage codes) for commercial and industrial properties were developed:

- **commercial properties** — these generally include all businesses, shops and small retailers whose building area is less than about $200m^2$. Commercial properties have been further divided into the following categories;

  - CL : commercial property with relatively low potential damages;
  - CM : commercial property with medium potential damages;
  - CH : commercial property with high potential damages;

  Table F.1 provides a list of the types of properties that have been included in these categories in this study;

- **small industrial properties** — these generally include businesses such as automotive, engineering and electrical type establishments, where the building area is between about $200m^2$–$600m^2$. Small industrial properties have been further divided into the following categories:

  - IL : industrial property with relatively low potential damage;
  - IM : industrial property with medium potential damage;
  - IH : industrial property with high potential damage;

  Table F.2 provides a list of the types of properties that can be included in these categories;

- **large industrial properties (L1)** — these larger establishments generally have assets stored close to the floor and include those with on-ground machinery and supplies stored on pallets, such as food warehouses, printing factories and large woodworking businesses. In these types of properties, large damages can be incurred as soon as water reaches the base of the machinery or the top of the bottom pallet (i.e. 100mm above the ground). **Table F.3** provides a list of the types of properties that can be included in this category;

- **large retail and commercial properties (L2)** — these are larger establishments where flooding just above floor level is critical and includes furniture stores and warehouses, motels and clubs, indoor sport centres and generally any large businesses with carpet and/or stock located on the floor. Serious damage could result with only 10mm of water over the floor. **Table F.3** provides a list of the types of properties that have been included in this category.

F.4.3 Assumptions for Estimating Flood Damage at Business Properties

Assumptions that have been made for estimating commercial and industrial flood damages in this study are listed as follows:

- each business within the study area in Scone has been identified;
- floor/building areas of individual commercial buildings have not been determined as part of this study — 'small', 'medium' and 'large' buildings have been estimated from aerial photos and the property survey conducted for the study;
- each commercial and industrial property in the flood damages data base has been assigned one of the eight codes described above and is included in **Tables F.1**, **F.2** and **F.3**, (i.e. CL, CM, CH, IL, IM, IH, L1 or L2);
- it was beyond the scope of this study to assess the adequacy of any individual flood-proofing measures, such as the strength and integrity of protective walls and levees, that may have been installed by individual property owners. Therefore, estimates of flood damage have been based solely on the level of the main work area regardless of any flood-proofing measures;
- the presence of local drainage paths that may flood the premises has not been assessed — only mainstream flooding has been considered.

F.4.4 Adopted Stage–Damage Curves

The eight stage–damage curves that have been adopted for Scone for estimating potential direct commercial and industrial flood damages are presented in **Figure F.2**.

From interviews with business owners in previous studies, most proprietors indicated that they would be 'out-of-business' should 1.5m–2.0m of water flow through their property. This is reflected in the adopted stage–damage curves.

TABLE F.1: FLOOD DAMAGE CATEGORIES FOR SMALL COMMERCIAL PROPERTIES

Code:	CL	CM	CH
Size:	up to approx. 200 m²		
Description:	Comparatively low value	Medium value	High value
Types of business included in category	Cafes Offices - general - government - factory - insurance Consulting rooms (but not professional services)	Food shops - general Grocers Take-away food shops Corner stores Supermarkets - small Hotels and pubs Fire Station Police Station	Motor vehicle accessories - spare parts Dance Studios Art and craft shops Cameras and photography Dance Studios

TABLE F.2: FLOOD DAMAGE CATEGORIES FOR SMALL INDUSTRIAL PROPERTIES

Code:	IL	IM	IH
Size:	Between approx. 200 m² and 600 m²		
Description:	Comparatively low value	Medium value	High value
Types of business included in category	Small sports clubs / halls - Softball Association - scout and guide halls - community centres - childcare centres - kindergartens Plastic products Plumbing, bathroom and ceramics supplies Automotive repairs - brakes - clutch - diesel repairs - tyres Nuts, bolts, steelwork and welding yards / supplies Fuel depots Council and Govt. works depots Chemical storage - general & small	Dairy products Food distribution & storage Groups of small professional offices and workshops	Smash repairs, spray painting & panel beating Car or truck yards - sales Garages, service stations fuel / shops etc. Large offices and studios Electrical transformer station (small)

TABLE F.3: FLOOD DAMAGE CATEGORIES FOR LARGE COMMERCIAL AND INDUSTRIAL PROPERTIES

Code:	L1	L2
Size:	Larger than approx. 600 m²	
Description:	Lower value	Higher value
Types of business included in category	Metal working, Engineering and Manufacturing Precast concrete products Large materials handling Chemical storage - general & large Wholesale storage of food hardware, materials etc.	'Self-storage' centres Clubs with carpets and/or poker machines etc. including RSL and Bowling Clubs

F.5 POTENTIAL AND 'PREDICTED ACTUAL' DAMAGE

All the calculation techniques for estimating direct flood damages described above relate to the `potential' flood damage — representing a situation where damages are not mitigated in any way. 'Actual' damages make allowances for mitigating effects, such as:

- the flood awareness of the community;
- the available and effective warning time;
- the availability of residents and businesses to effectively save their goods and possessions — in terms of their physical ability as well as having suitable locations to raise or move goods to.

Experience from previous floods in other NSW towns has shown that `actual' flood damages can be significantly less than potential flood damages in a community experienced in dealing with floods where effective warning times are greater than about 12–24 hours. Scone (Figtree Gully) has negligible warning time and on Parsons Gully only about 6 hours warning time, so the difference between potential and actual damage would be very small.

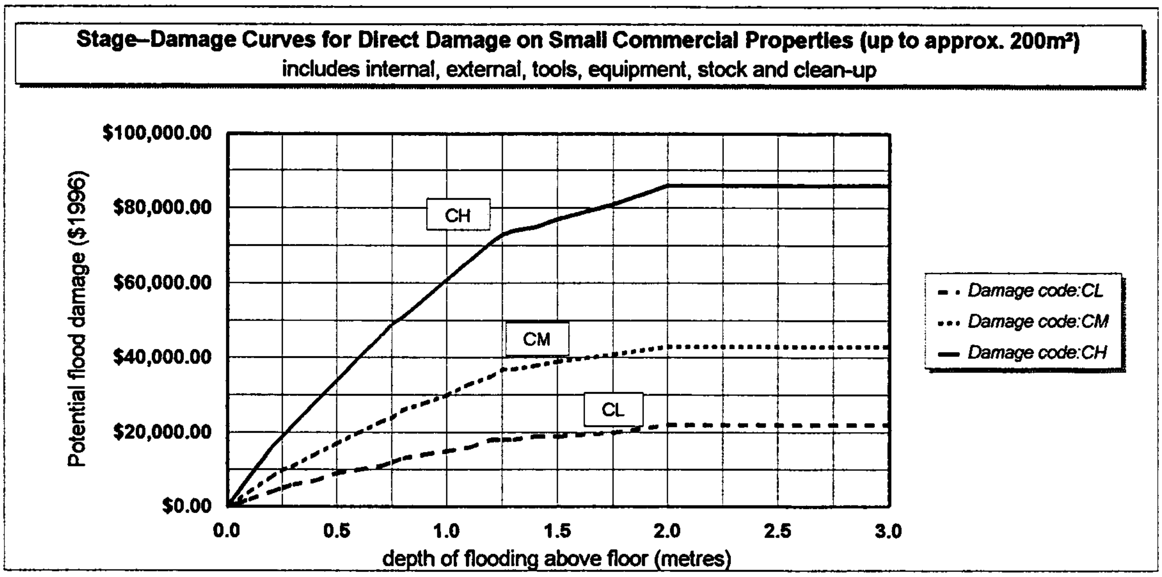
From inferred relationships in **Reference 11** between available warning time, level of flood awareness and ratios of actual to potential damage for four historical flood damage surveys, **Table F.4** summarises the adopted actual to potential ratios considered to be applicable to Scone.

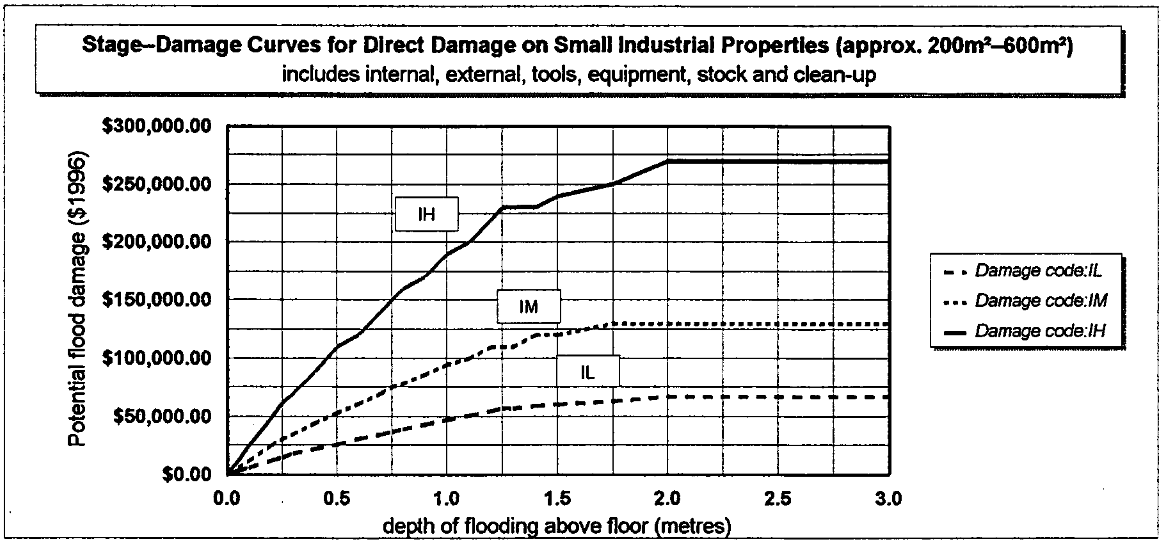
For this study, the term `predicted actual' damages has been used instead of simply 'actual' damages because in Scone, very little `actual' or historical flood damages have been quantified.

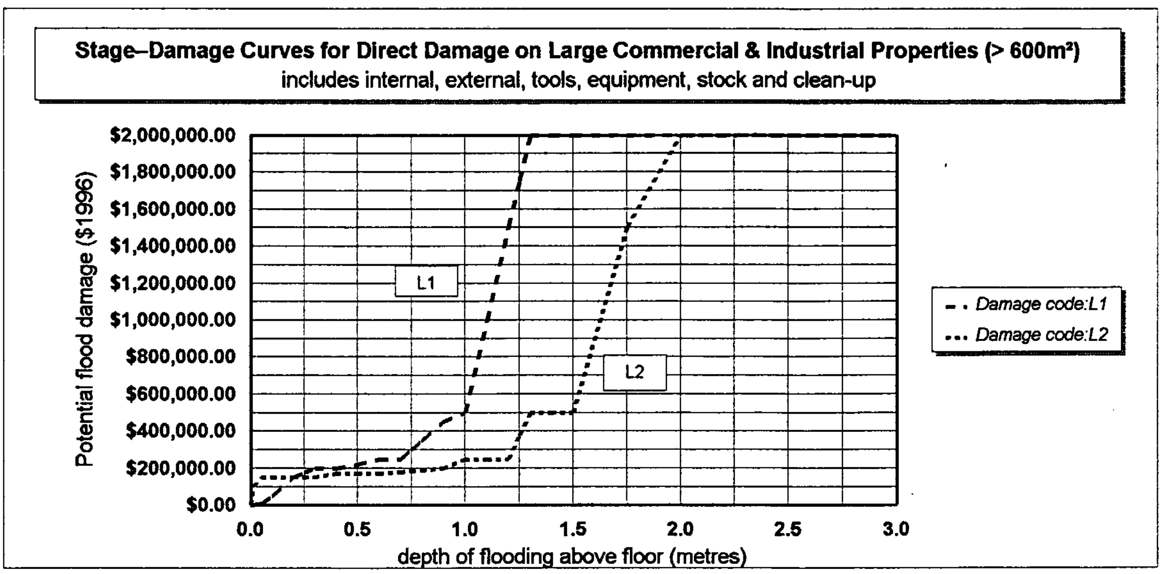
TABLE F.4: `PREDICTED ACTUAL' DAMAGE VERSUS POTENTIAL DAMAGES

TYPE OF FLOOD DAMAGE	PREDICTED ACTUAL DAMAGE AS A PROPORTION OF POTENTIAL DAMAGE
Direct house damage	0.85
Direct property damage	0.50
Direct commercial and industrial damage	0.90
Infrastructure and public sector damages	0.90
Social damages	1.0

Figure F.2
ADOPTED STAGE–DAMAGE CURVES FOR DIRECT DAMAGE TO BUSINESS PROPERTIES







F.6 INDIRECT FLOOD DAMAGE

Indirect flood damages incurred by the community include:

- costs for alternative accommodation while houses are inundated or being cleaned;
- loss of trading profit for commercial and industrial enterprises;
- additional transport and time costs resulting from disruption caused by flooded roadways.

Indirect flood damage is difficult to assess and the amount of calculated damage varies widely between different studies and technical references. Some references also include all clean up costs as indirect damages. In this study clean up costs have been included in the direct damages, rather than the indirect damages. It is generally accepted, however, that indirect damages can be assumed to a proportion of the total direct damages.

F.6.1 Indirect Residential Damage

From '*The Sydney Floods of August 1986*' (**Reference 25**) indirect residential damages were estimated to be about 5%–15% of the total direct residential damages. Conversely, the *Nyngan April 1990 Flood Investigation* (**Reference 16**) estimated that indirect residential damages were about 25% of the total direct residential damages. It can be concluded that the Nyngan value would be much higher than for the Sydney situation because:

- in Nyngan, residents were away from home for much longer than in Sydney;
- most people in Nyngan stayed away from home at public expense rather than staying with friends and relatives.

The duration of flooding in Scone is very short and only a proportion of properties in the catchment would be inundated, even in an extreme flood. If evacuation of properties became necessary it is most likely that people would stay with friends or relatives. Consequently, the Sydney value is considered more realistic for Scone. A value of indirect residential of 5% of the actual residential damage has been adopted. This is consistent with the recommendation of **Reference 24**.

F.6.2 Indirect Commercial and Industrial Damage

Reference 11 suggests an approximate method for calculating indirect commercial and industrial damages, based on actual flood survey data; i.e: the indirect cost to business is about 5% of the actual direct damage for every day that trading could be lost.

For example, in Nyngan when about 50 days (i.e. 10 weeks) of trading were lost, the indirect damage to business was in the order of 250% of the direct damages. In Inverell, however, the average number of days of lost trading was only 6 days and hence the indirect damage to business was only about 30% of the direct damages.

In the absence of such details for Scone, it has been estimated that the average time that trading would be lost is of the order of 6 days. Almost all of this time would be spent cleaning up the flood damage and replacing stock and equipment. Hence for this study indirect commercial and industrial damage has been adopted as 30% of the actual direct commercial/industrial damage. This value is also consistent with other references such as **Reference 24.**

F.7 INFRASTRUCTURE AND PUBLIC SECTOR DAMAGE

Infrastructure damage relates to the flood damage caused to public and community facilities, such as roads, railways, bridges, water, sewerage, telephone, gas, schools and playing fields. The damage to infrastructure varies significantly from one event to another, and is site specific.

Often, a major component of infrastructure damage is the damage caused by the submerging of roads. Water that seeps under the pavement can cause weakening of the road sub-base, and can ultimately lead to failure of the road, indicated by the formation of pot-holes or loose sections of pavement slabs. Ideally, roads should be closed until they have dried out. However, where the majority of the inundated roads are suburban, this is often not practical.

Public sector property and infrastructure in the floodplain includes roads and the Great Northern Railway.

Data from the August 1990 flood at Molong (**Reference 29**) indicated that non-building infrastructure damage was approximately equal to 2% of the total predicted 'actual' damage. In the absence of any local data this relationship was used to estimate the damage to non-building infrastructure such as roads, railways and drainage.

F.8 INTANGIBLE OR SOCIAL DAMAGES

Intangible flood damages are the most difficult to quantify and there are limited studies that attempt to quantify them.

In two surveys of the social impacts of flooding (**Reference 28**), it was found that residents suffered both physical (30% of households) and mental (50% of households) effects because of flooding. Some of the physical problems that people have suggested included:

- stress and stress related ailments;
- influenza;
- viral infections;
- heart problems; and
- back problems (from lifting and cleaning).

Some of the psychological or sociological problems that people suffered from included:

- irritability;
- nervousness;
- alienation;
- obsessive behaviour;
- strain on family relationships; and
- stress from the knowledge that there may be insufficient insurance cover for damage caused by floods.

From the studies of residents whose houses were flooded in Sydney in 1986 and 1988, it appears that residents were much more severely affected when floodwaters entered the house, rather than when the flood only covered the ground outside, even where damage to items outside the house was substantial. This is apparently because the entry of water in the house is felt to be an invasion of privacy, and because personal items such as family photographs are lost. Such losses are frequently regarded by residents as worse than monetary losses. Thus the number of households flooded has been used as an indicator in an attempt to quantify the intangible or social impacts of flooding.

Social damages involve both the residential sector and the commercial sector, especially in the case of small businesses. Both suffer from anxiety caused by lack of insurance covering flood damage.

Based on a survey of residents after the August 1986 floods in Sydney, Handmer et al., (**Reference 26**) attempted to quantify social damages in terms of the percentage of households affected and the lost time solely associated with:

- disruption;
- ill-health; and
- hospitalisation.

Based on this reference, and in the absence of more recent information, **Table F.5** quantifies some of the items suggested by **Reference 26** and provides the values of social damages adopted for Scone.

TABLE F.5: ADOPTED SOCIAL DAMAGES

COMPONENT OF SOCIAL DAMAGES	Assumed cost per day ($)	BELOW-FLOOR FLOODING			ABOVE-FLOOR FLOODING		
		Percentage of total flood-affected households (%)	Average time lost per affected household (days)	Average cost for every flood-affected household ($)	Percentage of total flood-affected households (%)	Average time lost per affected household (days)	Average cost for every flood-affected household ($)
DISRUPTION ILL-HEALTH HOSPITALISATION	50 110 1100	100 13 5	25 3.4 7.5	1,250 50 450	100 55 5	75 3.4 7.5	3750 200 400
TOTAL ADOPTED FOR THIS STUDY		Below floor flooding		say $1,500	Above floor flooding		say $4,500

Source: derived from ***Reference 26****.*

APPENDIX G

PRO FORMA FOR APPLICATION FOR FUNDING OF FLOOD MITIGATION PROJECTS

Floodplain Management Authorities

FLOOD MITIGATION PROJECT

Funding Assessment

Project Identification

(a)	Project Name	:	....
(b)	Town or Locality	:	....
(c)	Type of Project	:	....
(d)	Name of Waterway	:	....
(e)	Proponent (Council)	:	....
(f)	Description of Work	:	....
			....

1. Benefit Cost Ratio

(a) Calculated Benefit/Cost Ratio. . . . . BCR = ...

2. Hazard Level

Please place X in appropriate boxes

(a) Evacuation may be required. . . . . ☐

(b) Project area is high hazard floodway defined by Floodplain Development Manual ☐

(c) Little warning time (less than 2 days). . . . . ☐

(d) Rapid water level rise (more than 0.1 metres per hour). . . . . ☐

(e) Essential services (electricity, water, sewerage) are at risk of failure. . . . . ☐

3. Average Annual Damage

(a) Calculated Average Annual Damage. . . . . AAD = $....................

4. Damage in Project Design Flood

(a) Damage in project design flood. . . . . $....................

5. Properties Affected by Flooding in Design Flood

("Flooding" includes both under floor and over floor flooding)

(a)	Residential buildings.	No. = ...
(b)	Commercial (Shops, offices).	No. = ...
(c)	Factories, warehouses.	No. = ...
(d)	Other.	No. = ...
	Total Number of Affected Properties	No. = ...

6. Community Involvement

Please place X in ONE box only for the highest level of community involvement in the project:

(a) Developed by Floodplain Management Committee with community membership. . ☐

(b) Developed by a project steering committee with community membership. . . . . ☐

(c) Input from more than one community meeting during the evolution of the project. . ☐

(d) Input from one community meeting during the evolution of the project. . . . . ☐

(e) Public comment invited on Environmental Impact Statement and/or development application. . . . . ☐

(f) No public comment or input. . . . . ☐

7. Strategic Planning

Please place X in ONE box only for the highest level of strategic planning achieved.
Development subject to:

(a) Floodplain Management Plan or Catchment Management Plan supported by a Local Environmental Plan and Development Control Plans. . . . . ☐

(b) Floodplain Management Plan or Catchment Management Plan not supported by other planning controls. . . . . ☐

(c) Local Environmental Plan with specific flood mitigation controls. . . . . ☐

(d) Development Control Plan with specific flood mitigation controls. . . . . ☐

(e) Policy which provides that floor levels must be above a nominated flood standard ☐

(f) Conditions placed on individual applications. . . . . ☐

8. Local Contribution

Please place X in appropriate boxes:

(a) Additional contributions from developers or private interests. . . . . ☐

(b) Community contributes to development controls by accepting additional development costs. . . . . ☐

(c) Community contributes through normal council rates. . . . . ☐

9. Total Catchment Management Compatibility

Please place X in appropriate boxes:

(a) Option evaluated in the context of the impacts on catchment flood behaviour. . . . . ☐

(b) Project does not contribute to environmental degradation within the catchment. . . . ☐

(c) Concept for project developed with input from government agencies which have responsibilities for management and utilisation of natural resources. . . . . ☐

(d) Project consistent with Total Catchment Management strategy. . . . . ☐

FLOOD MITIGATION PROJECT

BACKGROUND INFORMATION

Background information is used to determine the source of data and the stage of project development. Information provided on this page is not used to assess eligibility for funding.

A. Funding

Requested funding	Commonwealth	$	
	State	$	
	Local Govt.	$	
	Total Cost	$	Staged as follows:

Stage	Cost	Year	Proposed Work
1	$..............	...../.....	....
2	$..............	...../.....	....
3	$..............	...../.....	....
4	$..............	...../.....	....
5	$..............	...../.....	....
6	$..............	...../.....	....

B. Project Design Flood

Annual Exceedance Probability of Project Design Flood. . . . . AEP = ...%

C. Economic Information

Summary of Benefits (in present worth values, list below)

(a)	Residential.	$.....................
(b)	Commercial.	$.....................
(c)	Industrial.	$.....................
(d)	Infrastructure.	$.....................
(e)	Rural.	$.....................
	Total	$.....................

Summary of Costs (in present worth values)

(a)	Investigation and environmental assessment costs	$.....................
(b)	Design cost.	$.....................
(c)	Construction cost (including acquisition, supervision etc.).	$.....................
	Total	$.....................

D. Flood Estimates

Please place X in appropriate boxes:

(a) Comprehensive flood damage analysis (eg ANUFLOOD). ☐
Name of flood model used: ....

(b) Simplified flood damage analysis (eg average property damages, extrapolation from historical damages). . . . . ☐

(c) Indicative flood damage analysis. . . . . ☐
Briefly describe the method used: ....
....

E. Project Readiness

Please place X in appropriate boxes:

(a) Detailed design and documentation complete. . . . . ☐

(b) Development consent obtained. . . . . ☐

(c) Environmental assessment complete (complies Env. Planning & Assessment Act) . ☐

(d) Environmental assessment commenced. . . . . ☐

(e) Preliminary / concept design complete. . . . . ☐

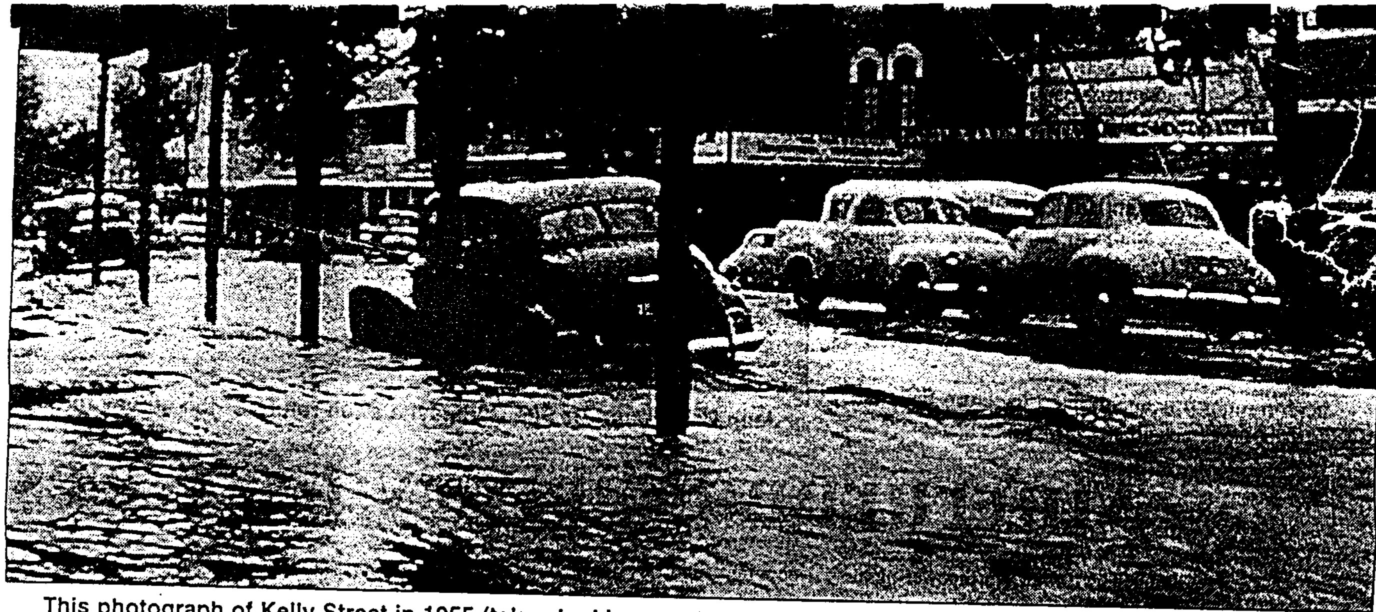
(f) Preliminary / concept design commenced. . . . . ☐

F. Contact

Project contact person: ....
Position: ....
Telephone: ....

APPENDIX H

NEWSPAPER FEATURE ABOUT FLOODING



This photograph of Kelly Street in 1955 (taken looking south from near the Civic Theatre) is a reminder of the unpredictable nature and impact of flooding in Scone.

First the drought, then...

Scone Flood Plan

Flood flows from Figtree Gully affect both the central business area of Scone and the adjacent residential areas with rural areas impacted by flows from Middle Brook, Kingdon Ponds and Parsons Gully.

Many locals can recall the effects of past flood events such as in 1955, 1971, 1976, 1977 and 1992. Experts tell us that larger floods can and will occur again. It is not a matter of "if" but "when" flooding will again hit. Are you prepared?

Scone Council is committed to addressing stormwater and flooding in Scone. In 1995 Council successfully obtained funding to carry out a flood study for the Scone district.

It engaged experts from the Department of Land and Water Conservation who last year successfully completed the Scone Flood Study.

Following the Flood Study, Scone Council has now obtained funding towards the next step, the "Scone Floodplain Management Study and Plan" and have engaged Sydney-based specialist flood consultants Bewsher Consulting Pty Ltd to undertake the study.

The study will investigate possible options to control flood hazard and reduce flood damages including stormwater-/channel culvert upgrading, stormwater detention structures, creation of overland flow paths as well as a range of environmental, town planning, emergency management and flood awareness issues.

The consultants contact the most affected residents and business proprietors directly, distribute a newsletter and questionnaire and hold a public meeting in relation to the study.

Additionally, Scone Council has formed a Floodplain Management Committee with representatives from Council, SES and other relevant government departments.

Council is looking for local residents to join the committee. Anyone interested in contributing to development of the Scone Floodplain Management Plan by becoming a member on the committee should make a written submission to Scone Council by Friday, August 8.

Success of the plan will depend upon community input and acceptance. Contact David Casson at Scone Council on 401136.

APPENDIX I

NSW FLOOD WARNING CONSULTATIVE COMMITTEE APPLICATION PROCEDURE FOR DEVELOPMENT OF IMPROVED FLOOD WARNING SERVICES

NSW FLOOD WARNING CONSULTATIVE COMMITTEE

Address Correspondence to:
PO Box 413
DARLINGHURST NSW 2010

Telephone: (02) 9296 1555
Fax: (02) 9296 1506
File Ref: 70/18/35

DEVELOPMENT OF IMPROVED FLOOD WARNING SERVICES

Co-operative arrangements between the Commonwealth, State and Local Governments has led to the establishment of a Flood Warning Consultative Committee (FWCC) to advise respective government agencies on the development of flood warning services in NSW.

Members of the Committee are:

- Bureau of Meteorology (Chair)
- State Emergency Service
- Department of Land and Water Conservation
- Sydney Water
- NSW Floodplain Management Authorities
- Local Government and Shires Associations of NSW

The procedures that have now been put in place by the FWCC for considering proposals for introducing new or improved flood warning services are:

1. Proposals by Councils for new or improved flood warning systems, including clear information on the benefits of the proposed system, are considered by the local Flood Plain Management Committees (FPMC) in the first instance.

2. Council forwards a FPMC endorsed proposal to the FWCC.

3. The FWCC reviews the proposal against feasibility and cost criteria, and assesses the proposals effectiveness for fully meeting flood warning requirements in the catchment(s) concerned.

4. The FWCC returns the reviewed proposal to the Council inviting its comment.

5. The Council submits an agreed proposal endorsed by the FPMC to the FWCC.

6. The FWCC ranks the agreed proposal against others, co-ordinates a commitment of funds from the three tiers of government in accordance with the agreed basis for cost sharing, and includes implementation of the proposal in the forward program for upgrading flood warning services in NSW.

APPENDIX J

STUDY BRIEF

SCONE SHIRE COUNCIL

SCONE FLOODPLAIN MANAGEMENT STUDY AND PLAN

CONSULTANT BRIEF

1. GENERAL

1.1 CONTRACTUAL ARRANGEMENTS

Written confirmation of acceptance in accordance with the Brief is required before any work can commence.

Final contract documents will include the Council's Brief, the Consultant's accepted tender/quote and Council's and the Consultant's final letters of acceptance.

The study shall be carried out generally on accordance with the attached "Consultancy Agreement - Version III" (attachment 3), except that the roles of the Department of Land and Water Conservation and its officers will be transferred to Scone Shire Council and its staff.

1.2 INSURANCE

The Consultant is responsible for taking out insurance giving cover to himself, his employees and any agent engaged by the Consultant. Professional Indemnity and Public Liability shall have a minimum cover of $5 million, for each and every event.

The Consultant's employees shall be covered by Workers Compensation as required by the Statute. The successful Consultant shall be expected to produce documentary evidence of such a Policy with the interests of Scone Council suitably endorsed.

1.3 MANAGEMENT OF PROJECT

1.3.1 Scone Council will manage the study with input from the Scone Floodplain Management Committee.

The Consultant will be responsible to the Council for overall liaison and completion of the study. Overall policy direction will be provided by Scone Council.

Contacts	Council:	Name:	Mr David Casson
		Position:	Manager Land Use Planning
		Phone:	(065) 401132
		Fax:	(065) 452671
		Name:	Mr Graeme Gardiner
		Position:	DirectorEnvironmentalServices
		Phone:	(065) 401139
		Fax:	(065) 452671

The following Council personnel are authorised to give directions to the Consultant with respect to the study:

Name: Mr David Casson
Name: Mr Graeme Gardiner

1.3.2 Liaison Required

Liaison by the Consultant's should include (but is not limited to):

(i) the appropriate officers of the Technical Services Department and the Environmental Services Department of Scone Council;

(ii) Department of Land and Water Conservation;

(iii) Department of Urban Affairs and Planning;

(iv) Roads and Traffic Authority;

(v) Environment Protection Authority;

(vi) State Emergency Services (Head Office);

(vii) State Rail Authority;

(viii) Community Groups (as required by Council); including the Scone Floodplain Management Committee and landholders in the floodplain.

1.3.3 Progress Reports and Meetings

A monthly progress report detailing the work carried out is to be prepared for Council and the Department of Land and Water Conservation. The report should include a projected monthly cash flow and the anticipated completion date. Reasons for variation to cash flow or completion date, if necessary, must be provided. In addition, a public participation program will be required. The content and means of implementing an appropriate program to involve the public throughout the study are to be provided as part of the Consultant's proposal. The public participation could include:

* Brochures and questionnaires to advertise the study and collect input from residents
* Direct contact with local community groups to promote flood awareness and encourage community involvement in the study
* Public notices in local newspapers to seek public participation
* Community consultation to obtain both input and feedback from the public.

During the study the Consultant is expected to attend meetings with Council representatives, including the Floodplain Management Committee (FPMC) and Council, to discuss progress reports and details of the work and to make presentations in respect of the various final reports. The Consultant shall provide for attendance at up to 6 meetings of Council and/or the FPMC in its proposal.

1.3.4 Programming

Programming of the work shall be as follows:-

Stage 1: Completion of "preliminary draft Floodplain Management Study report" (5 copies required) - approximately 20 weeks.

Stage 2: Completion of "draft final Floodplain Management Study report" (10 copies required) - further 5 weeks.

Stage 3: Public exhibition of "draft final Floodplain Management Study report" - further 5 weeks

Stage 4: Completion of "final Floodplain Management Study report" (15 copies required) and Draft Floodplain Management Plan (10 copies required) - further 6 weeks

Stage 5: Public exhibition of "draft Floodplain Management Plan" - further 6 weeks

Stage 6: Completion of "Final Floodplain Management Plan" (15 copies required) - further 4 weeks

Stage 7: Completion of contract - further 5 weeks.

A Time Base Program of the key tasks/events, leading to the submission of the final Floodplain Management Plan to Council is required.

1.4 PAYMENT

The principal required to be observed is that the Consultant's tender must identify with clarity, certainty and detail the scope of total payments to be made and received under the contract. An UPPER LIMITING FEE for the project is to be presented based on the activities identified in the attached "COST SCHEDULE" (attachment 2), designated hourly rates for the nominated project team members and estimated time inputs for:-

nominated members of the project team
support staff

together with estimates for:-

report preparation and printing
travel and accommodation
other services.

All costs, but particularly the unit cost for the team members, are to be those which currently apply. Cost items not identified in the proposal will not be allowed in the final contract.

Progress payments will be made following receipt of an itemised monthly account. A payment of up to 80% of each claim shall be forwarded to the Consultant.

The final payment of 20% shall be made upon approval of the "Scone Floodplain Management Plan" by Council.

The Council will not make any payments where it is considered that the Consultant's performance is unsatisfactory.

The approved UPPER LIMITING FEE is not to be exceeded without written approval from Council.

1.5 CONSULTANT

The Consultant's proposal shall include the following information:

1.5.1 Methodology

An outline of the proposed study methodology, with details of the proposed public participation program.

1.5.2 Staffing

Structure of the proposed study team, together with roles and responsibilities of team members.

Curriculum Vitae of team members including details of experience in similar projects.

Details of sub-consultants to be used.

1.5.3 Quality Assurance

Details of the Consultant's Quality Assurance system and how this system will be applied to the study.

1.5.4 Fees

Upper Limiting Fee to complete all work required by the Brief based on the estimated costs for each item of the study in accordance with the Schedule.

Hourly charge out rates for team members. These charge out rates shall also apply for any additional work.

Breakdown of the Upper Limiting Fee to show:

- Professional fees, indicating the number of hours to be worked by major tasks for each team member.
- Disbursements
- Sub-consultant fees
- Estimate for collection of additional data.

1.5.5 Program

A program showing the timing, duration and completion of major tasks of the study, together with estimated monthly expenditure.

1.5.6 Key Persons

Consultants are required to identify which members of their project team are regarded as essential to the performance of the project.

The Consultant shall nominate a project team manager to represent the Consultant at all meetings and discussions.

1.5.7 Conflict of Interest

The Consultant is required to assure that it has no conflict of interest in performing the project for the Council and to identify any potential conflict of interest and the steps is considers appropriate to protect the Council.

1.6 SPECIFIC REQUIREMENTS

At the completion of the Study (and in addition to the Reports) the Consultant shall provide Council with:-

(i) data sets and accompanying specifications;

(ii) cadastral maps for the Study Area depicting recommended densities for future development;

(iii) maps and plans for the study area depicting the recommended vegetation corridor strategy.

Note: Original (including data sets and a copy of the final reports) shall be compatible with WordPerfect 6.1. Information to be provided on 3.5" computer disc (IBM compatible). Any mapping shall be compatible with MapInfo.

2. INTRODUCTION

Kingdon Ponds, Middlebrook and Parsons Gully flow through the town of Scone (1991 census population 4,300) and eventually into the Hunter River downstream. It is part of the Hunter river system. Figtree Gully also passes through the town of Scone.

During severe flooding these four watercourses break their banks and affect residential areas to the east and west. Figtree Gully affects a residential area to the east of the Kingdon Ponds as well as the commercial district of Scone. The Scone to Merriwa road crosses the floodplain. This road also links a significant residential area to the rest of the town of Scone. Floodplain management to date has largely been through zoning controls and flood levels have been derived from previous flood events.

In 1996, the Department of Land and Water Conservation completed the Scone Flood Study Report. This study did not investigate flooding along Figtree Gully.

3. STUDY AREA

The study is to cover the whole of the Scone town area as shown on attachment 1 to this brief together with the Figtree Gully catchment.

The Study is to address flooding from Kingdon Ponds, Middlebrook, Parsons Gully and Figtree Gully.

4. OBJECTIVES

4.1 THE OBJECTIVES OF THIS STUDY ARE TO:

4.1.1 Define flood behaviour along Figtree Gully for the 20%, 10%, 5%, 2% 1% and PMF events. It will be necessary to undertake this through analyses using hydrologic and hydraulic mathematical models. The extent of the hydraulic model for Figtree Gully shall be sufficient to provide reliable estimates of flood levels, flood velocities and flow distributions for the area downstream of Barton Street.

4.1.2 Identify works, measures and restrictions aimed at reducing the impact of flooding and the losses caused by flooding from Kingdon Ponds, Middlebrook, Parsons Gully and Figtree Gully, on both existing and future development over the full range of potential flood events.

4.1.3 Identify works, measures and restrictions aimed at reducing the impact of flooding and the losses caused by flooding on both existing and future development over the full range of potential flood events;

4.1.4 To assess the effectiveness of these works for reducing the effects of flooding on existing or proposed developments;

4.1.5 To consider whether the proposed measures might produce adverse effects in the floodplain;

4.1.6 To provide a strategy for vegetation planning that will create a valuable corridor of vegetation without having a detrimental affect on flooding;

4.1.7 To prepare a draft floodplain management plan for the Study area. A plan of action is required to mitigate the effects of flooding on the existing community and future development, including an integrated mix of flood, property and response modification measures. The plan should also be consistent with the objectives of relevant State policies, in particular, the State Rivers and Estuaries Policy and provide a plan of action to implement the vegetation corridor strategy.

4.1.8 To identify development strategies that are consistent with the nature of flooding.

The overall objective of the Study is to develop a Floodplain Management Plan for the Study area that addresses the existing, future and residual flood and environmental problems, in accordance with the NSW Government's Flood Policy as detailed in Section 2 of the Floodplain Development Manual, and the NSW Government's State Rivers and Estuaries Policy.

The Consultant is to complete the entire Study.

4.2 <u>SPECIFICALLY, THE FLOODPLAIN MANAGEMENT STUDY WILL:</u>

4.2.1 Develop appropriate hydrologic and hydraulic models for the Figtree Gully. The Consultant shall be responsible for obtaining all the survey for setting up the model(s).

4.2.2 Assess existing information provided by Council and incorporate, where applicable, such information into the Floodplain Management Study. In addition, as assessment of their impact on floodplain occupation, risk and emergency response is required.

4.2.3 For the full range of potential flooding events identify the existing flood problem, the hazards, extent of inundation, floodways, flood fringe and flood storage areas and recommend a Designated Flood Event(s) based on assessment of flooding, social, ecological and economic considerations.

4.2.4 Identify the extent to which infill, new development and redevelopment may safely occur and how these will interact with existing and future planning processes for Scone.

4.2.5 Determine design parameters to be used as guidelines for future new urban developments permissible under Scone Local Environmental Plan 1986.

4.2.6 Identify how effective each of the mitigation options (flood, property and response modification) would be (over the full range of potential flooding) in reducing the impact of flooding on existing and new development and determine how this would affect the development and building controls in the Scone township area.

Note that options such as stream clearing through an appropriate vegetation corridor strategy and channel diversion should be considered.

4.2.7 Examine the environmental impact of any proposed works and/or measures and ways in which the river and floodplain environment may be enhanced through an appropriate vegetation corridor strategy.

4.2.8 Examine the emergency response measures including flood warning currently in place for Scone and make recommendations on how these could be integrated with the resultant Floodplain Management Plan.

4.2.9 Ensure that community input through the Scone Floodplain Management Committee, is obtained at key times throughout the study.

4.2.10 Examine the social and economic effects of floods, assess tangible and intangible damages and the importance of flood preparation, response and recovery.

4.2.11 Make recommendations for regular programs to increase awareness of floodplain management issues amongst relevant government authorities, interest groups, community organisations, and the general public, concerning the nature of flooding problems, and the range of measures available for effective management of the Scone floodplain.

4.2.11 Recommend ways of implementing, monitoring, co-ordinating and revising the Floodplain Management Plan.

5. DATA

The Consultant is to collect, compile and assess all data relating to flooding and previous studies in the catchment and initiate further data collection if required.

The following information will be made available to the consultant:-

* 1996 Scone Flood Study report compiled by the Department of Land and Water Conservation.
* Land use, zoning and demographic information applying to the township of Scone.
* Relevant minutes of the Scone Floodplain Management Committee.
* Flood inundation maps which have been derived from information out of the 1996 Flood Study Report.
* Figtree Gully Detention Basin Study.

The Consultant shall indicate any additional type of data required to carry out the project including supply deadlines and formats, and proposed methods for accessing the required data.

The latest runoff (RAFTS-XP) and water surface profile (MIKE-11) models are available from the Department of Land and Water Conservation at no charge to the successful consultant.

6. EXISTING FLOOD BEHAVIOUR

6.1 DESCRIPTION OF FLOODING

The Consultant should provide a description of the nature of flooding for the full range of potential floods in the Study area. This should include:

6.1.1 A flood hazard categorisation for the existing level of development and investigation release areas, in accordance with the classifications outlined in the NSW Government's Floodplain Development Manual.

6.1.2 The quantifications of the impacts of the full range of floods considered assessing the population affected and the average annual damages (direct and indirect).

6.1.3 An examination of the social/economic and environmental factors, as detailed below:-

6.2 SOCIAL AND ECONOMIC FACTORS

An assessment of the social disruption should be undertaken, encompassing the following:-

6.2.1 Investigation of direct and indirect costs associated with:-

(i) damage from contact of floodwater with buildings, motor vehicles, community infrastructure;

(ii) evacuation and reinstatement;

(iii) loss of trade; and

(iv) restrictions on travelling.

6.2.2 A brief examination of the following intangible costs:-

(i) inconvenience;

(ii) isolation;

(iii) psychological disturbances as a result of anxiety and trauma; and

(iv) physical ill health.

The economic assessment of possible management/mitigation options must be carried out in accordance with the NSW Treasury guidelines and undertaken by an accredited economist.

6.3 <u>ECOLOGICAL FACTORS</u>

Review existing data on the ecology of Kingdon Ponds, Middlebrook, Parsons Gully and Figtree Gully and their floodplains with a view to identifying:

6.3.1 The major elements of the environment which contributes to, or have an impact on the Study area, its drainage system and the floodplain.

6.3.2 A preliminary assessment of the environmental impact of alternative development and flood mitigation proposals.

6.3.3 An assessment of the potential for river and floodplain enhancement and any associated impacts.

These assessments will provide the basis upon which a vegetation corridor strategy for Kingdon Ponds, Middlebrook, Parsons Gully and Figtree Gully can be developed.

7. FLOOD MITIGATION AND VEGETATION MANAGEMENT OPTIONS

The options for mitigating the social disruption and damage caused by flooding and the options proposed as part of the vegetation corridor strategy are to be examined. Investigation should include flood, property and response modification damage reduction measures and be undertaken in conjunction with the development of a vegetation corridor strategy for Kingdon Ponds, Middlebrook, Parsons Gully and Figtree Gully. Refer also 8.1.1.8.

The Consultant shall:

7.1 Provide cost estimates for four (4) flood mitigation works and/or measures and works and/or measures proposed under the vegetation corridor strategy. Such works/measures to be selected following consultation with the Floodplain Management Committee (FPMC).

7.2 Propose a prepared option or mix of options to achieve the objectives of the Study/Plan. Options which are likely to be unacceptable on environmental, social, economic or flooding grounds are to be excluded. The preferred options will be selected in consultation with Council and its Floodplain Management Committee.

7.3 Provide advice on the recurrent and capital costs of the preferred option(s).

7.4 Propose a mechanism for co-ordinating implementation of the mitigation and vegetation corridor options, outlining priorities, implementation schedules and ongoing performance monitoring. This must include the integration of the Floodplain Management Plan, Flood Plan and any other relevant Catchment Management Plans.

The Scone Flood Study Report should be used in consideration of various Floodplain Management options for use in preparation of the Floodplain Management Study and the final preparation of the Floodplain Management Plan.

Attention is also drawn to the NSW Floodplain Development Manual in particular Appendix D, Floodplain Management Measures and Appendix F, Draft Flood Proofing Code.

8. REPORT AND PRESENTATION

8.1 REPORTS

The final report is to be suitably bound and shall clearly indicate the stated recommendations for the Floodplain Management Plan, with supporting facts, figures and arguments, as well as clear and accurate plans showing suggested zonings for the development and proposed vegetation within the floodplain.

The following process shall be undertaken.

i. Consultant prepares "Preliminary Draft Report" (10 copies required) for review by FPMC.
ii. Consultant incorporates comments from FPMC and produces "Draft Report" (10 copies required) for public exhibition (4-6 weeks).
iii. Following public exhibition, the Consultant reviews submissions received and, in consultation with FPMC prepared "Final Report" (20 copies required).

Note: Original (including data sets and a copy of the report) shall be compatible with WordPerfect 6.1. Information to be provided on 3.5 computer disc (IBM compatible). Any mapping shall be compatible with MapInfo.

8.1.1 Format of Final Reports

At the completion of the Study, a final report is to be prepared containing sections generally as detailed below

* Summary

Explaining the function of the Floodplain Management Study both as part of the series of activities associated with implementation of the Government's Flood Policy and associated catchment management policies and its function in relation to the Kingdon Ponds, Middlebrook, Parsons Gully and Figtree Gully. It should highlight the methodology and findings within this framework.

* Introduction

Setting the scene for the reader regarding the nature of the Study, the need for it and the elements comprising the study.

* Background

Detail the parties involved, previous studies and data bases.

* Existing Flood Behaviour

This section provides a description of the nature of flooding on the floodplain. This section should also provide a description of the existing Kingdon Ponds habitat in relation to species of flora in supporting fauna and aquatic life.

It is to include:-

A flood hazard categorisation for the existing and proposed level of development for four (4) potential flood events as specified by the FLOOD PLAIN MANAGEMENT COMMITTEE in accordance with the classification outlined in the Floodplain Development Manual.

A definition of the number of residential, commercial and industrial properties affected.

The quantification of the impacts for the range of flood events, assessing the population affected and the number of buildings, the average annual damages (direct and indirect), an assessment of the hazard to life and an assessment of the impact of the existing creek vegetation.

An examination of the cultural/heritage issues.

An examination of the current flood warning, evacuation and recovery practise and deficiencies.

* <u>Selection of the Designated Flood Event</u>

This section discusses the various factors that influence the selection of the Designated Flood Event (DFE). These factors include:

Topography and zoning
Flood History and Community Perception
Flood Frequency - Damage Relationship
Future Development
Economic, Environmental and Social Impact
Implications of the Occurrence of a Flood Greater than the DFE

* <u>Existing Floodplain Management Measures</u>

Discuss existing planning controls Local Environmental Plan(s), Development Control Plan (s), Flood Policy, etc, Flood mitigation works and flood warning measures.

* <u>Hydraulics</u>

To include a discussion of available techniques and justification for adoption of selected methodology, shortcomings, expected order of accuracy and assumptions necessary with selected modelling procedures.

Include a discussion of methods available to simulate the effects of urban development and vegetation and a justification for the approach development.

* <u>Modelling</u>

The modelling procedures and findings should be discussed in detail in this Section. All relevant information and data associated with running the models should be presented in this Section with use of appendices as appropriate.

A section which discusses the rationale and methodology for modelling various flood mitigation measures and vegetation strategies should also be included.

* <u>Practical Strategies</u>

The possible measures for mitigating the social disruption and damage caused by flooding are to be examined. They are to include flood, property and response damage reduction measures.

These measures shall <u>include</u> (but are not limited to):-

- flood mitigation dams;

- levees;

- by-pass floodways;

- channel improvements;

- flood proofing of buildings;

- flood forecasting, flood warning, evacuation and recovery planning including the role of the SES;

- building and development controls;

- voluntary purchase;

- house raising - considering the categories of:
  I. existing houses with habitable rooms at low levels, and
  ii. existing houses with habitable rooms which have a low flood risk;

- public information and education;

- use of land use zonings;

- maintenance and cleaning of stormwater drainage systems; and

- wetlands.

The possible strategies for the removal and revegetation of flora species, ongoing management and any associated environmental impacts in relation to carrying out stream clearing and replanting are to be examined.

* <u>Hydraulic Performance</u>

Evaluate the hydraulic impacts over the full range of flood events, for four (4) alternatives or combination of alternatives as selected after consultation with the FLOOD PLAIN MANAGEMENT COMMITTEE, specifically the changes in floodwater depth, velocity, discharge and general direction of flow. In order to assist in the comparison of options, land inundated by the recommended DFE is to be categorised in accordance with the classifications outlined in the Floodplain Development Manual for each of these alternatives.

The findings are also to be supported by a series of diagrams which show the effects of various strategies compared with existing conditions. These diagrams will take the form of peak height profiles along the river and tributaries, in addition to depth/velocity hazard diagrams at appropriate locations.

* <u>Economic Evaluation of Alternatives</u>

The cost of structural measures are to be estimated and the benefits assessed.

The cost estimates are to be based on preliminary designs. Comments on the cost effectiveness and a comparison of the relative benefits/disbenefits of the alternatives is to be made. This must be in accordance with NSW Treasury guidelines and undertaken by an accredited economist.

* <u>Environmental Impacts</u>

The study of the environment of the various watercourses and their floodplain is to include:-

- identification of the major elements of the environment contributing to the integrity of the creek and floodplain;

- an identification of the major threats to these elements;

- an assessment of the environmental implications of alternative development and flood mitigation proposals; and

- a recommended strategy for a vegetation corridor for the study area in detail and the Scone catchment in general.

* Social Impacts

An assessment of the social disruption should be undertaken, encompassing the following:-

- inconvenience;

- isolation;

- disruption;

- psychological disturbances as a result of anxiety and trauma; and

- physical ill health.

* References

Reference material used is to be acknowledged.

* Appendices

Copies of all computer data files are to be included as appendices. All supportive/incidental information/calculations.

8.2 Floodplain Management Plans

The Floodplain Management Plan should include both written and diagrammatic information as appropriate, describing how each of the recommended floodplain management options may be used and managed to achieve the objectives of the study.

The final maps in the plan which are required to identify the floodplain management strategies are to be based on 1:4000 scale. The base maps will be supplied by Council. Information to be shown on the maps shall include:

Extent of inundation due to the DFE
Designated flood levels (DFLs) at model cross section
Land owned by Council
Proposed flood mitigation works
Outline showing management areas
Each management areas and their conditions of development
Floodway areas
Flood prone land (land inundated by the PMF) and land where a minimum floor level of 0.5m above the designated flood level is required.

8.3 PRESENTATION

The Consultant is to be prepared to attend meetings of the Scone Floodplain Management Committee during the progress of the Floodplain Management Study.

At the end, the Consultant will present the Draft and the final report to the Committee and the final report to a full Council meeting. In addition, the Consultant is to be prepared to attend public forums to present the results of the Study and resultant plan.