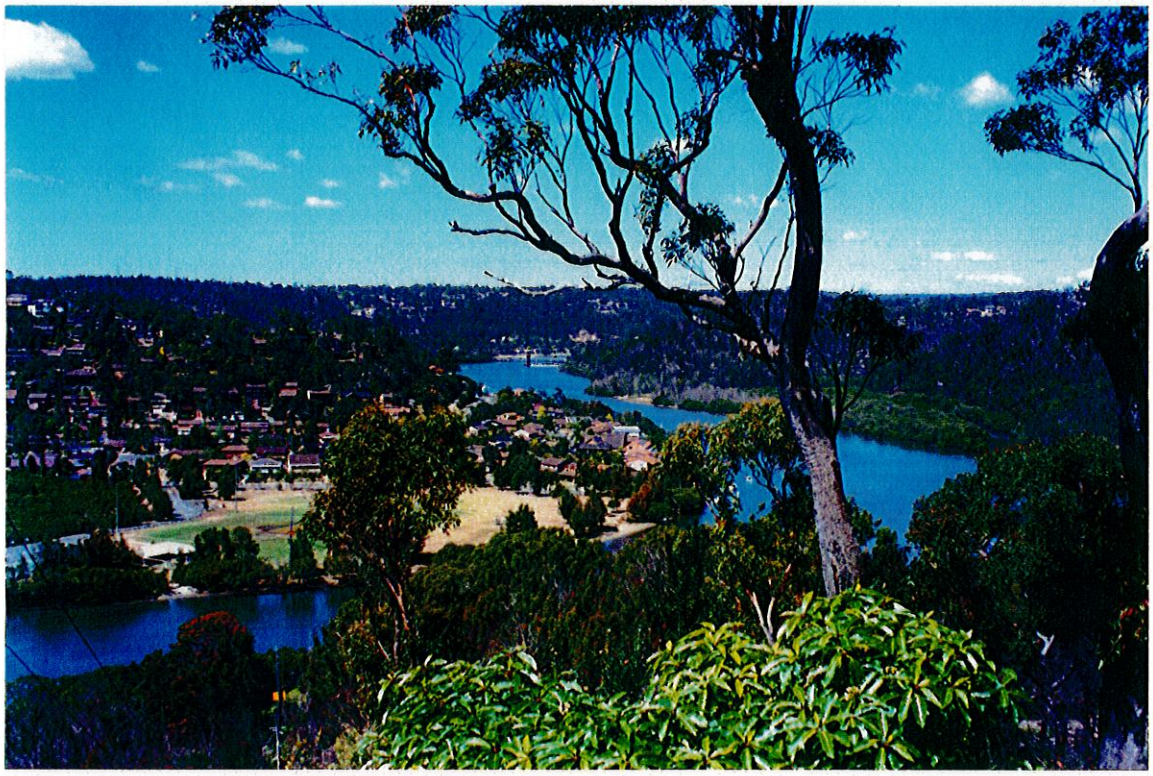
WORONORA RIVER
FLOODPLAIN MANAGEMENT PLAN



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SUTHERLAND SHIRE COUNCIL

WORONORA RIVER FLOODPLAIN MANAGEMENT PLAN

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FOREWORD

The State Government's Flood Policy is directed at providing solutions to existing flooding problems in developed areas and to 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 State Government subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist Councils in the discharge of their floodplain management responsibilities.

The Policy provides for technical and financial support by the Government through the following four stages:

1. Flood Study
   determines the nature and extent of the flood problem.

2. Floodplain Management Study
   evaluates management options for the floodplain in respect of both existing and proposed development.

3. Floodplain Management Plan
   involves formal adoption by Council of a plan of management for the floodplain.

4. Implementation of the Plan
   construction of flood mitigation works as well as implementation of non-structural measures to protect existing development, and use of Local Environmental Plans to ensure new development is compatible with the flood hazard.

The Woronora River Floodplain Management Plan constitutes the third stage of this management process. Management strategies recommended in the Floodplain Management Study are incorporated into a plan for the future management of flood-liable land along Woronora River.

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GLOSSARY OF TERMS

Alert	a flood warning system involving the transmission of a radio signal from a field station to a "base" station computer each time a flood event occurs to allow for prediction of flood levels.
Annual Exceedance Probability (AEP)	refers to the chance or risk of a flood of a given size occurring or being exceeded in any given year. A 90% AEP flood has a high chance of occurring or being exceeded; it would occur quite often and would be relatively small. A 1% AEP flood has a low chance of occurrence or being exceeded; it would be fairly rare but it would be relatively large.
Australian Height Datum (AHD)	a common national plane of level corresponding approximately to mean sea level.
average annual damage	the average economic loss caused by flooding for a catchment, eg the Woronora valley, measured over a year.
catchment	the area draining to a site. Includes the catchments of tributary streams as well as the main stream.
compatible developments	developments appropriate to both the flood hazard at the development site and to the impact of the development on existing flood levels and flood flows.
conditional developments	developments likely to cause/suffer excessive flood damage or likely to have an unacceptable impact on flood levels and flood flows.
datum	specified reference level used in survey measurement (see Australian Height Datum).
designated flood	(see flood standard)
development	the erection of the building or the carrying out of work; or the use of land or of a building or work; or the subdivision of land.

discharge	the rate of flow of water measured in terms of volume over time. It is to be distinguished from the speed or velocity of flow which is a measure of how fast the water is moving rather than how much is moving.
extreme event	a large flood event substantially greater than the 1% AEP event.
flood	relatively high stream flow which overtops the natural or artificial banks in any part of a stream or river.
flood hazard	potential for damage to property or persons due to flooding.
flood liable land	land which would be covered with water as a result of a designated flood.
floodplain	the portion of a river valley, adjacent to the river channel, which is covered with water when the river overflows during floods.
floodplain management measures	the full range of techniques available of floodplain managers.
floodplain management options	the measures which might be feasible for the management of a particular area.
flood standard (or designated flood)	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.
flood storages	those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.
floodways	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.

freeboard	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.
high hazard	possible danger to life and limb; evacuation by trucks difficult; potential for structural damage; social disruption and financial losses could be high.
hydraulics	the term given to the study of water flow in a river, in particular, the evaluation of flow parameters such as stage and velocity.
hydrology	the term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.
hydrograph	a graph which shows how the discharge changes with time at any particular location.
low hazard	should it be necessary, people and their possessions could be evacuated by trucks. Able-bodied adults would have little difficulty wading.
management plan	a document including, as appropriate, both written and diagrammatic information describing how a particular area of land is to be used and managed to achieve defined objectives. It may also include description and discussion of various issues, problems, special features and values of the area, the specific management measures which are to apply and the means and timing by which the plan will be implemented.
mathematical/computer models	the mathematical representation of the physical processes involved in catchment runoff and stream flow. These models are often run on computers due to the complexity of the mathematical relationships. In this report, the models referred to are mainly involved with rainfall, runoff and stream flow eg MIKE 11 and RORB.

MIKE 11	a computer program developed by Danish Hydraulics Institute to determine flood hydraulic characteristics ie flood depth and velocities.
peak discharge	the maximum discharge occurring during a flood event.
probable maximum flood (PMF)	the flood calculated to be the maximum which is likely to occur.
probability	a statistical measure of the expected frequency or occurrence of flooding. For a fuller explanation see Annual Exceedance Probability.
present worth	the present worth is taken as the equivalent value today of a future transaction eg. with a discount rate of 7%, $107 in one year's time has a present worth of $100.
RORB	a computer program developed by Laurenson and Mein to simulate hydrologic (flood volumes) characteristics of a catchment.
runoff	for the purposes of this study the amount of rainfall which actually ends up as stream flow, also known as rainfall excess.
stage	equivalent to 'water level'. Both are measured with reference to a specified datum.
stage hydrograph	a graph which shows how the water level changes with time. It must be referenced to a particular location and datum.
stormwater flooding	inundation resulting from the incapacity of an urban stormwater drainage system to handle runoff.
survey plan	a plan prepared by a registered surveyor.
telemetry	the transmission of information by radio waves.
water surface profile	a longitudinal plot showing the flood stage at any given location along a watercourse.

1.0 INTRODUCTION

Sutherland Shire Council, through its Floodplain Management Committee, is developing a Floodplain Management Strategy for the Woronora River floodplain in accordance with the New South Wales Government's Floodplain Development Manual (PWD, 1986).

The Woronora River catchment falls within the area administered by Sutherland Shire Council, Campbelltown City Council, Liverpool Council and Wollongong City Council. Woronora Dam, is a major feature of the catchment area.

The Woronora River drains from south to north with Heathcote Creek, Forbes Creek and Still Creek being the main tributaries. The majority of the drainage systems are natural channels. In tidal areas the catchment is reasonably urbanised and parts of the catchment are prone to frequent main stream flooding.

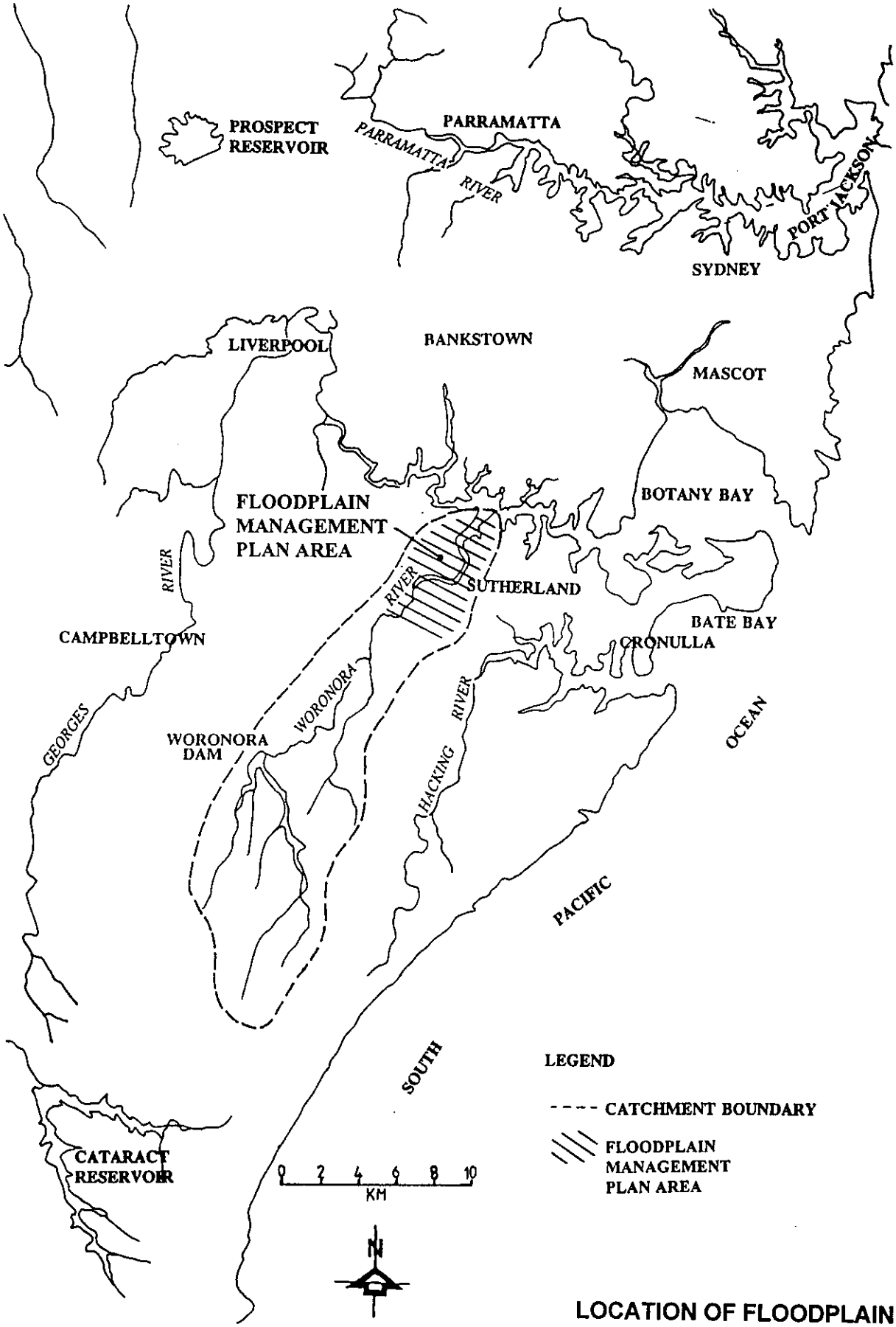
Significant floods since 1930 have occurred in 1933, 1943, 1949, 1952, 1956, 1961 and 1988.

Floodplains are areas of land alongside the banks of a river, which often have been developed by the deposition of sediments from river floodwaters. As such, floodplains usually consist of level ground with fertile soils, and are developed for land uses such as housing, agriculture and recreation.

Management of river floodplain areas can enable the land to be developed, while at the same time minimising the risk of damage caused by flooding. The Woronora River Flood Study (1991) provides information on the behaviour of floodwaters within the river channel and across the floodplain areas.

In February 1994 Acer Wargon Chapman was commissioned by Sutherland Shire Council to undertake preparation of a Floodplain Management Study and Floodplain Management Plan for the Woronora Valley. Information from the 1991 Flood Study has been utilised in the Woronora River Floodplain Management Study to develop a number of floodplain management options. Strategies selected from these options by the Woronora River Floodplain Management Committee form the basis of this Floodplain Management Plan. The Committee consists of representatives from Sutherland Shire Council, the local community, NSW Public Works, the Environment Protection Authority, the Soil Conservation Service and the State Emergency Service.

The purpose of this plan is to provide detailed information on the implementation and operation of the selected management strategies. Figure 1.1 shows the location of the Floodplain Management Plan area.



LOCATION OF FLOODPLAIN MANAGEMENT PLAN AREA
FIGURE 1.1

2.0 SUMMARY OF FLOOD STUDIES

Sutherland Shire Council commissioned a flood study for the Woronora River in 1991. The study examined flooding along the 10.8 kilometre stretch of the river from The Needles to the Como Railway Bridge. Design flood levels were determined for the 1%, 2% and 5% Annual Exceedance Probability (AEP) events and an Extreme Flood event using computer models.

A review of this study, conducted as part of the Floodplain Management Study, validated the results for the 1%, 2% and 5% AEP flood events. However, the extreme event described in the 1991 study was found to be substantially lower in magnitude than the estimated PMF (6 hour rainfall duration) determined using recently updated rainfall figures from the Bureau of Meteorology. Increases in levels of 1.1 to 1.8 metres above the extreme event were predicted for the PMF, and these revised figures were used for the determination of flood hazard and flood damage calculations in the Floodplain Management Study.

It is noted that Woronora Dam was over 90% full for 18 of the 20 actual flood events considered in the 1991 study, and for the 1% AEP event a 10% depletion in capacity was found to cause a negligible reduction in peak streamflow. It was therefore concluded that flows for the 1% AEP event were generally not sensitive to variations in the water level for Woronora Dam. Sydney Water is currently undertaking a program to review the safety of Woronora Dam for large flood events such as the PMF.

A flood analysis of Forbes Creek, which is a tributary of Woronora River, was undertaken by NSW Public Works in 1992. The analysis indicated that flooding of properties in Woronora along Forbes Creek from the 5%, 2% and 1% AEP events is predominantly due to backwater effects from flooding in the Woronora River.

The construction of a high level road bridge over the Woronora River, 120 metres downstream from the existing bridge, commenced in late 1994. The effect of the new bridge on flooding was modelled, and was found to raise the 5%, 2% and 1% AEP flood levels by up to 0.03 metres at the bridge diminishing to zero within approximately 200 metres from the bridge.

The "Greenhouse" effect has been predicted to cause a sea level rise of 200 to 1000 mm over the next 50 years, as well as changes to rainfall and flooding. It is recommended that flood levels should be reviewed when the "greenhouse" effects can be predicted with some degree of certainty.

3.0 SUMMARY OF THE FLOODPLAIN MANAGEMENT STUDY

3.1 INTRODUCTION

The objective of the Woronora Floodplain Management Study is to define the nature of the flood hazards and identify, assess and optimise strategies and measures aimed at reducing the impact of flooding on both existing and future development. The study identified a number of flood mitigation strategies, which could be developed into a Floodplain Management Plan for the Woronora River catchment.

3.2 THE STUDY AREA

Woronora River has a total catchment area of about 170 km^2 and is situated approximately 22 km south of the Sydney Central Business District. The Woronora River drains from south to north with Heathcote Creek, Forbes Creek and Still Creek being the major tributaries. The catchment is reasonably urbanised with some areas prone to frequent mainstream flooding. Woronora Dam is a major feature of the catchment area supplying water to the Sutherland district, Allawah and Penshurst.

The study area comprises the areas fringing the 10.8 km length of the river from The Needles downstream to the Como Railway Bridge (located immediately downstream of the confluence with the Georges River). Areas potentially affected by flooding include principally low-lying areas of Woronora and Bonnet Bay, as well as a smaller proportion of river frontage properties in Lucas Heights, Bangor, Illawong and Como.

3.3 THE EXISTING ENVIRONMENT

The study area environment is characteristic of Hawkesbury sandstone areas of Sydney, with a natural vegetation cover of dry sclerophyll woodland ranging to open forest. The Mean Annual Rainfall varies from 1000 to 1400 mm over the catchment, and is strongly influenced by local topography.

Since European settlement modifications to the natural environment have resulted from urbanisation, dredging, and reclamation of tidal flats and mangrove swamps. Residents perceive that water quality has decreased with the increase in urban development.

The maintenance of flood frequency and intensity is important for the preservation of the natural environment. Altering the flood regime can cause changes to channel morphology, reduction in fish breeding and loss of nutrient supply to aquatic ecosystems and floodplain areas. The 1991 flood study indicated that the Woronora Dam does not appear to substantially affect the magnitude of larger floods, due to typically high levels of storage.

3.4 SOCIAL CONSIDERATIONS

Prior to European settlement the land around the Woronora River was occupied by Aboriginal people for many thousands of years. European occupation commenced before the middle of the nineteenth century, with initial development concentrated around the suburb of Woronora. Urban development on the surrounding plateau areas accelerated in the mid 1960's, and continues to the present day with current development activity focused on the Menai and West Menai area.

Predominant land uses within the study area are either residential or open space (a large proportion of which is natural bushland) for passive recreation. The Sutherland Shire Council Local Environmental Plan (LEP) indicates that flood mitigation works are allowable for all of the zonings present in the study area.

A component of the Floodplain Management Study was a community workshop held in Woronora in April 1994. A range of possible flood mitigation options was discussed at the workshop with a clear objective expressed of ensuring that the high environmental amenity of the valley was maintained. Issues of local concern which were raised included water quality, localised stormwater flooding problems, perceived increase in siltation due to new urban developments, the effect of the new Woronora bridge on flood levels and general environmental issues.

A flood hazard assessment was carried out examining the 5% and 1% AEP events and the PMF. Areas of most severe flood hazard were found to occur on the western foreshore areas of Woronora, the eastern foreshore area of Woronora near Prince Edward Park, and Deepwater Estate.

Surveyed property levels provided by Sutherland Shire Council indicated that for the 1% AEP flood, 323 properties in the Woronora Valley would be flooded, including 289 houses which would experience flooding above floor level. Above-floor flooding causes a major social impact due to loss or damage to possessions, and because the entry of water may be perceived to be like an invasion of property. Early warning of flooding allows possessions to be raised above flood waters thus reducing social and economic impacts. The community can also be affected by psychological and sociological problems following property flooding.

Community consultation undertaken during preparation of the Floodplain Management Study indicated that many residents appear prepared to accept a level of inconvenience associated with flooding.

The Woronora Caravan Park is located on the western foreshore of the river immediately north of the Woronora Bridge. There are presently 35 caravans and 5 cabins in the Woronora caravan park, all of which are occupied permanently.

Some 82 people live on the caravan site on a permanent basis.

The site is extremely flood-prone, being even subject to flooding on king tides.

In the last flood, there was considerable difficulty in moving the caravans, and for this reason, the current plan of the SES for the caravan park is to evacuate only the people and not the caravans.

In a 5% AEP flood, it is likely that most caravans would be destroyed. Thus, practically all possessions would be lost. Given the susceptibility of the caravan site to flooding and the likely total loss to residents it can be forecast that the social impact of a flood on these residents would be substantial. It is also likely that, should severe flooding occur, residents would be unwilling and in many cases unable to move back to this site, resulting in further dislocation from social networks.

3.5 ECONOMIC IMPACTS

The estimated economic impacts of flooding for the existing development conditions are listed in Table 3.1 below:

TABLE 3.1 FLOOD LOSSES FOR EXISTING DEVELOPMENT CONDITIONS

Flood AEP	Residential Losses	Commercial Losses
20%	$0	$0
5%	$2,200,000	$160,000
2%	$3,100,000	$190,000
1%	$4,500,000	$220,000
PMF	$24,500,000	$980,000
Av. Annual Damage	$480,000	$29,000
Present Worth (50yrs @ 7%)	$6,600,000	$400,000

Note: Table includes losses for indirect damage, at 5% for residential and 55% for commercial.

The present worth is the equivalent value today of a future transaction, for example, with a discount rate of 7%, $107 in one year's time has a present worth of $100.

Approximately 95% of the economic impacts relate to residential property. Flood insurance is not available to most residences in NSW, and the 1991 Census data showed that about 10% of the Woronora community have incomes below the "poverty level".

The level of community preparedness for flooding at the study area is estimated to be 30%. Community preparedness tends to decrease with time as people move out of the area, and new residents arrive. It is usual for people not to appreciate the severity of a flood unless they have actually experienced one. Since the last significant flood occurred in 1988, people have moved away from the area and new residents are less aware of the risk of potential flooding.

Management of emergency procedures during a flood is the responsibility of the State Emergency Services. Existing rainfall gauges within the catchment provide 2 to 3 hours warning of a flood, and the SES are able to mobilise within 1 hour of receiving a flood warning. Evacuation difficulties result from the dispersed nature of the urban development along the floodplains on each side of the river. A number of properties, in particular on the eastern shore upstream of Woronora, are accessible by boat or foot only. Another evacuation problem arises from the early flooding of access roads, in particular Menai Road (at the western approach to Woronora Bridge) which floods on a king tide.

The existing Council flood standard for new residences and extensions is set at 0.5 m above the 1% AEP flood level, for habitable floors, and at the 5% AEP flood level for non-habitable floors. An economic assessment of benefits versus costs for new residences suggests that maximum economic advantage could be gained by having floor levels at least 0.5 m above the 1% AEP flood level and preferably within a range of 1 to 2 m above. Council could consider revising the present flood standard in the light of this assessment.

3.6 LOCAL FLOOD PLAN

The primary objective of the Government's Flood Policy 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. The impact of flooding on existing developed areas can be reduced by flood mitigation works and measures, variation of development and building controls consistent with minimising the impact of flooding, and voluntary purchase of property. The potential for flood losses in new developing areas can be contained by the application of effective planning and development controls. These aspects are addressed in the options and strategies contained in this plan.

However, only under extremely rare circumstances would these measures completely remove the flood threat. Therefore, wherever a flood threat exists, arrangements need to be made to prepare the community to respond effectively to flooding. This is done by developing and maintaining a Local Flood Plan for each Local Government Area which faces a flood threat.

The State Emergency Service Act 1989 defines one of the functions of the Service as follows:

> "To act as the combat agency for dealing with floods (including the establishment of flood warning systems) and to co-ordinate the evacuation and welfare of affected communities."

The State Flood Plan recognises this function and directs that "each SES Local Controller in whose area there is a flood threat is to develop a Local Flood Plan". In doing so, SES Local Controllers act as agents for their communities in developing what are essentially community plans.

(i) Implementation

With the support of the Sutherland Shire Council, the Sutherland SES Local Controller has begun the process of developing a Sutherland Local Flood Plan. This plan will:

(a) cover preparedness measures, the conduct of response operations and the co-ordination of immediate recovery measures for flooding within the Sutherland Local Council area;

(b) use the work done for the Floodplain Management Study as the basis of understanding of the flood threat;

(c) record the agreed responsibilities of agencies and individuals during flood response operations;

(d) record arrangements for activation, collection of flood intelligence, development and distribution of effective warnings to the community, operational control, communications and liaison;

(e) indicate how the recovery process might be initiated.

The plan will be developed in conjunction with the Sutherland Local Emergency Management Committee and be formally presented to that Committee for acceptance as a sub-plan of the Sutherland Shire Local Disaster Plan. The Plan will then be printed and distributed as an "interim" document.

The Sutherland Shire Council will ensure that copies of the Local Flood Plan are made available through the Council Information Centre, Schools and Libraries. Comment and suggestions for improvement will be welcomed from members of the community and the plan will be regularly reviewed.

3.7 POSSIBLE FLOODPLAIN MANAGEMENT OPTIONS

A number of floodplain management options were assessed to determine suitability for application to the Woronora River valley:

(i) Non-structural

Flood Forecasting System
Community Preparedness Campaign
Planning and Building Controls
Voluntary Purchase
Voluntary House Raising
Flood Insurance Scheme
Access Road Improvements

(ii) **Structural**

Flood Retarding Basin
Modification to Waterway at Woronora Bridge
Levees
Dredging

The floodplain management options were assessed on environmental, social and economic grounds and selected options were assembled into seven management strategies approved by the Woronora River Floodplain Management Committee for detailed evaluation.

4.0 FLOODPLAIN MANAGEMENT PLAN

The Woronora Floodplain Management Committee examined the results of the detailed analysis for the following seven management strategies.

(i) Strategy 1, comprising improved flood forecasting system, community preparedness campaign and planning and building controls.

(ii) Strategy 2, voluntary house raising to be made available as a measure where properties are not proposed for protection by a levee.

(iii) Strategy 3a, access road improvements in Woronora comprising raising low lying areas of Prices Circuit and an emergency access from Nundah Place to Menai Road.

(iv) Strategy 3b, re-establishment of an emergency access from Nundah Place to Menai Road only.

(v) Strategy 4, construction of a levee to protect the southern area of Bonnet Bay, comprising Harrison Avenue, McKinley Avenue and Washington Drive, up to the 1% AEP flood level.

(vi) Strategy 5, raising Woronora Bridge to reduce the effect of the bridge deck on upstream flood levels.

(vii) Strategy 6, dredging a 50 m wide channel along the length of the river to reduce flood levels.

(viii) Strategy 7, construction of a levee on the western foreshore at Woronora to the 5% AEP level to protect the Woronora Caravan Park, Menai Road and residential properties north of the intersection of Nundah Place with Prices Circuit.

Strategies 2, 3a, 3b, 4, 5, 6 and 7 each include the provisions of Strategy 1.

Following further assessment by the Woronora River Floodplain Management Committee strategies 1, 2, 3b and 7 are recommended for consideration by the community.

It should be noted that Strategy 7 was not favoured by community representatives on the Floodplain Management Committee but had to be considered by Council as a possible strategy.

4.1 STRATEGY 1

4.1.1 Flood Forecasting System

Flood forecasting involves obtaining data from telemetered rainfall and flow gauges throughout the catchment to enable the size of a flood to be predicted rapidly. Existing gauges within the catchment will be upgraded to provide information for automatic input to a computer model. The prediction of flood levels well in advance of their arrival allows emergency services personnel to assess the severity of the predicted flood, and to respond effectively.

In particular, it allows for the development of effective warnings which advise the community what level of flooding is predicted, how they might be affected, and what actions to take to minimise the impacts. The planned flood forecasting system will aim at providing between 5 and 10 hours warning of a flood resulting from the critical 36 hour storm. It will provide somewhat shorter warning for the less severe levels of flooding resulting from short duration storms.

(i) Benefits

The flood forecasting system does not in any way affect the frequency or height of flood waters. The role of the system is purely to minimise the risk to life, loss of goods and social impacts of flooding. By ensuring an adequate flood warning time, and by having an evacuation plan in place and a prepared community, the people affected by the floodwaters are able to maintain control over their belongings. An organised and pre-planned schedule of packing, lifting, storing and evacuation replaces feelings of helplessness and victimisation with positive action.

The flood forecasting system can be upgraded to provide information on wind direction and speed, temperature and humidity. This will allow the system to be utilised for the tracking and prediction of movements of any bushfires which occur in the area. This information can assist fire fighters with decisions on where to back-burn, which residences might be endangered and when to evacuate residents.

(ii) Implementation

There are three pluviometers (rain gauges) in the catchment, all owned by the Water Board. One is at the Woronora Dam, one is about halfway between the dam and upper extremity of the catchment, and the other is in the vicinity of The Needles. These will require upgrading, and an additional pluviometer will be added in the upper catchment area.

A base station for computer modelling of rainfall data will be established. This will receive information automatically from the pluviometers, and use semi-empirical relationships developed by the Bureau of Meteorology and 1991 flood study data to forecast flooding within the catchment. A signal

repeater station will be required to boost field information to the base station.

In order to check on its predictions, the SES will require access to river level information. There is a water level gauge at Woronora Dam which is already set up for an ALERT system. An existing system gauge at The Needles will be upgraded, and a new gauge installed at Woronora Bridge (Figure 4.1).

Upgrading of existing pluviometers and the installation of an additional signal repeater station are all that will be required to set up a bush fire monitoring system.

Following installation of the field and base station equipment, a short set-up and training period will be required to calibrate the equipment and computer model.

(iii) Costing

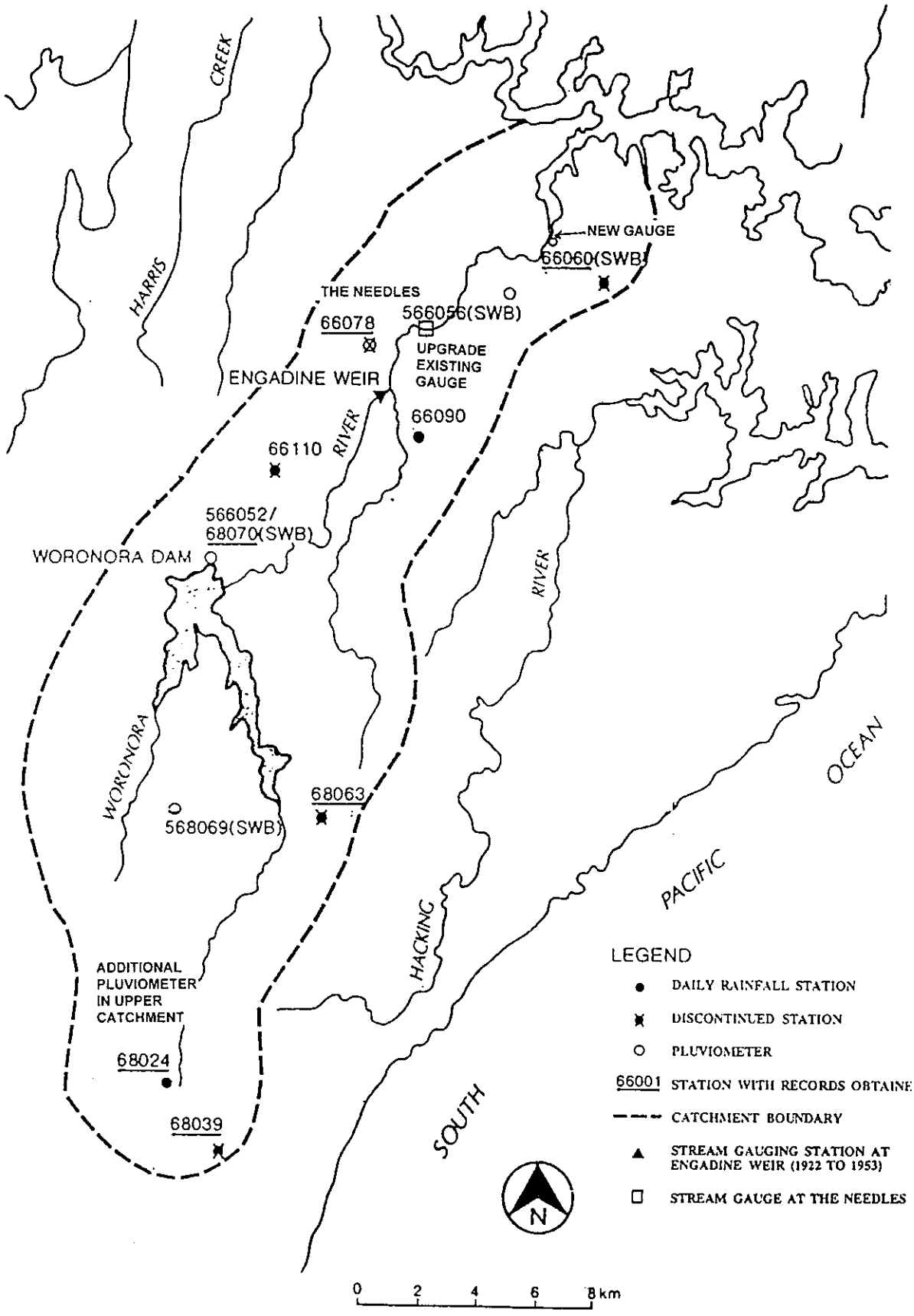
Table 4.1 shows the itemised costs of the warning system. While funding could be made available from the State Government for capital costs, operational costs would need to be borne by the Sutherland Shire Council.

TABLE 4.1 COSTS OF FLOOD FORECASTING SYSTEM

Costs of Flood Forecasting System	
Additional pluviometer	$ 7,000
Signal repeater station	$ 3,000
Base station	$ 7,000
New river gauge at Woronora Bridge	$ 20,000
Improved telecommunications for warnings	$ 10,000
Modelling	$ 8,000
Sub Total	**$ 62,000**
Maintenance (10%)	$ 6,200
Present worth (50 yr) 7%	$ 86,000
Total	**$148,000**
Extra costs for bush fire warning	
3 stations @ $4,000	$ 12,000
Repeater station	$ 3,000
Total	**$15,000**

(iv) Operation

The operation of the computer model will be undertaken by Sutherland Shire Council, and the dissemination of flood information produced from the model and distribution of warnings will be performed by the Sutherland SES.



SOURCE: SINCLAIR KNIGHT (1991)

LOCATION OF GAUGING AND RAINFALL STATIONS
FIGURE 4.1

4.1.2 Community Preparedness Campaign

One aspect of a community's preparedness for flooding is the "flood awareness" of individuals. This includes awareness of the flood threat in their area and how to protect themselves against it. It is fair to assume that the level of awareness drops as individuals' memories of previous experience dim with time.

It is also fair to assume that many individuals will not have experienced floods and none will have experienced the full range of floods which might be possible in the area.

Therefore, the Council and SES in partnership will establish and maintain an active eduction campaign to provide a substitute for recent experience. Some of the ways in which flood awareness may be increased are:

- permanent marks showing the levels reached by previous floods
- teaching about floods in schools
- sending out regular information with rates notices
- SES displays
- educational videos
- talks by SES officers
- wide distribution of the Local Flood Plan

(i) Benefits

The benefits of a regular flood education campaign will enable residents to save a great many of their personal possessions, and in some cases reduce damage to their property as well as risk to life. The campaign will also improve peoples' feeling of control, since they will be in a position to take positive action to mitigate the impacts of the flood. This improved sense of control will reduce the adverse social impacts of flooding, as people who can take positive action will no longer feel like helpless victims.

(ii) Implementation

The preparedness campaigns will need to be designed by professionals skilled in motivation on public health and safety issues and based on market research. It will be repeated at regular intervals to enable adjustment to be made for demographic changes within the community. It will make best use of the printed and electronic public awareness material produced by Emergency Management Australia and available through SES.

One aim will be to enhance the pool of local knowledge concerning:

(a) what steps to take well in advance, eg. develop a procedure for collecting important documents, memorabilia, pets and treasured items for rapid evacuation;

(b) precautions to take in light of an early, indefinite warning;

(c) developing procedures for lifting and evacuation of property;

(d) understanding the potentials and limitations of the warning system.

(iii) **Costing**

The estimated costs of the flood preparedness campaigns would be about $10,000 initially, with an on-going cost of about $2,500 per year.

(iv) **Operation**

The campaigns will need to be maintained on a regular basis, because community flood preparedness is decreased over time by people moving out of the area and by people forgetting. Innovative ideas for the campaigns will be required to maintain the interest of the community, and some types of incentive schemes might be considered.

4.1.3 Planning and Building Controls

The use of planning controls as a floodplain management measure primarily involves the adoption of appropriate zoning for land subject to flooding. Public reserves and land which is currently not developed, and which have the potential to be affected by flooding, will be examined to determine whether it is appropriate for these areas to remain undeveloped.

One purpose of planning controls is to place restrictions on future development to prevent the further constriction of the floodway. This is particularly significant for the Woronora River valley due to the narrow nature of the floodplain, which is generally less than 900 metres in width.

Another purpose is to limit the number of residents at risk from flooding by restricting new development and reducing the development densities which could arise from dual occupancies or medium-density housing.

(i) **Benefits**

Areas where this floodplain management measure would be most appropriate and cost effective are the foreshore areas currently subjected to low hazard flooding. Other areas which have well-established developments would benefit less from such measures in the short term. However, new developments or additions to existing buildings in these areas would be subject to these building controls with the long-term objective of reducing potential flood damages to all buildings in the area.

Building controls, when used to floodproof new developments and maintain a free flow of water through the floodway, can significantly reduce the economic and social effects of flooding.

(ii) Implementation

Council's current policy is to set habitable floor levels for new residences and extensions to existing residences at 0.5 metres above the 1% AEP flood level. Non habitable floor levels are set at the 5% AEP flood level. A number of residents are in the process of rebuilding their properties to meet this standard. The high value of the land in this area makes this an economically viable proposition in many cases.

The effect of increased development in floodplain areas may reduce flood storage available or in certain instances constrict the floodway. The layout of individual developments has a bearing on this.

For example, if a dense row of development was allowed to proceed along the foreshores of the river, it is likely that this would perform the function of a levee and flooding behaviour would change significantly regardless of the extent of development in the floodplain further away from the river.

There are opportunities for further development without affecting flood levels and if managed properly could also have minimal impact on flow velocities in the floodplain and the hazard categories of these areas as they exist.

Developments with solid fencing around them would prevent flooding of the individual properties but would most likely lead to increased flow velocities in their vicinity. Developments which allow flood waters to flow through them are likely to have the least impact on the surrounding area. It is obvious that developments of both kinds would be appropriate in some situations and not in others.

If Council is to allow further development in the floodplain, it is necessary to implement planning controls.

Designation of an "environmentally sensitive" residential zone will be considered for those properties in the Woronora Valley that are affected by flooding. Such a zone would restrict development potential to single dwellings only. Further, a Development Control Plan will be prepared to be used in dealing with Development Building Applications within the study area dealing with issues such as floor heights, setbacks, building design and construction etc.

Typical considerations will include:

(a) setting minimum levels for habitable floors;

(b) local development flood mitigation works including land fills, levee banks and flood walls;

(c) appropriate construction methods and building materials;

(d) access to buildings for evacuation purposes.

(iii) **Costing**

No costs are involved in the setting of Council's policies apart from the essential professional and administrative costs..

(iv) **Operation**

The Council's planning and building controls will automatically apply to all new developments and extensions to existing developments. In all cases, building and development controls will be imposed on a merit basis, balancing restrictive development conditions with the impact of development on flood behaviour in the floodplain having regard to the NSW Floodplain Development Manual.

4.2 STRATEGY 2

4.2.1 Voluntary House Raising

House raising involves the elevating of existing residences to a height where habitable floor levels conform with Council's flood standard. House raising has been successfully undertaken in parts of Sydney such as Fairfield, where houses were flooded by the Georges River.

The most easily raised houses are those which are constructed of timber frame clad with fibro or timber. Brick houses can be raised by the addition of a second storey or in certain circumstances jacked up. In either case, the ground floor level of the house becomes a non-habitable floor, and can be used for storage or garage space.

The following Figures 4.2 and 4.3 show examples of properties raised for flood protection purposes.

(i) **Benefits**

The benefits of voluntary house raising accrue from the reduction in over-floor flooding. When floodwaters top the floor level of a house carpets are immediately ruined. As waters rise further furniture such as lounges, chairs, tables, electrical equipment and bedding are destroyed. Following the recession of the floodwater, ooze and mud cover the floors, walls and furniture of the house. Much of the householder's goods will require replacement, and the clean-up poses a formidable task.

The elevating of a house floor level above a design flood level, such as the 1% AEP flood, can avoid these social and economic costs of over-floor flooding.

(ii) Implementation

Timber framed houses with either fibro or timber cladding are the easiest type of house to raise. The whole house is braced, and is jacked up to the required level, which should be at least equal to the Council's recommended 0.5 metres above the 1% AEP flood level. Piers or some other form of support are then added below the house to secure it at the desired height. Residents who wish to raise their house should confirm with Council the height to which it should be raised, in order to be sited above the 1% AEP flood and attain conformance with Council height restrictions and regulations applying to visual impacts and privacy.

Brick houses may be raised by the addition of an extra storey (or in some instances jacked as described above). In these cases the living quarters are moved up to the top storey, and the ground floor rooms become non-habitable, ie. they can be used for storage, garage space or rumpus room areas only.

(iii) Costing

The cost of raising a fibro or weatherboard house in the Fairfield area has recently averaged about $35,000 per house. The cost of adding an extra storey to a brick home could be about $50,000. These costs depend upon the size and condition of the house being raised. The cost of raising all of the single storey houses which are affected by the 1% AEP flood event in the Woronora River valley has been estimated at $7,800,000.

(iv) Operation

There are about 179 houses in the Woronora River valley which are subject to flooding from the 1% AEP event that may be suitable for raising. Of these houses, 77 are constructed of fibro or timber and 102 are brick or stone. A number of residents are already re-building their houses to the level to suit Council's policy.

Some lower to middle-income earners may be unable to afford the cost of house raising, should an owner contribution be required. Some property owners may object to the house-raising option as they may feel that it alters the character of their houses, or it could reduce the visual amenity of the residential area. It is therefore important that some flexibility with regard to these matters and Council's height restrictions be exercised.

HOUSE RAISED ABOVE FLOOD LEVEL
SOURCE: FLOODPLAIN DEVELOPMENT MANUAL (PWD 1986)
FIGURE 4.2

COMMERCIAL DEVELOPMENT RAISED ABOVE FLOOD LEVEL
SOURCE: FLOODPLAIN DEVELOPMENT MANUAL (PWD 1986)
FIGURE 4.3

4.3 STRATEGY 3b

4.3.1 Improved Access

Concern has been expressed by the SES that a major evacuation problem occurs due to the early flooding of the critical access to Prices Circuit at the intersection with Menai Road at the western approach to the Woronora Bridge.

The provision of emergency access from Nundah Place to Menai Road would allow residents a longer period of time to evacuate, without the need to raise the western approach to the bridge.

This work will not alter flood levels or behaviour.

(i) **Benefits**

The emergency access to Menai Road will allow residents of Prices Circuit and Nundah Place to evacuate the area even after the western approach to the bridge is underwater. The access improvement will also allow SES and other emergency personnel to enter the flooded areas to assist residents with evacuation procedures. This access route currently exists but is blocked off to traffic. The permanent barrier will be replaced by a layback and a lockable barrier, which will be raised during times of flood.

(ii) **Implementation**

Council work which will be required for the implementation of this strategy include the provision of an emergency access route from Menai Road to Nundah Place, a lay back and a lockable gate. The location of the access site is shown in Figures 4.4 and 4.5.

(iii) **Costing**

The estimated total cost of the works is $5,000.

(iv) **Operation**

Following advice from the Flood Forecasting System of an expected flood event, the emergency access gate will be opened for use by evacuating residents and emergency personnel.

Bi-lock bushfire type keys to the gate should be held by the SES, the Woronora Bushfire Brigade, Council and local police. Ambulance services and residents should be made aware of the location of the keys.

4.4 STRATEGY 7

4.4.1 Woronora West Levee

Among the most commonly used structural flood mitigation options are levees or flood walls. Levees serve to flood-proof substantial areas in the floodplain. The Woronora West levee will be constructed to protect the area behind the levee from 5% AEP flood levels. The actual height of the levee will vary with ground level, for example, along the foreshore reserve adjacent to Prices Circuit property boundaries, the levee will be about 1.3 m high. The levee will extend along the western foreshore for a distance of approximately 550 metres, as shown in Figure 4.6.

(i) Benefits

The area behind the levee will be protected from the waters of any floods equal to or less than the 5% AEP event. Although levees protect an area of floodplain from flooding, they can have the impact of worsening the level of flooding downstream through the removal of flood storages, or increasing flood levels upstream through the effect of increased downstream levels. Results of the flood study suggest that the construction of the levee bank as described above would not lead to any significant loss of flood storages or increases in flood levels.

The levee will protect the Woronora Caravan Park, Menai Road and residential properties up to 250 m south of Woronora Bridge.

A possible disadvantage associated with the levee would be that surface runoff may pond behind the levee when river levels are elevated and water is unable to be discharged through the stormwater system. A preliminary flood analysis carried out indicates that if river levels were elevated and a 20% AEP event occurred over the catchment behind the levee localised flooding of the order of 0.5 m would result in low lying areas behind the levee. It should be noted that the combined probability of a 20% AEP storm event and built river levels is less than 20%. As the majority of houses are elevated more than 0.5 m above ground level significant over floor flooding is unlikely to result.

(ii) Implementation

The levee is to be built along the route shown in Figure 4.6, being placed as closely as possible to the rear of the property boundaries of the houses to minimise impacts on views. The levee is to be constructed of earth and fill, suitably graded and turfed, as shown in Figure 4.7. A curvilinear alignment would be adopted to minimise impacts on existing trees in the foreshore reserve.

Where the width of the foreshore reserve is narrow, adjacent to the caravan park, a sea wall could provide a viable alternative to the wide earth and fill type to levee. The levee will block the caravan park residents' views of the river. The Bushfire Brigade Station is to be either raised or relocated to a higher location.

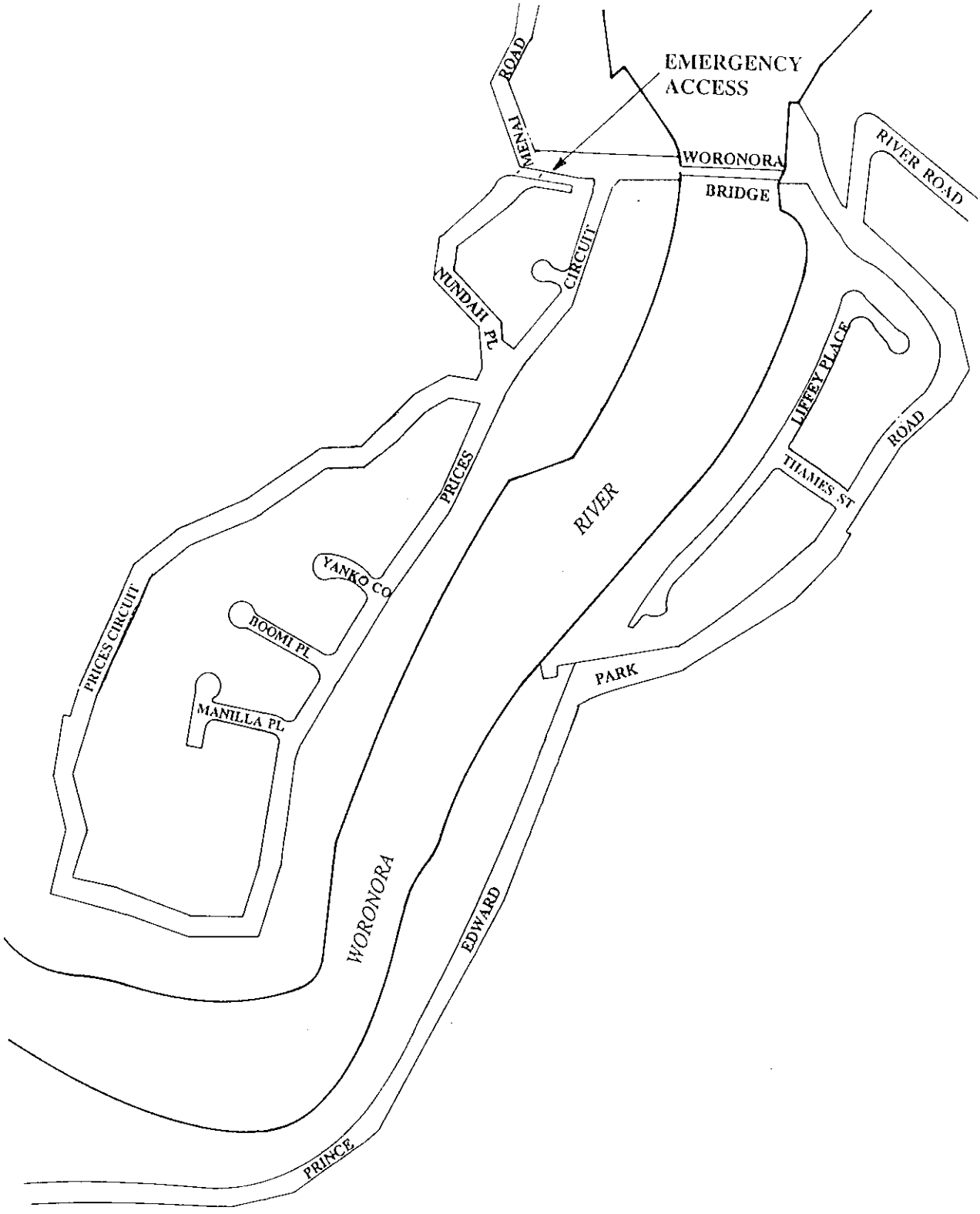
(iii) Costing

The total cost of construction of the levee has been estimated at $225,000. This cost may be reduced depending upon availability of excess fill as a result of Council's works program.

(iv) Operation

Levee banks can result in the community gaining a false sense of security regarding the level of flood protection offered by the works. It is an important part of the education programme that the community is aware of the selected design standard of the levee, and that there is an associated risk of the levee bank being overtopped by a flood event which exceeds the level for which the levee was designed.

The levee bank needs to be maintained in good condition, and any erosion of the levee surfaces should be repaired as soon as possible.

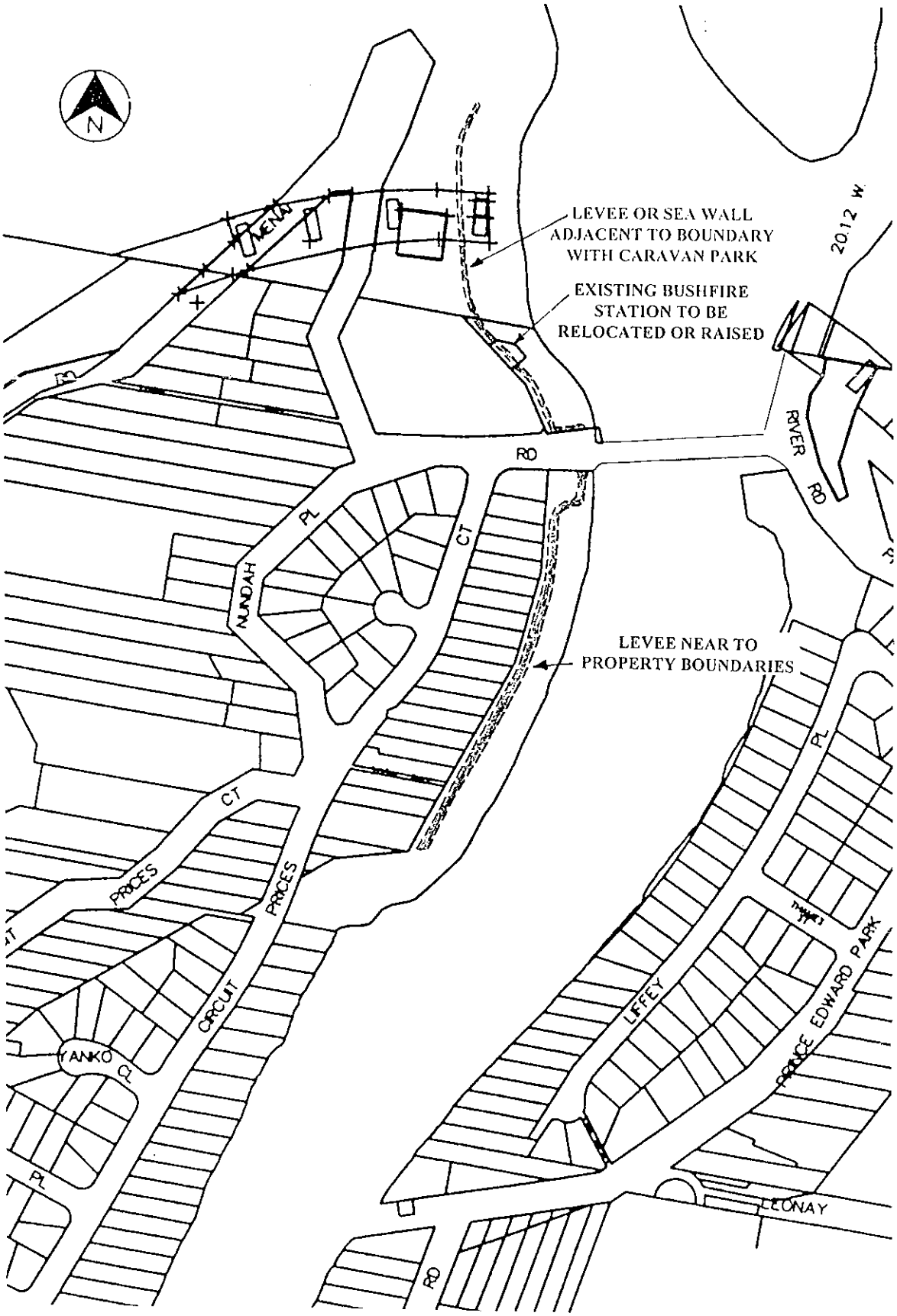


PRINCE EDWARD PARK

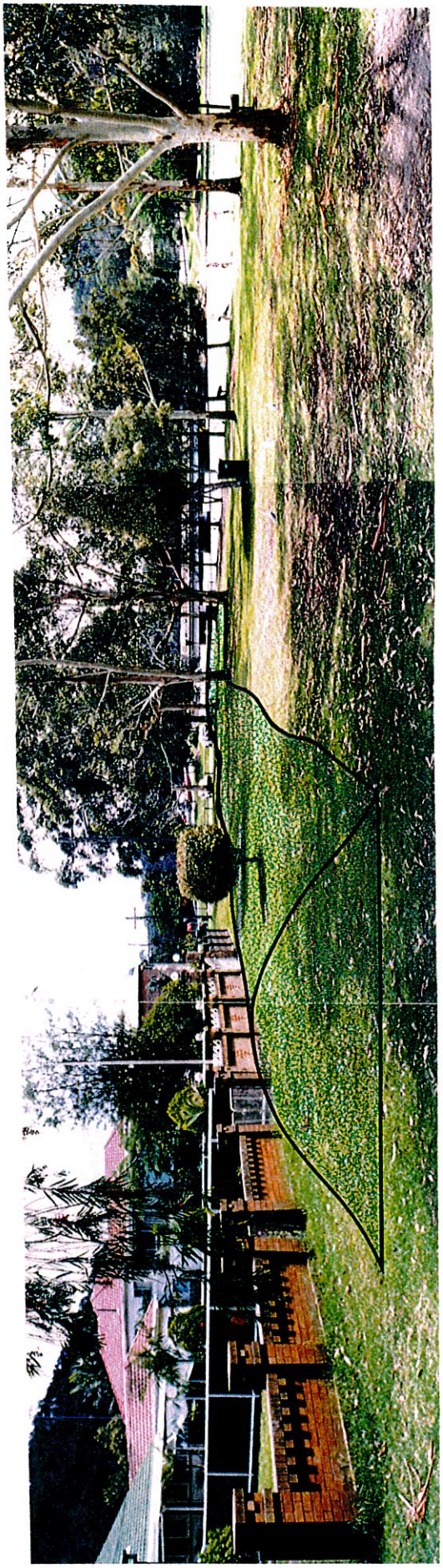
LOCATION OF EMERGENCY ACCESS AT NUNDAH PLACE & MENAI ROAD

FIGURE 4.4

VIEW OF EMERGENCY ACCESS AT NUNDAH PLACE & MENAI ROAD
FIGURE 4.5



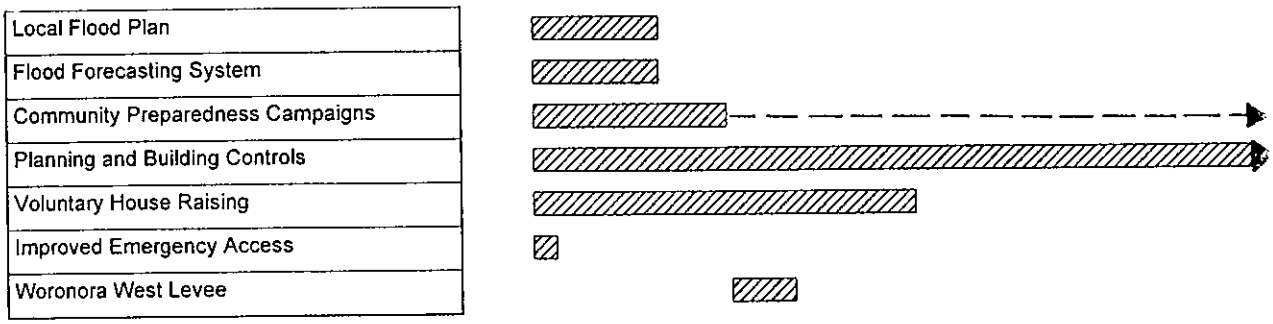
LEVEE ON WESTERN FORESHORE, WORONORA
FIGURE 4.6



IMPRESSION OF PROPOSED LEVEE AT FORESHORE RESERVE NEAR PRICES CIRCUIT
FIGURE 4.7

5.0 IMPLEMENTATION

The proposed program of implementation for the Woronora River Floodplain Management Plan is illustrated in Figure 4.8 below.



IMPLEMENTATION OF FLOODPLAIN MANAGEMENT OPTIONS
FIGURE 4.8

It should be noted that all measures are proposed for immediate implementation except for construction of the Woronora West levee. The delay in implementation of the levee is designed to ensure that, through a community preparedness campaign, and improved flood forecasting people are made aware of the risks associated with the possibility of a flood overtopping the levee.

The combination of the Local Flood Plan, improved flood forecasting system, community preparedness campaigns, planning and building controls, voluntary house raising and improved emergency access allows those people living within the floodplain areas to avoid many of the economic and social impacts of flooding. The levee will provide protection of high flood hazard areas from small, frequent floods, and increase the evacuation time available in the event of a large flood.

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The Consultant's study team members responsible for both inputs to and the preparation of this document were as follows:

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