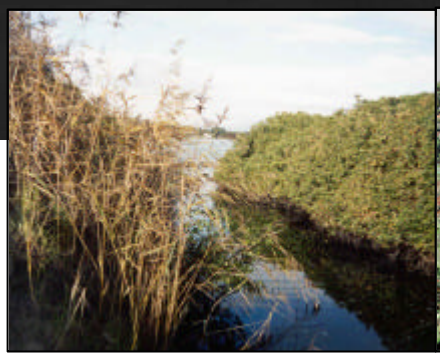

Minnegang Creek

Floodplain Risk Management Plan

Wollongong
City of Innovation

KBR

MINNEGANG CREEK FLOODPLAIN RISK MANAGEMENT PLAN

Final Report

Prepared for:

WOLLONGONG CITY COUNCIL
41 Burelli Street
Wollongong NSW 2500

Prepared by:

Kellogg Brown & Root Pty Ltd
ABN 91 007 660 317
Level 9, 201 Kent Street Sydney NSW 2000
Telephone 02 9911 0000, Facsimile 02 9241 2900

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Limitations Statement

The sole purpose of this report and the associated services performed by Kellogg Brown & Root Pty Ltd (KBR) is to prepare a floodplain risk management plan in accordance with the scope of services set out in the contract between KBR and Wollongong City Council ('the Client'). That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

KBR derived the data in this report primarily from visual inspections, examination of records in the public domain and interviews with individuals with information about the area. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

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This sheet records the issue and revisions of the document. If only a few revisions are made, only the new or revised pages are issued. For convenience, the nature of the revision is briefly noted under 'Remarks', but these remarks are not part of the document.

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Foreword

The NSW State Government's Flood Prone Land 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 is the responsibility of local government. The State Government subsidises flood mitigation works to alleviate existing flooding 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 State Government through five sequential stages. These stages are:

- **Data Collection:** determines the availability of data and defines data requirements.
- **Flood Study**: determines the nature and extent of flooding.
- **Floodplain Risk Management Study:** evaluates management options for the floodplain in respect of both existing and proposed developments.
- **Floodplain Risk Management Plan:** involves formal adoption by Council of a plan of management for the floodplain.
- **Implementation of the Plan:** includes undertaking property modification and flood mitigation works to protect existing development, implementing appropriate flood response procedures, increasing community awareness and the use of policy documents such as Local Environmental Plans to ensure development and land use is compatible with the flood hazard.

This draft Floodplain Risk Management Plan constitutes the fourth stage of the management process for the Minnegang Creek catchment.

The next stage of the process will involve the formal adoption of the Plan by Wollongong City Council, followed by implementation of the Plan.

Executive Summary

INTRODUCTION

Wollongong City Council commissioned Kellogg Brown & Root Pty Ltd (KBR), formerly Kinhill Pty Ltd, to undertake preparation of a draft Floodplain Risk Management Plan (FRMP) for the Minnegang Creek catchment, which is located approximately nine kilometres south of Wollongong on the northern shore of Lake Illawarra.

This draft FRMP forms the fourth stage of the overall floodplain risk management process for the Minnegang Creek catchment and follows on from the previous Flood Study and Floodplain Risk Management Study, also undertaken for Council by KBR.

THE FLOOD SITUATION

The steepness of the Minnegang Creek catchment results in flooding that is relatively well contained, and generally there is little difference between the flood extents for events of different exceedance probabilities, including the Probable Maximum Flood (PMF) event. The catchment has a fast response to rainfall, due to its small size, steep terrain and urbanised nature, with a critical storm duration in the order of two hours.

The key feature of the catchment is a lack of dedicated overland flow paths to convey flood flows through what is essentially a fully developed urban-residential catchment. The worst affected area is immediately downstream of the Barina Park detention basin where there is no overland flow path to convey flood flows spilling over the embankment, which is predicted to occur on average at least once every five years.

Approximately 60 properties in the catchment are predicted to experience inundation for the PMF event, of which one-third would experience inundation above habitable floor level. For the 20% Annual Exceedance Probability (AEP) event, it is predicted that 35 properties would suffer yard flooding with five affected above habitable floor level.

FLOOD RISK MANAGEMENT ACTIONS

A range of management options were considered to manage:

- existing flood risk, through protection of existing development;
- future flood risk, through improved planning and development controls for flood prone land; and
- continuing flood risk, through increased community flood awareness and improved flood intelligence to assist emergency management and response.

The following table provides a summary of the management actions recommended for implementation.

Floodplain Risk Management Actions for the Minnegang Creek catchment

Management Action		Priority	Timeframe	Predecessors	Indicative Cost	Responsibilities
Property modification measures						
1A	Voluntary purchase of six properties in Mirrabooka Road and Weringa Avenue	High	1-2 years	-	$1,512,000	Council, DIPNR
1B	House raising at one property in Barina Avenue	High	1-2 years	-	$54,000	Council, DIPNR
1C	Rezoning of land acquired under voluntary purchase	Low	5+ years	1A	Internal	Council
1D	Incorporation of the Minnegang Creek Planning and Development Control Matrix into Draft DCP 54	High	1-2 years	-	Internal	Council
1E	Provision of a mechanism for property owners to obtain updated certification as to the flood affectation of their properties	Medium	2-5 years	-	Internal	Council
Response modification measures						
2A	Development and implementation of a community education and awareness program	High	1-2 years	-	$90,000	Council, DIPNR
2B	Installation of flood warning signs in Barina Park	High	1-2 years	-	$600	Council, DIPNR
2C	Maintenance of catchment flow paths and drainage easements	Medium	2-5 years	-	$5,000 initially (ongoing costs to be met by Council)	Council, DIPNR
2D	Provision of flood intelligence to emergency service providers	High	1-2 years	-	Internal	Council, emergency service providers
Flood modification measures						
3A	Construction of floodway downstream of Barina Park, including associated spillway and culvert works	High	1-2 years	1A	$431,000	Council, DIPNR

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ABBREVIATIONS AND ACRONYMS

AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
DCP 54	Draft Development Control Plan 54 “Managing Our Flood Risks”
DIPNR	Department of Infrastructure, Planning and Natural Resources
DLWC	Department of Land and Water Conservation (now incorporated into DIPNR)
FMM	Floodplain Management Manual
FRMC	Floodplain Risk Management Committee
FRMP	Floodplain Risk Management Plan
FRMS	Floodplain Risk Management Study
FRP	Flood Risk Precinct
LEP	Local Environmental Plan
LGA	Local Government Area
PMF	Probable Maximum Flood
SES	State Emergency Service

1 Introduction

1.1 INTRODUCTION

Kellogg Brown & Root Pty Ltd (KBR), formerly Kinhill Pty Ltd, was engaged by Wollongong City Council (Council) to undertake the preparation of a draft Floodplain Risk Management Plan (FRMP) for the Minnegang Creek catchment.

This FRMP represents the culmination of a series of three studies undertaken by KBR, involving preparation of a Flood Study, Floodplain Risk Management Study (FRMS) and, finally, the FRMP. This approach is consistent with that specified in the NSW Government's Floodplain Management Manual (FMM) (2001).

1.2 PURPOSE OF THE PLAN

The purpose of the Minnegang Creek FRMP is to provide Council with a strategic plan of management to address existing, future and continuing flood risk specific to the Minnegang Creek catchment.

The FRMP is intended to provide input to the strategic and statutory planning role of Council, representing a comprehensive and considered approach to the management of flood prone land within the Minnegang Creek catchment. The FRMP is also intended to be consistent with relevant environmental planning instruments and Council policies, in particular the draft *Development Control Plan No. 54 "Managing our Flood Risks"* (DCP 54) (Wollongong City Council, 2003). The FRMP, when formally adopted by Council, will form a fundamental component of DCP 54. Council has developed DCP 54 to provide an overall management framework for flood prone land throughout the local government area (LGA), with general provisions relating to all floodplains in the LGA and specific provisions relating to individual floodplains.

1.3 OBJECTIVES OF THE PLAN

The primary objective of the Minnegang Creek FRMP is the identification and prioritisation of measures for the long-term, sustainable management of flood risk in the Minnegang Creek catchment.

Development of this FRMP has also taken into account the relevant aims and objectives of DCP 54, which are to:

- Minimise the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors.
- Increase public awareness of the hazard and extent of land affected by all potential floods, including floods greater than the 100 year average recurrence interval (ARI)

flood and to ensure essential services and land uses are planned in recognition of all potential floods.

- Inform the community of Council's policy for the use and development of flood prone land.
- Reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods.
- Provide detailed controls for the assessment of applications lodged in accordance with the *Environmental Planning and Assessment Act 1979* on land affected by potential floods.
- 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.
- Apply a "merit-based approach" to all development decisions which takes account of social, economic and ecological as well as flooding considerations.
- Control development and other activity within the floodplain having regard to the characteristics and level of information available for the floodplain, in particular the availability of FRMS's and FRMP's prepared in accordance with the FMM.
- Deal equitably and consistently with applications for development on land affected by potential floods, in accordance with the principles contained in the FMM.

1.4 PARTIES INVOLVED

The following parties have been involved in the floodplain risk management process for the Minnegang Creek catchment:

- Wollongong City Council - councillors and engineers;
- Department of Infrastructure, Planning and Natural Resources (DIPNR), incorporating the former Department of Land and Water Conservation (DLWC);
- State Emergency Service (SES), Wollongong branch;
- KBR; and
- the local community.

Representatives from each of the above stakeholders form the Minnegang Creek Floodplain Risk Management Committee. This committee acts as a focal point and a forum for the discussion of technical, social, economic, ecological and cultural issues related to flooding within the catchment.

The implementation of floodplain risk management measures detailed and prioritised in this FRMP will generally be undertaken by Council, with assistance from DIPNR and SES where required.

1.5 COMMUNITY CONSULTATION

Community consultation and participation in the floodplain risk management process for the Minnegang Creek catchment has included:

- requests for community representatives to be members of the FRMC for the catchment in early 2001;
- distribution of a community newsletter sent to residents in the catchment in September 2001;
- display of the draft flood extent maps on Level 6 of the Council Administration Building in October 2001;
- residents' meeting to confirm the results of the draft Flood Study and to collect extra information about flooding in the catchment in November 2001;
- distribution of a second community newsletter to inform residents of draft floodplain management options being considered for the catchment, distributed in August 2003;
- display of flood extent map, flood risk precinct map and preliminary floodplain management options at Wollongong City Library, Warrawong District Library and Wollongong Council Administration Building throughout September 2003; and
- a public information session at Illawarra Yacht Club on Saturday 13 September 2003.

The level of community participation in these programs has generally been low. Feedback on the preliminary floodplain risk management options (refer Appendix A), which form the basis of the management actions outlined in this FRMP, was received only from those residents directly affected by the proposed voluntary purchases. Concerns related primarily to the valuation of properties affected and likely price that Council would offer as part of a voluntary acquisition, and the likely timeframe for implementation of the FRMP.

Ongoing communication between Council and those residents directly affected by the management actions proposed as part of this FRMP will obviously be imperative as the floodplain risk management process continues into the adoption and implementation phase.

1.6 STRUCTURE OF THE PLAN

Chapter 2 contains a background to the existing flood situation within the Minnegang Creek catchment, including:

- a description of the catchment
- previous studies undertaken
- a generalised description of existing flood behaviour
- flood extent and flood risk precinct maps.

Chapter 3 provides a description of recommended management actions aimed at avoiding, minimising or mitigating flood risk in the catchment. An Implementation Action List provides a summary of these actions with associated priorities, indicative costs and responsibilities.

2 Background

2.1 STUDY AREA

The Minnegang Creek catchment is located approximately 8.5 km south of Wollongong, in the suburb of Lake Heights. The catchment covers an area of approximately 90 ha on the northern shore of Lake Illawarra, and lies wholly within the Wollongong City Council LGA. Figure 2-1 shows the location of the catchment and the area to which this FRMP applies.

Approximately 80% of the catchment is developed, mostly with low-density residential housing. The remaining 20% is either recreational area or cleared open space. The drainage system within the catchment consists of a combination of natural creeks and piped drains. Minnegang Creek flows from the north-west of the catchment to the south-east where it discharges into Lake Illawarra. Figure 2-1 shows the location of Minnegang Creek and its major tributaries within the overall catchment boundary.

2.2 PREVIOUS STUDIES

2.2.1 Minnegang Creek Flood Study

The *Minnegang Creek Flood Study* (KBR 2002) was completed in June 2002.

This study involved the development of detailed hydrologic and hydraulic models of Minnegang Creek and its major tributaries in order to investigate the nature and extent of the flood situation in the catchment.

2.2.2 Minnegang Creek Floodplain Risk Management Study

The *Minnegang Creek Floodplain Risk Management Study* (KBR 2003) is currently in draft format awaiting final approval from Council and the FRMC.

This study involved the development and evaluation of options for managing flood risk in the catchment, based on the findings of the Flood Study and a comprehensive analysis of existing flood problems.

This FRMP draws heavily on the outcomes and recommendations of the FRMS and is essentially the formalisation of the development, evaluation and selection process for flood risk management actions to be implemented in the catchment.

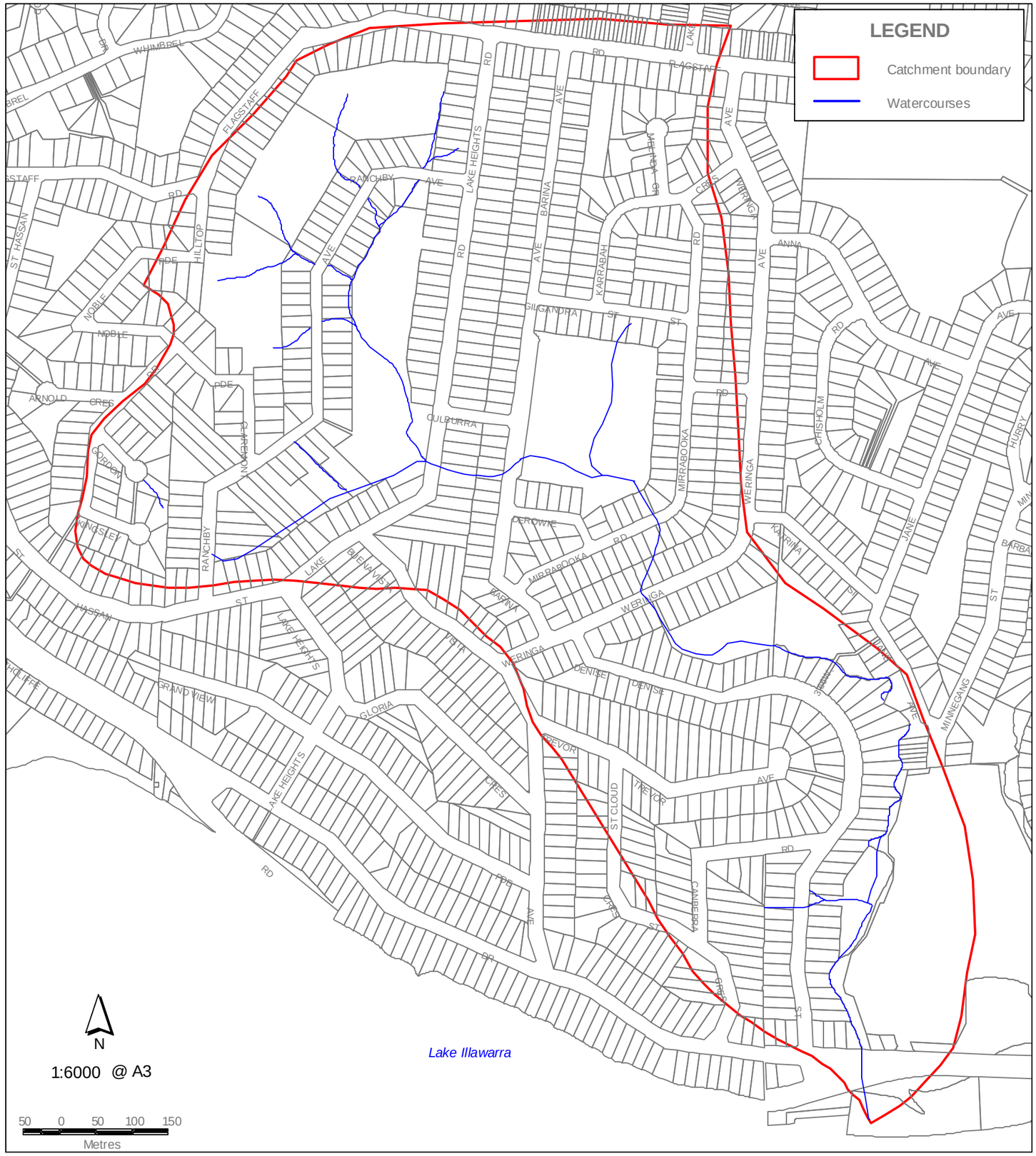

Figure 2-1
Locality Plan

2.2.3 Other studies

The only other study related to flooding in the vicinity of Minnegang Creek is the *Lake Illawarra Flood Study*, undertaken for Wollongong City Council by Lawson & Treloar Pty Ltd (2000). The study investigated flood behaviour for the whole of Lake Illawarra and covered a catchment area of approximately 235 km^2, incorporating the Minnegang Creek catchment. However, detailed hydraulic analysis was only undertaken within the lake and did not extend up Minnegang Creek.

2.3 SUMMARY OF THE MINNEGANG CREEK FLOOD SITUATION

2.3.1 Flood mapping

Flood extent and flood risk precinct (FRP) mapping was prepared as part of the Flood Study (KBR 2002) and FRMS (KBR 2003) respectively. These maps identify the parts of Minnegang Creek catchment that are subject to flood affectation. The scope of detailed investigation and hydraulic analysis undertaken incorporates not only the major drainage corridors through the catchment, which give rise to mainstream flooding, but also extends upstream to a number of smaller local drainage tributaries that result in local overland flooding. Flood extents for the 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) events under existing conditions are shown in Figure 2-2. Flood risk precincts are shown in Figure 2-3.

2.3.2 Flooding characteristics

The topography of the catchment plays an important role in determining the flooding characteristics of Minnegang Creek. The steepness of the catchment results in flooding that is relatively well contained. Barina Park forms the one exception, where flood waters pond behind an embankment constructed to form a detention basin in the 1980s. However, over much of the catchment there is little difference between the flood extents for events of different exceedance probabilities, including the PMF event. The catchment has a fast response to rainfall, due to its small size, steep terrain and urbanised nature, with a critical storm duration in the order of two hours.

The key feature of the catchment, to which the most serious flood problems can be attributed, is a lack of dedicated overland flow paths (or paths with sufficient capacity) to convey flood flows through what is essentially a fully developed urban-residential catchment. Although an extensive piped drainage network exists to convey frequent minor flows, widespread property flooding occurs when the capacity of this system is exceeded. The worst affected area is immediately downstream of the Barina Park detention basin where there is no overland flow path to convey flood flows spilling over the embankment, which is predicted to occur on average at least once every five years.

Approximately 60 properties (almost all residential) in the catchment are predicted to experience inundation for the PMF event, of which one-third would experience inundation above habitable floor level. For the 20% AEP event, it is predicted that 35 properties would suffer yard flooding with five affected above habitable floor level.

Detailed discussion of the existing flood situation is documented in the Flood Study (KBR 2002) and the FRMS (KBR 2003).

Figure 2-2
Flood extents for PMF and 1% AEP flood events (existing conditions)

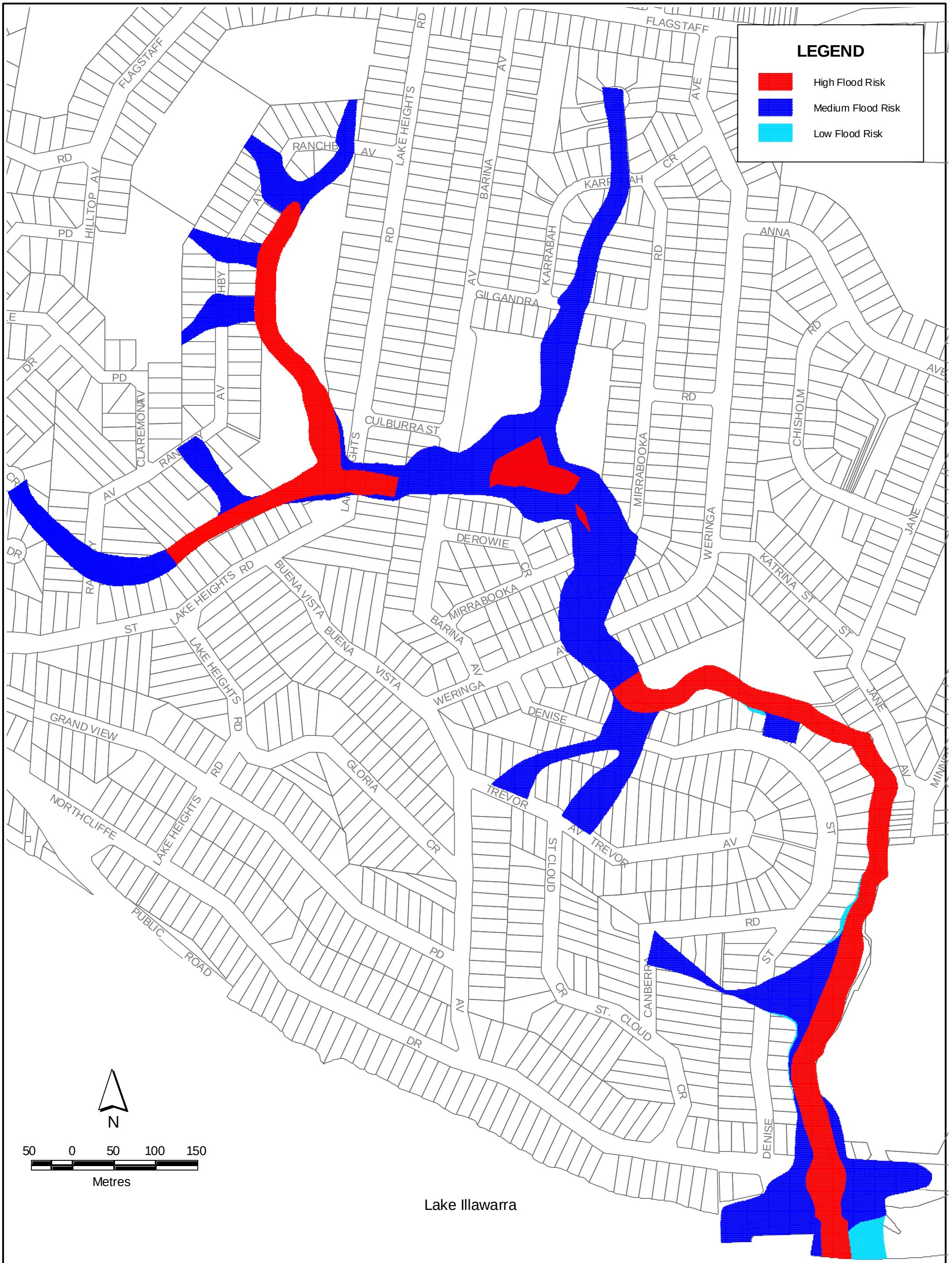

Figure 2-3
Flood risk precincts (existing conditions)

2.3.3 Conduit blockage

There are five major structures within the catchment:

- Barina Park detention basin
- Jane Avenue pedestrian bridge
- Lake Heights Road culvert
- Northcliffe Drive culverts
- Illawarra Yacht Club carpark culverts.

In addition to these individual structures, the upper part of the catchment contains an extensive piped drainage network, which discharges into Minnegang Creek proper downstream of Weringa Avenue.

Existing flood behaviour, as established in the Flood Study, was determined based on the adoption of Council's *Conduit Blockage Policy* (Wollongong City Council 2002). The blockage criteria require the following blockage factors to be applied to structures across all watercourses when calculating design flood levels:

- 100% blockage for structures with a clear major diagonal opening width less than 6.0 m;
- 25% bottom up blockage for structures with a clear major diagonal opening width greater than 6.0 m; and
- 100% blockage for handrails above structures when overtopping occurs.

Identification and analysis of cross-catchment flow diversions, as a result of structure blockage, is also a fundamental requirement of the Policy.

Application of the Policy essentially leads to the worst case scenario for flooding within the catchment. Although this may seem a conservative approach, Council's experience and evidence collected following previous major floods (particularly during the 1998 event) indicates a high probability of structure blockage throughout all catchments in the LGA.

2.4 LIMITATIONS

It is relevant to note that flood extents and flood risk precincts have been generated based on the results of hydraulic modelling but with interpolation, guided by Council's contour data, between locations of detailed survey. Therefore, flood extent and flood risk precinct mapping should only be used as a guide to flood behaviour in the catchment.

The mapping provides a basis for assessment of the existing flood risk and development of a strategy for managing existing, future and continuing flood risk on a catchment-wide scale. The mapping is not intended to provide a definitive description of flood behaviour at the individual property scale.

For more detailed analysis of flood behaviour at an individual property, including likely extent of flooding, local hazard and risk precinct categorisation, a site-specific detailed topographic survey and flood study is recommended.

3 Recommended Floodplain Risk Management Measures

3.1 INTRODUCTION

As outlined in the FMM, there are essentially three ways of managing flood risk to reduce the threat to life and property:

- property modification
- response modification
- flood modification.

A broad overview of these measures is provided in Figure 3-1, which describes the purpose and application of each measure in general terms. The key issues of Asset Management and Environmental Protection and Enhancement require consideration when assessing the suitability of *any* flood risk management measure to address a particular situation. An integrated and community-involved framework is also fundamental to the process.

The FRMS (KBR 2003) documents the development, assessment and selection of preferred measures for flood risk management in the Minnegang Creek catchment.

Flood risk management measures recommended for implementation are summarised in the following sections.

3.2 PROPERTY MODIFICATION MEASURES

3.2.1 Voluntary purchase

Management Action 1A
Voluntary purchase of six properties in Mirrabooka Road and Weringa Avenue

Voluntary purchase of the six properties shown in Table 3-1 is recommended in order to:

- significantly reduce the threat to personal safety and flood damages; and
- facilitate the creation of a dedicated flow path connecting Barina Park detention basin to Minnegang Creek.

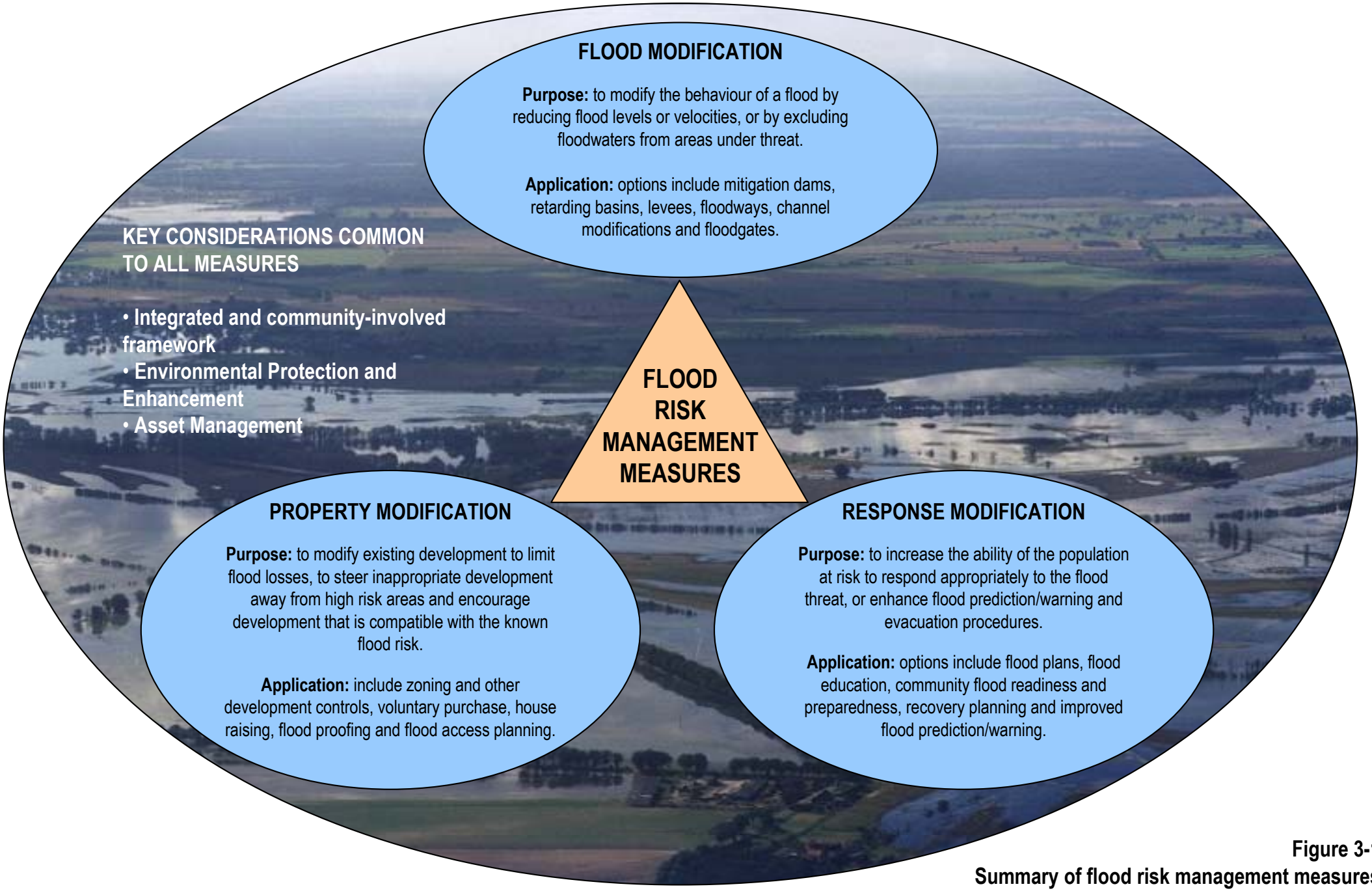

Figure 3-1
Summary of flood risk management measures

Table 3-1 Properties to be acquired by voluntary purchase

Property	Lot and DP Number
42 Mirrabooka Road	Lot 334, DP 201106
63 Mirrabooka Road	Lot 109, DP 201106
65 Mirrabooka Road	Lot 108, DP 201106
96 Weringa Avenue	Lot 2, DP 31939
98 Weringa Avenue	Lot 1, DP 31939
99 Weringa Avenue	Lot 279, DP 31939

The ultimate effectiveness of the voluntary purchase scheme relies on acquisition of all six properties identified in Table 3-1. Preliminary consultation with property owners indicates general support for this aspect of flood risk management in the catchment. However, ongoing consultation will be necessary to ensure all stakeholders are kept informed of progress, the negotiation process and the anticipated timeframe for implementation.

It is anticipated that a significant portion of the funds required for implementation of Management Action 1A would be provided by the State Government under the Floodplain Management Program.

3.2.2 House raising

Management Action 1B
House raising at one property in Barina Avenue

Housing raising at 68 Barina Avenue is recommended as the most cost-effective and least disruptive means of eliminating frequent above floor level flooding at this property. No works other than raising the habitable floor level of the house are proposed at this property.

It is anticipated that a significant portion of the funds required for implementation of Management Action 1B would be provided by the State Government under the Floodplain Management Program.

3.2.3 Zoning

Management Action 1C
Land rezoning

The ultimate rezoning of land is recommended for the six properties to be acquired under Management Action 1A, as shown in Table 3-2. It is recommended that the current zoning of 2(a) Low Density Residential is changed to 6(a) Public Recreation, which is the most relevant and flood compatible use provided for by the *City of Wollongong Local Environmental Plan 1990 (as amended)* (LEP). Such rezoning should take place on completion of Management Action 1A.

Management Action 1C does not require any funding from the State Government. It is anticipated that the cost of implementation would be met by Council within the constraints of its internal operating budget.

Table 3-2 Land rezoning

Property	Lot and DP Number	Current zoning	Proposed zoning
42 Mirrabooka Road	Lot 334, DP 201106	2(a)	6(a)
63 Mirrabooka Road	Lot 109, DP 201106	2(a)	6(a)
65 Mirrabooka Road	Lot 108, DP 201106	2(a)	6(a)
96 Weringa Avenue	Lot 2, DP 31939	2(a)	6(a)
98 Weringa Avenue	Lot 1, DP 31939	2(a)	6(a)
99 Weringa Avenue	Lot 279, DP 31939	2(a)	6(a)

3.2.4 Development controls

Management Action 1D
Incorporation of the Minnegang Creek Planning and Development Control Matrix into Draft DCP 54

It is recommended that the Planning and Development Control Matrix for the Minnegang Creek catchment, which was developed as part of the FRMS (KBR 2003), be incorporated into Draft Development Control Plan 54 *"Managing Our Flood Risks"* (Wollongong City Council 2003).

The Planning and Development Control Matrix is reproduced in this FRMP in Appendix B.

Management Action 1D does not require any funding from the State Government. It is anticipated that the cost of implementation would be met by Council within the constraints of its internal operating budget.

Management Action 1E
Provision of a mechanism for property owners to obtain updated certification as to the flood affectation of their properties

Certificates issued in accordance with Section 149 of the *Environmental Planning and Assessment Act 1979* are the primary means of formal certification that a particular property is subject to flood affectation.

Due to the low level of community involvement in the floodplain risk management process, as well as a discernibly poor level of knowledge and understanding of flood behaviour in the catchment, it is recommended that Council update and reissue Section 149(2) and Section 149(5) Certificates to the owners of properties wholly or partly contained within the area of flood prone land.

The wording on updated flood certificates is yet to be finalised by Council, however preliminary wording is provided in the FRMS (KBR 2003).

Management Action 1E does not require any funding from the State Government. It is anticipated that the cost of implementation would be met by Council within the constraints of its internal operating budget.

3.3 RESPONSE MODIFICATION MEASURES

3.3.1 Flood education and community readiness

Management Action 2A
Development and implementation of a community education and awareness program

Community education would aim to increase flood awareness of the community, contributing towards a reduction in the threat to personal safety, lower realised flood damages during a flood event, and ensuring that localised flooding is not exacerbated by inappropriate responses to flooding.

Proposed activities and programs include:

- pamphlets and brochures aimed at the general population in the catchment with information about road closures and other flood affected areas;
- targeted information for residents whose properties lie within flood prone land, with more specific information about the flood risk and outlining appropriate preparation and responses to flooding (this would also include information on contact points for Council, SES and other emergency services);
- periodic community forums to give residents an opportunity to identify problem areas and share information about flooding with each other and with Council, and serve as a data collection exercise for Council after storm events; and
- periodic displays of flooding information at community facilities to act as a reminder of the flood risk which faces the community.

It is anticipated that a significant portion of the funds required for implementation of Management Action 2A would be provided by the State Government under the Floodplain Management Program.

Management Action 2B
Installation of flood warning signs in Barina Park

It is recommended that two flood warning signs are installed in Barina Park (adjacent to Barina Avenue, at the northern and southern ends of the park) to inform park users, as well as neighbouring residents, that the park is subject to flash flooding following heavy rainfall and that significant depths of water can accumulate behind the embankment.

It is anticipated that a significant portion of the funds required for implementation of Management Action 2B would be provided by the State Government under the Floodplain Management Program.

Management Action 2C
Maintenance of catchment flow paths and drainage easements

It is recommended that Council implement an ongoing program to maintain efficient and appropriate flow paths throughout the catchment. Key areas include:

- Minnegang Creek, from Lake Illawarra extending upstream of Lake Heights Road to the Ranchby Avenue tributaries;

- Barina Park, where removal of grass clippings and rubbish should be undertaken to prevent or reduce blockage of the detention basin outlet; and
- publicly-owned drainage easements, such as between 97 and 99 Weringa Avenue and 75 and 77 Denise Street, which should be kept mown and clear of obstructions.

It is also recommended that Council inspect drainage easements across privately-owned land to ensure such easements are currently free of unapproved development and/or obstructions.

It is anticipated that the initial investigation of catchment flow paths and drainage easements would be eligible for funding from the State Government under the Floodplain Management Program, while ongoing maintenance requirements would be funded by Council within the constraints of its operating budget.

3.3.2 Emergency response

Management Action 2D
Provision of flood intelligence to emergency service providers

It is recommended that Council liaise with the SES and other emergency service providers and provide appropriate flood intelligence based on the findings of the Minnegang Creek floodplain risk management process to assist in further development of the *Wollongong City Local Flood Plan* (SES 2003). This would include but not necessarily be limited to:

- flood inundation plans
- flood risk precincts
- predicted road inundation and depths of flooding.

Other information could be provided by Council on request.

Management Action 2D does not require any funding from the State Government. It is anticipated that the cost of implementation would be met by Council within the constraints of its internal operating budget.

3.4 FLOOD MODIFICATION MEASURES

3.4.1 Channel modification

Management Action 3A
Construction of floodway downstream of Barina Park, including associated spillway and culvert works

It is recommended that a floodway is constructed within the land currently occupied by the six properties identified for voluntary purchase (Management Action 1A). This would allow the creation of a dedicated overland flow path between Barina Park detention basin and Minnegang Creek.

The scope of works would involve:

- preliminary investigations and detailed design;
- demolition of the existing houses and other structures;

- construction of a channel to provide a level of flood protection consistent with the FRMS;
- retention of the existing pipes under Mirrabooka Road and Weringa Avenue as culverts, with new headwalls to be installed; and
- construction of a formal spillway for Barina Park detention basin, to direct flood flows into the new floodway.

It is anticipated that a significant portion of the funds required for implementation of Management Action 3A would be provided by the State Government under the Floodplain Management Program.

3.5 IMPLEMENTATION ACTION LIST

The Implementation Action List (Table 3-3) identifies all management actions recommended for the Minnegang Creek catchment, along with relevant priorities, predecessors, indicative costs and timeframes, and responsibilities.

While the timeframes indicated may be desirable, the actual schedule of implementation will be dependent on the availability of resources and funding.

It should also be noted that the implementation of some management actions may be delayed by logical constraints that exist with preceding actions, as shown in Table 3-3.

3.6 FUNDING ARRANGEMENTS

Funding for this FRMP was provided by Council and the State/Federal Governments (through DIPNR) on a 2:1 (State/Federal Government:Council) basis.

The continuing subsidisation of flood risk management studies, works and measures is a key role of the State Government, as part of the administration of its Flood Prone Land Policy and Floodplain Management Program. While Councils have a statutory responsibility for land use planning and management for their local government area, State Government funding for flood risk management, as well as assistance in the form of specialist technical advice and flood recovery and emergency management services, provides vital support to enable Councils to effectively fulfil this responsibility.

It is anticipated that the State Government's Floodplain Management Program can support Council in implementing the Minnegang Creek FRMP through funding investigation, design, capital works and ongoing programs that contribute to reducing existing flood problems. However, funds are not available to avoid future flood risks for new developments, and the responsibility for maintenance costs would also generally lie with Council.

It should be noted that funding cannot be guaranteed despite the fact that many of the components of this FRMP may be eligible for Government assistance. Government funds are allocated on an annual basis to competing projects throughout the State. Flood mitigation measures that receive Government funding must be of significant benefit to the community.

Table 3-3 Implementation Action List for Minnegang Creek catchment

Management Action		Priority	Timeframe	Predecessors	Indicative Cost	Responsibilities
Property modification measures						
1A	Voluntary purchase of six properties in Mirrabooka Road and Weringa Avenue	High	1-2 years	-	$1,512,000	Council, DIPNR
1B	House raising at one property in Barina Avenue	High	1-2 years	-	$54,000	Council, DIPNR
1C	Rezoning of land acquired under voluntary purchase	Low	5+ years	1A	Internal	Council
1D	Incorporation of the Minnegang Creek Planning and Development Control Matrix into Draft DCP 54	High	1-2 years	-	Internal	Council
1E	Provision of a mechanism for property owners to obtain updated certification as to the flood affectation of their properties	Medium	2-5 years	-	Internal	Council
Response modification measures						
2A	Development and implementation of a community education and awareness program	High	1-2 years	-	$90,000	Council, DIPNR
2B	Installation of flood warning signs in Barina Park	High	1-2 years	-	$600	Council, DIPNR
2C	Maintenance of catchment flow paths and drainage easements	Medium	2-5 years	-	$5,000 initially (ongoing costs to be met by Council)	Council, DIPNR
2D	Provision of flood intelligence to emergency service providers	High	1-2 years	-	Internal	Council, emergency service providers
Flood modification measures						
3A	Construction of floodway downstream of Barina Park, including associated spillway and culvert works	High	1-2 years	1A	$431,000	Council, DIPNR

4 References

KBR (2002), *Minnegang Creek Flood Study, Final Report - Rev 1*, Kellogg Brown & Root Pty Ltd (KBR), Sydney.

KBR (2003), *Minnegang Creek Floodplain Risk Management Study, Draft Report - Rev C*, Kellogg Brown & Root Pty Ltd (KBR), Sydney.

Lawson & Treloar Pty Ltd (2000), *Lake Illawarra Flood Study, Draft Report - Version 6*, Lawson & Treloar Pty Ltd, Sydney.

New South Wales Government (2001), *Floodplain Management Manual: the management of flood liable land*, New South Wales Government.

SES (2003), *Wollongong City Local Flood Plan* (June 2003 Draft Edition), Wollongong City State Emergency Service (SES), Wollongong.

Wollongong City Council (1990, amended 9 March 2001), *City of Wollongong Local Environmental Plan 1990*, Wollongong City Council, Wollongong.

Wollongong City Council (2002), *Conduit Blockage Policy*, Wollongong City Council, Wollongong.

Wollongong City Council (2003), *Draft Development Control Plan 54 "Managing Our Flood Risks"*, April 2003, Wollongong City Council, Wollongong.

Appendix A

PRELIMINARY FLOODPLAIN RISK MANAGEMENT OPTIONS

LEGEND

- Flood warning signs
- Existing pipes to be retained as culverts
- Channel construction
- Construction of spillway
- House raising
- Voluntary purchase
- PMF flood extent (existing)

House raising at one property on Barina Av

Flood warning signs in Barina Park

Existing embankment crest - levels to be retained

Construction of spillway to direct overflows from basin into channel

Construction of rock-lined channel to link Barina Park with Minnegang Creek

Voluntary purchase of 6 properties on Mirrabooka Rd and Weringa Av

Existing pipes under Mirrabooka Rd and Weringa Av retained as culverts

25 0 25
Metres

N

50 0 50 100 150
Metres

WOLLONGONG
City of Innovation

PREFERRED FLOODPLAIN RISK MANAGEMENT ACTIONS FOR IMPLEMENTATION

Minnegang Creek Floodplain Risk Management Study

CATCHMENT-WIDE MEASURES

✓ **Development of a Community Awareness Program**

Flood education, including distribution of flood information leaflets, articles in newspapers and meetings/workshops with residents, will assist in increasing community awareness of flood behaviour in the catchment

✓ **Revision of Planning and Development Controls**

Incorporation of planning and development controls, in the form of a Flood Risk Management Development Control Plan, will ensure that future development is compatible with flooding risks, provides for safe overland flow paths, limits the amount of filling on the floodplain and incorporates floor levels elevated above flood levels.

Appendix B

PLANNING AND DEVELOPMENT CONTROL MATRIX

Minnegang Creek Floodplain
Planning and Development Controls

Planning and Development Consideration	Flood Risk Precincts																							
	Low Flood Risk								Medium Flood Risk								High Flood Risk (and Interim Riverine Corridor)							
	Sensitive Uses and Facilities	Critical Utilities and Uses	Subdivision	Residential	Commercial or Industrial	Tourist Related Development	Recreation or Non-urban Uses	Concessional Development	Sensitive Uses and Facilities	Critical Utilities and Uses	Subdivision	Residential	Commercial or Industrial	Tourist Related Development	Recreation or Non-urban Uses	Concessional Development	Sensitive Uses and Facilities	Critical Utilities and Uses	Subdivision	Residential	Commercial or Industrial	Tourist Related Development	Recreation or Non-urban Uses	Concessional Development
Floor Level		3										2	2 or 5	2	1	2,4							1	2,4
Building Components		2										1	1	1	1	1							1	1
Structural Soundness		3		2		2						2	2	2	2	2							1	1
Flood Affectation		2	2		2	2					1	2	2	2	2	2							1	1
Evacuation		2,4	*	3,4	4	3,4					*	3,4	1,4	3,4	1	1 or 3							1	1
Management and Design		4,5	1								1		2,3,5	2,3,5	2,3,5	2,3,5							2,3,5	2,3,5

Not relevant

Unsuitable landuse

* Refer to 'Management and Design' consideration for Subdivision

Freeboard equals an additional height of 500 mm

Notes:
1. Filling of the site, where acceptable to Council, may change the FRP considered to determine the controls applied in the circumstances of individual applications.
2. Terms in italics are defined in the glossary of this Plan and Schedule 2 specifies development types included in each land use category. These development types are generally as defined within Environmental Planning Instruments applying to the local government area.

Floor Level

1. All floor levels to be equal to or greater than the 5% AEP *flood* level plus *freeboard* unless justified by site specific assessment
2. *Habitable floor* levels to be equal to or greater than the 1% AEP *flood* level plus *freeboard*
3. All floor levels to be equal to or greater than the *PMF flood* level plus *freeboard*
4. Floor levels to be as close to the *design floor level* as practical and no lower than the existing floor level when undertaking alterations or additions
5. Floor levels of shops to be as close to the *design floor level* as practical. Where below the *design floor level*, more than 30% of the floor area is to be above the *design floor level* or premises to be flood-proofed below the *design floor level*

Building Components and Method

1. All structures to have *flood compatible building components* below or at the 1% AEP *flood* level plus *freeboard*
2. All structures to have *flood compatible building components* below or at the *PMF flood* level plus *freeboard*

Structural Soundness

1. Engineers report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP *flood* plus *freeboard*
2. Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP *flood* plus *freeboard*
3. Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a *PMF flood* plus *freeboard*

Flood Affectation

1. Engineers report required certifying that the development will not increase *flood* affectation elsewhere
2. The impact of the development on flooding elsewhere to be considered

Note: When assessing *flood* affectation, the following must be considered:
1. Loss of storage area in the *floodplain*
2. Changes in *flood* levels and velocities caused by alteration of conveyance of *flood* waters

Evacuation

1. *Reliable access* for pedestrians required during a 1% AEP *flood*
2. *Reliable access* for pedestrians and vehicles required during the *PMF flood*
3. *Reliable access* for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest *habitable floor* level to an area of refuge above the *PMF flood* level, or a minimum of 40% of the gross floor area of the dwelling to be above the *PMF flood* level
4. The development is to be consistent with any relevant *flood evacuation strategy* or similar plan

Management and Design

1. Applicant to demonstrate that potential development as a consequence of a subdivision proposal can be undertaken in accordance with this Plan
2. Site Emergency Response Flood Plan required (except for single-dwelling houses) where floor levels are below the *design floor level*
3. Applicant to demonstrate that area is available to store goods above the 1% AEP *flood* level plus *freeboard*
4. Applicant to demonstrate that area is available to store goods above the *PMF flood* level plus *freeboard*
5. No external storage of materials below the *design floor level* which may cause pollution or be potentially hazardous during any *flood*