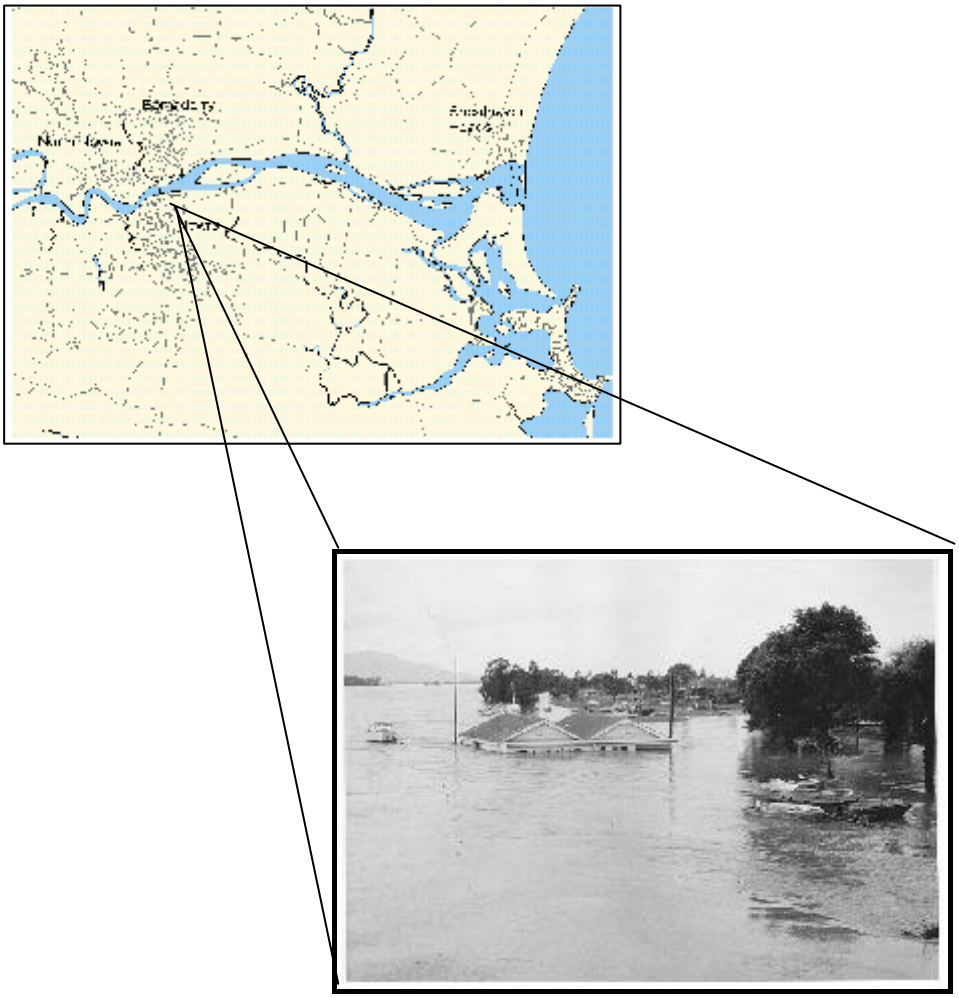
Shoalhaven City Council

Environment - Growth - Community

RIVERVIEW ROAD AREA - NOWRA FLOODPLAIN MANAGEMENT PLAN



Nowra Sailing Club, 1978 Flood

FEBRUARY 2002

SHOALHAVEN CITY COUNCIL

RIVERVIEW ROAD AREA - NOWRA FLOODPLAIN MANAGEMENT PLAN

FEBRUARY 2002

Webb, McKeown & Associates Pty Ltd
Level 2, 160 Clarence Street, SYDNEY 2000
Telephone: (02) 9299 2855
Facsimile: (02) 9262 6208
98066:RiverRdPlan PDF Version.wpd

Prepared by: _____

Verified by: _____

RIVERVIEW ROAD AREA - NOWRA
FLOODPLAIN MANAGEMENT PLAN

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

FOREWORD

The State Government's Flood Prone Land 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 sequential 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 or implementation of floodplain management measures to protect existing development,
   - use of Local Environmental Plans to ensure new development is compatible with the flood hazard.

The Riverview Road Area - Nowra Floodplain Management Plan constitutes the third stage of the management process and has been developed by the Shoalhaven Floodplain Management Advisory Committee. It was prepared for the Committee by Webb, McKeown and Associates and provides the basis for the future management of flood liable lands in the Riverview Road area east of the Princes Highway and north of Moss Street.

The terminology used in this report is in accordance with the NSW Government's Floodplain Development Manual (1986 edition) and draft Floodplain Manual (1999 edition). Subsequently the final Floodplain Management Manual was released in January 2001. This latter document provided several changes in terminology which have not been included in this report.

1. INTRODUCTION

The Shoalhaven River catchment covers an area of 7000 square kilometres with approximately 120 square kilometres of floodplain downstream of Nowra. The Riverview Road area (Figure 1) is located on the floodplain immediately downstream of Nowra Bridge and was first developed in the early 1960's with the Riverview Road subdivision initiated in the 1970's. The area experienced minor flooding in the 1970's. Following the 1974 flood a small earthen levee was constructed along Riverview Road. This levee was overtopped in places in the March 1978 flood and in 1986/87 the river bank levee was upgraded to provide protection up to the 1% AEP event (no freeboard allowance included). There is continuing pressure to develop the remaining vacant land and in 1995 a 55 lot subdivision to the south of Riverview Road was approved. Subsequently in 2000 this land is proposed to be developed as a retirement village. Council has a proposal to develop part of the vacant land as a recreation area. There are approximately 190 residential buildings (single dwelling and units) in the area, the majority of which are brick and less than 30 years old.

The Shoalhaven River has a well documented history of flooding going back to 1860 (Reference 1). The Lower Shoalhaven River Flood Study (Reference 2) was completed in April 1990 and established design flood levels across the floodplain (Table 1). The Riverview Road Area - Nowra Floodplain Management Study (Reference 3) identified the existing flood problem and canvassed the various measures to mitigate the effects of flooding and minimise the damages for future development.

Table 1: Peak Levels of Major Floods (mAHD)

	Historical Events				Design Events (AEP)				
	1860	**1870**	**1974**	**1978**	**5%**	**2%**	**1%**	**0.5%**	**Extreme**
Nowra Bridge	5.5E	6.55E	4.9*	5.3*	5.3	5.8	6.3	6.8	8.9
Riverview Road East (River)	U	U	U	U	5.1	5.5	6.0	6.3	8.2
Vacant land west of Ferry Lane	U	U	2.8#	4.3#	LR	3.7	4.5	5.1	8.0
Shoalhaven Caravan Park	U	U	U	U	3.7	4.8	4.9	5.2	7.5
Shoalhaven River at Terara	4.8E	5.7E	4.4*	4.7*	4.7	5.0	5.4	5.7	7.4
Terara (Hyams Hotel - at the intersection of Forsyth and South Streets)	4.6*	5.5*	3.7*	3.9*	3.6	3.9	4.7	5.1	7.2
Estimated AEP at Nowra Bridge	3%	0.7%	8%	5%					
Estimated Average Recurrence Interval at Nowra Bridge	30 years	150 years	12 years	20 years					

NOTES:
- * Recorded level taken from the Lower Shoalhaven River Flood History at Nowra Bridge 1860-1980.
- E Estimated level based on other historical flood data taken from the Lower Shoalhaven River Flood History at Nowra Bridge 1860-1980.
- U Unknown: # Taken from Reference 2
- LR Subject to local runoff which has not been accurately determined.
- Note 1: The more recent floods show a much greater difference in level between Terara (Hyams Hotel) and the river at Terara than the 1860 and 1870 events. This is due to the different heights of the river bank levee.
- Note 2: The design levels at Ferry Lane near Terara Road for floods smaller than a 0.5% AEP event reflect the benefit provided by the Riverview Road levee and are the result of backwater flooding.
- Note 3: The levels for the 1860 and 1870 floods at Nowra Bridge and in the Shoalhaven River at Terara are estimated as no actual levels were recorded.
- Note 4: Residents on the riverbank at Terara have provided levels of 4.3 mAHD and 4.6 mAHD for the 1974 and 1978 floods respectively.
- AEP: Annual Exceedance Probability.

1.1 Floodplain Management Study - Outcomes

The main outcomes of the Floodplain Management Study were:

- the area is currently protected to the 1% AEP level from direct inundation from the Shoalhaven River by the 2 m high Riverview Road levee (constructed in 1986/87). In a 1% AEP event 7 buildings are inundated above floor level (due to backwater flooding across Ferry Lane and not overtopping of the levee). In the 0.2% AEP event 167 buildings are inundated (90% of all buildings in the area),
- west of Ferry Lane the flood hazard is low for events less than a 1% AEP and high for larger events as a result of overtopping of the levee. The flood hazard is high for the 2% AEP and greater events at the Shoalhaven Caravan Park (east of Ferry Lane). It is likely that the community will not be prepared for the sudden change in hazard which may occur with levee overtopping or failure,
- an extensive public consultation program was undertaken to ensure that the community was fully informed about the floodplain management process and was able to effectively contribute during the course of the study,
- the average annual damages for the study area are $70 000,
- major flood modification measures (dams, levees) to reduce the flood levels are not financially, socially or environmentally acceptable,
- property modification measures (house raising, flood proofing) will assist but will not eliminate the flood hazard,
- response modification measures (flood warning, evacuation planning) offer the most cost effective and socially and environmentally acceptable solutions,
- development outside the study area is already controlled under Council's existing development policies. However, monitoring of the Greenhouse Effect should be undertaken,
- further development or subdivision, outside the areas already approved, will increase the demand on rescue services and the risk to life during a flood. Filling of lots may increase flood levels or redirect flows elsewhere,
- there are a number of outstanding issues regarding future development within this area. These should be clarified and the land within IDO No. 1 included under the current LEP framework.

2. BACKGROUND

2.1 Catchment Description

The Shoalhaven River rises approximately 50km inland of Moruya and follows a northerly direction for 170km before turning east for a further 90km to reach the Pacific Ocean at Crookhaven Heads. Two hundred years ago the main entrance was at Shoalhaven Heads. This entrance is now intermittent following the construction of the Berry's Canal link to the Crookhaven River in 1822.

The valley can be categorised into three broad regions:

- upstream of Welcome Reef where the terrain is rolling plateau,
- between Welcome Reef and Nowra where the catchment consists of steep forested country with the main streams entrenched in deep gorges,
- downstream of Nowra where an expansive floodplain has developed.

The floodplain area was formed by the infilling of an old coastal lagoon. The southern part of the floodplain is drained by the Crookhaven River, which rises near Nowra, while the northern section is drained by Broughton Creek, which rises upstream of Berry. Flood behaviour in the area has been extensively modified since European settlement through the construction of flood mitigation and bank protection works. The excavation of Berry's Canal has also had a major impact by opening up a second entrance at Crookhaven Heads.

2.2 Riverview Road Area

2.2.1 Description

The Riverview Road area (Figure 1) comprises:

- approximately 160 residential lots in Riverview Road, Elia Avenue, Lyrebird Drive, Hawthorn Avenue and the northern part of Ferry Lane. The majority of these lots carry a single or two storey brick detached residential building with 141 buildings in total. The ages of the buildings vary from over 25 years to very recent,
- 10 residential lots on the western side of Ferry Lane and south of Riverview Road. Seven lots carry a residential building, consisting of either a single dwelling or a block of flats,
- 9 residential flats in Campbell Place and Brereton Street,
- approximately 30 residential buildings along Moss Street and Terara Road. These buildings are a mixture of brick and non-brick construction and are generally older than 20 years,
- a motel at 8 Pleasant Way,
- approximately 23 hectares of vacant land within the area generally bounded by Lyrebird Drive, Ferry Lane, Moss Street and the high ground near the Princes Highway,
- the Shoalhaven Caravan Park located immediately east of Ferry Lane comprising 117 cabins or van sites of which 85 are permanently occupied; 13 casual van sites; 50 tent sites; a manager's house and an amenities block,

- the Willows East Caravan Park at the southern abutment of Nowra bridge off The Pleasant Way. This park is protected to approximately the 1% AEP flood level by an extension of the Riverview Road levee. It has 60 permanent cabins or van sites; 10 easily moved permanent vans; 10 casual van sites; 10 tent sites; a house; an office and shop.

There are approximately 190 residential buildings in the study area of which some 70% are single storey and 85% of brick construction.

The area is currently protected (to the height of the levee bank) from direct inundation from the Shoalhaven River by an earthen grassed levee which is generally up to 2 m above natural surface. The levee crest is at approximately 6.4 mAHD and will not be overtopped until greater than a 1% AEP event. The levee was raised to its present height in 1986/87.

The ground level within the area varies from approximately 2.0 mAHD to 4.7 mAHD and the majority of the ground will be inundated by backwater flooding across Ferry Lane in a 2% AEP event or greater. **The area becomes a high velocity floodway when the levee is overtopped.** The lowest floor level is at 3.3 mAHD. Details of the number of buildings flooded in different events are given in Table 2.

Table 2: Riverview Road Area - Damages to Buildings and Caravan Parks

Flood	Number [1]	Caravan Park Damages ($1999)	Total Tangible Damages ($1999) [2]
Extreme	177	3 600 000	13 300 000*
0.2% AEP	167	3 200 000	10 500 000*
0.5% AEP	119	1 100 000	3 800 000*
1% AEP	7	480 000	940 000
2% AEP	2	370 000	430 000
5% AEP	nil	1 000	11 000
10% AEP	nil	nil	10 000

Notes: (1) Assumes only one building per property (i.e. a block of units is taken as one building). The number of caravans inundated is not shown.

(2) Includes the total tangible damages to private property within the study area including caravan parks and unit developments.

* Damages will be higher if buildings are completely destroyed.

Construction of the existing Riverview Road levee in 1986/87 made a significant differences to the design flood data within the area. Further details of this are provided in Appendix C.

2.2.2 History of Development

The Riverview Road subdivision was initiated in the early 1970's and a 12 hectare area along Riverview Road was largely developed by the early 1980's. It has a complex history with regard to flooding and planning. This is summarised chronologically in the Floodplain Management Study.

2.2.3 Local Environmental Plan

The Riverview Road area residential subdivision was proposed to be zoned Residential 2(a4) (restricted residential) under the major Draft LEP of 1985. Subsequently Council recommended a change to 2(a1) subject to showing the flood line. In formulating the major Draft LEP there was no resolution on the most appropriate zoning and the May 1985 Local Environmental Plan does not apply to the majority of the study area as it was excluded pursuant to Section 68(5) of the Environmental Planning and Assessment Act, 1979. The land is presently administered under Interim Development Order No. 1 (IDO No. 1). Properties on Moss Street are zoned 2(b2) or 2(b1). Land near the Leagues Club is zoned 6(b) and 2(b2).

A Rural Environmental Plan was gazetted in July 1999 and amends the 1985 LEP. The main features of this plan as they relate to flooding are:

> The policy position of minimising development and settlement in flood prone areas has been retained. The 1(g) zone remains the principal control in conjunction with clauses 29 and 30. Zone objectives and provisions have been redrafted as a result of Council's 1993 working party debate.

The only development permitted in a 1(g) zone without development consent is agriculture, and even this is subject to other controls embodied in the LEP.

2.2.4 Heritage

There are six heritage listed items in the Draft Heritage LEP identified within the study area (Figure 1), namely:

- Graham Lodge and a Cemetery on Hawthorn Avenue,
- Moss Cottage at 3 Ferry Lane,
- timber slab cottage at 19 Ferry Lane,
- Elyard's boatshed and the Nowra Wharf on Wharf Road.

This Draft LEP has been publically exhibited and comments are being reviewed ahead of preparation of a report to Council (July 2001). The area east of Ferry Lane and Wondalga Crescent (Figure 1) is identified as a pastoral landscape in the Shoalhaven Heritage Study. There may be other heritage items in the study area, which have not been identified in these plans. There are no identified Aboriginal sites within the study area.

2.2.5 Environmental

A preliminary review of the environmental qualities of the area has indicated that:

- the presence of acid sulfate soils and the release of acid into the river system is becoming of increasing importance and is currently being investigated. Some floodplain management measures (levees, drains) may upset the existing regime,
- at this point in time, no record of threatened or endangered species of flora or fauna has been identified within the study area.

3. RECOMMENDATIONS

The recommendations of this Plan are summarised in the following tables:

- Table 3: Proposed Floodplain Management Measures,
- Table 4: Planning Outcomes,
- Table 5: Possible Methods of Flood Education,
- Table 6: Proposed Upgrades to Council's Flood Policy on Further Residential Development.

Table 3: Proposed Floodplain Management Measures

MEASURE	DISCUSSION	RECOMMENDATION	PRIORITY
FLOOD MODIFICATION:			
Levee Audit	The existing levee (constructed in 1986/87) provides protection from overtopping up to the 1% AEP event. However, floodwaters will enter the area in smaller floods from downstream across Ferry Lane. Raising the levee is not viable on social or financial grounds. The main concern is possible failure due to structural collapse or erosion of the river bank.	A management and maintenance audit of the levee should be undertaken. Consideration must be given to the effects of boat ramps (or other structures), vegetation cover and the Shoalhaven Caravan Park. The cost of such an audit would be $30 000. The cost of any remedial works (if required) cannot be defined at this stage and should not include any substantial change to the crest level. One of the outcomes of the audit would be to establish an ongoing levee audit procedure.	Medium
Improving Local Drainage	Local runoff ponds in the roads approximately twice a year causing inconvenience to users. It is not a threat to property or lives.	The local residents' association and Council should address the problem and seek solutions. One suggestion is to ensure that grass clippings are cleared away. The costs of any works cannot be defined at this stage.	Medium
Opening the Entrance at Shoalhaven Heads	Maintenance of an open entrance will marginally reduce flood levels. A permanent open entrance cannot be justified solely on the grounds of reducing flood levels at Riverview Road. Maintenance of the entrance berm and opening (if possible) prior to a flood is currently undertaken by Council. The annual cost is minimal.	Council should formalise its entrance opening policy.	Medium
Flood Mitigation Dams	Flood mitigation dams will reduce flood levels in the Lower Shoalhaven valley. Dams are expensive to build and their construction may have a significant impact upon the environment.	Inclusion of some flood storage should be considered on a catchment wide basis when new dams (or upgrading works) are proposed.	Low

MEASURE	DISCUSSION	RECOMMENDATION	PRIORITY
Catchment Treatment	Reafforestation and the encouragement of methods and materials to reduce runoff will have negligible impact on flood levels. However, they will assist in reducing the adverse impacts of development, such as the increase in sedimentation and pollution, and an increase in local catchment runoff.	As a general policy Council policies should encourage the use of appropriate and targeted catchment treatments. Assumed to be no cost to Council.	Low
PROPERTY MODIFICATION MEASURES:			
Planning	The majority of the study area is administered under IDO No.1 and was omitted from the May 1985 Local Environmental Plan. The levee was constructed in 1986/87 to mitigate the impact of flooding on existing development (including approved subdivision) at the time and not to promote further development. The Floodplain Management Study undertook a rigorous review of the present and proposed developments taking into account the social, heritage, environmental and hydraulic characteristics of the area. It concluded that infill residential development within the existing subdivided areas should continue, subject to the existing conditions for development approval. However, no further residential development approvals should be undertaken as it would increase the demand on the rescue services and the risk to life.	Council needs to clarify its conditions regarding future development in this area. This would require inclusion of the area under a revised LEP and updating of Council's Flood Policy to take account of the 2001 Floodplain Management Manual and the outcomes of this study. Table 4 summarises the proposed planning outcomes. Updates to the Flood Policy should include: 1. Formalisation of the process of dissemination of flood information to the public (Appendix B). 2. Determine the 1% AEP and Extreme Flood (or PMF) extents. How should land inundated in the Extreme Flood be treated? 3. Identification of areas which may suddenly become hazardous (levee failure or overtopping). 4. One of the requirements for development approval (if appropriate and consistent with the zoning) is the preparation of a Flood Evacuation Plan by the developer and demonstration of a capacity to self evacuate. Preparation of a Plan does not imply consent for approval. 5. Review the existing structural and flood proofing requirements for new residential developments in the study area. 6. Proposed upgrades to the Flood Policy regarding further residential development are provided in Table 6.	High
Flood Proofing of Buildings and House Raising	Flood proofing of buildings (sealing of openings) costs approximately $10 000 per house. A number of houses may be suitable. House raising is only applicable for three buildings on Ferry Lane but social and heritage issues would seem to make it unacceptable.	Further investigation of these measures and discussions with the property owners are required.	Low

MEASURE	DISCUSSION	RECOMMENDATION	PRIORITY
RESPONSE MODIFICATION MEASURES:			
Improve the Flood Warning System	The existing ALERT system could be improved by installation of additional gauges and minor system upgrades. These works will reduce the future flood damages and are likely to have a high benefit/cost ratio.	Install river gauges at Terara (automatic), Grassy Gully (manual), rainfall gauges in Colyers Creek and the Yalwal catchment (automatic) and undertake the minor system upgrades, and prepare a Flood Warning Manual (to ensure that the existing knowledge is fully documented). The costs of the proposed works are $25 000 and would benefit other floodplain users.	High
Update the Evacuation Planning System	The SES has a comprehensive Local Flood Plan. This could be updated by inclusion of more quantitative data on flood depths, the houses which require evacuation and the possibility of overtopping of the levee. This measure will reduce the risk to life and future damages.	Update the Local Flood Plan to include the latest information as provided in the Floodplain Management Study. In particular identify that the entire area will require evacuation in (say) the 0.5% AEP and greater events including an evacuation strategy for the floods. Flood depth indicators are also required in the area. Suggestions for inclusion in Flood Evacuation Plans for individual buildings are provided in Appendix A. The SES must ensure that it has sufficient information regarding evacuation from all existing developments.	High
Improve Flood Awareness and Preparedness	A more heightened awareness of the flood problem and level of preparedness by the community and the SES will reduce flood damages.	A flood awareness program should be initiated (refer Table 5).	High
OTHER ISSUES:			
Monitor the Effects of Bank Erosion.	The existing river bank adjacent to the Riverview Road levee is reasonably stable and has accreted in parts. Further downstream at the Shoalhaven Caravan Park the risk of bank erosion is higher.	The situation should be closely monitored by Council as part of the Estuary Management Program. The possibility of a set back for development from the river bank should be considered for the area downstream of Ferry Lane.	Medium
DEVELOPMENT MEASURES:			
Caravan Parks	Caravan parks are potential areas of high damage and significant risk to life (residents and rescuers) during a flood. The management of caravan parks on the floodplain needs to be addressed to ensure that the risks are minimised.	Council needs to ensure (say annually) that existing caravan park owners are complying with Council's Caravan Parks on Flood Prone Land Interim Flood Policy (August 1995).	High
The Greenhouse Effect	The Greenhouse Effect has the potential to affect flood levels in the Lower Shoalhaven River.	Council should monitor the available literature and reassess Council's Flood Policy annually.	Low
Control of Development Outside the Study Area	Developments elsewhere on the floodplain or upstream have the potential to affect the erosional and sedimentational regime of the river, cause adverse hydraulic impacts and increase the amount of pollutants and sediments.	This issue is already addressed under Council's existing development controls.	No action required

Table 4: Planning Outcomes

AREA	OUTCOME	SUGGESTED LEP ZONE
New residential buildings within the Riverview Road, Elia Avenue and Lyrebird Drive subdivision and Lot 7, DP809132 (previously approved subdivision). Up to 27 new buildings are possible within this area. Approvals for these subdivisions were made in 1972.	Infill development permitted subject to Council's existing Flood Policy conditions which take into account the history of the development, social factors and hydraulic considerations. It is considered that a Residential 2(a1) zone would not adequately account for the particular flood hazard of the area (sudden change when the levee is overtopped). Some of the major reasons given by objectors to the proposed Residential 2(a4) zone in the Draft 1985 LEP were: *The factual basis for the design flood levels is incorrect* - This issue has been addressed on many occasions in the past. The 1990 Flood Study provides the most comprehensive and up to date investigation into flooding with the results to be reviewed following each future major flood. *The levee provides adequate protection* - The levee will be overtopped (greater than a 1% AEP event) and in those events **high hazard floodway conditions develop** and there is a significant hazard and risk to life. There is also the risk of failure prior to overtopping. *Impact upon property values* - Residents have been aware of the flood related development controls since the early 1980's. No changes to these controls are proposed. *Provide further protection or undertake voluntary purchase* - These measures are not supported on hydraulic, social or economic grounds. The evacuation needs of the existing community will be addressed by the SES.	Residential 2(a4). For conditions refer to the current LEP. Details of the conditions for development include: 1. structural requirements, 2. minimum floor levels, 3. evacuation requirements, 4. in order to limit the increase in population requiring evacuation there are to be no Dual Occupancies. Attached aged resident accommodation will be permitted.
Approved residential subdivision, yet to be developed, on Lot 1, DP131820.	Any changes to the approved subdivision (if applicable) should be reviewed at the Development Application stage to ensure that the proposal is compatible with the approved conditions, will not be exposed to increased damages or flood hazard and there is an appropriate evacuation strategy. Appendix C indicates the pre and post Riverview Road levee design flood data.	Dependant upon the type of usage. Part of the land will be Residential 2(c) with the remainder as Open Space - Recreation 6(c). The future zone should reflect the flood hazard of the area.

AREA	OUTCOME	SUGGESTED LEP ZONE
All vacant land within IDO No.1 not already subdivided. Lot 2 DP 714140 and Lot 6 DP 538956 are privately owned and Lot 1 DP 449102 is owned by the Department of Education and used as a school farm. The remainder is (or will become) owned by Council.	Approvals for previous subdivisions were given based upon a merits based assessment taking into account the earlier approvals by Council to the developments. Council has no records of approvals for development of vacant land within this area. A hydraulic and social assessment indicated that any increase in the population would lead to an increase in the demand on rescue services and the risk to life. This could not be justified as there is suitable land elsewhere within the Nowra region for development. Lot 2, DP714140 is the largest (approximately 2.4ha) privately owned land in the study area which has not been developed. One dwelling may be permitted on the land (within a 1000 m^2 parcel of land zoned as 2(a4), with the remainder of the land zoned as Rural 1(g) but conditional so that all forms of development (including agriculture) require development consent.	Either Rural 1(g) or Open Space 6. Suggested upgrades to Council's policy on residential development are provided in Table 6.
Approved subdivisions along Ferry Lane and east of Moss Street. These include the seven occupied lots (four of the lots have medium density developments and three single storey residences) and three vacant lots on Ferry Lane south of the Riverview Road/Lyrebird Drive subdivision and four lots (Lot 11 DP 225826, Lot 2 DP 540745 - single storey residences and Lots 1 & 2 DP 521592- vacant) east of Moss Street and south of Terara Road.	The vacant lots may be appropriate for single dwelling houses subject to the applicant demonstrating that safe evacuation is possible (level of flood awareness and preparedness, written Flood Evacuation Plan), that there is no adverse hydraulic impact and all other requirements can be satisfied. Evacuation needs for the existing buildings (example of Flood Evacuation Plan - Appendix A) have to be addressed by the Body Corporate or the individual owner. As part of the measure to update the Evacuation Planning System, the SES will contact residents to obtain this information.	Residential 2(a4). For conditions refer to the current LEP.
Approved subdivisions north of Moss Street (SP 11052 and SP 22292/SP 32482). Both contain medium density developments.	Evacuation needs have to be addressed by the Body Corporate. As part of the measure to update the Evacuation Planning System, the SES will contact residents to obtain this information.	Residential 2(b1)
Land outside IDO No.1 within the study area.	This includes Rural 1(g) land to the east of Ferry Lane, Residential 2(b) land on the north side of Moss Street and Open Space 6(b), Special Use 5(a) and Residential 2(b) land on the east side of the Princes Highway. The existing zones are appropriate for the flood hazard.	No change. Suggested upgrades to Council's policy on residential development are provided in Table 6.

AREA	OUTCOME	SUGGESTED LEP ZONE
Caravan Parks - Willows East (within IDO No.1) and the Shoalhaven Caravan Park (within Rural 1(g)).	Both parks are in high hazard floodway areas (the Shoalhaven Caravan Park in the 2% AEP and greater events and the Willows East in events greater than the 1% AEP). Council has a Flood Policy for caravan parks on flood prone land but it is essential that the policy be enforced. Evacuation needs have to be addressed by the caravan park owners. As part of the measure to update the Evacuation Planning System, the SES will contact residents to obtain the type information that might be required. There should be no increase in the number of permanent, semi-permanent unregistered vans or cabins within the Rural 1(g) zone (Shoalhaven Caravan Park), on account of the increased demand on the rescue services and the risk to life. Further development of the Willows East Park may be considered, as the land only becomes inundated in the 1% AEP event and there is relatively easy access to high ground (Princes Highway). Any application for further development of the Willows East Park should be evaluated on its merits and subject to a full implementation of the development conditions contained in Council's existing Policy.	The Willows East Park to be Open Space 6(b). No change for the Rural 1(g) zone. Suggested upgrades to Council's policy on residential development are provided in Table 6.
Motel - Hawthorne Avenue on Lot 101 DP 611544	The land is adjacent to the Willows East Caravan Park and is occupied by a similar type of use (tourist accommodation). The land becomes high hazard in events greater than the 1% AEP. Evacuation to high ground (Princes Highway) is relatively easy. Evacuation needs (example of Flood Evacuation Plan - Appendix A) have to be addressed by the owner. As part of the measure to update the Evacuation Planning System, the SES will contact residents to obtain this information.	Open Space 6(b)

Table 5: Possible Methods of Flood Education

Method	Comment
Letter/Pamphlet from Council	These may be sent (annually or bi-annually) with the rate notice or separately. A Council database of flood liable properties/addresses makes this a relatively inexpensive and effective measure. The pamphlet can inform residents of subsidies, changes to flood levels or any other relevant information.
School Project or Local Historical Society	This provides an excellent means of informing the younger generation about flooding. It may involve talks from various authorities and can be combined with water quality, estuary management, etc.
Displays at Council Offices, Library, Schools, Local Fairs	This is an inexpensive way of informing the community and may be combined with related displays.
Historical Flood Markers or Depth Indicators on Roads	Signs or marks can be prominently displayed in parks, on telegraph poles or such like to indicate the level reached in previous floods. Depth indicators on roads advise drivers of potential hazard.
Articles in Local Newspapers	Ongoing articles in the newspapers will ensure that the problem is not forgotten. Historical features and remembrance of the anniversary of past events (1860, 1870) make good copy.
Collection of Data from Future Floods	Collection of data assists in reinforcing to the residents that Council is aware of the problem and ensures that the design flood levels are as accurate as possible. A Post-Flood Evaluation Program (in the Floodplain Management Study) documents the steps to be taken following a flood.
Notification of 149 Certificate Details	All property owners were notified that they were flood affected as part of the public consultation program. Future owners are advised during the property searches at the time of purchase (through a Section 149 Certificate).
Types of Information Available	A recurring problem is that new owners consider they were not adequately advised that their property was flood affected on the 149 Certificate during the purchase process. Council may wish to advise interested parties, when they inquire during the property purchase process, regarding flood information currently available, how it can be obtained and the cost.
Establishment of a Flood Affectation Database	A database would provide information on (say) which houses require evacuation, which roads will be affected (or damaged) and cannot be used for rescue vehicles, which public structures will be affected (e.g. sewage pumps to be switched off, telephone or power cuts). This database should be reviewed after each flood event. It could be developed by various authorities (SES, Police, Council).
Flood Preparedness Program	Providing information to the community regarding flooding informs it of the problem. However, it does not necessarily adequately prepare people to react effectively to the problem. A Flood Preparedness Program would ensure that the community is adequately prepared. One of the elements of this is preparation of a Flood Evacuation Plan (Appendix A). The SES would take a lead role in this.
Foster Community Ownership of the Problem	Flood damage in future events can be minimised if the community is aware of the problem and takes steps to find solutions. For example, Council should have a maintenance program to ensure that its drainage systems are regularly maintained. Residents have a responsibility to advise Council if they see a maintenance problem such as a blocked drain. This process can be linked to water quality or other water related issues including estuary management.

Table 6: Proposed Upgrades to Council's Flood Policy on Further Residential Development

REQUIREMENTS	NEW RESIDENTIAL BUILDINGS OR EXTENSIONS
Floor Level	1% AEP level plus a 0.5 m freeboard. In the past a minimum floor level of 4.9 mAHD has been adopted for the land within the original Riverview Road, Elia Avenue and Lyrebird Drive subdivision. This level may still be appropriate (only within this area) for extensions or in special circumstances. However, to be compatible with current floodplain management practice the recommended level is the 1% AEP (pre levee - refer Appendix C) level plus a 0.5 m freeboard.
Location	Development in a Floodway will only be permitted if it can be shown that there is no other viable alternative. Further consideration would then need to be made regarding the precise location of the development.
Building Components	The proponent should demonstrate that where possible all building components are designed to withstand inundation up to the 1% AEP +0.5 m level with minimal affectation.
Structural Soundness	The structural integrity of the completed works to withstand water and debris damage up to the 0.2% (1 in 500y) is to be certified by a professional structural engineer.
Impact upon Others	Not to be considered unless the works are greater than 250 m^2 in area.
Flood Evacuation	Any new development will require that the owners advise the SES of their development and evacuation requirements.
Flood Awareness	Approval will only be provided if the owners have measures in place which demonstrate their commitment to increased flood awareness (signs, literature available, preparation of an Evacuation Plan).
Other Issues	For an agricultural enterprise a report is required from the Department of Agriculture to confirm the economic viability. A number of other planning issues are required to be addressed including the relationship of the dwelling to the agricultural activity.

4. REFERENCES

1. Public Works Department
Lower Shoalhaven River Flood History at Nowra Bridge 1860-1980
Draft Report, July 1981.

2. Public Works Department
Lower Shoalhaven River Flood Study
Webb, McKeown & Associates Pty Ltd, April 1990.

3. Shoalhaven City Council
Riverview Road Area - Nowra Floodplain Management Study
Webb, McKeown & Associates Pty Ltd, February 2002.

FIGURES

FIGURE 1

LOCALITY PLAN

SHOALHAVEN RIVER

TO BOMADERRY

NOWRA BRIDGE

NOWRA WHARF

SAILING CLUB

RIVERVIEW ROAD

LEVEE

RESERVATION 30.48M FROM H.W.M.

6(a)

RESERVE DP 634524

SHOALHAVEN CARAVAN PARK

DP 505763

1(g)

DRAINAGE EASEMENT

THE WILLOWS EAST VAN PARK

MOTEL

HAWTHORN AVE.

ELIA AVENUE

LYREBIRD DRIVE

RIVERVIEW RD.

SLAB COTTAGE

LANE

ELYARDS BOATSHED

PLEASANT WAY

LEAGUES CLUB

6(b)

CEMETERY

VACANT LAND PRIVATE OWNERSHIP

VACANT LAND COUNCIL OWNERSHIP

LAND TO BE DEDICATED TO COUNCIL

DEFERRED UNDER SECTION 68(5) (IDO No.1)

LOT 2 DP 714140

FERRY

MOSS COTTAGE

TERARA

TERARA ROAD

GRAHAM LODGE

PRINCES HIGHWAY

2(b)

VACANT LAND PRIVATE OWNERSHIP

LOT 1 DP 1318 20

APPROVED 55 LOT SUBDIVISION

LAND TO BE DEDICATED TO COUNCIL

PUBLIC RESERVE DP 802068

PUBLIC RESERVE DP 130989

CAMPBELL PLACE

STREET

MOSS

BRERETON STREET

WONDALGA CRESCENT

2(a)

5(a)

NOWRA

TO SOUTH NOWRA

DP 616269

DP 186738 SEWAGE T'MENT WORKS GAZ.28/2/36

DP 500900 SEWAGE TREATMENT WORKS

DP 634042

LEGEND

- HERITAGE ITEM
- UNITS
- STUDY AREA
- PASTORAL LANDSCAPE DRAFT DCP No.76 (DRAFT HERITAGE LEP)
- 53 HOUSE NUMBER
- 1(a) ZONE (LEP 1985)

0 40 80 120 160 200m

SCALE

NOTE:
HOUSE NUMBERS ARE ONLY SHOWN WHERE A BUILDING EXISTS ON THE PROPERTY

FIGURE 2

BUILDINGS INUNDATED

SHOALHAVEN RIVER

TO BOMADERRY

NOWRA BRIDGE

NOWRA WHARF

SAILING CLUB

RIVERVIEW ROAD

LEVEE

RESERVATION 30.48M FROM H.W.M.

RESERVE DP 634524

SHOALHAVEN CARAVAN PARK

DP 505763

DRAINAGE EASEMENT

THE WILLOWS EAST VAN PARK

MOTEL

ELYARDS BOATSHED

PLEASANT WAY

LEAGUES CLUB

CEMETERY

HAWTHORN AVE.

ELIA AVENUE

LYREBIRD DRIVE

RIVERVIEW RD.

SLAB COTTAGE

VACANT LAND PRIVATE OWNERSHIP

VACANT LAND COUNCIL OWNERSHIP

LAND TO BE DEDICATED TO COUNCIL

VACANT LAND PRIVATE OWNERSHIP

FERRY LANE

MOSS COTTAGE

TERARA

TERARA ROAD

DP 634042

GRAHAM LODGE

PRINCES HIGHWAY

LAND TO BE DEDICATED TO COUNCIL

APPROVED 55 LOT SUBDIVISION

PUBLIC RESERVE DP 130989

DP 802068

CAMPBELL PLACE

MOSS STREET

WONDALGA CRESCENT

BRERETON STREET

DP 616269

DRAINAGE EASEMENT

DP 186738 SEWAGE T'MENT WORKS GAZ.28/2/36

DP 500900 SEWAGE TREATMENT WORKS

TO SOUTH NOWRA

NOWRA

LEGEND

0.5% AEP OF FLOOD WHICH FIRST INUNDATES THE BUILDING

0 40 80 120 160 200m

SCALE

NOTE:
FOR CARAVAN PARKS, THE AEP IS SHOWN FOR THE MAIN RESIDENTIAL BUILDING

FIGURE 3

PROPOSED AND EXISTING LAND USE ZONES

SHOALHAVEN RIVER

Proposed Open Space 6

6(a)

RESERVATION 30.48M FROM H.W.M.

RESERVE DP 634524

TO BOMADERRY

NOWRA BRIDGE

NOWRA WHARF

SAILING CLUB

RIVERVIEW ROAD

LEVEE

ROAD

RIVERVIEW

AVE.

HAWTHORN

AVENUE

ELIA

LYREBIRD

DRIVE

RIVERVIEW RD.

LANE

THE WILLOWS EAST VAN PARK

6(b)

MOTEL

PLEASANT WAY

LEAGUES CLUB

ELYARDS BOATSHED

SHOALHAVEN CARAVAN PARK

DP 505763

EASEMENT

DRAINAGE

Proposed 2(a4)

1 (g)

SLAB COTTAGE

Dependant upon the type of usage Proposed Part Residential 2(c) Part Open Space - Recreation 6(c)

CEMETERY

VACANT LAND PRIVATE OWNERSHIP

VACANT LAND COUNCIL OWNERSHIP

LAND TO BE DEDICATED TO COUNCIL

2(b)

GRAHAM LODGE

PRINCES HIGHWAY

VACANT LAND PRIVATE OWNERSHIP

FERRY

MOSS COTTAGE

TERARA

TERARA ROAD

DP 634042

Proposed Rural 1(g) or Open Space 6

APPROVED 55 LOT SUBDIVISION

LOT 1 DP 1318209

Proposed 2(a4)

1 (g)

PUBLIC RESERVE DP 130989

DP 802068

CAMPBELL PLACE

STREET

PUBLIC RESERVE

WONDALGA CRESCENT

2(a)

Proposed 2(b1)

2(b)

MOSS

BRERETON

NOWRA

5 (a)

TO SOUTH NOWRA

DP 616269

DP 186738 SEWAGE T'MENT WORKS GAZ.28/2/36

DP 500900 SEWAGE TREATMENT WORKS

LEGEND

- HERITAGE ITEM
- UNITS
- STUDY AREA
- PASTORAL LANDSCAPE DRAFT DCP No.76 (DRAFT HERITAGE LEP)
- 53 HOUSE NUMBER
- 1(a) ZONE (LEP 1985)

0 40 80 120 160 200m

SCALE

NOTE:
HOUSE NUMBERS ARE ONLY SHOWN WHERE A BUILDING EXISTS ON THE PROPERTY

APPENDIX A: FLOOD EVACUATION PLAN - INDIVIDUAL BUILDINGS

APPENDIX A: FLOOD EVACUATION PLAN - INDIVIDUAL BUILDINGS

A Flood Emergency Plan (FEP) provides one of the most cost effective and successful means of mitigating tangible and intangible flood damages. It has no environmental and few social adverse impacts. Generally FEP's are used for non-residential buildings but can also be applied to single dwellings or in a generic form to all householders via the progress association or such like. The following list provides the key elements of a FEP.

TYPICAL FLOOD EVACUATION PLAN

PURPOSE OF THE PLAN:

Advise of the potential for flooding.
List what actions should be undertaken in the event of an impending flood.
Advise who should be contacted for further information or can provide assistance during a flood.
Relate the predicted level of the flood to the premises.
Advise the types of hazards for the range of flood events.
Advise of actions to be undertaken following the flood.

INFORMATION GENERALLY REQUIRED ON THE PLAN:

Name of Business (if applicable), description of location (nearest cross roads) and building.
Name, Address and contact numbers of occupier.
Name, Address and contact numbers of owner.
Primary and Secondary contact - Name and Address.
Nature of development, activity and number of occupants.
Historical flood data (if available).
Flood and Hazard category for the range of flood events.
Types of materials kept on premises.
Flood protection devices and emergency equipment kept at premises.
What assistance will be required (evacuation, sand bags).

POSSIBLE ACTIONS REQUIRED IN THE EVENT OF A FLOOD:

Listen to the local radio.
Secure personal papers, high value items, memorabilia (photographs) and office records.
Install shutters or seal vents.
Raise carpets, furniture and stock.
Remove equipment and vehicles (if possible).
Evacuate occupants to the designated safe point.
Advise the SES.
Turn of power/gas/electricity and the main valves of the water supply.
Collect items likely to be washed away.
Raise poisons or chemicals.
Prevent discharge from the septic or sewer system.

TYPICAL FLOOD EVACUATION PLAN

ACTIONS DURING THE RECOVERY PHASE:

Check with the SES or Police first.

Have electrics and gas fixtures checked by qualified personnel.

Beware of snakes and spiders.

Beware of the health risk of walking or working in muddy water.

Plan which items should be cleaned first.

APPENDIX B: DISSEMINATION OF FLOOD INFORMATION TO THE PUBLIC

APPENDIX B: DISSEMINATION OF FLOOD INFORMATION TO THE PUBLIC

Dissemination of flood information to the public is a key element of the floodplain management process for a number of reasons. Firstly, since this is often the only formal way that a property owner is able to obtain flood information, it must be accurate, concise, easy to read and as unambiguous as possible. Secondly, Council may be exposed to potential liability issues if the information is incorrect or supplied inappropriately. Finally, appropriate dissemination of flood information can be a valuable means of raising the public's flood awareness and preparedness.

Council's existing policy for the dissemination of flood information to the public should be reviewed in light of the recent studies and the public's heightened awareness of flooding. The objectives of this policy should be:

- to ensure that the information supplied is accurate, concise, easy to read and as unambiguous as possible,
- to maximise the potential to increase flood awareness and preparedness within the community and Council's staff,
- to ensure that the release of information is undertaken in a consistent, orderly and efficient manner,
- to ensure that Council meets its statutory obligations,
- to advise owners of Council's policy regarding flooding and any restrictions that may be imposed on developments,
- to ensure that those providing the information understand the policy, the liability issues and the consequences of flooding,
- to minimise Council's liability associated with issuing the use of flood information,
- to provide a flood related information service to other sections of Council.

The exact mechanism for the dissemination of flood information should be developed on a city wide basis and not solely as a result of this study. It will require at least the following elements, legal advice may need to be sought to determine other elements :

- who should provide the information? Possibly two levels may be required depending upon the type of information to be supplied,
- how should the information be updated, by whom and how often?
- preferably standardised procedures should be introduced (handouts),
- record keeping (preferably on a database) of what information was provided, by whom and where,
- which transmittal modes should be used, e.g. telephone, counter, letter, e-mail, fax,
- a procedure for review of the policy and updating,
- flow charts to show the various procedures.

APPENDIX C: PRE AND POST RIVERVIEW ROAD LEVEE - DESIGN FLOOD DATA

APPENDIX C: PRE AND POST RIVERVIEW ROAD LEVEE - DESIGN FLOOD DATA

The present Riverview Road levee was constructed in 1986/87 to replace the previous smaller levee constructed following the August 1974 flood.

Hydraulic model runs were undertaken as part of this investigation to document the resulting changes in flood levels and velocities for the pre and post 1986/87 levee topography. There is no formal survey of the pre 1986/87 levee and the crest level was assumed to grade from approximately 5.1 mAHD near the Sailing Club to 4.7 mAHD at the eastern end of Ferry Lane. No other changes were made to the model topography. The pre and post levee results are summarised in Table C1.

Table C1: Pre and Post 1986/87 Levee Design Flood Data

	Extreme Flood		1% AEP		2% AEP		5% AEP	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	Level (mAHD)	Change in level in m	Level (mAHD)	Change in level in m	Level (mAHD)	Change in level in m	Level (mAHD)	Change in level in m
Section 17.1	8.9	0.01	6.3	0.05	5.8	0.03	5.3	0.01
Cell 8	8.8	0.01	6.2	0.05	5.7	0.03	5.2	0.01
Cell 14	8.4	0.01	6.1	0.05	5.6	0.03	5.1	0.01
Cell 19	8.2	0.01	5.9	0.05	5.5	0.03	5.1	0.01
Cell 21	7.8	0.00	5.7	0.04	5.3	0.02	4.9	0.01
Cell 10	8.7	-0.03	6.2	-1.49	5.7	-1.00	5.1	-0.43
Cell 13	8.4	-0.01	6.0	-1.63	5.5	-1.20	4.9	-0.57
Cell 22	7.9	-0.11	5.5	-0.57	5.2	-0.99	4.5	-0.26
Cell 25	7.6	-0.01	4.9	-0.03	4.4	-0.55	3.1	-1.07
Cell 17	8.3	-0.01	5.8	-1.26	5.3	-1.01	4.9	-0.59
Cell 20	8.1	-0.01	5.7	-1.15	5.3	-1.02	4.7	-0.40
Cell 23	7.0	0.00	5.4	-0.92	4.9	-1.39	3.7	-1.92
Cell 28	7.5	-0.01	4.7	-0.24	3.9	-0.01	2.8	-0.71
	Peak Flow (m3/s)		Peak Flow (m3/s)		Peak Flow (m3/s)		Peak Flow (m3/s)	
Weir 42	346	348	0	0	0	0	0	0
Weir 43	451	417	132	0	66	0	16	0
Weir 44	331	351	95	0	45	0	6	0
Weir 45	403	416	118	0	63	0	7	0
Weir 46	654	458	77	0	13	0	0	0
Weir 47	3459	3598	270	306	20	26	0	0
Weir 103	425	432	109	1	53	0	9	0
Weir 104	542	543	133	1	67	0	8	0
Weir 51	851	846	180	2	95	0	29	0
Weir 52	1102	1103	100	10	52	0	9	0
Weir 55	765	583	141	14	95	0	4	0
Weir 56	1389	1385	278	53	145	6	8	0
	Peak Velocity (m/s)		Peak Velocity (m/s)		Peak Velocity (m/s)		Peak Velocity (m/s)	
Weir 103	1.2	1.3	1.1	0.4	0.8	0.0	0.5	0.0
Weir 104	1.4	1.4	0.8	0.1	0.6	0.0	0.7	0.0
Weir 51	1.4	1.4	1.3	0.3	1.0	0.0	0.9	0.0
Weir 52	0.4	0.4	1.1	0.8	0.8	0.0	0.7	0.0
Weir 55	0.9	0.7	0.7	0.4	0.7	0.0	0.4	0.0
Weir 56	4.5	4.3	4.6	3.7	4.3	2.8	3.5	0.0

Notes:
Refer to Figure C1 for model layout.
The peak velocity and peak level do not necessarily occur at the same time.
Weir 56 indicates high velocities as it includes a small open channel.
Velocities are not available across the riverbank weirs (no's 42-47).

FIGURE C1
CELL MODEL LAYOUT