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YOU CAN'T MOVE NARRABRI OUT OF THE FLOODPLAIN!

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Summary

The town of Narrabri is located within the floodplain of the Namoi River in the north-west of New South Wales. About ten major floods have inundated the town this century. The duration of inundation can be lengthy. As well as the risks to property and life, the duration of flooding in the town places significant social pressures on the town's people and increases the risk of disease through the absence of sewerage treatment, water and electricity services.

A large proportion of residential land, the Central Business District and industrial areas would flood to a depth of 1.0—1.5m in a 100 year ARI event. About 40% of all houses and nearly 70% of all business would be flooded above floor level.

With the people of Narrabri being very 'flood-aware' and the extent of inundation being so large, large-scale structural flood mitigation options and particularly 'moving the town out of the floodplain' are economically and socially inappropriate. The floodplain management plan will therefore concentrate on 'living with floods'— planning and development controls, flood warning, evacuation and an understanding of flood behaviour.

This paper shows how the success of any floodplain management plan hinges on community acceptance of the proposal, and how this can be achieved by involving the local community at all stages of the decision-making process.

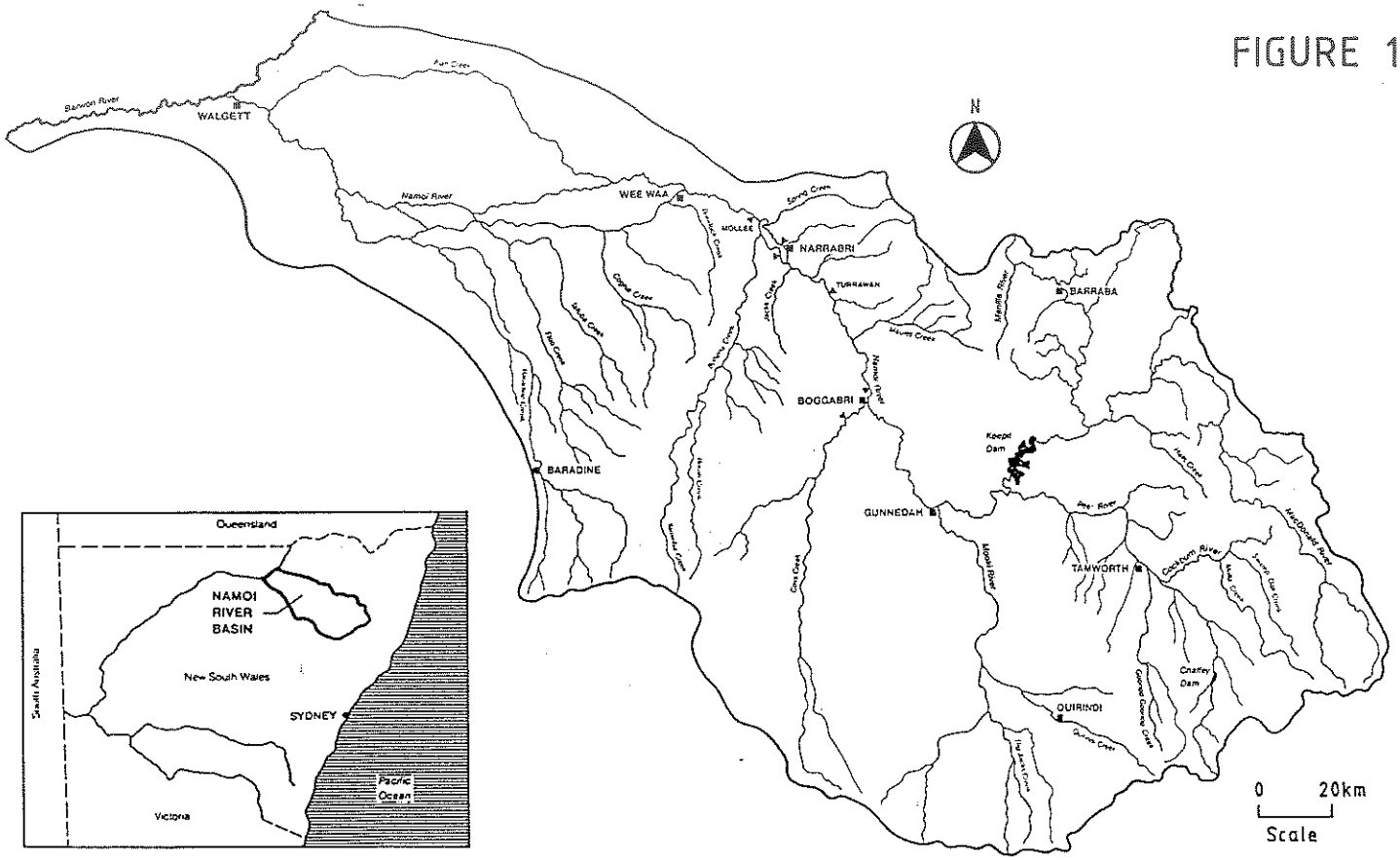
1. INTRODUCTION

The town of Narrabri is located within the floodplain of the Namoi River and Narrabri Creek about 600 km north-west of Sydney, New South Wales (**Figure 1**). The town has a population of about 8,000 people and is a major centre for agriculture in the area, particularly cotton and wheat. **Figure 1** shows the location of Narrabri in the Namoi River Basin. Large towns upstream of Narrabri include Boggabri, Gunnedah, Quirindi and Tamworth, while large dams include Keepit and Chaffey. (**Reference 1**).

About 2.5km upstream of the Narrabri town centre, the Namoi River divides into two branches— Namoi River and Narrabri Creek (**Figure 2**). The two branches join back together about 10km downstream of Narrabri. Under normal flow conditions, all flow is carried by Narrabri Creek. A large sand and gravel bar in the Namoi River at its offtake from Narrabri Creek, about 3m high and 2km long, prevents water from entering the Namoi River until local low-level flooding from Narrabri Creek starts to occur.

Flood behaviour in Narrabri is further complicated by the existence of a number of high level flood runners (referred to as 'the floodways') that further fragment the town at flood times. **Figure 2** shows Lagoon Creek, Eathers Creek, O'Briens Creek, Doctors Creek, Mulgate Creek, Horsearm Creek, and Long Gully, all close to the town centre of Narrabri.

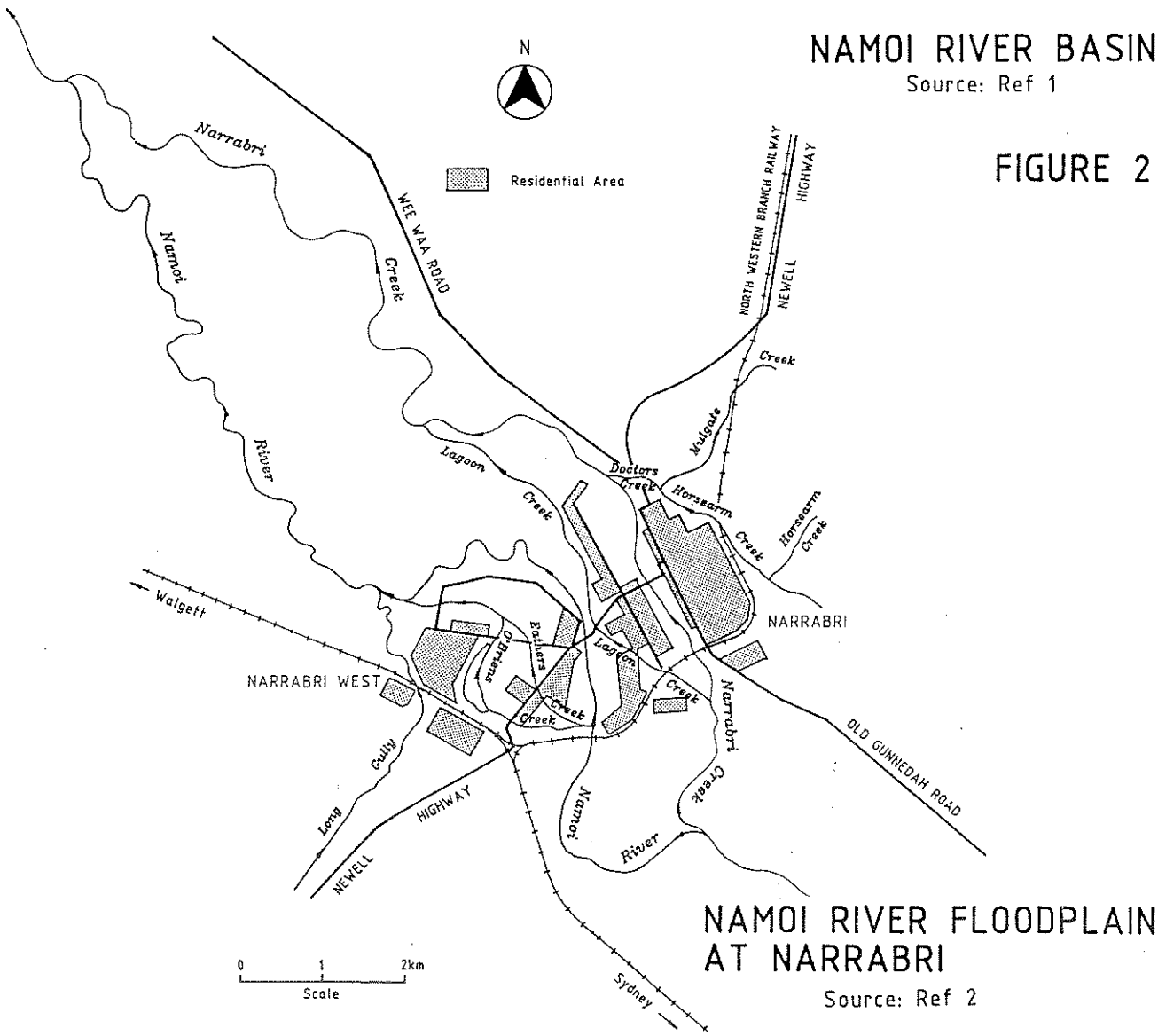
FIGURE 1



NAMOI RIVER BASIN

Source: Ref 1

FIGURE 2



NAMOI RIVER FLOODPLAIN AT NARRABRI

Source: Ref 2

2. FLOOD PROBLEMS IN NARRABRI

More than ten large floods have inundated the town this century, including the 1910 and 1955 floods in which the vast majority of the town were flooded to depths exceeding 2m. The duration of flooding can be lengthy. For example, during the February 1971 flood, the Namoi River remained above 'danger height' for 16 days. In general, flooding for up to one week can occur. The most severe floods recorded have occurred in January, February and March when summer cyclonic weather systems often move south from Queensland to cover the higher areas of the Namoi Basin (**Reference 1**).

Low lying areas of the Narrabri township become inundated in floods bigger than about a 10 year average recurrence interval (ARI) flood. Reports from the February 1984 flood (about a 20 year flood) however, indicate that a flood of this magnitude in Narrabri is 'manageable'. **Table 1** lists the ten largest floods (in terms of maximum flow rate) that have occurred in Narrabri this century. These floods are compared with the predicated 100 year, 50 year, 20 year and 10 year design maximum flow rates.

TABLE 1: MAJOR FLOODS IN NARRABRI

RANK	MONTH AND YEAR	TOTAL MAXIMUM FLOW RATE THROUGH NARRABRI (ML/d)
100 year flood		440,000
50 year flood		318,000
1	January 1910	312,000
2	February 1955	310,000
3	July 1920	231,000
4	February 1971	227,000
20 year flood		195,000
5	January 1976	186,000
6	January 1974	182,000
7	February 1984	179,000
8	March 1908	168,000
9	July 1921	144,000
10	February 1956	138,000
10 year flood		127,000

Source: Reference 1
Note: ML/d = megalitres per day

A significant number of properties in Narrabri including rural, residential, commercial and industrial lands are at risk from inundation in a 100 year ARI event. A large proportion of residential land, the Central Business District and industrial areas would flood to a depth of 1.0–1.5m in such an event. About 40% of all houses and nearly 70% of all business would be flooded above floor level. The damage bill is likely to be in the order of $46 million. **Table 2** quantifies details of the flood problem in Narrabri for a range of design events. To put the design events into perspective, the five most recent historical floods have also been included in **Table 2.**

TABLE 2: FLOOD PROBLEMS AT NARRABRI

SIZE OF FLOOD	Namoi River Gauge Height (m)*	Narrabri Creek Gauge Height (m)**	Residential				Business				Flood Damages									
			No. Prop. Flood Liable		No. House Floors Flood Liable		No. Prop. Flood Liable		No. Work Areas Flood Liable		Predicted Potential Damages					Predicted Actual Damages				
			No.	%***	No.	%***	No.	%***	No.	%***	Residential	Commercial	Infrastructure	Social	Total	Residential	Commercial	Infrastructure	Social	Total
Extreme	10.8	12.5																		
100 Year	8.8	10.2	1800	75%	1000	40%	290	80%	260	70%	$30 mil.	$31 mil.	$10 mil.	$11 mil.	**$82 mil.**	$11 mil.	$19 mil.	$9 mil.	$6 mil.	$45 mil.
1955	8.6	9.4																		
50 Year	8.4	9.6	1800	75%	500	20%	290	80%	220	60%	$18 mil.	$16 mil.	$6 mil.	$9 mil.	**$49 mil.**	$6 mil.	$10 mil.	$5 mil.	$4 mil.	$26 mil.
1971	8.2	8.9																		
1974	8.0	8.3																		
1976	7.9	8.5																		
20 Year	7.8	8.3	700	30%	100	4%	60	15%	20	6%	$5 mil.	$1 mil.	$1 mil.	$3 mil.	**$10 mil.**	$1 mil.	$1 mil.	$1 mil.	$1 mil.	$5 mil.
1984	7.8	8.3																		
10 Year	7.0	7.1	0	0%	0	0%	0	0%	0	0%					**<$1.0 mil.**					<$1.0 mil.
Average Annual Damage (AAD)											$1.3mil.	$1.1 mil.	$0.4 mil.	$0.5 mil.	**$3.3 mil.**	$0.5 mil.	$0.7 mil.	$0.4 mil.	$0.2 mil.	$1.8 mil.
Present Worth of Damages (No. of Years = 20, Discount Rate = 7%)											$13 mil.	$12 mil.	$4 mil.	$5 mil.	**$35 mil.**	$5 mil.	$8 mil.	$4 mil.	$5 mil.	$22 mil.

* *Guage zero at Newell Highway bridge on Namoi River = 205.0 m AHD*
** *Guage zero at Newell Highway bridge on Narrabri Creek = 204.7 m AHD*
*** *Percentage of all residences/businesses in Narrabri.*

Notes: *Number of flood liable residences rounded to the nearest 100 properties.*
Number of flood liable businesses rounded to the nearest 10 properties.
Except for Annual Average Damages, damages have been rounded to the nearest million dollars.
For Annual Average Damages, damages have been rounded to the nearest 0.1 million dollars.

Source: ***Reference 2*** *(in draft)*

3. IMPORTANCE OF COMMUNITY CONSULTATION

The people of Narrabri are, in general, a very 'flood-aware' and 'flood-experienced' community. Results from the recent community questionnaire (see below) indicated only a quarter of respondents had not experienced a flood in Narrabri. More than half the respondents had experienced the floods of the 1970s and 1980s. Nearly one-third of the respondents had experienced the 'big' flood of 1955— more than 40 years ago. Reports suggest that social gatherings and conversations in Narrabri often move towards 'talking about floods'. The people of Narrabri have a wealth of information about flood behaviour, how the various floods were different from one another, evacuation procedures, how much warning they are likely to receive, which roads are likely to cut first, and which areas are likely to be isolated first. There are also a large number of opinions, ideas and information of how Narrabri could deal with its flood problem better.

Therefore, as part of the Narrabri Floodplain Management Study (**Reference 2**), currently being carried out for Narrabri Council, it was agreed that the people of Narrabri should be encouraged to get involved at all stages of the decision-making process. It would be important to gain the community's input for the options available for minimising the danger to life and property during floods in Narrabri. It will also be important to seek comments and feedback on the preferred options once the analyses have been carried out. Afterall, the ultimate proposals adopted in the Floodplain Management Plan will need to be accepted, endorsed and 'owned' by the people of Narrabri if the plan is to succeed.

With the extent of inundation being so large, large-scale structural flood mitigation options and particularly 'moving the town out of the floodplain' are likely to be economically and socially inappropriate. The floodplain management plan will therefore also need to concentrate on 'living with floods'—planning and development controls, flood-warning, evacuation and an understanding of flood behaviour.

4. COMMUNITY CONSULTATION STRATEGY

The key elements of the Community Consultation Strategy for the Narrabri Floodplain Management Study are as follows:

- representatives from the community on the Floodplain Management Committee;
- the extensive use of the local press for advertising the progress of the study;
- the preparation, distribution and analysis of a community questionnaire accompanied by a newsletter;
- the use of ideas, information and statistics obtained from the questionnaire in the evaluation of floodplain management options;
- the organisation of a first Community Information Day/Evening to introduce the Floodplain Management Process, to discuss the results of the questionnaire and to promote discussion about ideas and information about flooding. An 'Information Day' is favoured in lieu of a public meeting because they allow more people to gain an insight to the study and allow a more personal atmosphere for asking and answering questions;
- the organisation of a special Floodplain Management Committee meeting at which each of the analysed options are discussed in detail. The aim of this 'workshop-type' meeting is to gain a preliminary consensus of the ranking and prioritising of options before a draft report is presented;
- the organisation of a second Community Information Day/Evening to formally present and explain the options to the community, and to seek written feedback on the proposed ranking and prioritising of works;

- the production of a display of the options to be exhibited in Council's foyer or in a shop front window after the second Information Day to try to seek as much comment as possible on the options;

- the use of community feedback to develop the recommended management plan, including the prioritising of works.

5. RESULTS FROM THE COMMUNITY QUESTIONNAIRE

The Community Questionnaire accompanied by a Newsletter was distributed to every household in Narrabri in late February 1995 (about 2,450 households). An addressed, postage-paid envelope was provided to facilitate the return of the completed questionnaires. About 620 responses (or about 26%) were received. This response rate was thought to be quite good, considering that the questionnaire covered the entire population of the town. The questionnaire has been reproduced as **Figure 3** of this paper. The results from the questionnaire have also been included in **Figure 3,** in lieu of ☐, for ease of presentation. The percentages given represent the percentage of the total 620 responses.

The questionnaire was divided into the following three parts:

- Part A—General Information on the Community
- Part B—Flood Experience
- Part C—Attitudes to Floodplain Management Options.

The results for each of these parts of the questionnaire are discussed below.

5.1 Part A—General Information on the Community

The results from Part A of the questionnaire highlighted the fact that a large proportion of the population of Narrabri are long-term residents who like the house and/or area that they live in. About 60% of the respondents have lived in Narrabri for more than 20 years, while about one-third of the respondents have lived in their current house for more than 20 years. Nearly 80% of respondents either own or are paying off their house or unit, while more than 60% have one or more people working in their household. It has been suggested that the 620 questionnaire responses do not represent a 'typical' cross-section of Narrabri's population. Rather, the respondents come from 'the older generation' who remember and are concerned with the devastation floods can cause in Narrabri.

5.2 Part B—Flood Experience

The results from Part B of the questionnaire highlight the fact that Narrabri is a very flood experienced community:

- only one-quarter of the respondents had not experienced a flood;

- only about one-third had not experienced a flood above floor level;

- of those who had experienced a flood in Narrabri:

  - only 15% had received less than 1 hours warning time to take action to prevent possible flood damage;
  - about one-third had more than 12 hours warning time to take action to prevent possible flood damage;
  - most people received the warning from more than one source;
  - nearly 60% received the warning from the radio;

- 30% received the warning from neighbours, friends, relatives, etc.;
- 25% received the warning from the SES.

- of those who were evacuated during a flood:

  - most were evacuated for 2–7 days
  - most stayed with relatives or friends
  - a large number stayed on the roof of their house in the 1955 flood.

Again, the question should be asked whether the questionnaire responses really represent a 'typical' cross-section of Narrabri's population.

The questionnaire revealed that information about flooding and flood levels at people's property has come through experiencing a flood or through 'word-of-mouth' (eg.neighbours, relatives, friends or the previous owner). Very little information, particularly in relation to the 100 year flood, has come from 'official' sources such as Council, Section 149 Planning Certificates, the Department of Water Resources or Real Estate Agents. Only 7% of the respondents had received a '100 year flood level' that applies to their property.

5.3 Part C—Attitudes to Floodplain Management Options

In the last section of the questionnaire, people were asked to indicate which floodplain management options they favoured or thought should be investigated in detail. **Table 3** lists the ranked options from the questionnaire in order of popularity. Although very little description of the options was provided in the questionnaire, prompting people to indicate that were undecided about some of the options, **Table 3** does provide a good indication of people's priorities and the importance they place on the various options.

6. CONCLUSIONS

The responses from the recent community flood questionnaire can be considered to be quite good, as nearly 26% of questionnaires were returned. However, with the results indicating only one-quarter of respondents not having experienced a flood in Narrabri, and one-third of respondents having experienced the 1955 flood, it has been suggested that the questionnaire does not represent a 'typical' cross-section of the population of Narrabri.

Nevertheless, a number of generalised conclusions can be drawn from the results of the recent questionnaire in Narrabri:

- the majority of the people of Narrabri are long-term residents who like the house and/or area that they live in and don't really want to move;

- the people of Narrabri want to know about flooding, wanting community participation, education and awareness;

- the people of Narrabri want to know about flood warning, evacuation and emergency plans. They want to know how to live with floods and how to minimise the disruption and damage to their property;

- the people of Narrabri are experienced with floods—it is this experienced coupled with a good warning and evacuation system that are likely to provide the greatest benefits in terms of flood damage. This can be seen when an average annual value of potential damage of $3.3 million is compared with an average annual value of predicated actual damage of $1.8 million.

TABLE 3: RANKING OF POPULARITY OF OPTIONS

RANK	OPTION	Percent in favour
1	Remove obstructions in areas zoned as 'floodways'	77%
2	Open up Namoi River at junction of Narrabri Creek	74%
3	Clear river/creek vegetation	70%
4	Community awareness and education	65%
5	Enlarge main river/creek channels through town	62%
6	Control development allowed in areas zoned as 'floodways'	61%
7	Improvement to flood warnings	60%
8	Riverbank stability works	57%
9	Control development in flood-liable areas of town	57%
10	Reassess areas and defined and zoned as 'floodways'	52%
11	Better evacuation and emergency assistance plans	49%
12	Use of dams upstream of Narrabri to store floodwaters	43%
13	Enlarge areas zoned as 'floodway' through town	40%
14	Raising of houses above 100 year flood	25%
15	Large bypass channel around the town	21%
16	Levees around urban areas of town	21%
17	Enlargement of road and rail bridges	20%
18	Use of temporary sandbag-type levees	19%
19	Relocation of houses to flood free areas	16%
20	Voluntary purchase of worst affected houses	15%
21	Flood-proofing, water-proof walls etc.	15%

Source:Reference 2.

- the people of Narrabri want a 'solution to flooding' but they realise that it is likely to be a difficult and expensive exercise;

- the people of Narrabri are concerned about increasing flood levels through encroachments to defined flowpaths, areas zoned as 'floodways' and the choking of the creek system through excessive debris and vegetation (particularly willow trees);

- generally the people of Narrabri are not keen on large-scale voluntary purchase or relocation of houses out of the floodplain. In general, they prefer the proximity to shops, services and schools, rather than a flood-free site. Allowing for a significant mark-up for new infrastructure if large-scale voluntary purchase was implemented, to purchase all 1,470 high hazard houses would be in order of $220 million. Similarly to purchase all those properties whose land would be inundated in a 20 year event (670 properties) would cost in the order of $100 million.

Even these generalised conclusions show how socially and economically inappropriate it would be to 'move Narrabri out of the floodplain.'

7. REFERENCES

1. Kinhill Engineers Pty Ltd. 1991, Narrabri Flood Study Report.
   Report prepared for Narrabri Council and Department of Water Resources (NSW).

2. Bewsher Consulting Pty Ltd. 1995 (in draft), Narrabri Floodplain Management Study.
   Report currently being prepared for Narrabri Council.

8. ACKNOWLEDGMENTS

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