CLARENCE VALLEY COUNCIL

ALIPOU CREEK
FLOODPLAIN RISK MANAGEMENT PLAN

DECEMBER 2006

WEBB, McKEOWN & ASSOCIATES PTY LTD

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ALIPOU CREEK
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FOREWORD

The State Government's Flood Policy is directed at providing solutions to existing flooding problems in developed areas and to ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas.

Under the Policy, the management of flood liable land remains the responsibility of local government. The State Government subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist Councils in the discharge of their floodplain management responsibilities.

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

1. *Flood Study*
   - determine the nature and extent of the flood problem.
2. *Floodplain Risk Management Study*
   - evaluates management options for the floodplain in respect of both existing and proposed development.
3. *Floodplain Risk Management Plan*
   - involves formal adoption by Council of a plan of management for the floodplain.
4. *Implementation of the Plan*
   - construction of flood mitigation works to protect existing development,
   - use of Local Environmental Plans to ensure new development is compatible with the flood hazard.

The Alipou Creek Floodplain Risk Management Plan constitutes the third stage of the management process for Alipou Creek and its catchment area. It has been developed for Clarence Valley Council and prepared by Webb, McKeown & Associates for the future management of flood liable lands in the area.

This Plan should be reviewed every five years or following any significant flood.

1. INTRODUCTION

1.1 Background

The Clarence River has a catchment area of some 21,900 km^2 to its mouth at Yamba, and some 19,800 km^2 to Grafton. Grafton is the main commercial centre and the most upstream crossing point on the lower Clarence River floodplain. The Clarence River divides the town into a north and south part. The north part is the main commercial centre whilst South Grafton has developed as a residential area with fringing commercial/industrial developments. The 32 km^2 Alipou Creek catchment (Figure 1) lies immediately downstream of South Grafton on the south bank of the river and is outside the South Grafton levee system. The lower floodplain of Alipou Creek is crossed twice by the Pacific Highway and is largely used for agricultural activities.

1.2 Floodplain Risk Management Process

As described in the Floodplain Development Manual (Reference 1), the Floodplain Risk Management Process entails four stages.

Stage 1:	Flood Study.
Stage 2:	Floodplain Risk Management Study.
Stage 3:	Floodplain Risk Management Plan.
Stage 4:	Implementation of the Plan.

The Flood Study stage was completed in March 2004 with publication of the Lower Clarence River Flood Study Review (Reference 2). In this study a 2D hydraulic model was established and used to determine design flood levels for the Lower Clarence River floodplain including the Alipou Creek catchment. A previous Alipou Creek Flood Study (Reference 3 - February 1998) determined design flood levels in the Alipou Creek catchment in the absence of Clarence River inflows over the levees.

The Floodplain Risk Management Study (Stage 2 – Reference 4) sought to fully identify the nature of the flood problem in terms of risk to floodplain occupants and their assets, and then to canvass various management measures to mitigate the effects of flooding.

The end product is this Floodplain Risk Management Plan (Stage 3) which describes how flood liable lands in the Alipou Creek catchment are to be managed in the future. Both the Risk Management Study and Plan have had significant community consultation and involvement (workshops, questionnaires, interviews).

Clarence Valley Council will complete the process through implementation of the actions (Stage 4) identified in the Plan depending upon financial, timing and other constraints.

2. STUDY AREA

2.1 Description

The study area incorporates the floodplains of Musk Valley Creek and Alipou Creek within the 32 km^2 catchment located to the east and south of South Grafton. The majority of the area (Figure 2) is occupied by rural lands and isolated homesteads, with the Pacific Highway crossing Alipou Creek from east to west in the south and then west to east in the northern part of the catchment. The Pacific Highway is cut by floodwaters at the Alipou and Musk Valley Creek crossings and downstream of the Heber Street levee. The main North Coast Railway line crosses Musk Valley Creek but is largely situated on high ground within the town of South Grafton which is located on the western fringe of the catchment.

2.2 Flooding Mechanism

Inundation of the lower Alipou Creek floodplain results from one or both of the following mechanisms:

- rainfall over the 19,800 km^2 catchment upstream of Grafton which causes the Clarence River to overtop the river bank levee (termed the Alipou Levee) and enter the lower floodplain. This will first occur in approximately a 5y ARI event. The Heber Street levee separates the southern floodplain upstream and downstream of South Grafton and prevents floodwaters entering the South Grafton Common from the Alipou Creek floodplain. This levee is first overtopped in approximately a 100y ARI event,
- rainfall over the local 32 km^2 Alipou Creek catchment causing Musk Valley and Alipou Creeks to overtop their banks. In the lower floodplain the Alipou Levee and Clarenza Control Levee prevent the outflow of runoff to the Clarence River. Some runoff will exit through the triple 2100 mm by 2100 mm box culverts at the mouth of Alipou Creek. However in a large flood the capacity of these culverts will be exceeded and floodwaters will pond upstream. The depth of ponding depends upon the rate of inflow and the rate of outflow. The rate of outflow being controlled by the “tailwater level” in the Clarence River. Once the river level exceeds the ponding level there will be no outflow until the river level falls. Flap gates on the triple culverts prevent inflow from the Clarence River.

The relative significance of the two mechanisms is complex and depends on the discharge in the Clarence River and the local catchment rainfall. Sometimes the two mechanisms will coincide and sometimes they will not. Generally the local runoff from Alipou Creek will arrive first, as the catchment area is much smaller than that of the Clarence River. Thus there may be two flood peaks in the Lower Alipou Creek floodplain with the latter greater than the former (as occurred in May 1996). It should be noted that flooding from the Alipou Creek catchment will produce lower flood levels in the lower floodplain than that from flooding in the Clarence River, but higher flood levels in the upper floodplain. The boundary between the two systems on Alipou Creek is approximately the southern (upstream) Pacific Highway crossing.

The 100y ARI peak level from rainfall over the Alipou Creek catchment is 5.3 mAHD in the lower floodplain, whilst from a 100y ARI event on the Clarence River it is 7.8 mAHD. Thus Clarence River flooding produces the greatest flood level. If the two mechanisms coincided the increase in flood level as a result of the additional runoff from the Alipou Creek catchment is less than 0.1 m.

2.3 Flood Damages

A levee system (Figure 2) has been constructed along the river bank but this only provides protection up to approximately a 5y ARI event in the Clarence River.

The Floodplain Risk Management Study identified the number of buildings inundated above floor level and the estimated tangible damages. These are provided in Table 1. No allowance has been made for losses through bank collapse or complete destruction of buildings. Also damages to crops, livestock or other agricultural related activities have not been quantified. The average annual tangible damages for the Alipou Creek catchment were estimated to be $140,000 ($2004).

Table 1: Flood Levels, Buildings Inundated, Tangible Damages

Flood	Alipou Creek Peak Level from Clarence River flooding (mAHD)	Buildings Inundated		Tangible * Damages ($mill - 2004)
		Residential #	Non-Residential	
Extreme	9.3	50	22	4.0
500y ARI	7.82	38	14	2.3
100y ARI	7.77	38	14	2.2
20y ARI	7.43	30	7	1.5
5y ARI	levees not overtopped	nil	nil	nil

Notes:

* Damages will be higher if buildings are completely destroyed.

The majority of buildings are vans/units within the caravan park on Musk Valley Creek.

Design flood flood extents and buildings inundated shown on Figures 3 and 4.

3. ASSESSMENT OF FLOODPLAIN RISK MANAGEMENT MEASURES

An assessment of all floodplain risk management measures was undertaken in the Floodplain Risk Management Study (Reference 4). In summary, the majority of the residents supported the following measures:

- install maximum height recorders and undertake further investigation to obtain a more accurate record of peak levels and duration times in future floods,
- house raising for two houses on Butters Lane and Mr Harvey's property,
- implementation of a suitable Flood Awareness Program,
- improve drainage to reduce inundation times throughout the Alipou and Musk Valley creek systems. A range of measures were suggested,
- raising Iolanthe Street to improve flood access,
- update Council's planning policies,
- implementation of a levee audit and maintenance program,
- installation of additional openings in The Block,
- audit of all structures along Alipou Creek, those without approval need to obtain it or be removed/modified,
- cleaning of culverts under the Pacific Highway,
- establish a voluntary purchase scheme,
- installation of a community based flood warning system for Alipou Creek,
- construction of stock mounds.

Residents recognised that these measures will have little (and in some cases no) affect on the peak flood levels however they will provide either improved flood warning, a longer evacuation time, reduced flood duration and/or a reduction in flood damages.

Stream clearing was also suggested but was not considered further due to potentially significant environmental impacts.

4. RECOMMENDED FLOODPLAIN RISK MANAGEMENT MEASURES

The recommendations of this Plan are summarised in Table 2. Measures within each priority class (high, medium or low) are not listed in any particular order, each measure in each class has the same level of priority.

Table 2: Recommended Floodplain Risk Management Measures for Alipou Creek

Measure	Discussion	Recommendation	Indicative Cost and Benefit	Respons-ibility	Required Approvals
HIGH PRIORITY					
H1: Install maximum height recorders and collect available data from next flood events. Consideration should also be given to the installation of automatic height recorders.	Maximum height recorders will assist in providing more accurate records of peak levels in future floods. Automatic recorders would also provide information about the rate of rise and recession of floodwaters in Alipou Creek. The locations of the recorders would be decided in conjunction with the local landowners. Information on inundation times from Alipou Creek flooding is required to assess whether modifications to the McClares Lane culvert and/or the Clarenza Control Levee can be justified. They would also provide data for the proposed Flood Studies of Alipou and Musk Valley Creeks (M3).	Recorders (with externally marked gauge boards) should be installed at say ten (or more) locations along Alipou Creek and Musk Valley Creek. Following a future flood event information must be obtained on peak levels, durations of inundation, etc.	$500 per recorder x 10 = $5,000 The benefits of obtaining more accurate data will be providing more accurate design flood levels and a more sound basis for decision making in regard to any modifications to structures along Alipou Creek.	CVC	Local land owners.
H2: Raising of Mr Harvey's house at the Pacific Highway crossing of Alipou Creek.	Assessment of the flood situation at Mr Harvey's property confirms that floodwaters have reached within 1 m or less of the house floor on several occasions in the past. Access to high ground (the Pacific Highway) is poor as it crosses an unsealed driveway which has a significant low spot.	The house be raised on the basis that: • the house floor is likely to be inundated in a major Alipou Creek flood, • there is limited safe refuge within the building as it is single storey, • there is potential for significant structural damage in a large flood, • access to high ground is poor and hazardous, • it is likely that flood levels at this property have increased over the last 20 years as a result of works by others.	$50,000 The benefit/cost ratio cannot be determined as there are no reliable estimates of design flood levels for Alipou Creek flooding at this location.	CVC DNR	Mr Harvey
H3: Implement Flood Awareness Program	This measure will ensure that residents are aware of the flood problem and the means available to help reduce flood damages.	A variety of measures should be implemented as part of a South Grafton wide program.	The cost will depend on the nature of the program. The benefits will be reflected in a reduction in flood damages and risk to life.	DNR SES CVC	None

Measure	Discussion	Recommendation	Indicative Cost and Benefit	Respons-ibility	Required Approvals
H4: Improve drainage from the Pacific Highway crossing to Clarenza levee.	Two residents upstream of the Clarenza Control Levee have requested further consideration be given to modifying the Clarenza Control Levee and the structures at McClares Lane. They consider these works would reduce inundation times upstream but also acknowledge that it may disadvantage other rural floodplain users downstream near Ulmarra. The three main issues are: • McClares Lane culverts, • augment the existing 3 cell flap gated culvert to the Clarence River (an indicative cost is $200 000), • stream clearing. Pumps have been suggested but are rejected for cost and practical (maintenance, failure) reasons.	The hydraulic benefits and disbenefits of this measure can only be accurately assessed once further information is obtained (refer H1) from future flood events and further hydraulic modelling is undertaken. The timeframe for full implementation of this measure is unclear as it is dependant upon collecting data from future floods and further hydraulic modelling. Prior to this the CVC should investigate further whether modifications can be made to optimise the performance of the the flap gated culvert under the Clarenza Control Levee. This may involve manual operation during floods.	The costs and benefits will be dependant upon the nature of the works. This measure may potentially have some environmental benefits by restoring low flows in the old creek system.	CVC	Local land owners Department of Natural Resources
H5: Raising of No. 2 Butters Lane	House raising is suitable for most non-brick single storey buildings constructed on piers. Some houses in the catchment have already been raised. No. 2 Butters Lane is suitable for house raising and a medium level of acceptance was perceived from discussions with the residents.	No. 2 Butters Lane should be included on a house raising program. Social and possibly heritage issues need to be resolved.	$50,000 Benefit/cost ratio is 1.0 for No. 2 Butters Lane.	CVC DNR	Resident
H6: Raising Iolanthe Street	Raising Iolanthe Street to approximately 6 mAHD would provide an improved access route for residents and stock from their Butters Lane properties during floods.	Raising Iolanthe Street is recommended on the grounds of providing a higher level evacuation route for residents and stock on Butters Lane. It may also eliminate the need for other measures such as stock mounds.	$50,000 The benefit is largely unquantifiable.	CVC	Local land owners Clarence Valley Council
H7: Installation of additional openings in the 'Block'	Construction of "the Block" has increased the duration of flooding and reduced the time to peak in an Alipou Creek flood. In 2002 a 1200 mm flap-gated pipe was installed. This has reduced the adverse impacts but local residents consider additional openings would further improve the situation.	Further hydraulic modelling is required to quantify the impacts of any additional openings in "the Block". In the first instance further base data are required (refer H1).	$100,000 The benefits cannot be accurately quantified (increase in warning time, reduction in duration of inundation).	CVC	Department of Natural Resources Clarence Valley Council

Measure	Discussion	Recommendation	Indicative Cost and Benefit	Respons-ibility	Required Approvals
MEDIUM PRIORITY					
M1: Implement levee audit and maintenance program	A levee audit and maintenance program will ensure that the levee system surrounding Alipou Creek is maintained at design conditions. Maintenance would include any repairs as a result of erosion or vegetation growth.	An audit should be undertaken annually as well as after any significant flood.	$5,000 per audit The cost of any works is unknown.	CVC	Department of Natural Resources Local land owners
M2: Raising of No. 1 Butters Lane	House raising is suitable for most non-brick single storey buildings constructed on piers. Some houses in the catchment have already been raised. Nos. 1 Butters Lane is suitable for house raising and a medium level of acceptance was perceived from discussions with the residents.	No. 1 Butters Lane should be included on a house raising program. Social and possibly heritage issues need to be resolved.	$50,000 Benefit/cost ratio is 0.3 for No. 1 Butters Lane.	CVC DNR	Resident
M3: Update Council's planning policies	A detailed review of Council's planning policies on flooding was not undertaken as part of this Study/Plan as it is being undertaken as part of a City of Grafton Floodplain Risk Management Study. However during the course of the study/plan several minor improvements were suggested. One outcome of this review is that design flood levels on Alipou Creek and Musk Valley Creek upstream of their respective Pacific Highway crossings have not been adequately defined in previous Flood Studies.	1. Council to create a GIS database to monitor the effects of cumulative filling on the floodplain and the potential impacts of upstream developments on both river and local catchment flooding. 2. Consideration be given to introducing special provisions for caravan parks located on flood prone lands. 3. Provision of guidelines to land owners proposing to construct works within or adjacent to the creek system. 4. SES to update the Local Flood Plan based on the information provided in the study and plan. 5. Flood Studies to determine design flood levels for Musk Valley and Alipou Creeks upstream of the Pacific Highway crossings should be undertaken. 6. Council's development controls outlined in DCP9 and LEP must be strictly enforced to ensure that existing floodplain users are not adversely affected as a result of future development on the floodplain or in the upper catchments.	Undertaken by Clarence Valley Council	Clarence Valley Council SES DNR	Clarence Valley Council

Measure	Discussion	Recommendation	Indicative Cost and Benefit	Respons-ibility	Required Approvals
LOW PRIORITY					
L1: Audit of all structures along Alipou Creek	An audit will ensure that all structures along Alipou Creek are not adversely affecting the flow regime. This may also assist in reducing blockages along the creek and improve flood recession times.	An audit of all structure along Alipou Creek should be undertaken. Those structures without Council approval will need to put in a post-constructed application. If they are not approved the structure will need to be removed or modified.	$7,000 The benefit will be in ensuring that the Alipou Creek system complies with current environmental standards.	CVC	Local land owners
L2: Cleaning of culverts under Pacific Highway	Removal of any significant debris (branches, trees) from culverts is supported on the grounds of maintaining the watercourse and waterway area. Stream clearing (vegetation removal) is not recommended.	As any minor debris will likely be washed away during the next flood event, it is only the larger items which are of a concern. Cleaning of the culverts should be implemented as part of an overall maintenance program. Residents could contact Council if any large debris items were noticed.	$5,000 per clearing The benefit is largely unquantifiable but will ensure that the system performs as designed.	CVC RTA	Department of Natural Resources
L3: Establish a Voluntary Purchase scheme This measure is only applicable if Measures H5, M2 and H6 are NOT undertaken.	Voluntary purchase of every flood affected building within the floodplain cannot be economically or socially justified but this strategy can be considered as a long term measure to reduce the number of flood liable buildings.	Residents should be informed that this measure is available to them if they are interested.	The cost will be determined by the Valuer General. The benefit will be in elimination of a residential building from the floodplain.	CVC DNR	Local landowners
L4: Installation of community based flood warning system for Alipou Creek	An accurate flood warning system for the Alipou Creek catchment would greatly assist in reducing flood damages for landowners by providing more time to move their stock.	Installation of four (or more) rainfall gauges linked to a central system that can be accessed by local landowners. The system has the potential to provide additional warning time to residents as well as providing data that would be useful for the analysis of future flood events.	$16,000 for installation of 4 gauges, $6,000 p.a. maintenance cost. The benefits cannot be accurately quantified (increased warning time, increased accuracy of design flood levels).	CVC	Local land owners
L5: Construction of stock mounds	Stock mounds are one means of limiting the potential for stock losses during a flood and are an alternative to evacuation. However, there are some disadvantages namely: • the stock may not reach the mound, • unless constructed to the Extreme level, the stock may still be stranded, or drown in a large flood, • fodder must be provided to the stock.	Stock mounds would assist in reducing stock losses during a flood. They could be built as a temporary solution until evacuation routes are improved, or be used as an alternate to evacuation in smaller events. One potential location is near the railway line where some high land owned by a public authority is currently (2006) for sale. There may be some issues with loss of public recreation lands and this would need further investigation. Further feedback is required from local land owners on their likely benefits.	The cost is unknown and would depend on the location and size of the mound. The benefits cannot be accurately quantified (reduction in stock losses, less worry about potential for loss).	CVC Local land owners	Local land owners

5. ACKNOWLEDGMENTS

This study was carried out by Webb, McKeown & Associates Pty Ltd and funded by Clarence Valley Council and the Department of Natural Resources. The assistance of the following in providing data and guidance to the study is gratefully acknowledged:

- Clarence Valley Council,
- Department of Natural Resources,
- Floodplain Management Committee,
- residents of the Alipou Creek catchment.

6. REFERENCES

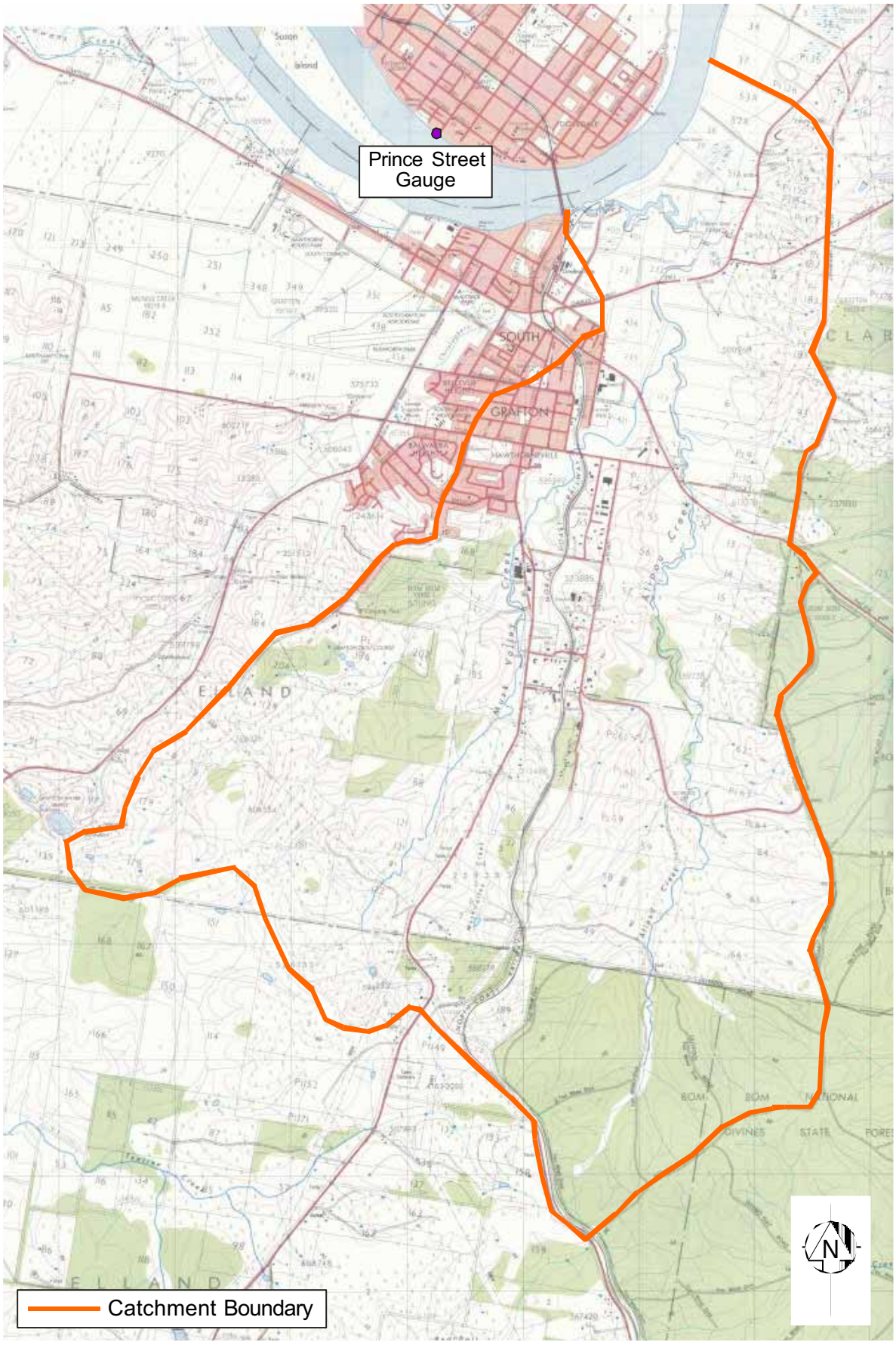
1. **Floodplain Development Manual**
NSW Government, April 2005.

2. Clarence Valley Council
Lower Clarence River Flood Study Review
Volumes 1 and 2
WBM Oceanics, March 2004.

3. Clarence River County Council
Alipou Creek Flood Study
Water Studies, February 1998.

4. Clarence Valley Council
Alipou Creek Floodplain Risk Management Study
Webb, McKeown & Associates Pty Ltd, November 2006.

FIGURE 1
LOCALITYPLAN



ScaleApprox. 1:50000

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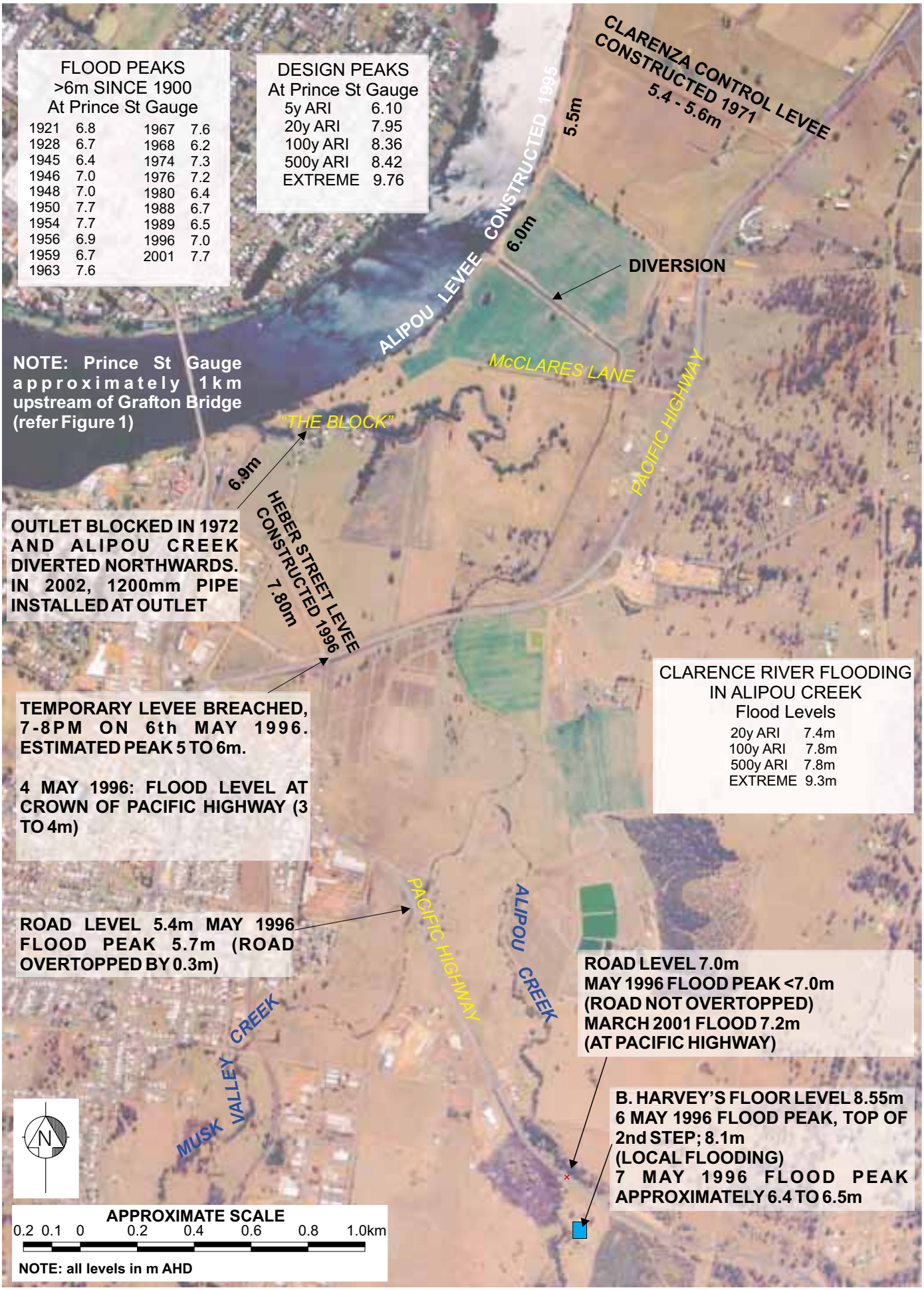
FIGURE 2

KEY FEATURES AND LEVELS IN THE LOWER FLOODPLAIN



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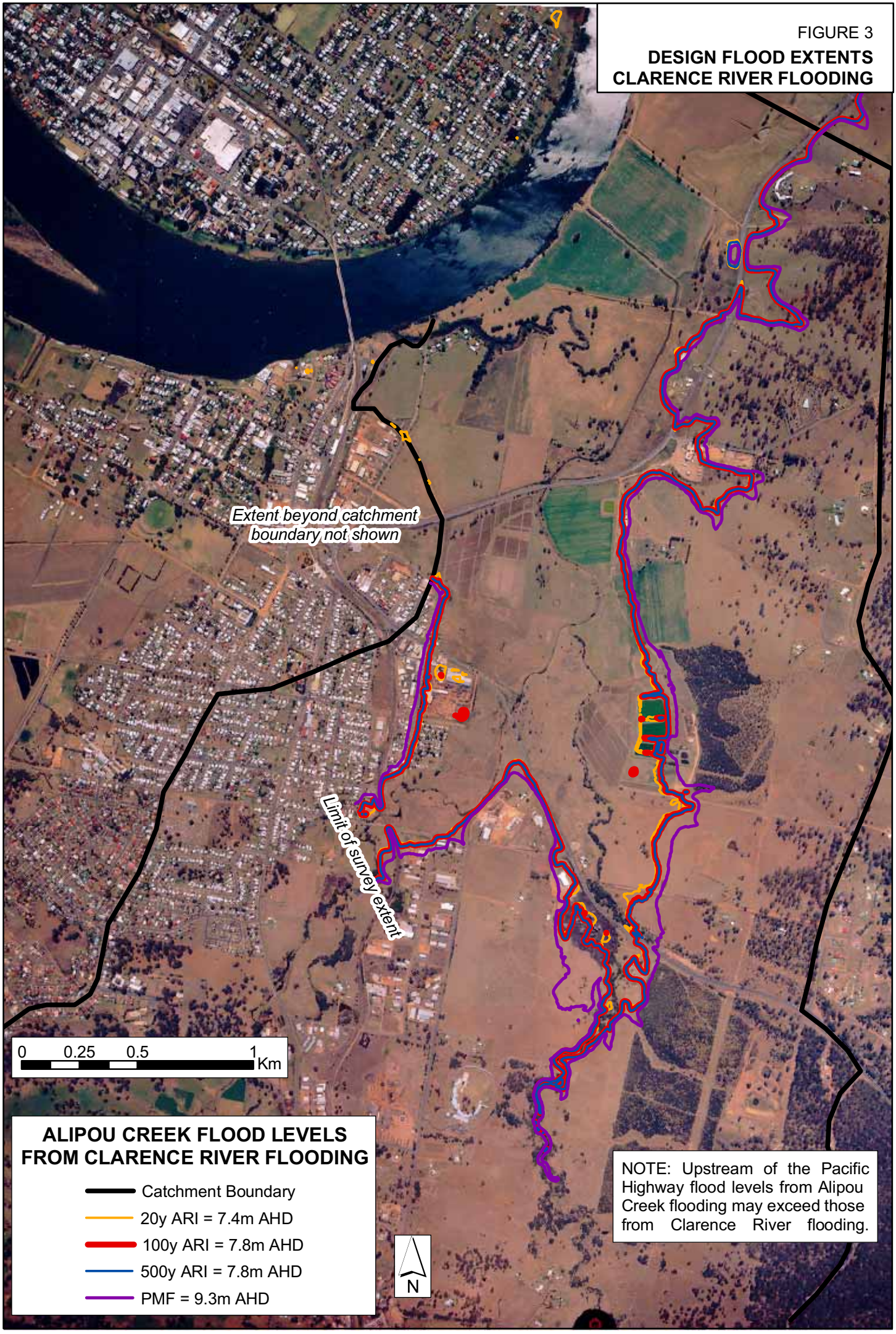
FIGURE 3
DESIGN FLOOD EXTENTS
CLARENCE RIVER FLOODING
Extent beyond catchment boundary not shown
Limit of survey extent
0 0.25 0.5 1 Km
ALIPOU CREEK FLOOD LEVELS FROM CLARENCE RIVER FLOODING
Catchment Boundary
20y ARI = 7.4m AHD
100y ARI = 7.8m AHD
500y ARI = 7.8m AHD
PMF = 9.3m AHD
N
NOTE: Upstream of the Pacific Highway flood levels from Alipou Creek flooding may exceed those from Clarence River flooding.

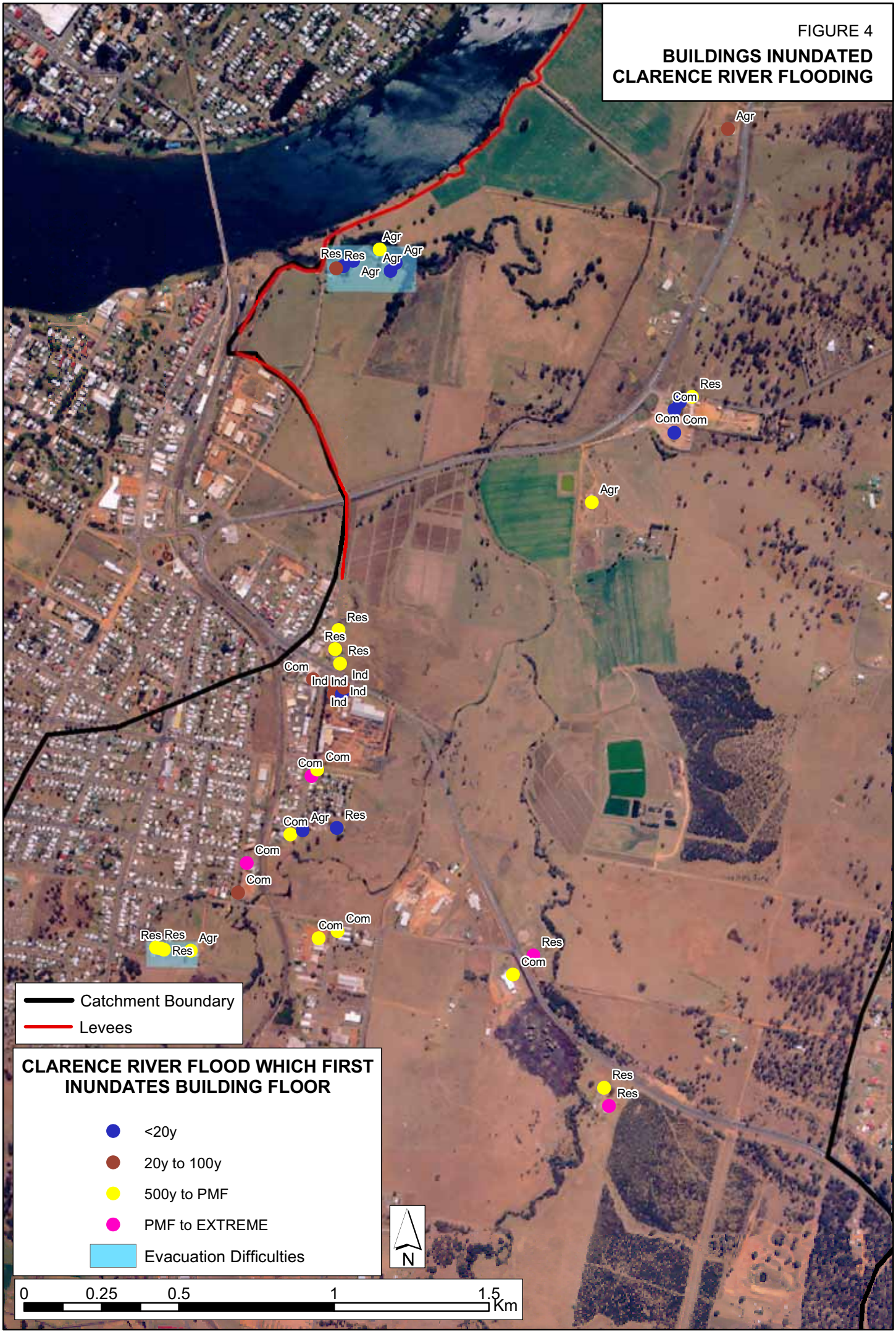
FIGURE 4
BUILDINGS INUNDATED
CLARENCE RIVER FLOODING
Agr
Agr
Res Res
Agr
Agr
Agr
Res
Com
Com Com
Agr
Res
Res
Res
Com
Ind Ind
Ind
Ind
Ind
Com
Com
Com Agr
Res
Com
Com
Com
Com
Res Res
Agr
Res
Res
Com
Res
Res
Catchment Boundary
Levees
CLARENCE RIVER FLOOD WHICH FIRST INUNDATES BUILDING FLOOR
<20y
20y to 100y
500y to PMF
PMF to EXTREME
Evacuation Difficulties
N
0
0.25
0.5
1
1.5
Km