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GOSFORD CITY COUNCIL

UPPER NARARA CREEK FLOODPLAIN MANAGEMENT PLAN

FINAL

MARCH 1995

Patterson Britton
& Partners Pty Ltd

consulting engineers

GOSFORD CITY COUNCIL

Upper Narara Creek Floodplain Management Plan

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Approved for release _____ on 31.3.95
[director] [date]

Note : This document is preliminary unless it is approved for release by a director of Patterson Britton & Partners

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TABLE OF CONTENTS

LIST OF TABLES

Page No.

LIST OF FIGURES

FOREWORD

The New South Wales State Government's flood policy is directed at providing solutions to existing flooding problems in developed areas, as well as ensuring that new development is compatible with the flood hazard and that it does not create additional flooding problems in other areas.

Under the policy, the management of flood prone 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 flood policy provides for technical and financial support by the government through the following four sequential stages:

- Flood Study: to determine the nature and extent of the flood problem;
- Floodplain Management Study: to evaluate management options for the floodplain with respect to both existing and proposed development;
- Floodplain Management Plan: involving formal adoption by Council of a plan of management for the floodplain; and
- Implementation of the Plan: involving construction of flood mitigation works to protect existing development and including use of local environmental plans to ensure new development is compatible with the flood hazard.

The Upper Narara Creek Floodplain Management Plan constitutes the third stage of the management process for the Upper Narara Creek catchment. This Plan has been prepared for Gosford City Council and provides the basis for future management of flood prone lands in the Upper Narara Creek study area.

SUMMARY

Narara Creek and its tributaries lie to the north-west of Gosford, discharging into Brisbane Water directly south of Gosford, as shown in **Figure 1**. The two main divisions in the Narara Creek catchment are the Lower and Upper Narara Creek catchments, with the boundary between the lower and upper catchment study areas taken as Deane Street, Narara.

From August 1986 to February 1990, Narara Creek experienced nine significant floods. The main focus during this period was on the Lower Narara Creek catchment area, downstream of Deane Street, where flooding was more severe. A Flood Study and Floodplain Management Study and Plan were undertaken for the Lower Narara Creek catchment by Kinhill Engineers.

In February 1992, a further significant storm event occurred, resulting in wide spread flooding in both the Lower and Upper Narara Creek catchments. Subsequent analysis of the February 1992 storm event estimated that this event was slightly higher than the 1% Annual Exceedence Probability (AEP) storm event. It is generally agreed that it was the worst flood event in the Narara catchment on record.

Flooding of the Upper Narara Creek catchment during the February 1992 event was particularly severe in the Koninderie Parade area, between Woorin Close and Narara Valley Drive, and adjacent to a small tributary crossing Narara Valley Drive opposite Yurunga Avenue. As a result of the flooding of these areas, a Flood Study for the Upper Narara Creek study area was undertaken by Kinhill in 1993 (**Reference 1**). The Upper Narara Creek study area is shown in **Figure 2**.

In accordance with the State Government's Flood Policy, a Floodplain Management Study for the Upper Narara Creek catchment was subsequently undertaken in March 1995 by Patterson Britton and Partners (**Reference 2**). The Study examined a range of floodplain management options and assessed the impact of options on flood levels and flood conditions using computer modelling techniques.

During the course of the Study, the proposed options were presented to the Floodplain Management Committee and refined to include comments and concerns from the Committee. Option 6, raising of floor levels, and Option 9, acquisition of affected houses were found to be uneconomic and not considered further. It was concluded that the recommended approach for the future development of the Upper Narara Creek Floodplain should be a combination of controls on future development and protection to at risk properties. This was agreed upon after consideration of the social, environmental, economic and hydraulic factors. The adopted floodplain management options from the Floodplain Management Study are shown in **Table 1** and on **Figure 3**.

Table 1 FLOODPLAIN MANAGEMENT OPTIONS

Option	*Estimated Cost ($1994)*	*Total Benefit Cost Ratio**
1. Deane Street bridge lengthening	85,000	0.3
2. Narara Valley Drive Bridge	445,000	0.5
3. Koninderie Parade channel improvements	315,000	0.5
4. Formalise floodflow across Narara Valley Drive at Yurunga Avenue		
4C. Overland flow path requiring acquisition of two residences	313,000	0.8
5. Floodfree access:		
5A. One lane bridge over Tributary A at Hanlan St	280,000	n/a
5B. Low key road access between Haggerty Close and Willari Ave	50,000	n/a
5D. Minor levee to reduce secondary flows	50,000	n/a
7. Bank Stabilisation:		
7A. Between Deane Street bridge and Narara Valley Drive culverts	250,000	n/a
7B. Upstream of Koninderie Parade to the primary school	750,000	n/a
8. Planning Controls	n/a	n/a
10. Flood Evacuation Plan	20,000	n/a

* Refer to the Floodplain Management study for explanation of the benefit/cost analysis.

For the 1% Annual Exceedence Probability (AEP) design flood event, assuming 75% blockage of the culverts under Narara Valley Drive (as per the February 1992 flood event), and with the catchment in its current state, it was found that 15 (fifteen) houses and 1 (one) commercial property are inundated above floor level. The implementation of Options 1,2,3 and 4 would relieve flooding above floor level in all properties in the study area for the 1% AEP flood event (refer **Reference 2**).

Following completion of the Floodplain Management Study, Patterson Britton and Partners were engaged by Gosford Council to undertake the Floodplain Management Plan for the Upper Narara Creek Floodplain. The formulation of this Plan was jointly funded by the Department of Land and Water Conservation (PWD) and Council under the State Only (2:1) Programme. The Management Plan incorporates an area extending upstream from Deane Street, Narara to the Niagara Park Public School (refer **Figure 2**).

It should be noted that although the study area and the Plan refer to the Upper Narara Creek catchment, the Geographical Names Board has advised, with reference to previous studies,

that the main tributary west of Hanlan Street is called Narara Creek. Therefore, for clarity, the main tributary covered in the study area of the Upper Narara Creek catchment has been called the Niagara Park Branch of Narara Creek. The confluence of this creek and the main Narara Creek lies downstream of the study area.

For the purpose of the Floodplain Management Plan, the floodplain of the Niagara Park Branch of Narara Creek was divided into areas (refer **Figure 4**), with a description of each area presented in this report. The areas are:

UNC0	Narara Creek Floodway - Niagara Park Branch
UNC1	Deane Street Bridge
UNC2	Narara Valley Drive Bridge
UNC3	Koninderie Parade Channel Improvement Area
UNC4	Narara Valley Drive at Yurunga Avenue
UNC5	Upstream Catchment

The key features of the Floodplain Management Plan are:

- ultimately no buildings will be flooded by the designated flood - this is accomplished through bridge upgrades, channel improvements, and upgrading the Tributary B crossing of Narara Valley Drive opposite Yurunga Avenue;
- reduction of flood hazards especially at road crossings;
- provision for limited development upon the flood fringe land subject to strict controls;
- lands within the floodway will be maintained in perpetuity for the passage of flood water; and
- a staging of actions based on the priority of actions.

The Plan is shown in the attached Council Drawings, detailed as follows:-

- Drawing No. 4/136/A1 - Intermediate Floodplain Management Plan(Sheet 1 of 2)
- Drawing No. 4/137/A1 - Ultimate Floodplain Management Plan (Sheet 1 of 2)
- Drawing No. 4/138/A1 - Intermediate Floodplain Management Plan (Sheet 2 of 2)
- Drawing No. 4/139/A1 - Ultimate Floodplain Management Plan (Sheet 2 of 2)

The components of the Intermediate Floodplain Management Plan include conditions for development, singular activities and ongoing activities. Singular activities, such as channel improvements and the development of a flood evacuation plan, will be able to be removed from the Floodplain Management Plan when the activities are completed. Also, the flood extents shown in the Floodplain Management Plan may, as a result of the completion of singular activities, require adjustment. For this reason an Ultimate Floodplain Management Plan has also been prepared. The Ultimate Plan includes conditions of development and

ongoing activities, as well as the adjusted flood extent resulting from the completion of all singular activities.

Draft copies of the Study and Plan were placed on public exhibition for a four week period. Following the exhibition, Council received submissions which were thoroughly considered by the Consultant and Council. The major issues resulting from the submissions have been incorporated into the Plan.

UNC0 - NARARA CREEK FLOODWAY - NIAGARA PARK BRANCH

DESCRIPTION OF THE PROBLEM

The Floodplain Development Manual (PWD, 1986) describes a floodway as follows:

> Floodways are those areas where a significant volume of water flows during floods. They are often aligned with obvious naturally defined channels. Floodways are areas which, even if only partially blocked, would cause significant redistribution of flood flow, which may in time affect other areas. They are often but not necessarily, the areas with deeper flow or areas where higher velocities occur.

Areas of floodplain in the Niagara Park Branch of Narara Creek, were in the past developed as urban areas when there was little understanding of the nature and extent of flooding. As a result, some residential areas experience flooding problems during significant flood events. Flood related problems include inundation of properties and residences, hazardous overland flows, impeded access into and out of residential areas and a series of related economic and social hardships.

Contributing to flood related problems in the Upper Narara Creek area is the lack of sufficient maintenance of creeks and floodways by Council in the past. A poorly maintained creek may accumulate sediment and debris, reducing the floodway area and exacerbating flood levels, or alternatively, may develop erosion problems causing the creek banks to migrate beyond their existing alignment.

DISCUSSION

The intention of the floodway is that it should provide sufficient capacity to convey the 1% Annual Exceedence Probability (AEP) flood event through the region, without high velocity flows encroaching upon other areas. To ensure that the conveyance of the floodway is not significantly reduced, landuse in floodways must be carefully controlled. Neither buildings nor hazardous uses, obstructions or operations likely to impede floodwaters should be permitted in floodways, only land use that is flood compatible or likely to enhance floodway capacity should be allowed.

Floodways may need to be crossed by service installations, for example water, sewer, power and gas mains. These should be permitted in the floodway provided they are investigated adequately and designed in a manner that did not significantly affect floodflow capacity or flood levels. They should also be designed so as to reduce damage potential to the services to the absolute minimum.

DESCRIPTION OF PROPOSED ACTIVITIES

To protect the existing banks from increased velocities as a result of the proposed bridge at Narara Valley Drive (refer UNC2), bank stabilisation works are to be constructed between the Narara Valley Drive bridge and Deane Street bridge. To prevent further erosion of the section of creek upstream of Koninderie Parade, this part of the creek should also be protected by bank stabilisation works.

A Flood Evacuation Plan should be formulated to provide residents with a plan for safe and orderly access to higher, flood free ground. Access routes and safe gathering areas should be identified for specific residential areas, in particular the Koninderie Parade area and the areas west of the Deane Street crossing. Part of the evacuation plan should ensure that there is safe access into residential areas for emergency services. Flood evacuation in the Hanlan and Deane Street areas is to be facilitated by the provision of a bridge over Tributary A (refer **Figure 2**), where the tributary crosses Hanlan Street.

To maximise the benefit of flood mitigation measures, a program of regular inspection and maintenance is to be developed by Council. Regular inspection would ensure that the floodplain conveyance area is not encroached upon by excessive vegetation or sedimentation, and would allow for monitoring of the stability of floodplain surfaces, in particular creek banks. Unstable or eroding surfaces in the floodway and creeks are to be stabilised and maintained to prevent transportation of sediment into downstream areas.

ECONOMIC ANALYSIS

The costs and intangible benefits for the proposed activities in this area are presented in **Table 2**.

Table 2 **SUMMARY OF ECONOMIC ANALYSIS FOR UNC0**

Proposed Activity	*Estimated Cost ($1994)*	*Intangible Benefits*
Bank Stabilisation	100,000	• Maintain channel conveyance area to prevent future flooding • Prevent accretion in downstream channel • Prevent loss of sediment from catchment
Flood Evacuation Plan	20,000	• Provides safe and orderly removal of people from hazardous situations • Brings flood victims together in designated areas where care and treatment can more effectively be provided
Bridge at Hanlan Street	280,000	• Allows evacuation of residents out of a potentially isolated area during flooding • Provides access to flood affected areas for emergency services
Maintenance Program	n/a	• Allows treatment of potential problems by regular and ongoing maintenance, particularly in terms of potential flood hazards, for example, removal of debris accumulated in the creek

CONDITIONS FOR DEVELOPMENT

The following conditions apply to proposed development within this area:

- The floodway is to be permanently maintained so that there would be no significant development within the floodway to reduce the future capacity of the floodway.
- All land uses are to be flood compatible.
- No filling and/or construction of structures, such as houses, garages, fences, in the floodway is to be permitted in the future.
- No construction of service lines such as water, sewer, power and gas, in the floodway is to be permitted in the future, unless it could be demonstrated that the proposed works would have no adverse impact on the floodway.
- Any proposed work within the floodway that involves disturbance of the existing ground surface shall be backfilled and/or stabilised at the completion of each day's work.
- No debris, including cleared vegetation and construction materials, or sediment is to be stored or stockpiled within the floodway.
- Any proposed development work within the catchment that involves disturbance of the existing ground surface or that changes the rate and/or volume of local runoff, is required to include an approved Erosion and Sedimentation Control Plan in accordance with Council's Code of Practice on Erosion and Sedimentation Control.

CONCISE DESCRIPTION OF THE PLAN

A concise description of the Plan for the Upper Narara Creek, Niagara Park Branch floodway, is shown in **Table 3**. The components of the Plan include conditions for development, singular activities and ongoing activities. Conditions for development and ongoing activities are applicable from the date of implementation of the Plan. Singular activities, when completed may require adjustment to be made to the Floodplain Management Plan, for example the flood extents may be altered and/or the activity description may be removed from the Plan.

The extent of the floodway area is shown schematically in **Figure 4**. The Intermediate and Ultimate Floodplain Management Plans, showing the components of the Plan relating to this area, are presented in Drawing Numbers 4/136/A1, 4/137/A1, 4/138/A1 and 4/139/A1, which are attached.

Table 3 UNC0 NARARA CREEK FLOODWAY - NIAGARA PARK BRANCH

Concise Description of Plan

CONDITIONS:

- The floodway is to be maintained in perpetuity for the passage of floodwaters and all land uses are to be flood compatible.
- No work that would impair the passage of floodwaters is to be permitted in the floodway.
- Building and filling is prohibited in the floodway.
- Fences or rigid paling, chainwire or similar construction likely to collect debris and/or impair floodwaters are not permitted in the floodway.
- Proposals to cross the floodway with services may be permitted, provided that the proposals were adequately investigated and designed in a manner that did not significantly affect flood-flow capacity and levels.
- Any proposed work within the floodway that involves disturbance of the existing ground surface shall be backfilled and/or stabilised at the completion of each day's work.
- No debris or sediment is to be stored or stockpiled within the floodway.
- All proposed developments will be subject to Council's Code of Practice for Erosion and Sedimentation Control.

ACTIVITIES:

- Bank stabilisation is to be undertaken between Narara Valley Drive bridge and Deane Street bridge and upstream of Koninderie Parade.
- A bridge is to be constructed over Tributary A where it crosses Hanlan Street South to facilitate flood evacuation.
- A Flood Evacuation Plan should be developed, particularly for the Koninderie Parade areas and the areas west of the Deane Street crossing.
- A program of regular inspection and maintenance of the floodway and creek is to be instigated.
- The floodway and creek are to be kept free of obstructions, including sediment and vegetation, by regular inspection and maintenance.

UNC1 - DEANE STREET BRIDGE LENGTHENING

DESCRIPTION OF THE PROBLEM

The bridge in Deane Street over the Niagara Park branch of Narara Creek (refer **Figure 4**) has a relatively small waterway area to pass flood flows. The existing bridge opening is offset slightly to the west of the channel alignment leading to high energy losses and increased flood levels.

Due to the low level of the road crest along Deane Street, flows in more severe floods discharge over a long weir formed by the road. The over bridge flows prohibit safe pedestrian and vehicular access during relatively minor floods.

DISCUSSION

The lengthening of the bridge would widen the opening under the Deane Street crossing and provide a larger waterway area as well as reduced energy losses. The resulting reduction in the peak 1% AEP flood level at the bridge would be about 0.1 m. The reduction in flood level diminishes in an upstream direction reducing to negligible values at the Narara Valley Drive crossing.

The improvement of the Deane Street Bridge would alleviate inundation above floor levels in one (1) residence and the Deane Street shop for 1% AEP flood event. In the entire study area, thirteen (13) houses would remain inundated above floor level for the designated 1% AEP flood event if no other improvements were implemented.

Discharge over the weir formed by the road either side of the bridge, in more severe floods, creates little backwater effect because of the high flow capacity across the weir. The flow under the bridge in severe storms is small compared to the flow over the bridge. As such, the possible blockage of the under bridge waterway would not have a significant impact on upstream flood levels.

The improvements in vehicular access hazards on the Deane Street crossing following upgrading would be significant, but would still not provide safe access during a 1% AEP flood (refer **Table 4**). Safe vehicular access would probably be possible in floods up to a 5% AEP severity while safe pedestrian access would be possible up to a flood between the 5% and 20% AEP severity.

Table 4 ACCESS HAZARDS AT DEANE STREET CROSSING (Velocity x Depth)

	Flood Severity (AEP)		
	1%	*3%*	*20%*
Existing Crossing	1.7	1.2	0.8
Upgraded Crossing	1.3	0.6	0.1

DESCRIPTION OF PROPOSED ACTIVITIES

The proposed crossing upgrade involves lengthening the bridge, to increase the opening from 8.7 m wide to 10 m wide, as shown in **Figure UNC1.1**. The opening is to be aligned with the creek channel in order to reduce the energy losses and to allow a reduction in the friction factor. The construction works would cause short term disruption to traffic and construction noise. These adverse effects could be minimised by appropriate control and programming of construction activities.

The lengthening of the Deane Street bridge requires the removal of three trees on the north eastern abutment and two small trees on the south eastern abutment. There are numerous other similar trees in the vicinity and removal of these introduced tree species is unlikely to cause a significant impact on the area. Replacement native trees should be planted alongside the new channel bank.

To maximise the benefit of flood mitigation measures, a program of regular inspection and maintenance is to be developed by Council. Regular inspection would ensure that the conveyance area of the underbridge waterway is not encroached upon by excessive vegetation or sedimentation, and would allow for monitoring of the stability of the creek banks adjacent to the bridge. Unstable or eroding surfaces in the creek are to be stabilised and maintained to prevent transportation of sediment into downstream areas.

An improvement which could be undertaken as part of maintenance works is the removal of the sediment obstruction on the eastern bank on the upstream side of the Deane Street bridge. This sediment obstructs flow and its removal would streamline flows under the existing bridge.

ECONOMIC ANALYSIS

The estimated cost of the bridge works is approximately $85,000 including allowances for contingencies, design and construction supervision. The estimated benefit cost ratio for the proposed work is 0.3. The benefits include the increased value of properties no longer flooded in the 1% AEP flood and the reduction in hazard of the bridge crossing as a result of the proposed work.

CONDITIONS FOR DEVELOPMENT

The following conditions apply to proposed development within this area:

- Any proposed future redevelopment of the shop property should place the shop out of the floodplain.

- Any proposed development work within the catchment that involves disturbance of the existing ground surface, placement of fill or that changes the rate and/or volume of local runoff, is required to include an approved Erosion and Sedimentation Control Plan in accordance with Council's Code of Practice on Erosion and Sedimentation Control.

CONCISE DESCRIPTION OF THE PLAN

A concise description of the Plan for the Deane Street Bridge is shown in **Table 5**. The components of the Plan include conditions for development, singular activities and ongoing activities. Conditions for development and ongoing activities are applicable from the date of implementation of the Plan. Singular activities, when completed, may require adjustment to be made to the Floodplain Management Plan, for example the flood extents may be altered and/or the activity description may be removed from the Plan.

Table 5 UNC1 DEANE STREET BRIDGE LENGTHENING

Concise Description of Plan
CONDITIONS: • Any proposed future development of the Narara General Store and Liquor Shop should include relocation of the shop out of the floodway. • All proposed developments will be subject to Council's Code of Practice for Erosion and Sedimentation Control. **ACTIVITIES:** • Conveyance area through the Deane Street Bridge to be improved by lengthening the bridge and accumulated sediment immediately upstream of the bridge to be removed. • A program of regular inspection and maintenance of the bridge conveyance area is to be instigated. • Bridge conveyance area is to be kept free of obstructions, including sediment and vegetation, by regular inspection and maintenance.

PRIORITY OF THE WORK

The bridge upgrade work is considered to be of medium priority because of the resultant significant reduction in flood access hazard along Deane Street.

The location of the Deane Street Bridge is shown in **Figure 4**. The Intermediate and Ultimate Floodplain Management Plans, showing the components of the Plan relating to this area, are presented in Drawing Numbers 4/136/A1, 4/137/A1, 4/138/A1 and 4/139/A1, which are attached.

UNC2 - NARARA VALLEY DRIVE BRIDGE

DESCRIPTION OF THE PROBLEM

The existing Narara Valley Drive culverts (refer **Figure 4**) are subject to blockage by debris washed down from the upstream catchment. This was most evident during the February 1992 flood event, where flood levels were exacerbated by debris trapped at the upstream end of the Narara Valley Drive culverts. The reduced flow area under Narara Valley Drive due to the culverts blocking, results in a backwater effect that increases flood levels immediately upstream of the culverts and causes flow over the top of the culverts, across Narara Valley Drive.

It is unlikely that measures could be taken to completely alleviate this potential blockage problem with the culverts. The existing culvert opening is approximately the same as the channel width and the culvert invert corresponds to the channel bed level leaving little scope for practical improvement to the flow area. The provision of debris traps further upstream would cause increased flood levels in upstream areas.

In order to overcome the debris blockage problem and reduce overtopping of the road during floods, the most appropriate upgrade option at this site would be a bridge with a higher road level than at present spanning the channel.

DISCUSSION

Provision of a high level bridge at the main creek crossing of Narara Valley Drive would reduce peak water levels just upstream of the bridge during a 1% AEP flood by up to 0.7 m, with the main benefit resulting from the low potential for blockage at the crossing. This improvement would alleviate above floor level inundation in seven (7) residences in the designated 1% AEP flood. The reduction in flood level diminishes in an upstream direction reducing to negligible values opposite Willari Avenue.

Another significant benefit of this option is the provision of floodfree access across the Narara Valley Drive crossing for residents in Koninderie Parade and connected streets during a 1% AEP flood. The increased road level of the bridge would provide safe pedestrian and vehicular access during floods and alleviate substantial social trauma and disruption associated with flood inundation of residences.

The construction of a bridge at the main creek crossing of Narara Valley Drive would not require removal of valuable vegetation nor impinge upon significant fauna habitats.

DESCRIPTION OF PROPOSED ACTIVITIES

The existing four cell culvert is to be replaced with a concrete bridge as shown in **Figure UNC2.1**. The proposed bridge spans the creek channel and has a deck invert level just above the predicted 1% AEP flood level of 8.5 m AHD. The road crest level on the bridge is

about 9.0 m AHD which is about 0.9 m above the existing road level. Roadworks are required either side of the bridge to regrade the approaches. The proposed bridge is about 22 metres long and 9 metres wide with rock protected abutments sloping at 1H:2V.

The construction works may cause short term disruptions to traffic and construction noise. These adverse effects can be minimised by appropriate control and programming of construction activities.

To maximise the benefit of flood mitigation measures, a program of regular inspection and maintenance is to be developed by Council. Regular inspection would ensure that the conveyance area of the underbridge waterway is not encroached upon by excessive vegetation or sedimentation, and would allow for monitoring of the stability of the creek banks adjacent to the bridge. Unstable or eroding surfaces in the creek are be stabilised and maintained to prevent transportation of sediment into downstream areas.

ECONOMIC ANALYSIS

The estimated cost of these works is approximately $445,000, including allowances for contingencies, design and construction supervision. This option has a benefit cost ratio of 0.5. The benefits include the increased value properties no longer flooded as a result of the proposed work.

Funding may be available from the Roads and Traffic Authority for the construction of the new bridge

CONDITIONS FOR DEVELOPMENT

Any proposed development work within the catchment that involves disturbance of the existing ground surface, placement of fill or that changes the rate and/or volume of local runoff, is required to include an approved Erosion and Sedimentation Control Plan in accordance with Council's Code of Practice on Erosion and Sedimentation Control.

CONCISE DESCRIPTION OF THE PLAN

A concise description of the Plan for the Narara Valley Drive bridge is shown in **Table 6**. The components of the Plan include conditions for development, singular activities and ongoing activities. Conditions for development and ongoing activities are applicable from the date of implementation of the Plan. Singular activities, when completed may require adjustment to be made to the Floodplain Management Plan, for example the flood extents may be altered and/or the activity description may be removed from the Plan.

Table 6 UNC2 NARARA VALLEY DRIVE BRIDGE

Concise Description of Plan
CONDITIONS: • All proposed developments will be subject to Council's Code of Practice for Erosion and Sedimentation Control. **ACTIVITIES:** • The existing culverts are to be replaced by a high level concrete bridge. • A program of regular inspection and maintenance of the bridge conveyance area is to be instigated. • Bridge conveyance area is to be kept free of obstructions, including sediment and vegetation, by regular maintenance.

PRIORITY OF THE WORK

The work is considered to be of high priority due to the resulting significant reduction in flood levels upstream of the bridge and the improvement in flood free access.

The location of the Narara Valley Drive bridge is shown in **Figure 4**. The Intermediate and Ultimate Floodplain Management Plans, showing the components of the Plan relating to this area, are presented in Drawing Numbers 4/136/A1, 4/137/A1, 4/138/A1 and 4/139/A1, which are attached.

UNC3 - KONINDERIE PARADE CHANNEL IMPROVEMENT AREA

DESCRIPTION OF THE PROBLEM

There is considerable accretion of sediments in the Niagara Park Branch of Narara Creek, in the section of channel running parallel to Koninderie Parade (refer **Figure 4**). The sediment shoaling reduces the available flow area and has a significant impact on raising flood levels in this vicinity. Clearing and widening of the channel would increase the flow area and significantly reduce the incidence of flooding in the Koninderie Parade area.

Just upstream of Koninderie Parade, the flow path in a 1% AEP flood event splits, with a breakout path flowing through the reserve behind 33 to 47 Koninderie Parade and re-entering the main creek via Willari Avenue (refer **Figure 4**). The flow conditions created by this breakout isolates a group of houses between the main creek and the breakout path, hindering safe access to and from these houses in times of flood as well as cutting off flood evacuation routes.

Contributing to this problem is a piped flow entering the reserve from Narara Valley Drive. This pipe discharges into an open drain across the reserve where it re-enters a pipe culvert flowing under 43 Koninderie Parade to finally discharge into the main creek.

DISCUSSION

For a 1% AEP flood, the clearing and widening of the channel causes a significant reduction in flood levels of up to 0.5 m. The decrease in flood levels extends from the Narara Valley Drive crossing to upstream of Haggerty Close. The channel works appear to cause a draw down of flood levels which extends upstream of the improvement works. To maximise the benefit of flood mitigation measures, adequate funding must be made available for continued inspection and maintenance of this section of the creek to ensure that the creek remains free of sediment and debris.

The channel works, assuming that the Narara Valley Drive culverts remain in place, would alleviate above floor inundation in three (3) residences *(out of 8 for existing conditions, excluding Tributary B flooding)*. The five (5) residences which would still remain affected are located towards the downstream end of the Koninderie channel and are potentially affected by backwater flooding due to blockage of the Narara Valley Drive culverts prior to the culverts being upgraded. Nonetheless, the channel improvements and maintenance works will reduce the likelihood of blockages of the Narara Valley Drive culverts in the future.

The combination of the Koninderie Parade channel improvements and the Narara Valley Drive bridge upgrade alleviates inundation above floor level in all residences (*excluding Tributary B flooding*).

The future construction of the north-south freeway bypass may have a significant effect on drainage and flooding in the Koninderie Parade area. This impact should be examined when the appropriate authority is considering the feasibility of such a project.

DESCRIPTION OF PROPOSED ACTIVITIES

Channel improvements in this area include clearing of sediment and weeds and a minor widening of the channel along the length of Koninderie Parade. The newly constructed banks are to be vegetated to stabilise the surface. Where required, rock protection is to be constructed to provide additional bank stabilisation, and rock bars at regular intervals may be used to define the base of the creek and to assist maintenance of the creek. The construction works may cause short term disruptions to traffic and construction noise. These adverse effects can be minimised by appropriate control and programming of construction activities.

The creek channel along Koninderie Parade has been invaded by many weed species and the clearing of accumulated debris and reformation of the eastern channel banks offers the opportunity to replant the banks with native species indigenous to the area. Young eucalypt trees have been planted at regular intervals along the grass nature strip on top of the western bank. The clearing of sediment from the channel using an excavator located on the western bank will require removal of some of these young trees. The number to be removed could be minimised by judicious placement of the excavator. Given the young age of the trees, any trees which were removed could be either transplanted or replaced with advanced tree stock. It would be necessary however in any replanting works to be mindful of the need to have access for possible similar future maintenance works. It would be necessary for Council to maintain the channel in its improved condition.

To improve flood access to the Koninderie Parade and Willari Avenue houses that are surrounded by flood waters due the breakout flow path, a small levee is to be constructed in the reserve behind Koninderie Parade. The levee will prevent flows splitting upstream of Koninderie Parade and will direct flow into the main creek channel running alongside Koninderie Parade. The open channel between the pipe culverts in the reserve is to be converted to a pipe to further contain flows in this area.

A flood evacuation route is to be provided for the residents in Willari Avenue and Apara Close, by constructing a low key road between Willari avenue and Haggerty Close to be used in times of flood.

To maximise the benefit of flood mitigation measures, a program of regular inspection and maintenance is to be developed by Council. Regular inspection would ensure that the channel conveyance area is not encroached upon by excessive vegetation or sedimentation, and would allow for monitoring of the stability of the creek. Unstable or eroding surfaces in the creek are to be stabilised and maintained to prevent transportation of sediment into downstream areas.

ECONOMIC ANALYSIS

The estimated cost of the channel improvement works is approximately $315,000, including allowances for contingencies, design and construction supervision. The option has a benefit

cost ratio of 0.5 and would markedly reduce the social trauma and disruption associated with floods. The benefits include the increased value properties no longer flooded as a result of the proposed work.

CONDITIONS FOR DEVELOPMENT

The Koninderie Parade channel improvement area has been divided into floodway and flood-fringe areas for the assignment of development conditions. The following conditions apply to proposed development within these areas:

- The floodway is to be permanently maintained so that there would be no significant development within the floodway to reduce the future capacity of the floodway.
- All land uses in the floodway are to be flood compatible.
- No filling and/or construction of structures, such as houses, garages, fences, in the floodway is to be permitted in future.
- No construction of service lines such as water, sewer, power and gas, in the floodway is to be permitted in the future, unless it could be demonstrated that the proposed works would have no adverse impact on the floodway.
- Any proposed work within the floodway that involves disturbance of the existing ground surface shall be backfilled and/or stabilised at the completion of each day's work.
- No debris, including cleared vegetation and construction materials, or sediment is to be stored or stockpiled within the floodway.
- Future building work in the flood fringe area, including house constructions or extensions, is to be constructed at a level above the 1% AEP flood level plus an additional 0.5 metre freeboard allowance. A freeboard of 0.5 metres would also prevent buildings being inundated in the Probable Maximum Flood (PMF) in most areas.
- Any redevelopment of properties in the flood fringe area should satisfactorily address the issue of safe flood access.
- Any proposed development work within the catchment that involves disturbance of the existing ground surface, placement of fill or that changes the rate and/or volume of local runoff, is required to include an approved Erosion and Sedimentation Control Plan in accordance with Council's Code of Practice on Erosion and Sedimentation Control.

CONCISE DESCRIPTION OF THE PLAN

A concise description of the Plan for the Koninderie Parade Channel Improvement area is shown in **Table 7**. The components of the Plan include conditions for development, singular activities and ongoing activities. Conditions for development and ongoing activities are

applicable from the date of implementation of the Plan. Singular activities, when completed may require adjustment to be made to the Floodplain Management Plan, for example the flood extents may be altered and/or the activity description may be removed from the Plan.

Table 7 UNC3 KONINDERIE PARADE CHANNEL IMPROVEMENT AREA

Concise Description of Plan

CONDITIONS:

- The floodway is to be maintained in perpetuity for the passage of floodwaters and all land uses are to be flood compatible.
- No work that would impair the passage of floodwaters is to be permitted in the floodway.
- Building and filling is prohibited in the floodway.
- Fences or rigid paling, chainwire or similar construction likely to collect debris and/or impair floodwaters are not permitted in the floodway.
- Proposals to cross the floodway with services may be permitted, provided that the proposals were adequately investigated and designed in a manner that did not significantly affect flood-flow capacity and levels.
- Any proposed work within the floodway that involves disturbance of the existing ground surface shall be backfilled and/or stabilised at the completion of each day's work.
- No debris or sediment is to be stored or stockpiled within the floodway.
- Special building provisions are be implemented for future construction work in the flood fringe area, to maintain floor levels above the 1% AEP flood level.
- Any redevelopment of properties in the flood fringe area should satisfactorily address the issue of safe flood access.
- All proposed developments will be subject to Council's Code of Practice for Erosion and Sedimentation Control.

ACTIVITIES:

- The conveyance area of the Niagara Park Branch of Narara Creek is to be increased by widening the channel.
- Sections of rock protected bank are to be incorporated and a managed revegetation program implemented, to improve the stability and appearance of the creek.
- A small levee is to be constructed in the reserve behind Koninderie Parade and the open channel across the reserve converted to a pipe culvert, to reduce flow through the reserve and improve flood access.
- A low key access road is to be constructed between Willari Avenue and Haggerty Close, to facilitate flood evacuation.
- A program of regular inspection and maintenance of the bridge conveyance area is to be instigated.
- Channel conveyance area is to be kept free of obstructions, including vegetation and sediment, by regular inspection and maintenance.

PRIORITY OF THE WORK

The channel work is considered to be of high priority due to the number of houses that would benefit, the relatively low cost of the works and the high benefit cost ratio.

The location of the Koninderie Parade Channel Improvement area is shown schematically in **Figure 4**. The Intermediate and Ultimate Floodplain Management Plans, showing the

components of the Plan relating to this area, are presented in Drawing Numbers 4/136/A1, 4/137/A1, 4/138/A1 and 4/139/A1, which are attached.

UNC4 - FORMALISE FLOOD FLOWS ACROSS NARARA VALLEY DRIVE AT YURUNGA AVENUE

DESCRIPTION OF THE PROBLEM

At present there is a 1.8 m diameter pipe which transfers flow from Tributary B, under Narara Valley Drive, Koninderie Parade and the properties in between, and discharges into Narara Creek (refer **Figure 4**). It is understood that in previous floods, floodwaters from Tributary B have overtopped Narara Valley Drive, knocked over timber fences on downstream properties and caused flooding above floor levels.

Local residents have indicated that floodwaters from Tributary B arrive prior to those in the main channel, which has subsequently been verified by hydraulic modelling. Residents have experienced inundation from floodwaters overflowing from Tributary B while waters in the Koninderie Parade channel have not overtopped the banks. Overflows from Tributary B tend to fan out as they flow towards the channel, affecting up to eight (8) properties in the Yurunga Avenue area.

DISCUSSION

A number of options for transferring floodwaters from Tributary B to the creek without causing inundation of residences around Yurunga Avenue were considered in the Floodplain Management Study. Options included large underground pipes and culverts extending from upstream of Narara Valley Drive to the creek, overflow paths between residences on private property and an overflow path on properties that have been voluntarily purchased by Council.

The preferred option recommended in the Floodplain Management Study, based on capital cost, risk of blockage and impact on Narara Creek, was to purchase two residences *(No. 17 Koninderie Pde and 83 Narara Valley Drive)* and form an overland flow path, consisting of a swale formed at grade and brick walls channelling flow to Koninderie Pde. The residences on these properties are the worst affected by flows from Tributary B over Narara Valley Drive. The overland flow path option for flows from Tributary B near Yurunga Ave would alleviate flooding problems from this source and overcome the potential for blockages of inlet pipes.

For the 1% AEP flood, it is estimated that the flow depth in a 20 m wide overland flow path would be approximately 0.65 m with a velocity of above 0.6 m/s. This represents a low flood hazard rating according to the NSW Floodplain Development Manual. The construction of the overland flow path would alleviate above floor inundation in the eight (8) residences currently affected by the 1% AEP event.

The future construction of the north-south freeway bypass may have a significant effect on drainage and flooding in this area. This impact should be examined when the appropriate authority is considering the feasibility of such a project

DESCRIPTION OF PROPOSED ACTIVITIES

An overland flow path is to be constructed which includes a swale at existing ground level with impermeable brick walls either side to channel the overflows. The wall is to extend from Yurunga Ave northwards and turn east along the southern boundaries of 17 Koninderie and 83 Narara Valley Drive. The brick wall is to be about 1.2 m high.

This option requires the purchase of 17 Koninderie Parade and 83 Narara Valley Drive but would alleviate inundation of the adjacent residences from the overflows. Vehicular access to 2 Yurunga Ave is to be relocated from Narara Valley Drive to Yurunga Ave and the driveway of 85 Narara Valley Drive requires realignment.

Further upgrading would be possible in the future to construct a pipe through this alignment to convey all design flows from this tributary under Narara Valley Drive and into the main creek channel, thereby creating flood free access across Narara Valley Drive.

To maximise the benefit of flood mitigation measures, a program of regular inspection and maintenance is to be developed by Council. Regular inspection would ensure that the overflow path is not encroached upon by excessive vegetation or sedimentation, and would allow for monitoring of the stability of the flowpath. The brick fences forming the overland flow path are to be maintained to ensure that the potential for breakouts onto adjacent properties is minimised. Inspection is to include the creek upstream of Narara Valley Drive. Unstable or eroding surfaces are be stabilised and maintained, without delay, to prevent transportation of sediment into downstream areas.

ECONOMIC ANALYSIS

The capital cost of constructing the overland flow path is approximately $313,000, including allowances for contingencies, design and construction supervision. This option has a benefit cost ratio of 0.8 and would relieve the substantial social trauma and disruption which is associated with the regular overtopping of Narara Valley Drive. The benefits include the increased value of properties no longer flooded as a result of the proposed work.

CONDITIONS FOR DEVELOPMENT

The following conditions apply to proposed development within this area:

- Future building work, including house constructions or extensions, is to be constructed at a level above the 1% AEP flood level plus an additional 0.5 metre freeboard allowance. A freeboard of 0.5 metres would also prevent buildings being inundated in the Probable Maximum Flood (PMF) in most areas.

- Any redevelopment of properties should satisfactorily address the issue of safe flood access.

- No structures which would significantly impede flood flows should be placed in the overland flow path.

- Any proposed development work within the catchment that involves disturbance of the existing ground surface, placement of fill or that changes the rate and/or volume of local runoff, is required to include an approved Erosion and Sedimentation Control Plan in accordance with Council's Code of Practice on Erosion and Sedimentation Control.

CONCISE DESCRIPTION OF THE PLAN

A concise description of the Plan for the formalisation of flow across Narara Valley Drive at Yurunga Avenue is shown in **Table 8**. The components of the Plan include conditions for development, singular activities and ongoing activities. Conditions for development and ongoing activities are applicable from the date of implementation of the Plan. Singular activities, when completed may require adjustment to be made to the Floodplain Management Plan, for example the flood extents may be altered and/or the activity description may be removed from the Plan.

Table 8 UNC4 FORMALISE FLOOD FLOW ACROSS NARARA VALLEY DRIVE AT YURUNGA AVENUE

Concise Description of Plan
CONDITIONS: • Special building provisions are to be implemented for future construction work to maintain floor levels above the 1% AEP flood level. • Any redevelopment of properties should satisfactorily address the issue of safe flood access. • No structures which would significantly impede flood flows should be placed in the overland flow path. • All proposed developments will be subject to Council's Code of Practice for Erosion and Sedimentation Control. **ACTIVITIES:** • Two flood effected houses are to be acquired to make way for the overland flow path. • An overland flow path is to be constructed to channel flood waters from Narara Valley Drive to the main Niagara Park Branch of Narara Creek. • A program of regular inspection and maintenance of the overflow path and upstream creek is to be instigated. • Channel conveyance area is to be kept free of obstructions, including vegetation and sediment, by regular inspection and maintenance.

PRIORITY OF THE WORK

The work is considered to be of high priority due to the significant reduction in the extent of residences experiencing flood inundation.

The location of the formalisation of flood flow across Narara Valley Drive at Yurunga Avenue area is shown schematically in **Figure 4**. The Intermediate and Ultimate Floodplain

Management Plans, showing the components of the Plan relating to this area, are presented in Drawing Numbers 4/136/A1, 4/137/A1, 4/138/A1 and 4/139/A1, which are attached.

UNC5 - UPSTREAM CATCHMENT

DESCRIPTION OF THE PROBLEM

The catchment upstream of the area covered by the Floodplain Management Plan study area consists of some large lots and there are pressures from private developers and Government bodies to develop parts of the catchment. Analyses have shown, however, that unregulated development has the potential to increase flooding and decrease water quality in the downstream areas of the catchment. In order to permit future development of the upstream catchment, consideration must be given to the potential impacts of development on downstream areas.

DISCUSSION

Urbanisation of the upper catchment of the Niagara Park Branch of Narara Creek will partially alleviate the demand for housing blocks in the future. However, uncontrolled urbanisation has the potential to increase flow volumes and flood levels in downstream areas, and to increase sediment loads and debris in downstream waterways. It would be possible to permit upstream development through construction of water retention structures (retarding basins) and soft engineering works along the creek corridors. Such works will need to be environmentally sensitive, and should also incorporate water quality improvement measures.

DESCRIPTION OF PROPOSED ACTIVITIES

Urbanisation of the upstream catchment will only be permitted if the impact of development on downstream flooding is not exacerbated. Prior to approval, a Flood Study must be undertaken for all significant development and the following constraints must be included:

- floodway areas remain undeveloped;
- proposed floodplain use must be flood compatible.
- flood flows and flood levels are not to be increased as a result of development;
- water quality must not be decreased as a result of development, and
- the use of soft engineering approaches are to be used where possible to mitigate the effects of development.

ECONOMIC ANALYSIS

The cost of Flood Studies and works would be borne by the developer.

CONDITIONS FOR DEVELOPMENT

The following conditions apply to proposed development within this area:

- future development will only be permitted if it is shown that the proposed development does not negatively impact on downstream areas of the catchment;
- development within the defined floodway will not be permitted and all uses of the floodplain must be flood compatible.

CONCISE DESCRIPTION OF THE PLAN

A concise description of the Plan for the upstream catchment is shown in **Table 9**.

Table 9 UNC5 UPSTREAM CATCHMENT

Concise Description of Plan
CONDITIONS: • Future development will only be permitted if it is shown that the proposed development does not negatively impact on downstream areas of the catchment • Development within the defined floodway will not be permitted • All proposed use of the floodplain must be flood compatible **ACTIVITIES:** • All significant proposed development must be accompanied by an Assessment Report, showing the hydrologic and hydraulic impacts of development on the downstream catchment and the measures proposed to mitigate those impacts.

PRIORITY OF THE WORK

Development proposals in the upstream catchment could be evaluated as they arise. As long as proposals are accompanied by the necessary documentation, and it is shown that development would not adversely impact on the downstream catchment, then proposals could be approved and the development implemented by the developer. A priority is therefore not considered relevant for this option.

The location of the upstream catchment is shown schematically in **Figure 4**. The Intermediate and Ultimate Floodplain Management Plans, showing the components of the Plan relating to this area, are presented in Drawing Numbers 4/136/A1, 4/137/A1, 4/138/A1 and 4/139/A1, which are attached.

PRIORITY OF ACTIONS

The proposed staging of actions is consistent with the provision of a reduced flood hazard and implementation of the plan as a whole. The proposed priority of actions is given in **Table 10**. This table is given as a guide; should Council have the funding available at any time then the lower priority actions could be undertaken to make use of the financial resources available.

Table 10 PRIORITY OF ACTIONS

Priority	*Item*	*Estimated Cost ($1994)*	*Total Benefit Cost Ratio*
High	Formalise flood flow across Narara Valley Drive at Yurunga Avenue	313,000	0.8
High	Koninderie Parade channel improvement	315,000	0.5
High	Replace culverts under Narara Valley Drive	445,000	0.5
High	Introduce appropriate planning controls	n/a*	n/a*
Medium	Deane Street bridge lengthening	85,000	0.3
Medium	Levee construction and pipe work in the reserve behind Koninderie Parade	50,000	0.1
Medium	Bank stabilisation between Narara Valley Drive bridge and Deane Street bridge	100,000	0.1
Medium	Bank stabilisation upstream of Koninderie Parade	100,000	0.1
Low	Bridge over Tributary A at the Hanlan Street South crossing	280,000	0.1
Low	Low key access road between Willari Avenue and Haggerty Close	50,000	0.1
Low	Prepare a Flood Evacuation Plan for the Koninderie Parade area and the areas west of the Deane Street crossing	20,000	n/a*

* n/a - not applicable

REFERENCES

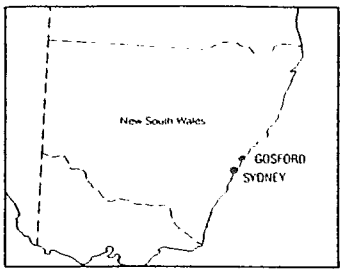
Reference 1 Upper Narara Creek Flood Study, Kinhill, 1993

Reference 2 Upper Narara Creek Floodplain Management Study, Patterson Britton, 1995

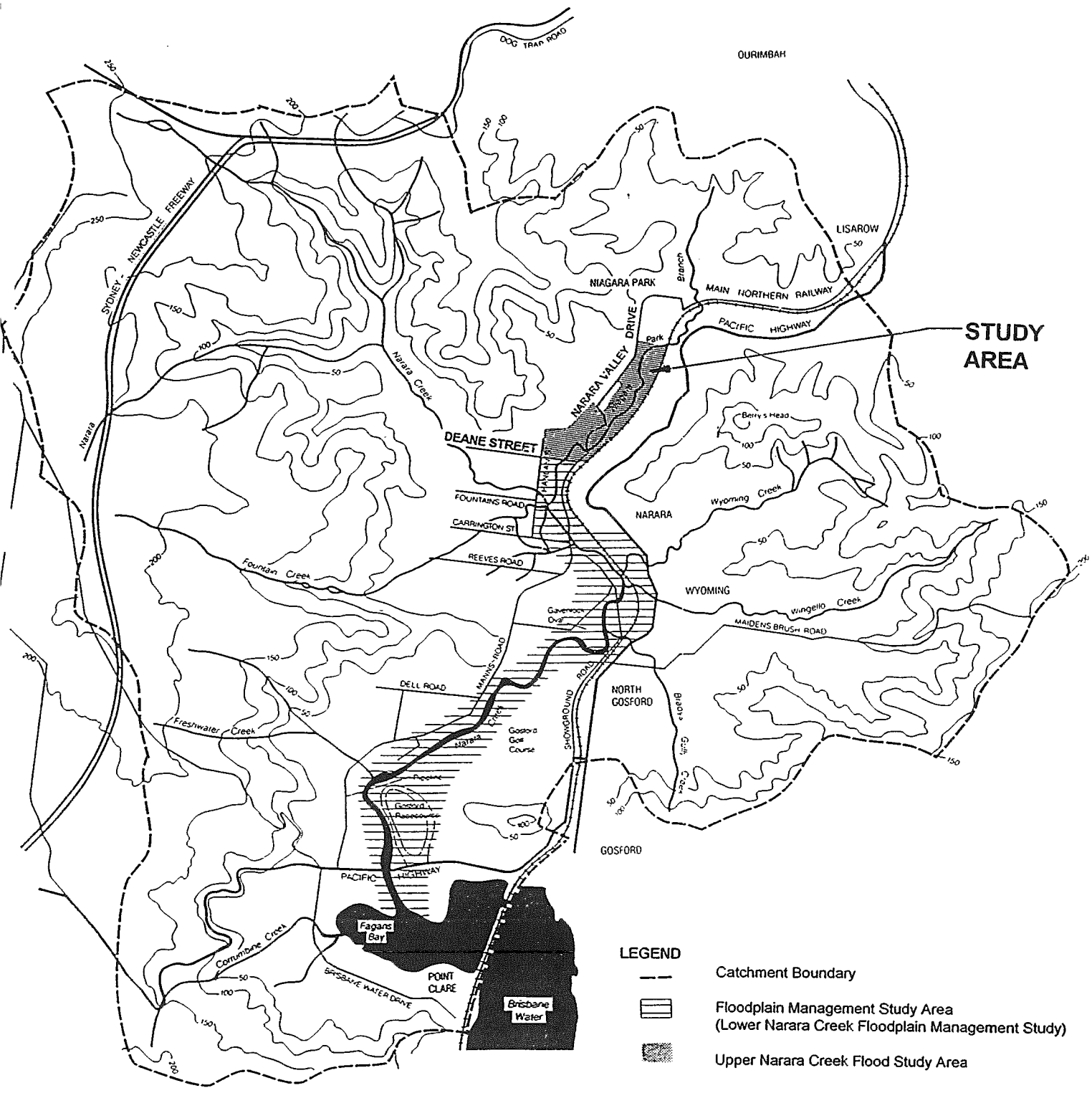
Reference 3 Floodplain Development Manual, PWD, 1986

FIGURES

FIGURE 1



LOCALITY PLAN



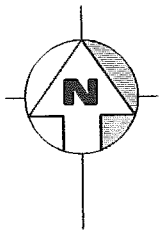
SOURCE: UPPER NARARA CREEK FLOOD STUDY

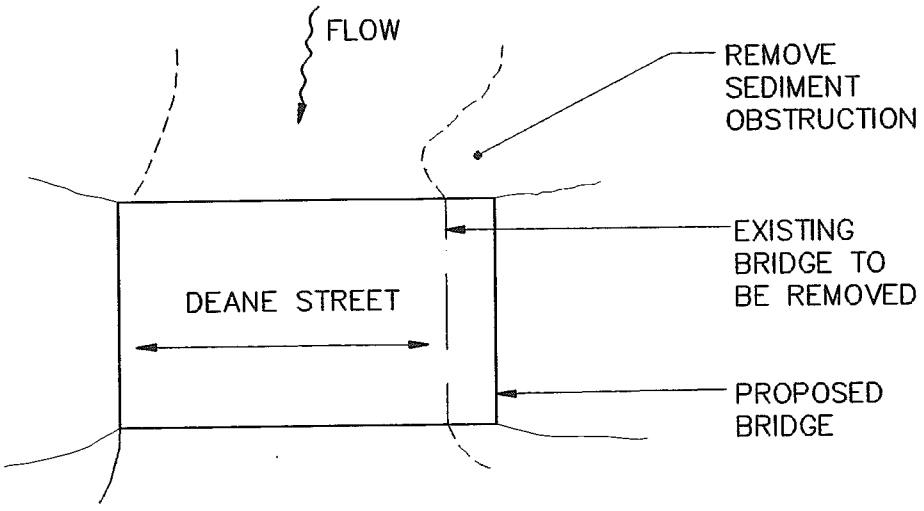
PATTERSON BRITTON AND PARTNERS

J1792/R1164

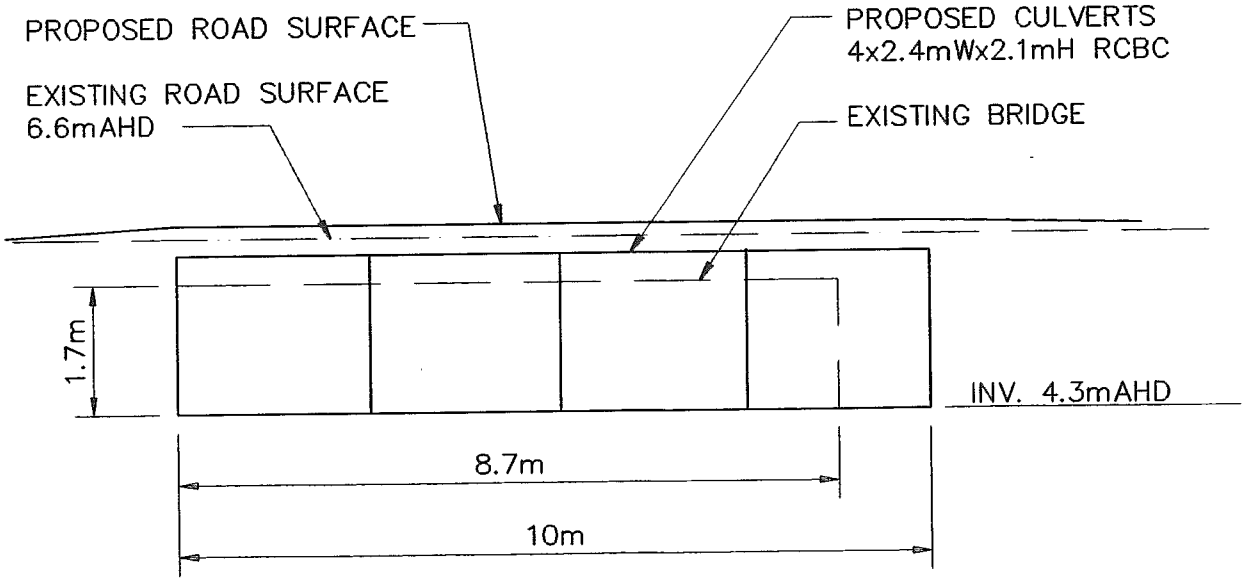
LOCALITY PLAN

FIGURE UNC1.1





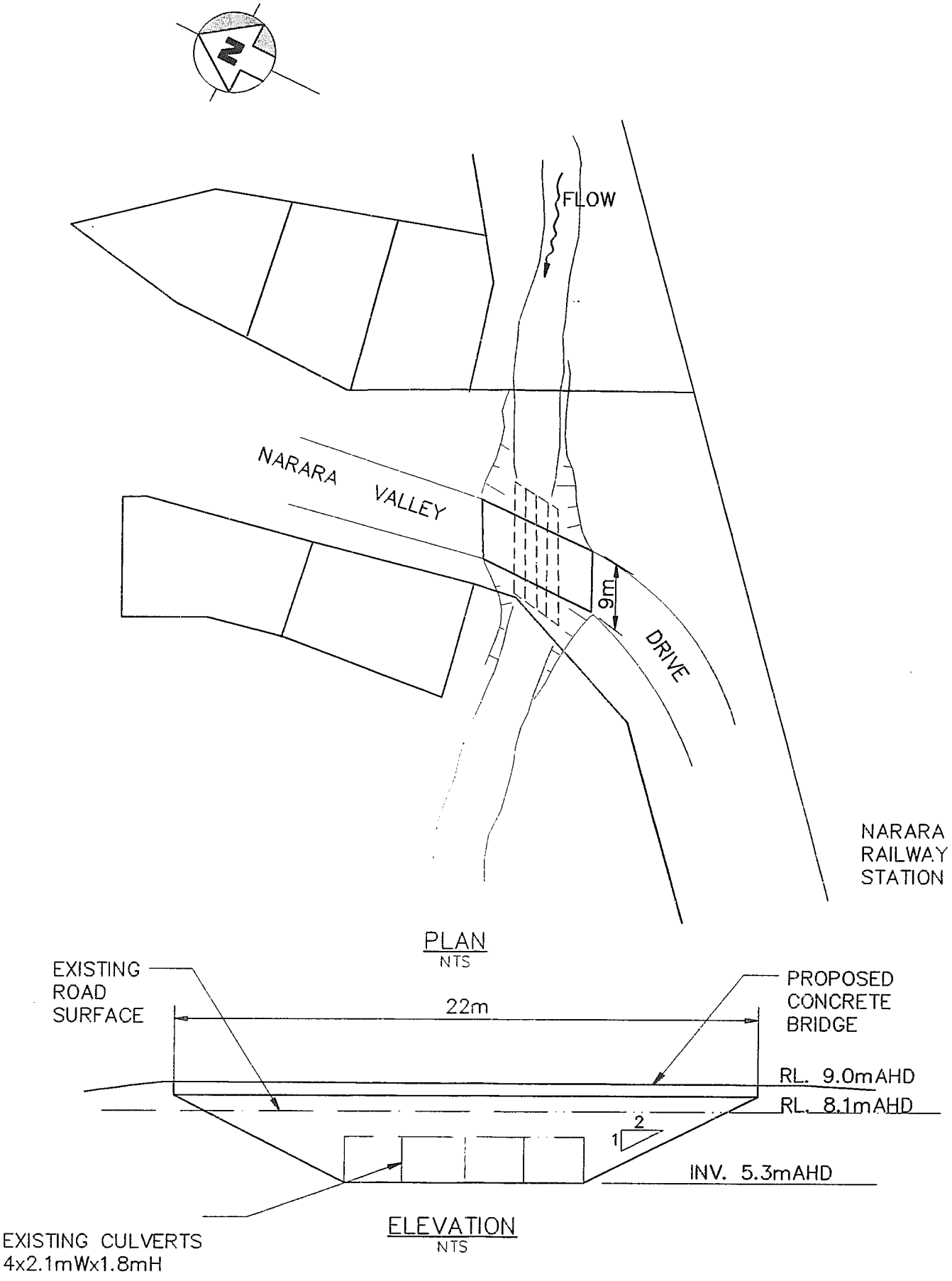
PLAN
NTS



ELEVATION
NTS

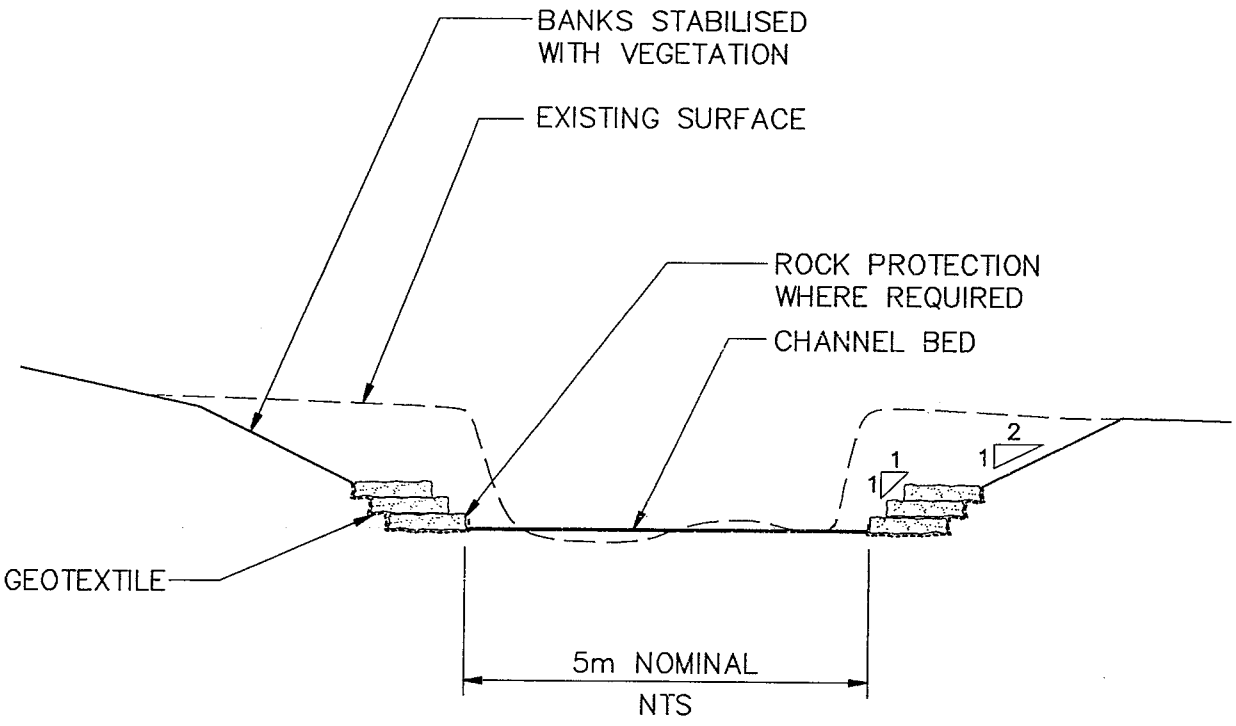
DEANE STREET BRIDGE LENGTHENING

FIGURE UNC2.1



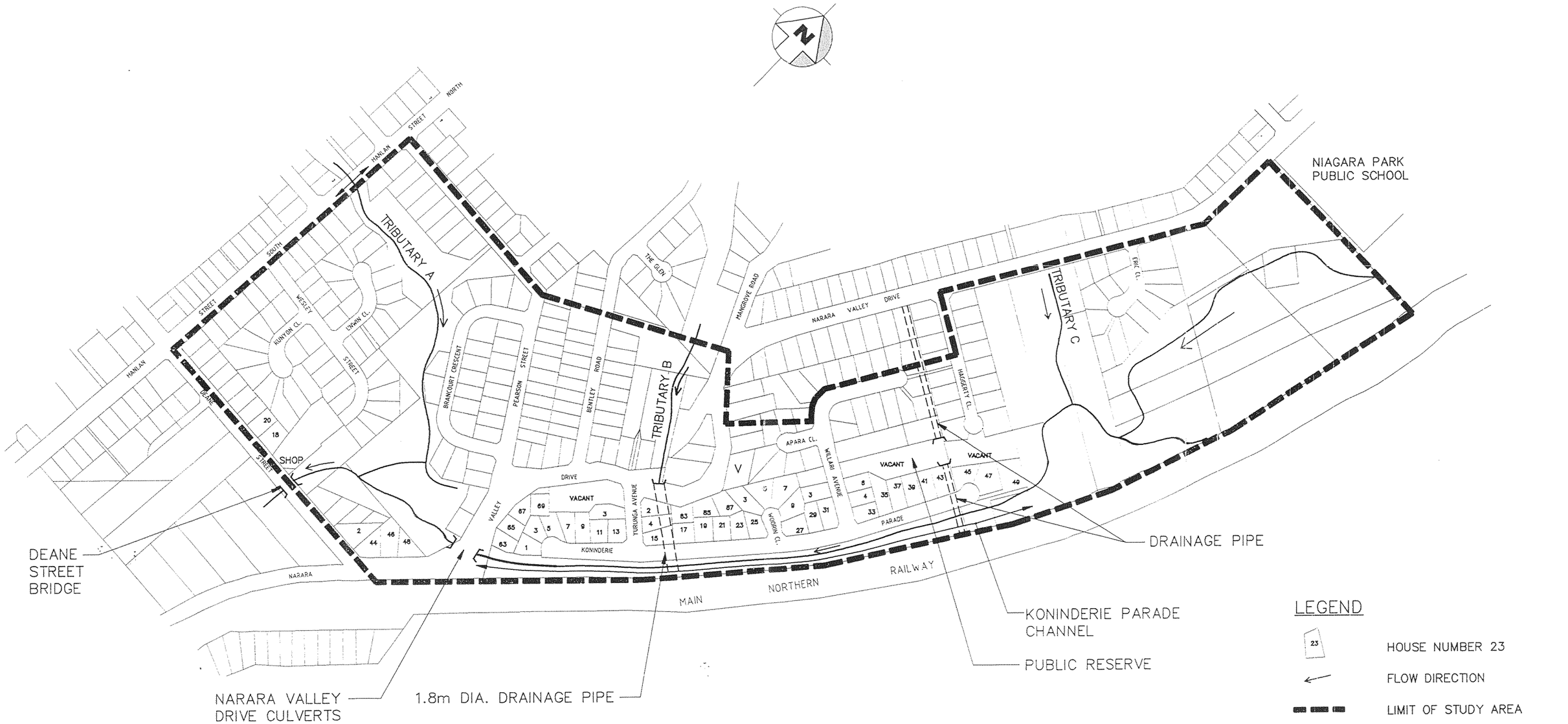
NARARA VALLEY DRIVE BRIDGE

FIGURE UNC3.1



KONINDERIE PARADE CHANNEL IMPROVEMENT

FIGURE 2



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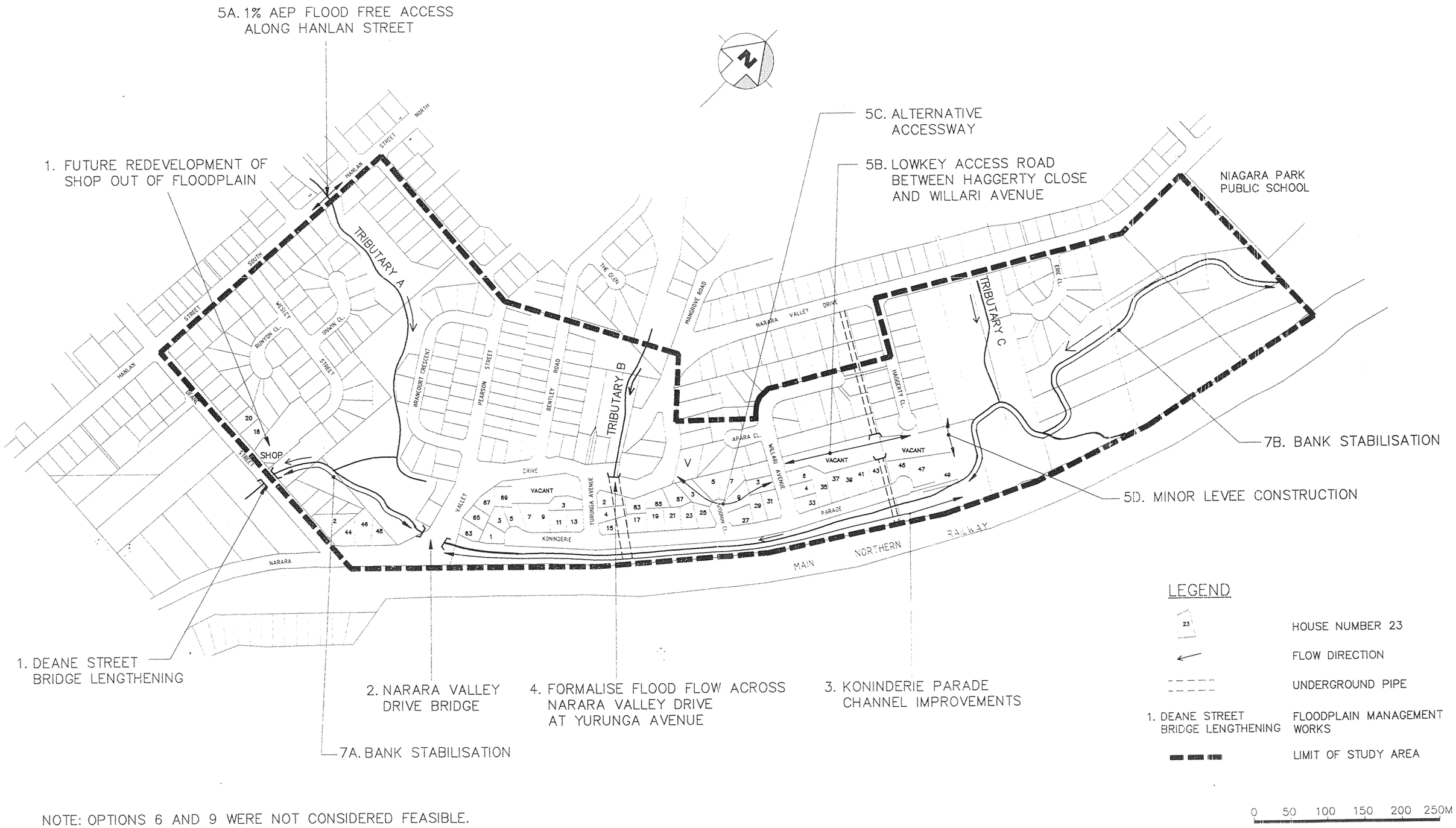
UPPER NARARA CREEK STUDY AREA

FIGURE 3



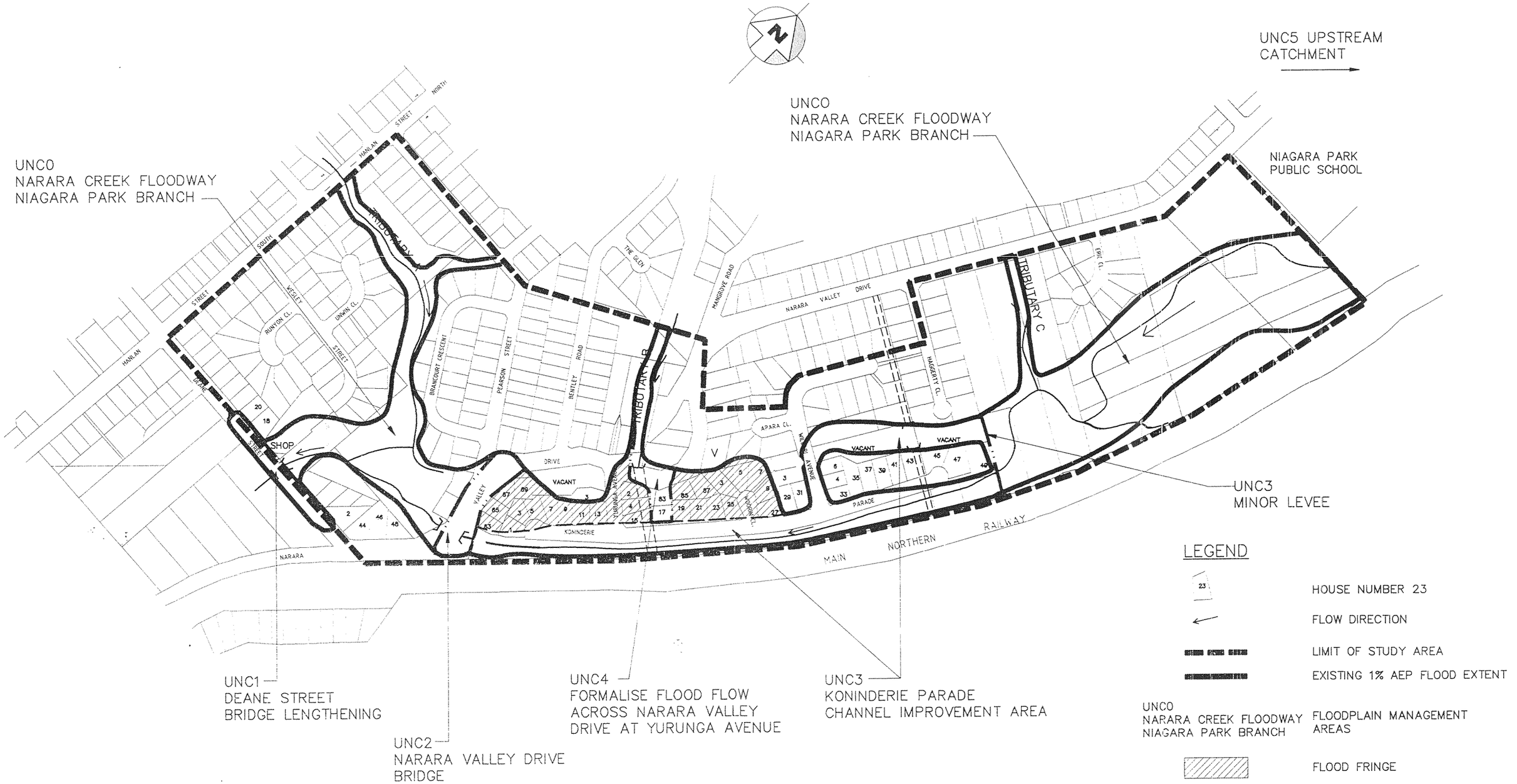
NOTE: OPTIONS 6 AND 9 WERE NOT CONSIDERED FEASIBLE.
SEE MANAGEMENT STUDY FOR DETAILS

PATTERSON BRITTON AND PARTNERS

J1792/R1164

UPPER NARARA CREEK FLOODPLAIN MANAGEMENT WORKS

FIGURE 4



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J1792/R1164

UPPER NARARA CREEK FLOODPLAIN AREAS

GOSFORD CITY COUNCIL

UNC0 - NARARA CREEK FLOODWAY, NIAGARA PARK BRANCH

CONDITIONS:

- THE FLOODWAY IS TO BE MAINTAINED IN PERPETUITY FOR THE PASSAGE OF FLOODWATERS AND ALL LAND USES ARE TO BE FLOOD COMPATIBLE.
- NO WORK THAT WOULD IMPAIR THE PASSAGE OF FLOODWATERS IS TO BE PERMITTED IN THE FLOODWAY.
- BUILDING AND FILLING IS PROHIBITED IN THE FLOODWAY.
- FENCES OR RIGID PALING, CHAINWIRE OR SIMILAR CONSTRUCTION LIKELY TO COLLECT DEBRIS AND/OR IMPAIR FLOODWATERS ARE NOT PERMITTED IN THE FLOODWAY.
- PROPOSALS TO CROSS THE FLOODWAY WITH SERVICES MAY BE PERMITTED, PROVIDED THAT THE PROPOSALS WERE ADEQUATELY INVESTIGATED AND DESIGNED IN A MANNER THAT DID NOT SIGNIFICANTLY AFFECT FLOOD-FLOW CAPACITY AND LEVELS.
- ANY PROPOSED WORK WITHIN THE FLOODWAY THAT INVOLVES DISTURBANCE OF THE EXISTING GROUND SURFACE SHALL BE BACKFILLED AND/OR STABILISED AT THE COMPLETION OF EACH DAY'S WORK.
- NO DEBRIS OR SEDIMENT IS TO BE STORED OR STOCKPILED WITHIN THE FLOODWAY.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- BANK STABILISATION IS TO BE UNDERTAKEN BETWEEN NARARA VALLEY DRIVE BRIDGE AND DEANE STREET BRIDGE AND UPSTREAM OF KONINDERIE PARADE.
- A BRIDGE IS TO BE CONSTRUCTED OVER TRIBUTARY A WHERE IT CROSSES HANLAN STREET SOUTH TO FACILITATE FLOOD EVACUATION.
- A FLOOD EVACUATION PLAN SHOULD BE DEVELOPED, PARTICULARLY FOR THE KONINDERIE PARADE AREAS AND THE AREAS WEST OF THE DEANE STREET CROSSING.
- A PROGRAM OF REGULAR INSPECTION AND MAINTENANCE OF THE FLOODWAY AND CREEK IS TO BE INSTIGATED.
- THE FLOODWAY AND CREEK ARE TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING SEDIMENT AND VEGETATION, BY REGULAR INSPECTION AND MAINTENANCE.

UNC5 - UPSTREAM CATCHMENT

CONDITIONS:

- FUTURE DEVELOPMENT WILL ONLY BE PERMITTED IF IT IS SHOWN THAT THE PROPOSED DEVELOPMENT DOES NOT NEGATIVELY IMPACT ON DOWNSTREAM AREAS OF THE CATCHMENT.
- DEVELOPMENT WITHIN THE DEFINED FLOODWAY WILL NOT BE PERMITTED.
- ALL PROPOSED USE OF THE FLOODPLAIN MUST BE FLOOD COMPATIBLE.

ACTIVITIES:

- ALL SIGNIFICANT PROPOSED DEVELOPMENT MUST BE ACCOMPANIED BY AN ASSESSMENT REPORT, SHOWING THE HYDROLOGIC AND HYDRAULIC IMPACTS OF DEVELOPMENT ON THE DOWNSTREAM CATCHMENT AND THE MEASURES PROPOSED TO MITIGATE THOSE IMPACTS.

UNC4 - NARARA VALLEY DRIVE AT YURUNGA AVENUE

CONDITIONS:

- SPECIAL BUILDING PROVISIONS ARE TO BE IMPLEMENTED FOR FUTURE CONSTRUCTION WORK TO MAINTAIN FLOOR LEVELS ABOVE THE 1% AEP FLOOD LEVEL.
- ANY REDEVELOPMENT OF PROPERTIES SHOULD SATISFACTORILY ADDRESS THE ISSUE OF SAFE FLOOD ACCESS.
- NO STRUCTURES WHICH WOULD SIGNIFICANTLY IMPEDE FLOOD FLOWS SHOULD BE PLACED IN THE OVERLAND FLOW PATH.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- TWO FLOOD EFFECTED HOUSES ARE TO BE VOLUNTARY PURCHASED TO MAKE WAY FOR THE OVERLAND FLOW PATH.
- AN OVERLAND FLOW PATH IS TO BE CONSTRUCTED TO CHANNEL FLOOD WATERS FROM NARARA VALLEY DRIVE TO THE MAIN NIAGARA PARK BRANCH OF NARARA CREEK.
- A PROGRAM OF REGULAR INSPECTION AND MAINTENANCE OF THE OVERFLOW PATH AND UPSTREAM CREEK IS TO BE INSTIGATED.
- CHANNEL CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING VEGETATION AND SEDIMENT, BY REGULAR INSPECTION AND MAINTENANCE.

UNC3 - KONINDERIE PARADE CHANNEL IMPROVEMENT AREA

CONDITIONS:

- THE FLOODWAY IS TO BE MAINTAINED IN PERPETUITY FOR THE PASSAGE OF FLOODWATERS AND ALL LAND USES ARE TO BE FLOOD COMPATIBLE.
- NO WORK THAT WOULD IMPAIR THE PASSAGE OF FLOODWATERS IS TO BE PERMITTED IN THE FLOODWAY.
- BUILDING AND FILLING IS PROHIBITED IN THE FLOODWAY.
- FENCES OR RIGID PALING, CHAINWIRE OR SIMILAR CONSTRUCTION LIKELY TO COLLECT DEBRIS AND/OR IMPAIR FLOODWATERS ARE NOT PERMITTED IN THE FLOODWAY.
- PROPOSALS TO CROSS THE FLOODWAY WITH SERVICES MAY BE PERMITTED, PROVIDED THAT THE PROPOSALS WERE ADEQUATELY INVESTIGATED AND DESIGNED IN A MANNER THAT DID NOT SIGNIFICANTLY AFFECT FLOOD-FLOW CAPACITY AND LEVELS.
- ANY PROPOSED WORK WITHIN THE FLOODWAY THAT INVOLVES DISTURBANCE OF THE EXISTING GROUND SURFACE SHALL BE BACKFILLED AND/OR STABILISED AT THE COMPLETION OF EACH DAY'S WORK.
- NO DEBRIS OR SEDIMENT IS TO BE STORED OR STOCKPILED WITHIN THE FLOODWAY.
- SPECIAL BUILDING PROVISIONS ARE BE IMPLEMENTED FOR FUTURE CONSTRUCTION WORK IN THE FLOODFRINGE AREA, TO MAINTAIN FLOOR LEVELS ABOVE THE 1% AEP FLOOD LEVEL.
- ANY REDEVELOPMENT OF PROPERTIES IN THE FLOOD FRINGE AREA SHOULD SATISFACTORILY ADDRESS THE ISSUE OF SAFE FLOOD ACCESS.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- THE CONVEYANCE AREA OF THE NIAGARA PARK BRANCH OF NARARA CREEK IS TO BE INCREASED BY WIDENING THE CHANNEL.
- SECTIONS OF ROCK PROTECTED BANK ARE TO BE INCORPORATED AND A MANAGED REVEGETATION PROGRAM IMPLEMENTED, TO IMPROVE THE STABILITY AND APPEARANCE OF THE CREEK.
- A SMALL LEVEE IS TO BE CONSTRUCTED IN THE RESERVE BEHIND KONINDERIE PARADE AND THE OPEN CHANNEL ACROSS THE RESERVE CONVERTED TO A PIPE CULVERT, TO REDUCE FLOW THROUGH THE RESERVE AND IMPROVE FLOOD ACCESS.
- A LOW KEY ACCESS ROAD IS TO BE CONSTRUCTED BETWEEN WILLARI AVENUE AND HAGGERTY CLOSE, TO FACILITATE FLOOD EVACUATION.
- A PROGRAM OF REGULAR INSPECTION AND MAINTENANCE OF THE BRIDGE CONVEYANCE AREA IS TO BE INSTIGATED.
- CHANNEL CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING VEGETATION AND SEDIMENT, BY REGULAR INSPECTION AND MAINTENANCE.

LEGEND

▨	COUNCIL OWNED AREAS
━━	1% AEP FLOOD EXTENT
1.000 ──	CROSS SECTION
── 9.3	FLOOD CONTOUR INTERPOLATED BETWEEN CROSS SECTIONS

CENTRAL MAPPING AUTHORITY
MAP REFERENCE: GOSFORD U2797 - 22

FLOODPLAIN MANAGEMENT PLAN OVERLAY
PRODUCED FOR
GOSFORD CITY COUNCIL - MARCH 1995
CONSULTING ENGINEERS - PATTERSON
BRITTON & PARTNERS

NOTES

1. FLOOD LEVELS HAVE BEEN CALCULATED AT CROSS SECTION LOCATIONS ONLY.
2. FLOOD LEVELS AND FLOOD CONTOURS BETWEEN CROSS SECTIONS HAVE BEEN LINEARLY INTERPOLATED.
3. FLOOD CONTOURS DEPICT APPROXIMATE WIDTHS OF FLOODING ONLY.
4. FLOOD LIABILITY SHOULD BE VERIFIED BY GROUND SURVEY.
5. FLOOD LEVELS ARE GIVEN IN METRES TO AUSTRALIAN HEIGHT DATUM.
6. SIZES SHOWN ON THIS PLAN ARE APPROXIMATE ONLY AND DETAILS SHOULD NOT BE SCALED FROM THIS DRAWING FOR DETAILED DESIGN PURPOSES.

195C	195D	196C
212A	212B	213A
212C	212D	213C

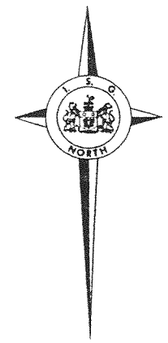
KEY TO ADJOINING SHEET

UPPER NARARA CREEK INTERMEDIATE FLOODPLAIN MANAGEMENT PLAN

COUNCIL DRAWING NUMBER 4/136/A1

212B

GOSFORD CITY COUNCIL



LEGEND

- COUNCIL OWNED AREAS
- 1% AEP FLOOD EXTENT
- 1.000 CROSS SECTION
- 8.4 FLOOD CONTOUR INTERPOLATED BETWEEN CROSS SECTIONS

CENTRAL MAPPING AUTHORITY
MAP REFERENCE: GOSFORD U2797 - 22

FLOODPLAIN MANAGEMENT PLAN OVERLAY
PRODUCED FOR
GOSFORD CITY COUNCIL - MARCH 1995
CONSULTING ENGINEERS - PATTERSON BRITTON & PARTNERS

NOTES

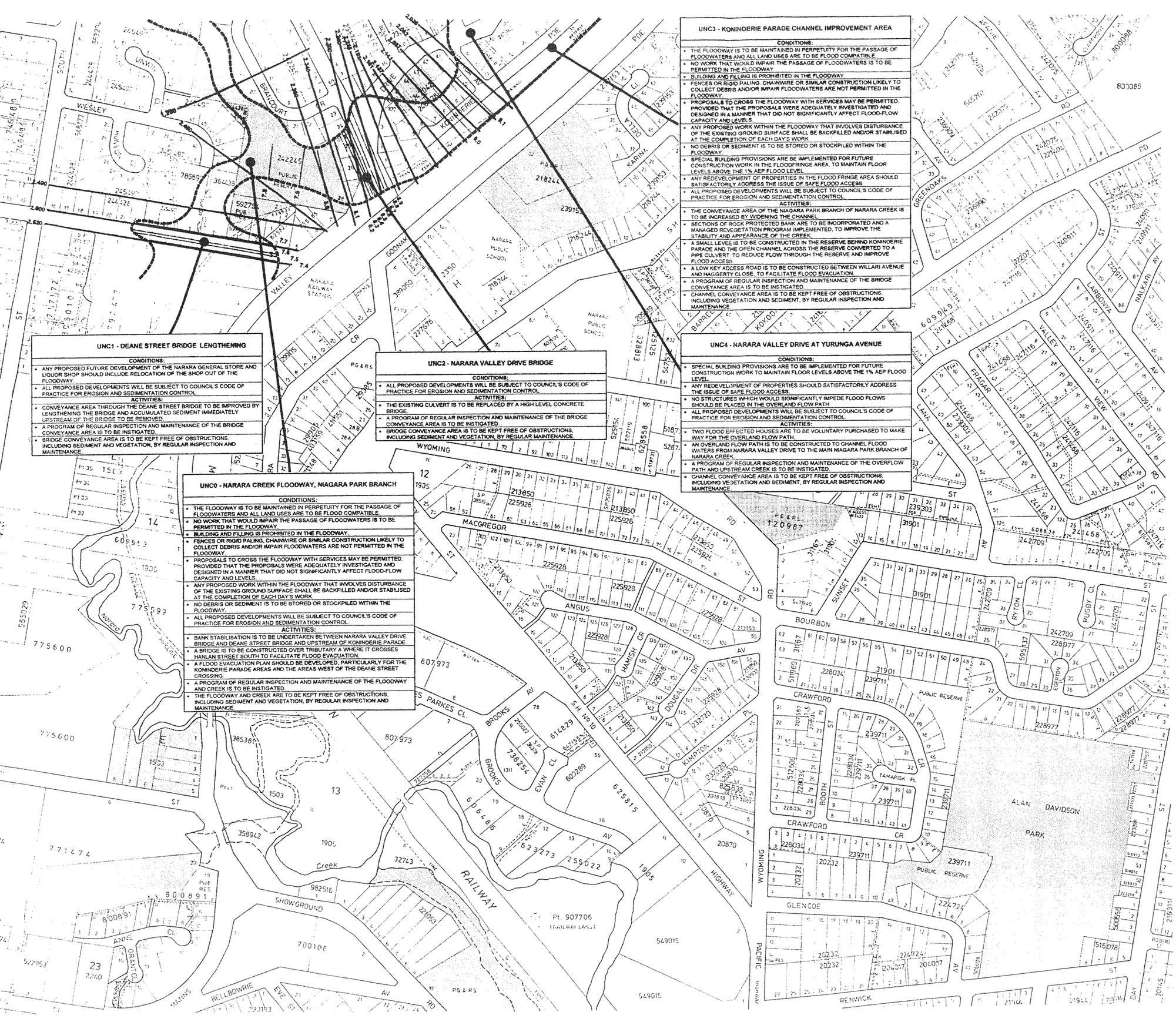
1. FLOOD LEVELS HAVE BEEN CALCULATED AT CROSS SECTION LOCATIONS ONLY.
2. FLOOD LEVELS AND FLOOD CONTOURS BETWEEN CROSS SECTIONS HAVE BEEN LINEARLY INTERPOLATED.
3. FLOOD CONTOURS DEPICT APPROXIMATE WIDTHS OF FLOODING ONLY.
4. FLOOD LIABILITY SHOULD BE VERIFIED BY GROUND SURVEY.
5. FLOOD LEVELS ARE GIVEN IN METRES TO AUSTRALIAN HEIGHT DATUM.
6. SIZES SHOWN ON THIS PLAN ARE APPROXIMATE ONLY AND DETAILS SHOULD NOT BE SCALED FROM THIS DRAWING FOR DETAILED DESIGN PURPOSES.

195C	195D	196C
212A	212B	213A
212C	212D	213C

KEY TO ADJOINING SHEET

UPPER NARARA CREEK ULTIMATE FLOODPLAIN MANAGEMENT PLAN

COUNCIL DRAWING NUMBER 4/137/A



UNC1 - DEANE STREET BRIDGE LENGTHENING

CONDITIONS:

- ANY PROPOSED FUTURE DEVELOPMENT OF THE NARARA GENERAL STORE AND LIQUOR SHOP SHOULD INCLUDE RELOCATION OF THE SHOP OUT OF THE FLOODWAY.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- CONVEYANCE AREA THROUGH THE DEANE STREET BRIDGE TO BE IMPROVED BY LENGTHENING THE BRIDGE AND ACCUMULATED SEDIMENT IMMEDIATELY UPSTREAM OF THE BRIDGE TO BE REMOVED.
- A PROGRAM OF REGULAR INSPECTION AND MAINTENANCE OF THE BRIDGE CONVEYANCE AREA IS TO BE INSTIGATED.
- BRIDGE CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING SEDIMENT AND VEGETATION, BY REGULAR INSPECTION AND MAINTENANCE.

UNC2 - NARARA VALLEY DRIVE BRIDGE

CONDITIONS:

- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- THE EXISTING CULVERT IS TO BE REPLACED BY A HIGH LEVEL CONCRETE BRIDGE.
- A PROGRAM OF REGULAR INSPECTION AND MAINTENANCE OF THE BRIDGE CONVEYANCE AREA IS TO BE INSTIGATED.
- BRIDGE CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING SEDIMENT AND VEGETATION, BY REGULAR MAINTENANCE.

UNC0 - NARARA CREEK FLOODWAY, NIAGARA PARK BRANCH

CONDITIONS:

- THE FLOODWAY IS TO BE MAINTAINED IN PERPETUITY FOR THE PASSAGE OF FLOODWATERS AND ALL LAND USES ARE TO BE FLOOD COMPATIBLE.
- NO WORK THAT WOULD IMPAIR THE PASSAGE OF FLOODWATERS IS TO BE PERMITTED IN THE FLOODWAY.
- BUILDING AND FILLING IS PROHIBITED IN THE FLOODWAY.
- FENCES OR RIGID PALING, CHAINWIRE OR SIMILAR CONSTRUCTION LIKELY TO COLLECT DEBRIS AND/OR IMPAIR FLOODWATERS ARE NOT PERMITTED IN THE FLOODWAY.
- PROPOSALS TO CROSS THE FLOODWAY WITH SERVICES MAY BE PERMITTED, PROVIDED THAT THE PROPOSALS WERE ADEQUATELY INVESTIGATED AND DESIGNED IN A MANNER THAT DID NOT SIGNIFICANTLY AFFECT FLOOD-FLOW CAPACITY AND LEVELS.
- ANY PROPOSED WORK WITHIN THE FLOODWAY THAT INVOLVES DISTURBANCE OF THE EXISTING GROUND SURFACE SHALL BE BACKFILLED AND/OR STABILISED AT THE COMPLETION OF EACH DAY'S WORK.
- NO DEBRIS OR SEDIMENT IS TO BE STORED OR STOCKPILED WITHIN THE FLOODWAY.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- BANK STABILISATION IS TO BE UNDERTAKEN BETWEEN NARARA VALLEY DRIVE BRIDGE AND DEANE STREET BRIDGE AND UPSTREAM OF KONINDERIE PARADE.
- A BRIDGE IS TO BE CONSTRUCTED OVER TRIBUTARY A WHERE IT CROSSES HANLAN STREET SOUTH TO FACILITATE FLOOD EVACUATION.
- A FLOOD EVACUATION PLAN SHOULD BE DEVELOPED, PARTICULARLY FOR THE KONINDERIE PARADE AREAS AND THE AREAS WEST OF THE DEANE STREET CROSSING.
- A PROGRAM OF REGULAR INSPECTION AND MAINTENANCE OF THE FLOODWAY AND CREEK IS TO BE INSTIGATED.
- THE FLOODWAY AND CREEK ARE TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING SEDIMENT AND VEGETATION, BY REGULAR INSPECTION AND MAINTENANCE.

UNC3 - KONINDERIE PARADE CHANNEL IMPROVEMENT AREA

CONDITIONS:

- THE FLOODWAY IS TO BE MAINTAINED IN PERPETUITY FOR THE PASSAGE OF FLOODWATERS AND ALL LAND USES ARE TO BE FLOOD COMPATIBLE.
- NO WORK THAT WOULD IMPAIR THE PASSAGE OF FLOODWATERS IS TO BE PERMITTED IN THE FLOODWAY.
- BUILDING AND FILLING IS PROHIBITED IN THE FLOODWAY.
- FENCES OR RIGID PALING, CHAINWIRE OR SIMILAR CONSTRUCTION LIKELY TO COLLECT DEBRIS AND/OR IMPAIR FLOODWATERS ARE NOT PERMITTED IN THE FLOODWAY.
- PROPOSALS TO CROSS THE FLOODWAY WITH SERVICES MAY BE PERMITTED, PROVIDED THAT THE PROPOSALS WERE ADEQUATELY INVESTIGATED AND DESIGNED IN A MANNER THAT DID NOT SIGNIFICANTLY AFFECT FLOOD-FLOW CAPACITY AND LEVELS.
- ANY PROPOSED WORK WITHIN THE FLOODWAY THAT INVOLVES DISTURBANCE OF THE EXISTING GROUND SURFACE SHALL BE BACKFILLED AND/OR STABILISED AT THE COMPLETION OF EACH DAY'S WORK.
- NO DEBRIS OR SEDIMENT IS TO BE STORED OR STOCKPILED WITHIN THE FLOODWAY.
- SPECIAL BUILDING PROVISIONS ARE BE IMPLEMENTED FOR FUTURE CONSTRUCTION WORK IN THE FLOODFRINGE AREA, TO MAINTAIN FLOOR LEVELS ABOVE THE 1% AEP FLOOD LEVEL.
- ANY REDEVELOPMENT OF PROPERTIES IN THE FLOOD FRINGE AREA SHOULD SATISFACTORILY ADDRESS THE ISSUE OF SAFE FLOOD ACCESS.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- THE CONVEYANCE AREA OF THE NIAGARA PARK BRANCH OF NARARA CREEK IS TO BE INCREASED BY WIDENING THE CHANNEL.
- SECTIONS OF ROCK PROTECTED BANK ARE TO BE INCORPORATED AND A MANAGED REVEGETATION PROGRAM IMPLEMENTED, TO IMPROVE THE STABILITY AND APPEARANCE OF THE CREEK.
- A SMALL LEVEE IS TO BE CONSTRUCTED IN THE RESERVE BEHIND KONINDERIE PARADE AND THE OPEN CHANNEL ACROSS THE RESERVE CONVERTED TO A PIPE CULVERT, TO REDUCE FLOW THROUGH THE RESERVE AND IMPROVE FLOOD ACCESS.
- A LOW KEY ACCESS ROAD IS TO BE CONSTRUCTED BETWEEN WILLARI AVENUE AND HAGGERTY CLOSE, TO FACILITATE FLOOD EVACUATION.
- A PROGRAM OF REGULAR INSPECTION AND MAINTENANCE OF THE BRIDGE CONVEYANCE AREA IS TO BE INSTIGATED.
- CHANNEL CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING VEGETATION AND SEDIMENT, BY REGULAR INSPECTION AND MAINTENANCE.

UNC4 - NARARA VALLEY DRIVE AT YURUNGA AVENUE

CONDITIONS:

- SPECIAL BUILDING PROVISIONS ARE TO BE IMPLEMENTED FOR FUTURE CONSTRUCTION WORK TO MAINTAIN FLOOR LEVELS ABOVE THE 1% AEP FLOOD LEVEL.
- ANY REDEVELOPMENT OF PROPERTIES SHOULD SATISFACTORILY ADDRESS THE ISSUE OF SAFE FLOOD ACCESS.
- NO STRUCTURES WHICH WOULD SIGNIFICANTLY IMPEDE FLOOD FLOWS SHOULD BE PLACED IN THE OVERLAND FLOW PATH.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- TWO FLOOD EFFECTED HOUSES ARE TO BE VOLUNTARY PURCHASED TO MAKE WAY FOR THE OVERLAND FLOW PATH.
- AN OVERLAND FLOW PATH IS TO BE CONSTRUCTED TO CHANNEL FLOOD WATERS FROM NARARA VALLEY DRIVE TO THE MAIN NIAGARA PARK BRANCH OF NARARA CREEK.
- A PROGRAM OF REGULAR INSPECTION AND MAINTENANCE OF THE OVERFLOW PATH AND UPSTREAM CREEK IS TO BE INSTIGATED.
- CHANNEL CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING VEGETATION AND SEDIMENT, BY REGULAR INSPECTION AND MAINTENANCE.

GOSFORD CITY COUNCIL

LEGEND

- COUNCIL OWNED AREAS
- 1% AEP FLOOD EXTENT
- 1.250 CROSS SECTION
- 9.1 FLOOD CONTOUR INTERPOLATED BETWEEN CROSS SECTIONS

CENTRAL MAPPING AUTHORITY
MAP REFERENCE: GOSFORD U2797 - 24

FLOODPLAIN MANAGEMENT PLAN OVERLAY
PRODUCED FOR
GOSFORD CITY COUNCIL - MARCH 1995
CONSULTING ENGINEERS - PATTERSON BRITTON & PARTNERS

NOTES

1. FLOOD LEVELS HAVE BEEN CALCULATED AT CROSS SECTION LOCATIONS ONLY.
2. FLOOD LEVELS AND FLOOD CONTOURS BETWEEN CROSS SECTIONS HAVE BEEN LINEARLY INTERPOLATED.
3. FLOOD CONTOURS DEPICT APPROXIMATE WIDTHS OF FLOODING ONLY.
4. FLOOD LIABILITY SHOULD BE VERIFIED BY GROUND SURVEY.
5. FLOOD LEVELS ARE GIVEN IN METRES TO AUSTRALIAN HEIGHT DATUM.
6. SIZES SHOWN ON THIS PLAN ARE APPROXIMATE ONLY AND DETAILS SHOULD NOT BE SCALED FROM THIS DRAWING FOR DETAILED DESIGN PURPOSES.

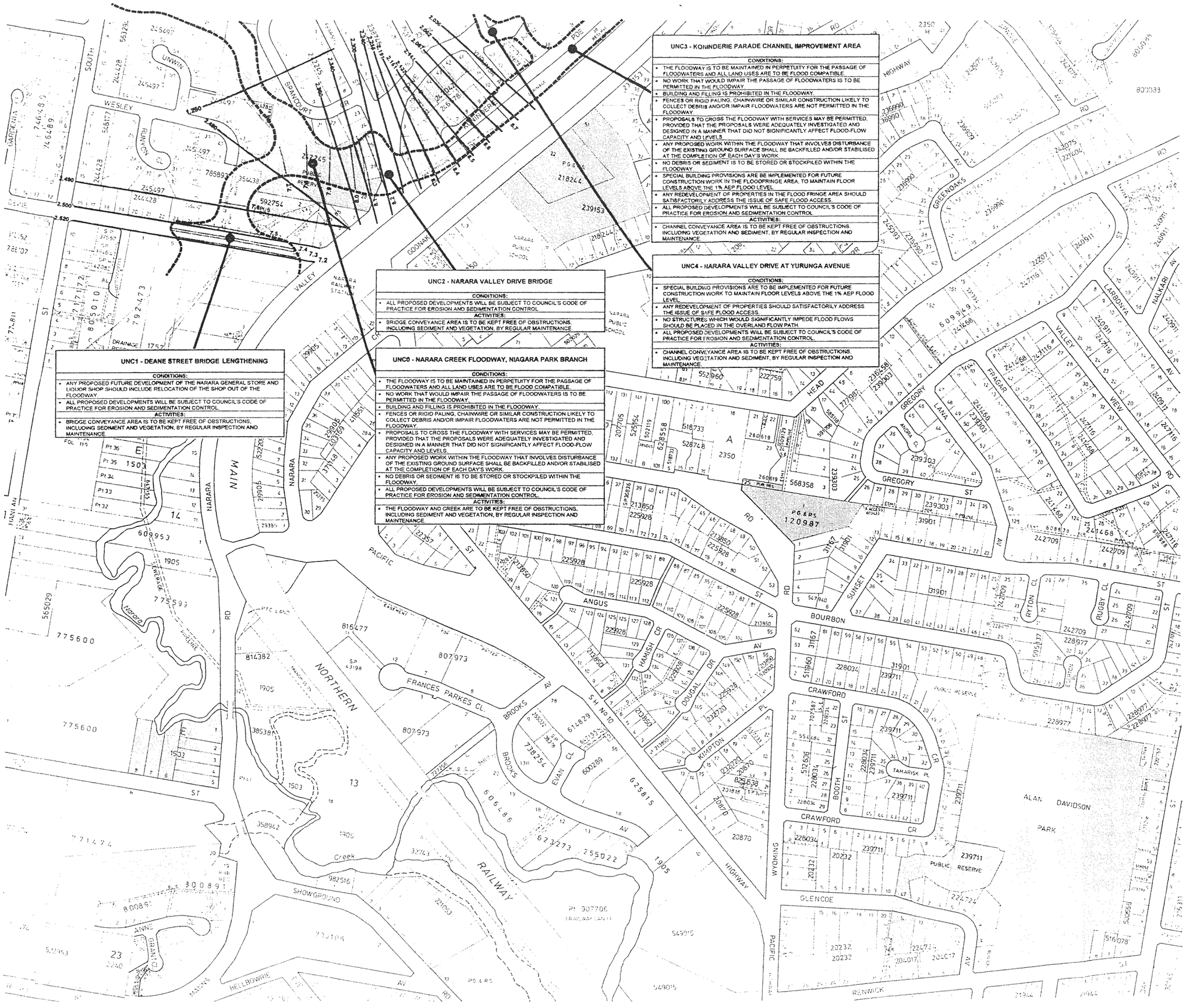
212A	212B	213A
212C	212D	213C
228A	228B	229A

KEY TO ADJOINING SHEET

METRES

UPPER NARARA CREEK INTERMEDIATE FLOODPLAIN MANAGEMENT PLAN

COUNCIL DRAWING NUMBER 4/138/A1



UNC1 - DEANE STREET BRIDGE LENGTHENING

CONDITIONS:

- ANY PROPOSED FUTURE DEVELOPMENT OF THE NARARA GENERAL STORE AND LIQUOR SHOP SHOULD INCLUDE RELOCATION OF THE SHOP OUT OF THE FLOODWAY.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- BRIDGE CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING SEDIMENT AND VEGETATION, BY REGULAR INSPECTION AND MAINTENANCE.

UNC2 - NARARA VALLEY DRIVE BRIDGE

CONDITIONS:

- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- BRIDGE CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING SEDIMENT AND VEGETATION, BY REGULAR MAINTENANCE.

UNC0 - NARARA CREEK FLOODWAY, NIAGARA PARK BRANCH

CONDITIONS:

- THE FLOODWAY IS TO BE MAINTAINED IN PERPETUITY FOR THE PASSAGE OF FLOODWATERS AND ALL LAND USES ARE TO BE FLOOD COMPATIBLE.
- NO WORK THAT WOULD IMPAIR THE PASSAGE OF FLOODWATERS IS TO BE PERMITTED IN THE FLOODWAY.
- BUILDING AND FILLING IS PROHIBITED IN THE FLOODWAY.
- FENCES OR RIGID PALING, CHAINWIRE OR SIMILAR CONSTRUCTION LIKELY TO COLLECT DEBRIS AND/OR IMPAIR FLOODWATERS ARE NOT PERMITTED IN THE FLOODWAY.
- PROPOSALS TO CROSS THE FLOODWAY WITH SERVICES MAY BE PERMITTED, PROVIDED THAT THE PROPOSALS WERE ADEQUATELY INVESTIGATED AND DESIGNED IN A MANNER THAT DID NOT SIGNIFICANTLY AFFECT FLOOD-FLOW CAPACITY AND LEVELS.
- ANY PROPOSED WORK WITHIN THE FLOODWAY THAT INVOLVES DISTURBANCE OF THE EXISTING GROUND SURFACE SHALL BE BACKFILLED AND/OR STABILISED AT THE COMPLETION OF EACH DAY'S WORK.
- NO DEBRIS OR SEDIMENT IS TO BE STORED OR STOCKPILED WITHIN THE FLOODWAY.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- THE FLOODWAY AND CREEK ARE TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING SEDIMENT AND VEGETATION, BY REGULAR INSPECTION AND MAINTENANCE.

UNC3 - KONINDERIE PARADE CHANNEL IMPROVEMENT AREA

CONDITIONS:

- THE FLOODWAY IS TO BE MAINTAINED IN PERPETUITY FOR THE PASSAGE OF FLOODWATERS AND ALL LAND USES ARE TO BE FLOOD COMPATIBLE.
- NO WORK THAT WOULD IMPAIR THE PASSAGE OF FLOODWATERS IS TO BE PERMITTED IN THE FLOODWAY.
- BUILDING AND FILLING IS PROHIBITED IN THE FLOODWAY.
- FENCES OR RIGID PALING, CHAINWIRE OR SIMILAR CONSTRUCTION LIKELY TO COLLECT DEBRIS AND/OR IMPAIR FLOODWATERS ARE NOT PERMITTED IN THE FLOODWAY.
- PROPOSALS TO CROSS THE FLOODWAY WITH SERVICES MAY BE PERMITTED, PROVIDED THAT THE PROPOSALS WERE ADEQUATELY INVESTIGATED AND DESIGNED IN A MANNER THAT DID NOT SIGNIFICANTLY AFFECT FLOOD-FLOW CAPACITY AND LEVELS.
- ANY PROPOSED WORK WITHIN THE FLOODWAY THAT INVOLVES DISTURBANCE OF THE EXISTING GROUND SURFACE SHALL BE BACKFILLED AND/OR STABILISED AT THE COMPLETION OF EACH DAY'S WORK.
- NO DEBRIS OR SEDIMENT IS TO BE STORED OR STOCKPILED WITHIN THE FLOODWAY.
- SPECIAL BUILDING PROVISIONS ARE BE IMPLEMENTED FOR FUTURE CONSTRUCTION WORK IN THE FLOODFRINGE AREA, TO MAINTAIN FLOOR LEVELS ABOVE THE 1% AEP FLOOD LEVEL.
- ANY REDEVELOPMENT OF PROPERTIES IN THE FLOOD FRINGE AREA SHOULD SATISFACTORILY ADDRESS THE ISSUE OF SAFE FLOOD ACCESS.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- CHANNEL CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING VEGETATION AND SEDIMENT, BY REGULAR INSPECTION AND MAINTENANCE.

UNC4 - NARARA VALLEY DRIVE AT YURUNGA AVENUE

CONDITIONS:

- SPECIAL BUILDING PROVISIONS ARE TO BE IMPLEMENTED FOR FUTURE CONSTRUCTION WORK TO MAINTAIN FLOOR LEVELS ABOVE THE 1% AEP FLOOD LEVEL.
- ANY REDEVELOPMENT OF PROPERTIES SHOULD SATISFACTORILY ADDRESS THE ISSUE OF SAFE FLOOD ACCESS.
- NO STRUCTURES WHICH WOULD SIGNIFICANTLY IMPEDE FLOOD FLOWS SHOULD BE PLACED IN THE OVERLAND FLOW PATH.
- ALL PROPOSED DEVELOPMENTS WILL BE SUBJECT TO COUNCIL'S CODE OF PRACTICE FOR EROSION AND SEDIMENTATION CONTROL.

ACTIVITIES:

- CHANNEL CONVEYANCE AREA IS TO BE KEPT FREE OF OBSTRUCTIONS, INCLUDING VEGETATION AND SEDIMENT, BY REGULAR INSPECTION AND MAINTENANCE.

GOSFORD CITY COUNCIL

NORTH

LEGEND

- COUNCIL OWNED AREAS
- 1% AEP FLOOD EXTENT
- 1.250 — CROSS SECTION
- 7.7 — FLOOD CONTOUR INTERPOLATED BETWEEN CROSS SECTIONS

CENTRAL MAPPING AUTHORITY
MAP REFERENCE: GOSFORD U2797 - 24

FLOODPLAIN MANAGEMENT PLAN OVERLAY
PRODUCED FOR
GOSFORD CITY COUNCIL - MARCH 1995
CONSULTING ENGINEERS - PATTERSON BRITTON & PARTNERS

NOTES

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4. FLOOD LIABILITY SHOULD BE VERIFIED BY GROUND SURVEY.
5. FLOOD LEVELS ARE GIVEN IN METRES TO AUSTRALIAN HEIGHT DATUM.
6. SIZES SHOWN ON THIS PLAN ARE APPROXIMATE ONLY AND DETAILS SHOULD NOT BE SCALED FROM THIS DRAWING FOR DETAILED DESIGN PURPOSES.

212A	212B	213A
212C	212D	213C
228A	228B	229A

KEY TO ADJOINING SHEET

UPPER NARARA CREEK ULTIMATE FLOODPLAIN MANAGEMENT PLAN

COUNCIL DRAWING NUMBER 4/139/A1

THE END