

SUTTON FLOODPLAIN RISK  
MANAGEMENT STUDY AND PLAN  
YASS VALLEY COUNCIL  
FINAL REPORT







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## SUTTON – FLOODPLAIN RISK MANAGEMENT STUDY AND DRAFT PLAN

### FINAL REPORT

DECEMBER 2016

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## ACRONYMS

AAD	Annual Average Damages
ABCB	Australian Building Codes Board
ABS	Australian Bureau of Statistics
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ALS	Airborne Laser Survey (also see LiDAR)
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
AWE	Average Weekly Earnings
B/C	Benefit Cost Ratio
BCA	Building Codes Australia
BoM	Bureau of Meteorology
CFERP	Community Flood Emergency Response Plan
CMA	Catchment Management Authority
DA	Development Application
DCP	Development Control Plan
DEM	Digital Elevation Model (A grid of terrain elevations usually obtained from ALS)
DRM	Direct Rainfall Method
EP&A Act	Environmental Planning and Assessment Act
EPA	Environmental Protection Authority
ERP	Emergency Response Planning
FPA	Flood Planning Area
FPL	Flood Planning Level
FRMC	Flood Risk Management Committee
FRMP	Floodplain Risk Management Plan
FRMS	Floodplain Risk Management Study
IPCC	Intergovernmental Panel for Climate Change
LEP	Local Environment Plan
LFP	Local Flood Plan
LGA	Local Government Area
LiDAR	Light Detection and Ranging (also see ALS)
mAHD	Meters above Australian High Datum
MHL	Manly Hydraulics Laboratory
NCC	National Construction Code
OEH	Office of Environment and Heritage
OSD	On Site Detention

PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PWD	Public Works Department
RMS	Roads and Maritime Services (formerly RTA)
SEPP	State Environmental Planning Policy
SES	State Emergency Services
TUFLOW	A one-dimensional (1D) and two-dimensional (2D) hydraulic computer model
WBNM	Watershed Bounded Network Model (hydrologic computer model)
WSUD	Water Sensitive Urban Design

In addition to the above listed Acronyms, a Glossary of terms is presented in Appendix A.

## FOREWORD

The NSW State Government's Flood Policy provides a framework to ensure the sustainable use of floodplain environments. The Policy is specifically structured to provide solutions to existing flooding problems in rural and urban areas. In addition, the Policy provides a means of ensuring that any 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 Federal Government may also provide subsidies in some circumstances.

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

1. ***Data Collection***
  - Data requirements for an ensuing flood study are assessed. Existing data sets are assessed for usability and existing reports collected and summarised.
2. ***Flood Study***
  - Determine the nature and extent of the flood problem.
3. ***Floodplain Risk Management***
  - Evaluates management options for the floodplain in respect of both existing and proposed development.
4. ***Floodplain Risk Management Plan***
  - Involves formal adoption by Council of a plan of management for the floodplain.
5. ***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 Sutton Floodplain Risk Management Study & Plan (FRMS&P) presented herein constitutes the third and fourth stages in the NSW Floodplain Management Program for the township of Sutton and follows on from the Flood Study finalised in March 2016. WMAwater have been engaged by Yass Valley Council to prepare this FRMS&P under the guidance of Council's Floodplain Risk Management Committee (FRMC).

This report has been prepared with financial assistance from the NSW Government through its Floodplain Management Program. This document does not necessarily represent the opinions of the NSW Government or the Office of Environment and Heritage.

WMAwater has prepared this report under a Consultancy with Yass Valley Council. Yass Valley Council owns the Intellectual Property rights in the report and related products.



## EXECUTIVE SUMMARY

### Introduction and Study Objective

This Study has been prepared by WMAwater on behalf of Yass Valley Council (Council). The Study is composed of two phases:

1. The Sutton Floodplain Risk Management Study; and
2. The Sutton Floodplain Risk Management Draft Plan.

This document details; The Sutton Floodplain Risk Management Study; and The Sutton Floodplain Risk Management Draft Plan (abbreviated to FRMS&P). This FRMS&P follows on from the Sutton Flood Study (the Flood Study, Reference 2) which defined the design flood behaviour in the township of Sutton under existing conditions to determine the nature and extent of the existing flood problem.

The main objective of this FRMS&P is to identify floodplain risk, test amelioration strategies for the management of risk and to put forward priorities and approximately costed recommendations in regards to flood risk mitigation at Sutton.

### The Study Area and Flood Affection

Sutton is located within the Sydney-Canberra Corridor, approximately 230 km south-west of Sydney and 20 km north of Canberra. The township is located within the upper reaches of the Yass River Catchment, at the confluence of the Yass River and McLaughlin's Creek.

The residential flood liability of the study area is summarised in the table below. Yard and lot flooding is experienced throughout Sutton, predominately due to major overland flow flooding with ten properties expected to be inundated over floor during the 1% AEP event. In the 0.2 EY event, two properties are flooded above floor level due to major overland flow flooding. Over floor flooding due to the McLaughlin's Creek and the Yass River is only experienced during events much larger than the 0.5% AEP event. 36 properties are expected to become flooded over flood during a PMF event.

Table A: Number of Flood Prone Residential Properties

Event	No. Properties Affected	No. Flooded Above Floor Level	Total Damages for Event	Event Contribution to AAD (%)
<b>0.2 EY</b>	5	2	\$ 117,000	51
<b>10% AEP</b>	5	2	\$ 117,000	13
<b>5% AEP</b>	8	4	\$ 222,000	9
<b>2% AEP</b>	11	7	\$ 392,000	10
<b>1% AEP</b>	14	10	\$ 619,000	5
<b>0.5% AEP</b>	14	11	\$ 644,000	3
<b>PMF</b>	40	36	\$ 2,527,000	9
<b>Average Annual Damages (AAD)</b>			<b>\$ 92,000</b>	

NOTE: Properties affected are those where there is flooding above ground level within the property boundary (ie the lot).

This does not necessarily mean that any buildings on the property are flooded or that the entire lot is inundated.

\*Events per Year (EY)

At Sutton the residential AAD is estimated to be \$92,000. This forms the base case scenario against which damages from a number of mitigation measures can be assessed. Damage

contributions due to non-residential properties are expected to be zero as limited development of this type is present.

## Recommendations

This FRMS&P identifies various flood risk management options and strategies to be considered by Council and the Floodplain Management Committee. Section 4 discusses the various options assessed in the process of coming up with the shortlisted recommendations presented in the Plan. The Plan itself is presented in Section 5 and this includes their priority, time for implementation and implementation strategy.

The structural flood risk management works, Option B1 basin at the corner of Victoria and Bywong Streets and associated drainage works, is recommended for further investigation alongside Option A4 pipe network. Investigation works as part of the detailed design is required to determine which is the preferred option for mitigating flood affectation on the Sutton Central Flow Path. Option B1 has an estimated implementation cost of \$325,000 and provides a \$42,000 reduction in average annual flood damages. Option A4 has an estimated implementation cost of \$400,000 and also provides a \$42,000 reduction in average annual flood damages. Both options mitigate overland flow floods such as those experienced in 2010. With implementation of either of these Options, the two properties previously flooded above floor in the 2010 event would no longer be flooded.

The combined Option C2 / C3 drainage works are recommended for implementation. These works are aimed to improve local drainage issues for areas in north Sutton and have an estimated cost of \$83,000.

Recommended high and medium priority flood risk management measures include:

- Construction of the bridge at the location of the existing Sutton Road crossing of McLaughlin's Creek to provide flood free access;
- Drainage maintenance;
- Alarm existing NOW stream gauges at site 410851 and install a pluviometer;
- Install manual gauge at Sutton;
- Preparation for potential future floods to increase flood warning
- Install warning signs and self-deploying boom gates on river and creek crossings;
- Review and update the Yass Valley Local Flood Plan and create a FIC for Sutton;
- Undertake a community flood education program;
- Investigate and update Council's LEP and DCP in line with the findings from this study;
- Define the Flood Planning Level;
- Include flood information on S149 certificates; and
- Provide flood information on Council's website.

The Sutton Floodplain Risk Management Study and Plan Draft Final report was placed on public exhibition for a period of 4 weeks between 26th October and 24th November. Hard copies of the report were available at Sutton Store, Sutton Public School and on Council's website. Four submissions including a group submission from the Sutton Community Association, are presented in Appendix F along with a response from WMAwater engineers. The public exhibition submissions results indicate that community acceptance of the study is generally good.

## **1. INTRODUCTION AND BACKGROUND**

This Study has been prepared by WMAwater on behalf of Yass Valley Council (Council). The Study is composed of two phases:

1. The Sutton Floodplain Risk Management Study; and
2. The Sutton Floodplain Risk Management Draft Plan.

This document details; The Sutton Floodplain Risk Management Study; and The Sutton Floodplain Risk Management Draft Plan (abbreviated to FRMS&P). This FRMS&P follows on from the Sutton Flood Study (the Flood Study, Reference 2) which defined the design flood behaviour in the township of Sutton under existing conditions to determine the nature and extent of the existing flood problem.

All levels provided in this report are to Australian Height Datum (AHD) or relate to the Yass River gauge (m) at Macks Reef Road (site number: 410851) which will be referred to as the Sutton Stream Gauge in this report for ease of reference. A glossary of terms is provided as Appendix A.

### **1.1. Study Objectives**

The main objective of this FRMS&P is to identify floodplain risk, test amelioration strategies for the management of risk and to put forward priorities and approximately costed recommendations in regards to flood risk mitigation at Sutton.

Council requires consideration of a range of management options to effectively manage existing, future and continuing flood risks at Sutton. The outcomes from the Floodplain Risk Management Study and draft Floodplain Risk Management Plan will also assist the SES in updating the Yass Valley Local Flood Plan to include risk management advice for Sutton.

The Objectives are more specifically described in Section 1.1.1 and 1.1.2 below.

#### **1.1.1. Floodplain Risk Management Study Objectives**

The objective of the Floodplain Risk Management Study is to investigate a range of flood mitigation works and measures to address the existing, future and continuing flood problems, in accordance with the NSW Government's Flood Policy. This includes:

- Review of Council's existing environmental planning policies and instruments including Council's long term planning strategies for the Study Area;
- Identification of works, measures and restrictions aimed to reduce the social, environmental and economic impacts of flooding and the losses caused by flooding on development and the community, both existing and future, over the full range of potential flood events;
- To assess the effectiveness of the works and measures for reducing the effect of flooding on the community and development, both existing and future;



- To consider whether the proposed works and measures might produce adverse effects (environmental, social, economic, or flooding) in the floodplain and whether they can be minimised;
- Examination of any existing flood warning systems, community flood awareness and emergency response measures in the context of the NSW State Emergency Service's developments and disaster planning requirements.
- Examine ways in which the rivers and floodplain environment may be enhanced by preparing a strategy for vegetation planning that will create a valuable corridor of vegetation without having a detrimental effect on flooding; and
- Identification of modifications required to current policies in the light of investigations.

### **1.1.2. Floodplain Risk Management Draft Plan Objectives**

The Floodplain Risk Management Draft Plan makes a range of recommendations relating to flood mitigation works and measures that address the existing, future and continuing flood problems, in accordance with the NSW Government's Flood Policy. The recommended works and measures presented in the Plan are aimed to:

- Reduce the flood hazard and risk to people and property in the community and to ensure future development is controlled in a manner consistent with the flood hazard and risk;
- Reduce private and public losses due to flooding;
- Protect and, where possible, enhance watercourses/creeks and floodplain environment;
- Be consistent with the objectives of relevant State policies, in particular, the Government's Flood Prone Lands and State Rivers and Estuaries Policies and satisfy the objectives and requirements of the Environmental Planning and Assessment Act, 1979;
- Ensure that the floodplain risk management plan is fully integrated with Council's existing corporate, business and strategic plans, existing and proposed planning proposals, meets Council's obligations under the Local Government Act, 1993 and has the support of the local community;
- Ensure actions arising out of the management plan are sustainable in social, environmental, ecological and economic terms;
- Ensure that the floodplain risk management plan is fully integrated with the local emergency management plan (flood plan) and other relevant catchment management plans;
- Establish a program for implementation and a mechanism for the funding of the plan and should include priorities, staging, funding, responsibilities, constraints, and monitoring; and the
- Preparation of concept design for recommended works with sufficient detail to enable Council to apply for funding and progress to the investigation and design stage.

## **1.2. The Study Area**

Sutton is located within the Sydney-Canberra Corridor, approximately 230 km south-west of Sydney and 20 km north of Canberra. The township is located within the upper reaches of the Yass River Catchment, at the confluence of the Yass River and McLaughlin's Creek (see Figure 1).

Sutton has a population of approximately 229 (2011 census) with land use in the township predominantly composed of low-density housing. There are large areas of open space along the Yass River and McLaughlin's Creek. In addition, Future Investigation Areas have been identified in Council's Town & Villages Study (YVC, 2010), whereby land to the west and south of the village could be rezoned to accommodate for an increasing demand for land due to Sutton's close proximity to Canberra.

The study area (presented in Figure 1) covers the floodplain near Sutton for regions affected by Yass River, McLaughlin's Creek and major overland flow flooding. The upstream limits of the Sutton Study Area is the Federal Highway. The downstream boundary is situated approximately 1.5 km north of town and 1 km north of the Yass River / McLaughlin's Creek confluence. The total study covers an area of approximately 12 km<sup>2</sup>. It should be noted that the hydraulic model extent extends further upstream and downstream of the study area extent to ensure model accuracy within the area of interest.

### **1.2.1. Flood Hotspots**

Flooding hotspots were identified as part of the Flood Study. A hotspot is identified as an area of interest from a flooding perspective. For example, locations where many residences are liable to flooding might be defined as hotspots as might other locations where key drainage assets are not meeting design standards or where key infrastructure, such as a highway, is flood affected. These Hotspots are often also SES points of interest that are useful for SES flood intelligence. The locations of each of the Hotspots are presented in Figure 3.

The four flood Hotspots identified as part of the Flood Study are described below. Liaison with the NSW SES also identified a number of additional hotspot not identified at the time of the Flood Study. These hotspots are not contained within the study area and have been described together as Hotspot #5.

#### **Hotspot 1: Sutton Road Crossing of McLaughlin's Creek**

The Sutton Road crossing of McLaughlin's Creek at Sutton provides an important access route to the north of the town, including to both Yass and Gundaroo. Additionally, flooding of this crossing has been identified as a major flood issue for Gundaroo residents as this the primary access route from Gundaroo to Canberra. Flooding of this low-level crossing may also cause isolation and reduced access which can impact on emergency services.

Analysis of design results indicates that the Sutton Road crossing of McLaughlin's Creek is overtopped during the 0.2 EY event, however it is likely also overtopped by more frequent events which have not been modelled as part of the current study. Peak flood levels for various design events are presented in Table 1 along with the culvert invert and roadway deck level.

The existing creek crossing structure is of concern to the local community and was identified as such as part of the community consultation process (see Section 2.4). This study recommends that the crossing be upgraded to provide flood free access in the 1% AEP flood to reduce isolation and risk to motorists. Further details are presented in Section 4.3.4.1.

Table 1: Sutton Road crossing of McLaughlin's Creek - Flood Levels

Event	Level (mAHD)
<b>Channel Invert</b>	<b>605.1</b>
<b>Road Crest</b>	<b>606.8</b>
0.2 EY	607.2
10% AEP	607.3
5% AEP	607.4
2% AEP	607.6
1% AEP	607.7
0.5% AEP	607.8
PMF	609.4

## Hotspot 2: North Street Crossing of Yass River

The crossing of the Yass River on North Street is the only access route for a small number of properties to the east of the Yass River at Sutton.

Analysis of design results indicates that the North Street crossing of the Yass River is overtopped during the 0.2 EY event, however it is likely also overtopped by more frequent events which have not been modelled as part of the current study. Peak flood levels for various design events are presented in Table 2 along with the culvert invert and roadway deck level.

Table 2: North Street Crossing of the Yass River - Flood Levels

Event	Level (mAHD)
<b>Channel Invert</b>	<b>601.5</b>
<b>Road Crest</b>	<b>602.3</b>
0.2 EY	602.8
10% AEP	603.2
5% AEP	603.8
2% AEP	604.3
1% AEP	604.5
0.5% AEP	604.8
PMF	605.7

Upgrading of this structures cannot be justified due to the estimated high cost of construction (+\$2 million based on other bridges of similar size) and the small number of people it services. However, Section 4.5.1 makes a number of recommendations to provide additional warning to residents that use this access road to help them make informed decisions relating to restrictions due to flood access.

## Hotspot 3: Bywong Street near North Street

The Sutton Northern Sheet Flow Area (see Figure 1) flows through a number of properties situated along Bywong Street causing yard flooding during the 0.2 EY event. The majority of houses in this region are built up and are unlikely to experience flooding until flood depths approach that of the PMF. Lot flood depths of up to 0.1 m are typically experienced during the 1% AEP.



The combined Option C2 / C3 (see Section 4.3.3.4) provides a number of modifications / additions to the drainage system in this area which significantly reduce lot flood affectation.

#### **Hotspot 4: Bywong Street between Middle Street and Victoria Street**

The Central Flow Path (see Figure 1) flows through properties along Bywong Street and Camp Street causing yard flooding in the 0.2 EY event. It was reported as a part of the Community Consultation process that over flood flooding of primary residences has occurred on a number of occasions in the last five years. In the 1% AEP event, flood depths up to 0.2 m are experienced in this residential area.

The Option B1 basin (see Section 4.3.6.1) provides significantly reductions in peak flood levels and flood affectation in this areas.

#### **Hotspot 5: Various Flood Susceptible Creek and River Road Crossing**

A discussion with the NSW SES Sutton Unit identified two creek and river crossings that are susceptible to flooding in the surrounding area. These crossing are the:

- Murrumbateman Road crossing of Back Creek; and
- Shingle Hill Way crossing of Yass River.

It was noted that these are well used access routes that pose significant risk to any motorist attempting to cross during flood.

Section 4.5.1 makes a number of recommendations to provide warning to motorists that use these access roads to help them make informed decisions relating to road closures and restrictions due to flooding.

### **1.3. Flood Mechanisms**

Sutton is affected by two primary sources of flooding. These are:

- Mainstream flooding, due to:
  - The Yass River;
  - McLaughlin's creek.
- Major Overland Flow (MOF) flooding.

Details of the above listed flood mechanisms are presented in the following sections.

#### **1.3.1. Mainstream Flooding**

Sutton is situated between the Yass River and McLaughlin's Creek, immediately upstream of their confluence. The Yass River flows approximately south-east to north-west and McLaughlin's Creek flows approximately south-west to north-east. The catchment areas of these two watercourses upstream of the study area are 101 km<sup>2</sup> and 34 km<sup>2</sup> respectively. The combined catchment area at their confluence is 137 km<sup>2</sup>. Both watercourses have catchments which are

largely rural in nature with some areas of dense vegetation, particularly in the Goorooyarroo National Park.

Flooding in both watercourses has been observed with inundation of the floodplain occurring. However, above floor flooding of residential properties is not expected in either watercourse for events up to and including the 0.5% AEP event. Residential flooding however, from overland flow may be experienced with this flood mechanism discussed below.

### 1.3.2. Major Overland Flow Flooding

MOF is the primary source of flood affectation in Sutton with flooding in the town in recent years due to this mechanism. Three flow paths that affect residential areas have been identified that flow west through the town to McLaughlin's Creek, namely the;

- Sutton Northern Sheet Flow Area;
- Sutton Central Flow Path; and
- Sutton Southern Flow Path.

The locations of these flows paths are presented in Figure 1 with further details for each flow path provided in the Flood Study.

## 1.4. Proposed Development Areas

As part of this study, land that has development potential has been included within the model domain so that flood behaviour for these areas can be defined. The development potential areas are presented in the Sutton Study Area map (Figure 1) and are numbered accordingly. Details for these regions are provided below:

1. West Sutton Future Investigation Area – is situated to the west of McLaughlin's Creek and is 100 ha of currently zoned *RU1 Primary Production*. The region has the potential for future development through a *RU5 Village* or *R5 Large Lot Residential* zone;
2. East Sutton Future Investigation Area – is situated east of Moorong Street and is 94 ha of *R5 Large Lot Residential* zoned land which has limited sub-division potential, whereby the minimum lot size is 2.5ha;
3. South Sutton Future Investigation Area – is situated to the south of the village, boarded by the Federal Highway to the south, Yass River to the east, and an unformed Crown Road to the west. This is 310ha of *RU1 Primary Production* zoned land with the potential for future development.
4. Sutton McLaughlin's Creek Future Investigation Area – is situated south-west of Sutton on the east bank on McLaughlin's Creek. This is 192 ha of *R5 Large Lot Residential* zoned land which has limited sub-division potential, whereby the minimum lot size is 10ha.

The proposed development areas are presented in the Sutton Study Area map (Figure 1) and are numbered accordingly.

## **1.4. Overview of Existing Catchment**

### **1.4.1. Land Use and Demographic Overview**

Understanding the social characteristics of the area can help in ensuring that the right risk management practices are adopted. The Census data can provide useful information on categories including dwelling and tenure type, languages spoken, age of population and movement of people into and from the area. Information has been extracted for the 2011 Census. The urban centre of the suburb of Sutton has a population of 229 living in 83 private dwellings.

Of interest is the data on population movement in recent years. Generally residents who have lived in an area for a longer time will have a better understanding of flooding issues in their area than those who have recently moved to the area. Within the last five years 50% of the population has moved to the Sutton area and in the year prior to the 2011 census 25% of the population moved into the area, many coming from the ACT. This means that much of the current population would not have experienced floods in 2010 to 2012 and therefore potentially do not have a good awareness of flood risk in the region.

It is useful to consider the tenure of housing. Those living in properties which they own are more likely to be aware of the flood risks and have measures in place to reduce them (where possible). Rental properties are likely to have a higher turnover of people living in them compared to privately owned properties and therefore those people in rental properties may be less aware of the flood risk. In Sutton 26% of houses are rented which is relative high, again indicating the generally the communities flood awareness is likely low.

The languages spoken by the population are also useful to consider as this can have implications in regard to the provision of flood information to the public. In Sutton less than 1% of the population speak a language other than English at home.

Land use from the LEP 2013 is shown in Figure 2. The majority of Sutton is comprised of lots zoned RU5 Rural Village and R5 Large Lot Residential areas. The RU5 classification not only allows for residential properties but also public/commercial/industrial uses of which there are approximately five in Sutton. Land use outside of the township of Sutton is generally zoned RU1 Primary Production with usage primarily devoted to grazing and cropping endeavours.

Outside the town boundaries, the only structures on the floodplain are roads and rail, individual farmhouses and other farm related infrastructure. Most roads are unsealed and creek and stream crossings are generally formed by low level causeways.

### **1.4.2. Key Infrastructure on the Floodplain**

Key infrastructure on the floodplain are those that impact on flood levels, for example upstream backwatering (and retention of floodwater) and lower levels in the downstream (relative to the case if the major structure was not there). Some of these may be deliberate flood management measures to control flooding. Sutton's key infrastructure is summarised in the Flood Study (Reference 2) including location map and photographs.

Table 3 below summarises each feature with the locations displayed on Figure 3.

Table 3: Key Infrastructure on the Floodplain

ID	Structure	Comment
1	Sutton Road crossing of McLaughlin's Creek	The Sutton Road crossing of McLaughlin's Creek at Sutton provides an important access route to the north of the town, including to both Yass and Gundaroo. Analysis of design results indicates that the Sutton Road crossing of McLaughlin's Creek is overtopped during the 0.2 EY event, however it is likely also overtopped by more frequent events which have not been modelled as part of the current study. This structure has been highlighted as an area of key interest (Hotspot #1) and is recommended for upgrading to a larger, flood free, access bridge (see Section 4.3.4.1).
2	North Street crossing of Yass River	The crossing of the Yass River on North Street is the only access route to properties to the east of the Yass River at Sutton. Analysis of design results indicates that the North Street crossing of the Yass River is overtopped during the 0.2 EY event, however it is likely also overtopped by more frequent events which have not been modelled as part of the current study.

## **2. COMMUNITY CONSULTATION**

Community consultation is an important element of the floodplain risk management process ultimately facilitating community engagement and acceptance of the overall project. During the Flood Study (Reference 2), community consultation was undertaken to assess the flood experience of the community and gather additional data. Further community consultation has also been undertaken as part of the FRMS&P. To date this has included a questionnaire, a community open day and a number of FMC meetings. Goals of ongoing community consultation are to keep residents informed of progress and gain their feedback on potential mitigation and management measures proposed. Final community consultation is in the form of public exhibition of the Floodplain Risk Management Study and Draft Floodplain Risk Management Plan.

### **2.1. Questionnaire Distribution**

A community newsletter and questionnaire (presented in Appendix B) was hand delivered to residents of Sutton by members of the NSW SES during March 2016. The newsletter aimed to inform the community of the Sutton FRMS&P and the questionnaire provided the community with an opportunity to highlight their flood affectation and to provide input into the current study. In particular, the questionnaire was intended to obtain ideas for mitigation works or management options to reduce flood affectation and risk.

A total of nine replies (out of 130 distributed) resulted in a return rate of 7% which higher than the return rate typically experienced for other FRMS in rural NSW. It should be noted that extensive community consultation was also undertaken as part of the Flood Study and the FRMS Community Information Session (Section 2.2) also provided the community with an opportunity to have their say.

When asked about potential flood mitigation options, nearly all respondents wished to see the construction of a bridge or bypass to replace the current McLaughlin's Creek crossing (as described as Hotspot #1). This Option is examined in Section 4.3.4.1. Other options that residents expressed interest in included increasing the capacity of local drainage networks and culverts. A summary of suggestions provided by the community consultation process is presented in Section 2.4.

### **2.2. Community Information Session**

WMAwater engineers attended a Community Information Session at Sutton Hall on the 11<sup>th</sup> of February 2016. The aim of the session was to discuss the findings of the Flood Study and to obtain community ideas and knowledge for potential flood mitigation options to reduce flood affectation in Sutton.

The meeting was attended by approximately 12 people with residents discussing a range of topics. A summary of suggestions provided by the community consultation process is presented in Section 2.4.

## **2.3. Flood Risk Management Committee**

The Sutton Floodplain Risk Management Committee (FRMC) comprises a number of representatives from the local community, including residents, members of Council, the SES and OEH.

Regular meetings have been held (6 in total) in order to inform the FRMC of the study progress regarding data collection and community consultation as well as the modelling of flood mitigation measures. As an advisory committee to Council, the FRMC has provided oversight to the objectives, inputs, outputs and recommendations contained in the draft Sutton floodplain risk management study and plan. This includes a number of potential flood mitigation measures that are presented in Section 2.4 in addition to those suggested by the broader community.

## **2.4. Summary of Community Consultation Findings**

The community consultation process yielded various suggestions to ameliorate flood risk and affectation. Many of these suggestions have been modelled and their viability has been assessed in Section 4.

The questionnaire responses and comments made as part of the Community Information Session included the following potential flood mitigation measures:

- Increased channel and culvert conveyance on Victoria Street (see Section 4.3.3.1);
- Additional culverts under North Street to the east of Quartz Street (see Section 4.3.3.2);
- Replacing the existing Sutton Road crossing of McLaughlin's Creek with a bridge (see Section 4.3.4.1);
- Additional culverts under Camp Street to allow flow through to McLaughlin's Creek (see Section 4.3.4.2);
- Increase existing culvert capacity under North Street (see Section 4.3.4.3);
- Drainage maintenance and clearing of culverts and bridges to increase flow conveyance of existing structures (see Section 4.3.5); and
- A diversion channel to transfer flow from the Sutton Central Flow Path along the existing Quartz Street Road easement to Victoria Street (a modification to this measure is presented in Section 4.3.6.1).

## **2.5. Public Exhibition of the Draft Final Sutton FRMS&P**

The Sutton Floodplain Risk Management Study and Plan Draft Final report was placed on public exhibition for a period of 4 weeks between 26th October and 24th November. Hard copies of the report were available at the Sutton Store and Sutton Public School. The report was also available online on Council's website during this period.

Four submissions were made, which along with a response from WMAwater engineers are presented in Appendix F.



### 3. FLOODPLAIN RISK MANAGEMENT STUDY

#### 3.1. Objectives of the Floodplain Risk Management Study

The primary objective of the Floodplain Risk Management Study is to investigate a range of flood mitigation works and measures to address the existing, future and continuing flood problems, in accordance with the NSW Government's Flood Policy, as detailed in the Floodplain Development Manual (Reference 1). A full list of objectives for the study area presented in Section 1.1.

#### 3.2. Impacts of Flooding

##### 3.2.1. Flood Damages

Properties suffer damages from flooding in a number of ways. Direct damages include loss of property contents and/or damage to the structure of the property. Indirect damage costs can be incurred when property occupiers live elsewhere while repairs are being made. A flood damages assessment was undertaken for every property in Sutton (107 total). Both commercial and residential properties were considered together in the flood damages assessment since there are only four commercial properties in Sutton and these properties were found not to be flood affected. Full details on this analysis are presented in the Flood Study (Reference 2).

Table 4 below details the total number of properties flooded in each design event, the potential damages for a range of design events and the Annual Average Damage (AAD) for residential properties.

Table 4: Number of Flood Prone Residential Properties

Event	No. Properties Affected	No. Flooded Above Floor Level	Total Damages for Event	Event Contribution to AAD (%)
<b>0.2 EY</b>	5	2	\$ 117,000	51
<b>10% AEP</b>	5	2	\$ 117,000	13
<b>5% AEP</b>	8	4	\$ 222,000	9
<b>2% AEP</b>	11	7	\$ 392,000	10
<b>1% AEP</b>	14	10	\$ 619,000	5
<b>0.5% AEP</b>	14	11	\$ 644,000	3
<b>PMF</b>	40	36	\$ 2,527,000	9
<b>Average Annual Damages (AAD)</b>			<b>\$ 92,000</b>	

NOTE: Properties affected are those where there is flooding above ground level within the property boundary (ie the lot).

This does not necessarily mean that any buildings on the property are flooded or that the entire lot is inundated.

\*Events per Year (EY)

The majority of houses at Sutton are not flood affected during the PMF, however a total of 36 properties are expected to be flooded over floor during this event. Yard and lot flooding is experienced throughout Sutton, predominately due to MOF flooding (see Section 1.3.2) with 14 properties experiencing yard flooding in the 1% AEP event. However, ten of these are expected to be inundated over floor during this event. In the 0.2 EY event, two properties are flooded above floor level due to MOF flooding. Over floor flooding due to the McLaughlin's Creek and

the Yass River is only experienced during events much larger than the 0.5% AEP event.

At Sutton the AAD is estimated to be \$92,000. This forms the base case scenario against which damages from a number of mitigation measures can be assessed. In assessing various mitigation measures it is important to compare them using a suitable metric. By applying a monetary value to property damages and then comparing damage estimates for the existing situation with assumed mitigation work (approximately costed) a benefit/cost (B/C) ratio can be calculated which is readily comparable.

### **3.2.2. Public Infrastructure and Other Land Uses**

Public sector (non-building) damages include; recreational/tourist facilities; water and sewerage supply; gas supply; telephone supply; electricity supply including transmission poles/lines, sub-stations and underground cables; rail; roads and bridges including traffic lights/signs; and costs to employ emergency services and assist in cleaning up. Public sector damages can contribute a significant proportion to total flood costs but are difficult to accurately calculate or predict.

Costs to Councils from flooding typically comprise;

- Clean-up costs;
- Erosion and siltation;
- Drain cleanout and maintenance;
- Removing fallen trees;
- Inundation of Council buildings;
- Direct damage to roads, bridges and culverts;
- Removing vehicles washed away;
- Assistance to ratepayers;
- Increases in insurance premiums;
- Closures of Streets;
- Loss of working life of road pavements; and
- Operational costs in the lead up to and during flood events.

#### **3.2.2.1. Electricity**

Essential Energy was contacted about potential flood risk to electrical infrastructure, however no electrical sub-stations are situated within the PMF extent at Sutton.

#### **3.2.2.2. Sewerage**

Sutton currently has no sewerage connection with the town using per lot septic tank systems. Septic tanks are prone to causing contamination of the surrounding region as effluent can overflow the storage tank. The community consultation process undertaken as part of the Flood Study highlighted this as an issue during a number of recent MOF flood events.

#### **3.2.2.3. Schools**

Sutton Public School is situated on Victoria Street near its intersection with Bywong Street. The school is situated next to the Sutton Southern Flow Path (see Section 1.3.2), however is not

flooded for events up to and including the 0.5% AEP. During a flood event Bywong Street is cut adjacent to the school however Victoria Street remains accessible until the PMF event. During the PMF, the grounds of the School are flooded to approximately 0.1 m depth, however the School is not flooded over floor during such an event.

Flooding to the school, and to similar institutions, would have different impacts depending on the time of day. During school hours response would be more critical due to the number of persons on the site. Although flooding at the school is unlikely, it is important that schools have effective flood plans.

#### **3.2.2.4. Operations Centres**

The Sutton NSW SES Unit, which opened in 2014, is responsible for servicing Sutton and the surrounding area. It is important to note that this SES unit may have restricted access in and out of Sutton during a large flood events due to road closures.

A number of SES Units in the surrounding areas including the Yass, Queanbeyan, Bungendore and Collector Units have assisted Sutton Unit during recent flood events. Again it should be noted that during large flood events there is potential for restricted access due to flood waters.

### **3.3. Hydraulic Categorisation**

The 2005 NSW Government's Floodplain Development Manual (Reference 1) defines three hydraulic categories which can be applied to different areas of the floodplain; namely floodway, flood storage or flood fringe. Floodway describes areas of significant discharge during floods, which, if partially blocked, would cause a significant redistribution of flood flow. Flood storage areas are used for temporary storage of floodwaters during a flood, while flood fringe is all other flood prone land.

The Flood Study (Reference 2) determined hydraulic categories for the 1% and 0.5% AEP events using the criteria proposed by Howells et. al. (2003). The hydraulic categories for these events are presented in Figure 35 and Figure 36 of the Flood Study respectively, and are reproduced herein as Figure 4 and Figure 5.

### **3.4. True Flood Hazard Classification**

The Flood Study (Reference 2) defined the provisional hydraulic hazard while the FRMS&P is required to consider the true flood hazard. The Flood Study (Reference 2) found that high provisional hydraulic hazard tends to be limited to defined flow paths and also those areas where water depths accumulate. Generally, areas of residential development in Sutton are classified as low hazard.

To assess the true flood hazard all adverse effects of flooding have to be considered. As well as considering the provisional (hydraulic) hazard it also incorporates other criteria such as threat to life, danger and difficulty in evacuating people and possessions and the potential for damage, social disruption and loss of production and those detailed in Table 5.

Table 5: Hazard Classification

Criteria	Weight <sup>(1)</sup>	Comment
<b>Size of the flood</b>	Medium	The size or magnitude of the flood can affect depths and velocities. Relatively low flood hazard is associated with more frequent minor floods while the less frequent major floods are more likely to present a high hazard situation. The majority of flood affectation at Sutton is due to MOF, which doesn't scale greatly for events of varying magnitude. The mainstream PMF, however, does scale significantly and much of the Yass River and McLaughlin's Creek floodplains would experience depths and velocities that could pose a risk to the structural stability of buildings.
<b>Depth and velocity of floodwaters</b>	High	The provisional hazard is the product of depths and velocity of flood waters. These can be influenced by the magnitude of the flood event. Generally at Sutton, high velocities and depths are confined to the river, creeks during the 1% AEP event. However, the PMF event experiences significant depths and velocities in populated areas of Sutton.
<b>Rate of rise of floodwaters</b>	Medium	Rate of rise of floodwaters is relative to catchment size, soil type, slope and land use cover. It is also influenced by the spatial and temporal pattern of rainfall during events. At Sutton, the rate of rise can be quite rapid due to the relatively small catchment sizes. This adds to the level of associated risk.
<b>Duration of flooding</b>	Low	The greater the duration of flooding the more disruption to the community and potential flood damages. A short period of inundation may allow some materials to dry and recover whereas a long duration may cause damages beyond repair. At Sutton the flooding duration is short.
<b>Effective warning and evacuation time</b>	Medium	This is dependent on the rate at which waters rise, an effective flood warning system and the awareness and readiness of the community to act. Currently, no BoM flood warnings are issued for the Yass River at Sutton and therefore specific warning is limited. In addition to this, upstream stream gauges provide only limited warning (see Section 4.5.1).
<b>Flood awareness and readiness of the community</b>	Medium	The community of Sutton has a degree of flood awareness but it is likely to be limited to those people aware of the more recent events. Recent flooding events and community consultation undertaken as part of the current flood risk management process (of which this report forms part) has raised awareness of the flood problem. The awareness of the community has a medium weight in considering flood hazard as a more aware community will be able to better prepare and therefore potentially evacuate before hazards become high. General community awareness tends to reduce as the time between flood events lengthens and people become less prepared for the next flood event. Even a flood aware community is unlikely to be wise to the impacts of a larger, less frequent event. In areas where flood warning is limited it is more important for a community to be flood aware so that individual can notice the signs of the onset of flooding and prepare themselves.
<b>Effective flood access</b>	High	Access is affected by the depths and velocities of flood waters, the distance to higher ground, the number of people using and the capacity of evacuation routes and good communication. A number of roads in and out of Sutton frequently become hazardous and impassable during flood.

Criteria	Weight <sup>(1)</sup>	Comment
<b>Evacuation problems</b>	Medium	Evacuation problems could also be exacerbated by the time of day during which flooding occurs. For example flooding overnight may be more difficult for residential areas. The number of people to be evacuated and limited resources of the SES and other rescue services can make evacuation difficult. Mobility of people, such as the elderly, children or disabled, who are less likely to be able to move through floodwaters and on-going bad weather conditions is a consideration.
<b>Type of development</b>	Low	The type of flood prone development will to some degree correspond to the level of occupant awareness, mobility of people as well as population density. Longer term home owners would likely have a better level of flood awareness than a guest at a hotel while residents from an residential care home are likely to be less mobile than average.
<b>Additional Concerns</b>	Low/ Medium	The impact of debris in overland flow flooding is unlikely to be a significant factor due to the low flood depths and/or velocities. However, there is always concern over floating debris causing injury to wading pedestrians or structural damages to property.  Additionally, it was noted by the NSW SES and the local community that flooding of septic tanks leading to contamination of the surrounding area by effluent release was a major concern.

<sup>(1)</sup> Relative weighting in assessing the hazard for Sutton determined by interrogation of Reference 2 results

The flood hazard for the study area varies by location based on the relative depths, velocities and effective flood access. Flood hazard will vary depending on the magnitude of the event, and therefore its AEP.

Consideration of the variables presented in Table 5 did not lead to significant amendments to the provisional flood hazard classifications. The only substantial areas upgraded to high hazard are areas on the floodplain that form, or nearly form, areas of low hazard surround by high hazard.

True flood hazard maps have been produced for the 1%, 0.5% AEP and PMF events and are presented in Figure 6 and Figure 8 respectively.

### 3.5. Road Inundation and Access

Understanding flood access issues is critical to effective evacuation and is an important consideration in emergency planning. The majority of properties in Sutton do have ease of egress to flood free land (see Section 3.6), however various rural properties outside of the township of Sutton can become isolated due to rural roads being cut between Sutton and surrounding areas. In particular, the Sutton Road crossing of McLaughlin's Creek (Hotspot #1, see Section 1.2.1) and the North Street crossing of Yass River (Hotspot #3, see Section 1.2.1) are both frequently flooded. Flooding of Sutton Road is a key issue described as part of the Community Consultation process for the current study (see Section 2.4) as well as for the Gundaroo FRMS&P (Reference 3). Upgrading of the existing creek crossing to a structure that allows flood free access is recommended as part of this study (see Section 4.3.4.1).

Furthermore, liaison with the NSW SES Sutton Unit highlighted two creek and River crossings

described in Hotspot #5 as high risk crossings during flood. The construction of large bridges would be required to provide flood free access at these locations which may not be financially feasible, however a number of measures such as early road closures and warning signage is recommended as part of this study (see Section 4.5).

The Flood Study (Reference 2) modelled peak flows, flood levels and velocities at Sutton. A selection of flood depths at road low-points is presented in Table 6. With the exception of the river and creek crossings mentioned above and identified as Hotspots #1 and #2, access road flood depths are generally shallow and are not likely to cause access issues during flood.

Table 6: Flood Depths and Velocities at Road Crossings

Event	Sutton Road at McLaughlin's Creek (m / m/s)	North Street at Yass River (m / m/s)	Majura Ln near West St (m / m/s)	Sutton Road north of East Tallagandra (m / m/s)
<b>5-year ARI</b>	0.4 / 1.9	0.5 / 2.1	0.1 / 0.6	n/a
<b>10% AEP</b>	0.5 / 2.6	0.9 / 2.1	0.1 / 0.7	n/a
<b>5% AEP</b>	0.6 / 2.9	1.5 / 2.4	0.2 / 0.8	n/a
<b>2% AEP</b>	0.8 / 3.0	2.0 / 2.4	0.2 / 0.9	0.1 / 0.4
<b>1% AEP</b>	0.9 / 3.0	2.2 / 2.5	0.2 / 1.0	0.1 / 0.6
<b>0.5% AEP</b>	1.0 / 3.0	2.5 / 2.6	0.3 / 1.0	0.1 / 0.6
<b>PMF</b>	2.6 / 3.5	4.2 / 4.3	0.8 / 3.2	0.4 / 1.3

Research undertaken for the revision of ARR shows that vehicles can become unstable in shallow depths (~0.1 m) where velocities approach 3 m/s. Small cars can float in still water depths of only 0.3 m (Reference 4). In addition, once flooding has subsided, structural damage could make access over a bridge/culverts unsafe.

Information about the depths and velocities of road inundation can aid flood response planning, and ensure that evacuation occurs in a timely fashion before conditions deteriorate and hinder the evacuation process, requiring rescue boats and helicopters.

### 3.6. Evacuation Constraints

In order to assist in the planning and implementation of response strategies, the NSW SES in conjunction with OEH has developed guidelines to classify communities according to the ease of evacuation (Reference 5). These flood Emergency Response Planning (ERP) classifications are mapped for various design floods by considering the inundation of land, roads and overland evacuation routes. Based on the guidelines, communities are classified as either: Flood Islands; Rising Road Access; Overland Escape Route; Trapped Perimeter or Indirectly Affected areas. The classification relates directly to the operational questions of evacuation, rescue and resupply (Table 7).



Table 7: Emergency Response Planning Classification of Communities

Classification	EMERGENCY RESPONSE		
	Resupply	Rescue/Medivac	Evacuation
High flood island	Yes	Possibly	Possibly
Low flood island	No	Yes	Yes
Area with rising road access	No	Possibly	Yes
Area with overland escape routes	No	Possibly	Yes
Low trapped perimeter	No	Yes	Yes
High trapped perimeter	Yes	Possibly	Possibly
Indirectly affected areas	Possibly	Possibly	Possibly

ERP classification was undertaken as part of the Flood Study (Reference 2) for the PMF event. The Sutton ERP classification map for the PMF has been reproduced herein as Figure 9. The majority of the township of Sutton is classified as 'High Trapped Perimeter Area'.

ERP classification maps have also been produced for the 1% and 5% AEP events. These maps are presented in Figure 10 and Figure 11 respectively.

### 3.7. Legislative and Planning Management

#### 3.7.1. State Legislative and Planning Context

It is important to understand the state legislation that overarches all local legislation to enable appropriate floodplain risk management measures to be proposed that are in keeping with both state and local statutory requirements. This section discusses the state legislation that influences planning in relation to flood risk at the local government level.

The NSW Environmental Planning and Assessment Act 1979 (EP&A Act) provides the framework for regulating and protecting the environment and controlling development.

Pursuant to Section 117(2) of the EP&A Act, the Minister has directed that Councils have the responsibility to facilitate the implementation of the NSW Government's Flood Prone Land Policy. Specifically, Direction 4.3 states:

#### **Objectives**

(1) *The objectives of this direction are:*

- (a) *to ensure that development of flood prone land is consistent with the NSW Government's Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005, and*
- (b) *to ensure that the provisions of an LEP on flood prone land is commensurate with flood hazard and includes consideration of the potential flood impacts both on and off the subject land.*

Clause (3) of Direction 4.3 states:

- (3) *This direction applies when a relevant planning authority prepares a planning proposal that creates, removes or alters a zone or a provision that affects flood prone land.*

Clauses (4)-(9) of Direction 4.3 state:

- (4) A planning proposal must include provisions that give effect to and are consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas).*
- (5) A planning proposal must not rezone land within the flood planning areas from Special Use, Special Purpose, Recreation, Rural or Environmental Protection Zones to a Residential, Business, Industrial, Special Use or Special Purpose Zone.*
- (6) A planning proposal must not contain provisions that apply to the flood planning areas which:*
  - (a) permit development in floodway areas,*
  - (b) permit development that will result in significant flood impacts to other properties,*
  - (c) permit a significant increase in the development of that land,*
  - (d) are likely to result in a substantially increased requirement for government spending on flood mitigation measures, infrastructure or services, or*
  - (e) permit development to be carried out without development consent except for the purposes of agriculture (not including dams, drainage canals, levees, buildings or structures in floodways or high hazard areas), roads or exempt development.*
- (7) A planning proposal must not impose flood related development controls above the residential flood planning level for residential development on land, unless a relevant planning authority provides adequate justification for those controls to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General).*
- (8) For the purposes of a planning proposal, a relevant planning authority must not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas) unless a relevant planning authority provides adequate justification for the proposed departure from that Manual to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General).*
- (9) A planning proposal may be inconsistent with this direction only if the relevant planning authority can satisfy the Director-General (or an officer of the Department nominated by the Director-General) that:*
  - (a) the planning proposal is in accordance with a floodplain risk management plan prepared in accordance with the principles and guidelines of the Floodplain Development Manual 2005, or*
  - (b) the provisions of the planning proposal that are inconsistent are of minor significance.*

#### **3.7.1.1. NSW Flood Prone Land Policy**

The primary objectives of the NSW Government's Flood Prone Land Policy are:

- to reduce the impact of flooding and flood liability on individual owners and occupiers of flood prone land, and
- to reduce public and private losses resulting from floods whilst utilising ecologically positive methods wherever possible.

The NSW Floodplain Development Manual 2005 (the Manual), relates to the development of flood prone land for the purposes of Section 733 of the Local Government Act 1993 and incorporates the NSW Flood Prone Land Policy.

The Manual outlines a merit based approach based on floodplain management. At the strategic level, this allows for the consideration of social, economic, cultural, ecological and flooding issues to determine strategies for the management of flood risk.

The Manual recognises differences between urban and rural floodplain issues. Although it maintains that the same overall floodplain management approach should apply to both, it recognises that a different emphasis is required to address issues particular to a rural floodplain. These issues include:

- The large area of land under investigation;
- The complexity of flood behaviour;
- The impacts of protection works for valuable crops on flood behaviour;
- The period of inundation;
- The uncertainties associated with flood related data, and
- The environmental values associated with flood dependent ecosystems on a rural floodplain.

### **3.7.1.2. Section 149 Planning Certificates**

Section 149 of the EP&A Act states:

- (1) A person may, on payment of the prescribed fee, apply to a council for a certificate under this section (a planning certificate) with respect to any land within the area of the council.*
- (2) On application made to it under subsection (1), the council shall, as soon as practicable, issue a planning certificate specifying such matters relating to the land to which the certificate relates as may be prescribed (whether arising under or connected with this or any other Act or otherwise).*
- (3) (Repealed)*
- (4) The regulations may provide that information to be furnished in a planning certificate shall be set out in the prescribed form and manner.*

The Environmental Planning and Assessment Regulation 2000 prescribes the matters which must be included in a s.149 Planning Certificate, including whether a parcel of land is subject to controls relating to flooding.

### 3.7.1.3. State Environmental Planning Policy (Exempt and Complying Development Codes (2008))

The aims of State Environmental Planning Policy (Exempt and Complying Development) 2008 are:

*This Policy aims to provide streamlined assessment processes for development that complies with specified development standards by:*

- (a) providing exempt and complying development codes that have State-wide application, and*
- (b) identifying, in the exempt development codes, types of development that are of minimal environmental impact that may be carried out without the need for development consent, and*
- (c) identifying, in the complying development codes, types of complying development that may be carried out in accordance with a complying development certificate as defined in the Act, and*
- (d) enabling the progressive extension of the types of development in this Policy, and*
- (e) providing transitional arrangements for the introduction of the State-wide codes, including the amendment of other environmental planning instruments.*

### 3.7.1.4. General Housing Code

Part 3 of the SEPP relates to the "General Housing Code".

Division 1 of Part 3 of the SEPP, which comprises clauses 3.1-3.6 of the SEPP, relates to:

#### ***Development that is complying development under this code***

Clause 3.1 states:

#### **3.1 Land to which code applies**

*This code applies to development that is specified in clauses 3.2-3.5 on any lot in Zone R1, R2, R3, R4 or RU5 that:*

- (a) has an area of at least 200 m<sup>2</sup>, and*
- (b) has a width, measured at the building line fronting a primary road, of at least 6m.*

Clause 3.2 of the SEPP states:

#### **3.2 New single storey and two storey dwelling houses**

*The erection of a new single storey or two storey dwelling house is development specified for this code.*

Clauses 3.3-3.5 generally relate to single and two storey dwelling houses and ancillary development.

Division 2 of Part 3 of the SEPP contains:

***Development standards for this code***

Subdivision 9 contains:

***Development standards for particular land***

Subdivision 9 contains Clause 3.36C of the SEPP which relates to development standards for the General Housing Code on "flood control lots". A "flood control lot" is defined in the SEPP as:

***flood control lot*** means a lot to which flood related development controls apply in respect of development for the purposes of industrial buildings, commercial premises, dwelling houses, dual occupancies, multi dwelling housing or residential flat buildings (other than development for the purposes of group homes or seniors housing).

**Note.** This information is a prescribed matter for the purpose of a certificate under section 149 (2) of the Act.

As such, a "flood control lot" is a lot where the Council has provided for flood related development controls, which are all lots with notation on a s.149 Planning Certificate that flood related development controls apply.

Clause 3.36C states:

**3.36C Development standards for flood control lots**

- (1) This clause applies:
  - (a) to all development specified for this code that is to be carried out on a flood control lot, and
  - (b) in addition to all other development standards specified for this code.
- (2) The development must not be on any part of a flood control lot unless that part of the lot has been certified, for the purposes of the issue of the relevant complying development certificate, by the council or a professional engineer who specialises in hydraulic engineering as not being any of the following:
  - (a) a flood storage area,
  - (b) a floodway area,
  - (c) a flow path,
  - (d) a high hazard area,

- (e) a high risk area.
- (3) The development must, to the extent it is within a flood planning area:
  - (a) have all habitable rooms no lower than the floor levels set by the council for that lot, and
  - (b) have the part of the development at or below the flood planning level constructed of flood compatible material, and
  - (c) be able to withstand the forces of floodwater, debris and buoyancy up to the flood planning level (or if on-site refuge is proposed, the probable maximum flood level), and
  - (d) not increase flood affectation elsewhere in the floodplain, and
  - (e) have reliable access for pedestrians and vehicles from the development, at a minimum level equal to the lowest habitable floor level of the development, to a safe refuge, and
  - (f) have open car parking spaces or carports that are no lower than the 20-year flood level, and
  - (g) have driveways between car parking spaces and the connecting public roadway that will not be inundated by a depth of water greater than 0.3m during a 1:100 ARI (average recurrent interval) flood event.
- (4) A standard specified in subclause (3) (c) or (d) is satisfied if a joint report by a professional engineer who specialises in hydraulic engineering and a professional engineer who specialises in civil engineering confirms that the development:
  - (a) can withstand the forces of floodwater, debris and buoyancy up to the flood planning level (or if on-site refuge is proposed, the probable maximum flood level), or
  - (b) will not increase flood affectation elsewhere in the floodplain.
- (5) If a word or expression used in this clause is defined in the Floodplain Development Manual, the word or expression has the same meaning as it has in that Manual unless it is otherwise defined in this clause.
- (6) In this clause:

**flood compatible material** means building materials and surface finishes capable of withstanding prolonged immersion in water.

**Floodplain Development Manual** means the Floodplain Development Manual (ISBN 0 7347 5476 0) published by the NSW Government in April 2005.



**flow path** means a flow path identified in the council's flood study or floodplain risk management study carried out in accordance with the Floodplain Development Manual.

**high hazard area** means a high hazard area identified in the council's flood study or floodplain risk management study carried out in accordance with the Floodplain Development Manual.

**high risk area** means a high risk area identified in the council's flood study or floodplain risk management study carried out in accordance with the Floodplain Development Manual.

### 3.7.1.5. Rural Housing Code

Part 3A of the SEPP contains the "Rural Housing Code".

Division 1 of Part 3A of the SEPP defines:

#### ***Development that is complying development under this code***

Clauses 3A.1 and 3A.2 state:

#### **3A.1 Land to which code applies**

*This code applies to development that is specified in clauses 3A.2-3A.5 on lots in Zones RU1, RU2, RU3, RU4, RU6 and R5.*

#### **3A.2 New single storey and two storey dwelling houses**

- (1) *The erection of a new single storey or two storey dwelling house is development specified for this code if the development is erected on a lot:*
  - (a) *in Zone RU1, RU2, RU4 or RU6 that has an area of at least 4,000m<sup>2</sup>, or*
  - (b) *in Zone R5.*
- (2) *This clause does not apply if the size of the lot is less than the minimum lot size for the erection of a dwelling house under the environmental planning instrument applying to the lot.*

Clause 3A.38 contains:

#### ***Development standards for flood control lots***

The development standards contained in clause 3A.38 are the same as those contained in clause 3.36 as detailed above.

### 3.7.1.6. Summary of State Legislative and Planning Policies

From the above discussion of both the General Housing Code and the Rural Housing Code, it is

clear that, unless a lot affected by flooding is included as a "flood control lot", a s.149 notification is not required and, as a result, planning controls relating to flooding do not apply and a Complying Certificate can be granted without having regard to any Council flood controls. This scenario has considerable implications with regard to Council deciding whether a lot which is flood affected is included in the Flood Planning Area. This is discussed further in Section 4.6.3.

### 3.7.2. Local Council Policy

Updated and relevant planning controls are important in flood risk management. Appropriate planning restrictions, ensuring that development is compatible with flood risk, can significantly reduce flood damages and risk to life. Planning instruments can be used as tools to guide new development away from high flood risk locations and ensure that new development does not increase flood risk elsewhere. They can also be used to develop appropriate evacuation and disaster management plans to better reduce flood risks to the existing population. Councils use Local Environmental Plans (LEPs) and Development Control Plans (DCPs) to govern control on development with regards to flooding. Plans and Policies have been discussed below and later have been reviewed in regards to flood risk management to identify where improvements might be made (see Section 4.6).

A LEP guides land use and development by zoning all land, identifying appropriate land uses that are allowed in each zone, and controlling development through other planning standards and Development Planning Controls (DCPs). LEPs are made under the EP&A Act 1979 which contains mandatory provisions on what they must contain and the steps a Council must go through to prepare them. In 2006 the NSW Government initiated the Standard Instrument LEP program and produced a new standard format which all LEPs should conform to. Yass Valley Council's LEP was adopted in 2013 and was prepared under the Standard Instrument LEP program.

#### 3.7.2.1. Yass Valley Local Environment Plan 2013 (LEP 2013)

Clause 6.2 of LEP 2013 relates to flood planning and states:

##### 6.2 Flood planning

- (1) *The objectives of this clause are as follows:*
  - (a) *to minimise the flood risk to life and property associated with the use of land,*
  - (b) *to allow development on land that is compatible with the land's flood hazard, taking into account projected changes as a result of climate change,*
  - (c) *to avoid significant adverse impacts on flood behaviour and the environment.*
- (2) *This clause applies to land at or below the flood planning level.*

- (3) *Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that the development:*
  - (a) *is compatible with the flood hazard of the land, and*
  - (b) *will not significantly adversely affect flood behaviour resulting in detrimental increases in the potential flood affectation of other development or properties, and*
  - (c) *incorporates appropriate measures to manage risk to life from flood, and*
  - (d) *will not significantly adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses, and*
  - (e) *is not likely to result in unsustainable social and economic costs to the community as a consequence of flooding.*
- (4) *A word or expression used in this clause has the same meaning as it has in the Floodplain Development Manual (ISBN 0 7347 5476 0) published by the NSW Government in April 2005, unless it is otherwise defined in this clause.*
- (5) *In this clause, flood planning level means the level of a 1:100 ARI (average recurrent interval) flood event plus 0.5 metre freeboard.*

Recommendations for amendments to Council's existing LEP as outlined above are presented in Section 4.6.4.1.

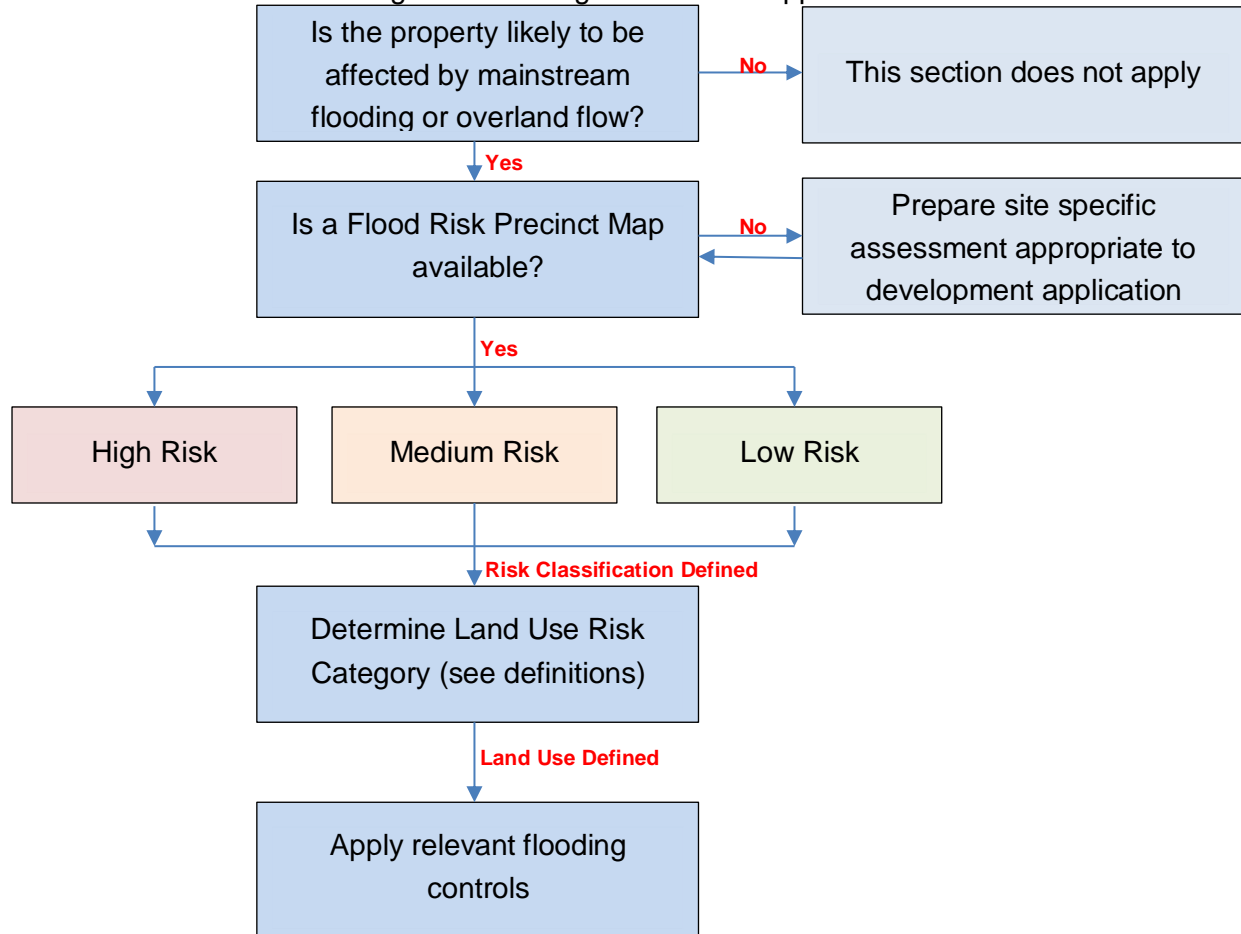
### **3.7.2.2. Yass Valley Development Control Plan**

Yass Valley Council are currently in the process of developing a DCP for the LGA. The DCP will have a chapter that relates to flood related development controls that can be applied to properties on the floodplain at Sutton.

To assist Council with development of flood related development controls, WMAwater have produced a draft Flood Policy that can be used in the flood chapter of Council's DCP. The draft Flood Policy is presented in Appendix C and is based the Flood Risk Precinct method which has been successfully implemented by a large number of Councils throughout NSW. The Flood Risk Precinct method identifies and utilised the idea that the floodplain is subject to different degrees of hazard, or flood risk. Further information on the proposed draft Flood Policy is presented in Section 4.6.4.2.

The flow chart below (Chart 1) presents how the process is applied to an individual lot.

Chart 1: Flow Chart illustrating how Planning Controls are applied to a flood affected lot



## 4. FLOODPLAIN RISK MANAGEMENT MEASURES

### 4.1. Identifying Floodplain Risk Management Measures

This FRMS aims to identify and assess risk management measures which could be put in place to mitigate flooding risk and reduce flood damages. This section sets out a number of measures which could be of benefit to Sutton. As well as the hydraulic impacts, flood risk management measures are assessed against the legal, structural, environmental, social and economic conditions or constraints of the local area. In the following sections a range of management options have been considered to effectively manage existing and future flood risks at Sutton.

### 4.2. Risk Management Measures Categories

The 2005 NSW Government's Floodplain Development Manual (Reference 1) separates risk management measures into three broad categories.

**Flood modification measures** modify the physical behaviour of a flood including depth, velocity and redirection of flow paths. Typical measures include flood mitigation dams, retarding basins, channel improvements, levees or defined floodways. Pit and pipe improvement and even pumps may also be considered where practical.

**Property modification measures** modify the existing land use and development controls for future development. This is generally accomplished through such means as flood proofing, house raising or sealing entrances, strategic planning such as land use zoning, building regulations such as flood-related development controls, or voluntary purchase/voluntary house raising.

**Response modification measures** modify the response of the community to flood hazard by educating flood affected property owners about the nature of flooding so that they can make better informed decisions. Examples of such measures include provision of flood warning and emergency services, improved information, awareness and education of the community and provision of flood insurance.

Table 8 provides a summary of typical floodplain risk management measures that have been assessed for the current study. It should be noted that many of these management measures are not appropriate for Sutton and have not been recommended.

Table 8: Flood Risk Management Measures

Flood Modification	Property Modification	Response Modification
Levees (Lv)	Land zoning	Community awareness
Temporary Defences (TD)	Voluntary purchase	Flood warning
Channel Construction (CC)	Building & development controls	Evacuation planning
Channel Modification (CM)	Flood proofing	Evacuation access
Major Structure Modification (MSM)	House raising	Flood plan / recovery plan
Drainage Network Modification (DNM)	Flood access	
Drainage Maintenance (DM)		
Retarding Basins (RB)		

Flood Modification Measures have been investigated below in Section 4.3, Property Modification Measures are presented in Section 4.4 and Response Modification Measures are discussed in Section 4.5. Additionally, planning and future development control measures are discussed in Section 4.6.

### 4.3. Flood Modification Measures

The purpose of flood modification measures is to modify the behaviour of the flood itself by reducing flood levels or velocities by excluding water from areas under threat. These measures usually involve structural works, most often permanent but temporary structures can be deployed where sufficient flood warning is available. This section considers management measures which modify flood behaviour on a wider scale. Flood modification measures at the individual property scale are discussed in Section 4.4.4. Table 9 lists the modelled modification options and further details on selected Options are presented in Appendix D.

Table 9: Flood Modification Measures Tested

Option	Description	Type*	Report Section
<b>C1</b>	Increasing the Existing Victoria Street Drain Capacity	(CM)	4.3.3.1
<b>C2</b>	Modifying the Existing North/Quartz Street Drainage System	(CM)	4.3.3.2
<b>C3</b>	Diversion of Northern Flow Path toward McLaughlin's Creek	(CM)	4.3.3.3
<b>C2 / C3</b>	Combined Options C2 and C3	(2 x CM)	4.3.3.4
<b>A1</b>	Replacing the Sutton Road Causeway	(MSM)	4.3.4
<b>A2</b>	Increasing the capacity of culverts crossing Camp Street	(MSM)	4.3.4.2
<b>A3</b>	Increasing the capacity of culvert crossing North Street	(MSM)	4.3.4.3
<b>A4</b>	Pipe network to convey Sutton Central Flow Path flows	(MSM)	4.3.5.1
<b>B1</b>	Bywong Street Basin	(RB)	4.3.6.1

\* See Table 8 for Type classification description

Flood impact maps have been produced to display the effect that the various mitigation structures have on flood behaviour. These maps display the difference in peak flood level between the 1% AEP design event and the same event with the mitigation structure implemented. Impact maps have only been presented where significant impacts have been produced.

Mitigation options that were determined to provide significant benefits in terms of reduction in private property inundation have had damages assessments undertaken such that a Benefit/Cost (B/C) ratio could be produced.

#### 4.3.1. Levees and Bunds

##### DESCRIPTION

Levees involve the construction of raised embankments between the watercourse and flood affected areas so as to prevent the ingress of floodwater up to a design height. Levees usually take the form of earth embankments but can also be constructed of concrete walls or similar where there is limited space or other constraints. They are more commonly used on large river systems, for example on the Murrumbidgee River at Wagga Wagga or the Murray River at



Albury, but can also be found on small creeks in urban areas and in overland flow situations where they usually take the form of smaller bunds.

Flood gates, flap valves and pumps are often associated with levees to prevent backing up of drainage systems in the area protected by a levee and/or to remove ponding of local water behind the levee.

Localised levees or bunding can be applied around individual properties. Such measures are considered minor property adjustments and are discussed in Section 4.4.4.

## **DISCUSSION**

Once constructed, levee systems generally have a low maintenance cost although the levee system needs to be inspected on a regular basis for erosion or failure. Although a levee can keep out flood waters, flooding can occur within the levee due to local runoff being unable to drain. In addition, as the levee causes a displacement of water from one area of the floodplain to another they should be carefully designed using hydraulic modelling techniques so as to ensure the levee does not increase flood risk to an adjacent area.

The design height of the levee is the event for which it prevents flooding and usually also includes a freeboard to allow for settlement of the structure overtime or variations in flood levels due to the behaviour of the flood event, wave action from passing vehicles or watercraft and effects of wind. A freeboard analysis has been performed to determine the suitable allowance for freeboard.

## **SUMMARY**

Levees and embankments are not considered a viable option for flood management in Sutton due to an absence of suitable locations for placement of these structures to achieve flood mitigation. Primarily this relates to a lack of mainstream flood affectation for which levees would be most suitable. Additionally, in the case of MOF flooding other mitigation measures, which are discussed in the ensuing sections, are more suitable.

As levees and embankments are not suitable for the study area, the economic, social and environmental impacts of these structures have not been investigated.

### **4.3.2. Temporary Flood Barriers**

#### **DESCRIPTION**

Temporary flood barriers include demountable defences, wall systems and sandbagging which is deployed before the onset of flooding.

#### **DISCUSSION**

Demountable defences can be used to protect large areas and are often used as a means to assist in current mitigation measures rather than as sole protection measures. For example they are best used to fill in gaps in levees or raising them as the risk of levee overtopping develops. The effectiveness of these measures relies on sufficient warning time and the ability of a workforce to install. They are more likely to be used for mainstream fluvial flooding from rivers

which have sufficient warning time and are not a suitable technique for overland flooding.

The use of temporary measures in protecting individual properties, such as sandbagging, is discussed in Section 4.4.3.

## **SUMMARY**

In Sutton, demountable defences are not suitable to be used to reduce flood risk and inundation, due to the lack of suitable locations for their placement and insufficient available warning time.

### **4.3.3. Channel Modifications**

#### **DESCRIPTION**

Channel modification includes a range of measures from increasing the size of a channel, straightening, concrete lining, removal of obstructing structures, dredging and vegetation clearing. In some instances increasing native vegetation density in the channel upstream can reduce peak levels downstream by slowing flows and making better use of flood storage. On the other hand, straightening and channelling the flow can improve flooding by removing flood waters from an area more efficiently. However, such measures may also increase flood levels in adjacent or downstream locations.

#### **DISCUSSION**

A number of issues relating to existing drainage channels have been discussed as part of the community consultation process (see Section 2). Residents have raised concerns about the Sutton local drainage system, particularly in regards to existing drains situated on Victoria, North and Quartz Streets. Whilst amendments to these drainage systems would typically not be considered as 'flood mitigation works', Options investigating how these two drains can be improved (Options C1 and C2 respectively) are discussed in the ensuing sections. In addition, a proposed new drainage system Option C3 has been investigated to channel and divert flows from the Northern Flow Path away from residential properties.

#### **4.3.3.1. Option C1 – Increasing the Existing Victoria Street Drain Capacity**

Option C1 is classified as drainage works rather than flood mitigation works. Option C1 was recommended as part of the Community Consultation process (see Section 2.4). The Option would be implemented by increasing the conveyance capacity of the existing drainage system on Victoria Street by increasing the channel width to 5 m and the depth by 0.5 m. Additionally, an existing culvert under Bywong Street (0.3 m diameter) would be replaced with a 0.45 m diameter culvert and a new culvert of the same capacity was placed to convey flows under Camp Street and into McLaughlin's Creek.

Option C1 was shown to only slightly reduce peak flood levels for a limited area proximate to the drain and does not provide any benefit to properties.

Due to a lack of significant impacts provided by Option C1, implementation of this Option in isolation is not warranted. However, this Option has been found to be effective when used in combination with Option B1 (see Section 4.3.6.1).

#### **4.3.3.2. Option C2 – Modifying the Existing North/Quartz Street Drainage System**

Option C2 is classified as drainage works rather than flood mitigation works. The Community Consultation results (see Section 2.1) indicate that the configuration and capacity of the drainage channel parallel to North and Quartz Streets is a key area of concern for residents. The drainage system currently conveys flow under Quartz Street to the southern side of North Street before flowing north passing under North Street via culverts situated near Bywong Street. The configuration currently transfers flow into the urban areas and requires the flow to be transferred twice through the road.

Modification of the existing drainage system is recommended through the following changes:

- Quartz Street to be raised to a minimum level of 612.5 mAHD. This is required to stop flow from crossing Quartz Street, a mechanism identified during the Flood Study. Approximately 40 m of road needs to be raised by a maximum of 0.4 m;
- Removal or blockage of the existing culverts under Quartz Street to stop the transfer of flow to the eastern side of the road;
- The conveyance capacity of the existing drainage channel on the eastern side of Quartz Street and northern side of North Street to be increased by lowering the drains by 0.6 m on average; and
- At the intersection of Quartz and North Streets 2 x 0.6 m culverts added to convey flows on the eastern side of Quartz Street under North Street.

The Option C2 impact map for the 1% AEP event is presented in Figure D 1. This Option eliminated flood affectation for three properties downstream of Quartz Street in the 1% AEP flood event. Flood levels were reduced by up to 0.2 m at other properties downstream of this measure. However, it must be noted that there is no over floor flood liability in this area until events larger than the 1% AEP and therefore associated economic benefits with implementation of this Option are minimal. The estimated cost of construction of Option C2 is \$53,000.

Option C2 has been investigated further in combination Option C3 (See Section 4.3.3.3) as the combined Option was shown to provide further benefits.

Information on the preliminary costing and design of Option C2 is contained in Appendix E.

#### **4.3.3.3. Option C3 – Northern Flow Path Minor Drainage Channel**

Option C3 is classified as drainage works rather than flood mitigation works. Option C3 investigated the impact of the construction of a 5 m wide drain to divert flows from the Northern Flow Path toward Camp Street. The drain is designed with a maximum depth of ~1 m with an average depth of approximately 0.5 m.

Several lots in northern Sutton are no longer flooded for a range of design events including the 1% AEP event with the implementation of Option C3 (see Figure D 2). However, it must be noted that there is no over floor flood liability in this area until events larger than the 1% AEP and therefore associated economic benefits with implementation of this Option are minimal. The estimated cost of construction of Option C3 is \$30,000.

Option C3 also leads to minor increases in flood level (0.02 m) on Camp Street in the 1% AEP event, however the depth of flooding where impacts are experienced are shallow (less than 0.1 m) and will not affect road access. Should Council wish to implement this option, the implementation of larger culverts under Camp Street could be examined to minimise flood impacts during detailed design.

Option C3 has been investigated further in combination Option C2 (See Section 4.3.3.2) as the combined Option was shown to provide further benefits.

Information on the preliminary costing and design of Option C3 is contained in Appendix E. Please note that Submission 4 submitted as part of the Public Exhibition Period (see Section 2.5) has several concerns related to the preliminary concept design of this option. These concerns are detailed in Submission 4 of Appendix F and can be addressed as part of the detailed design should Council implement this option.

#### **4.3.3.4. Combined Option C2 / C3**

Combined Option C2 / C3 aimed to reduce flood affectation in the area described as Hotspot #3 (see Section 1.2.1) for events up to and including the 1% AEP event. Option C2 / C3 is a combination of the minor drainage works, Options C2 and C3, with details of each Option provided in Sections 4.3.3.2 and 4.3.3.3 respectively.

The reduction in peak flood level associated with modelling of the combined Option C2 / C3 for the 1% AEP event is presented in Figure D 4. Results indicated that the combination of these Options significantly reduces flood affectation for a number of properties situated in north Sutton. However, it must be noted that there is little over floor flood liability in this area until events larger than the 1% AEP and therefore associated economic benefits with implementation of this Option are minimal. The estimated cost of construction associated with Option C2 / C3 is \$83,000.

A damages assessment was undertaken for the combined Option C2 / C3 which indicated that there was only a minor reduction to AAD (\$1,000) associated with this combined Option. However, the response from various community engagement opportunities has indicated that this area is of particular concern for residents and thus Option C2 / C3 can provide significant social benefits to the Sutton community. The intangible benefits, by their nature, are inherently more difficult to estimate in monetary terms. Potential intangible benefits incurred by residents with implementation of this Option include reductions in stress, ill-health, trauma, injury, loss of sentimental items etc. It is not possible to put a monetary value on the intangible benefits as they are likely to vary dramatically between each flood, dependent on a range of factors such as the size of flood, the individuals affected, and community preparedness. However, the intangible benefits often provide the greatest positive impact on the community when considering the benefits of flood mitigation works. Accordingly, Option C2 / C3 is recommended for implementation to reduce flood affectation in northern Sutton.

Information on the preliminary costing and design of Options C2 and C3 are contained in Appendix E.

## SUMMARY

Increasing the conveyance capacity of the Victoria Street (Option C1) drain was not considered a suitable flood mitigation strategy, however the described works have been incorporated into the Option B1 basin to improve downstream drainage.

Both Options C2 and C3 provide improvements to the local drainage network, however the economic benefit of implementation these works is poor. The implementation of the combined Option C2 / C3 was shown to significantly improve drainage in the north of Sutton (Hotspot #3) and is recommended for the intangible reasons described above.

## RECOMMENDATIONS

The following measures are recommended:

- Recommended that detailed costing and design be undertaken for the combined Option C2 / C3.

### 4.3.4. Major Structure Modification

#### DESCRIPTION

Hydraulic controls such as bridges or major culverts on significant waterways can affect upstream flood levels due to backwatering effects. By increasing hydraulic conveyance, flood levels upstream of a structure can be decreased. Generally the most effective way of increasing hydraulic conveyance is by increasing a structure's cross sectional area (normal to the flow direction). This is often done by lengthening a bridge, raising the deck level or increasing the size of culverts. Such works can also increase flood access which can lead to reduced isolation and risk associated with motorist entering flood waters. This is examined further in Section 4.5.

#### DISCUSSION

The Community Consultation process (see Section 2.1) identified that the Sutton Road crossing of McLaughlin's Creek (Hotspot #1, Section 1.2.1) is a key area of concern for residents. Flooding in McLaughlin's Creek causes frequent overtopping and closures of this crossing which isolates areas to the north and in particular the Gundaroo Township. Replacing this causeway with a bridge was investigated in Option A1 to improve flood free access.

Additionally, increasing the capacity of the culverts crossing Camp Street between Middle Street and Victoria Street was suggested as a part of the Community Consultation process. This mitigation measure is investigated in Option A2.

#### 4.3.4.1. Option A1 – Replacing the Sutton Road crossing of McLaughlin's Creek

The Sutton Road crossing of McLaughlin's Creek at Sutton provides an important access route to the north of the town, including to both Yass and Gundaroo. Flooding of this low-level crossing can cause isolation and reduced access which can impact on emergency services and increase risk to motorists. A key finding of the Community Consultation process (Section 2.1) is

that both Sutton and Gundaroo residents would like the existing McLaughlin's Creek low-level crossing replaced with a bridge which affords greater flood resilience.

A simulated bridge has been modelled at the location of the current creek crossing with the existing Sutton Road crossing of McLaughlin's Creek removed. The bridge deck was modelled as flood free in the 1% AEP event at a level of 608.0 mAHD. The dimensions of the piers were assumed to not block more than 5% of the total cross sectional area under the bridge, and pier spacing was assumed to be designed such that diagonal spans exceeded 6 m and are therefore not likely to block during a flood event (Reference 17).

Modelling indicates that replacing the existing structure with a bridge does not provide any significant reduction to peak flood levels in the 1% AEP event. However, the improved flood access significantly reduces isolation and risk associated with motorist entering flood waters which is examined further in Section 4.5. Increasing the design level of this creek crossing also has the added benefit that the Sutton SES Unit (see Section 3.2.2.4) can access Gundaroo and other areas to the north of Sutton during flood, and therefore provide a significant increase in emergency response effectiveness.

The estimated cost of constructing this bridge is significant (~\$2 million based on other bridges of similar size) with the associated benefits predominately intangible. Accordingly, the 'value' of implementing the Option A1 Bridge in terms of economic benefits cannot be defined. Intangible benefits, by their nature, are inherently more difficult to estimate in monetary terms. The primary benefit of the Option A1 Bridge is greatly improving the primary access route from areas to the north of Sutton, particularly the Gundaroo Township, to Canberra which allows flood free access for hundreds of residents and importantly for emergency services.

#### **4.3.4.2. Option A2 – Increasing the capacity of culverts crossing Camp Street**

As suggested in the Community Consultation process (Section 2.1), the culverts crossing Camp Street were increased in capacity (from 1 x 0.4 m diameter culvert to 4 x 0.4 m diameter culverts) and modelled for the 1% AEP event.

The results of this modelling indicated the Option A2 does not provide any reduction to peak flood levels in the 1% AEP event. Due to a lack of significant impacts provided by Option A2 further investigation of this Option is not warranted.

It should be noted that the community is also concerned by the duration of flooding in the areas upstream of Camp Street as flow cannot escape due to the blockage of culverts. Maintenance of the existing drainage network, including clearing of blocked culverts, is recommended as described in Section 4.3.5.

#### **4.3.4.3. Option A3 – Increasing the capacity of culvert crossing North Street**

Residents on the southern side of North Street noted in the Community Consultation process that they believed that the culvert crossing North Street near Bywong Street was undersized causing yard flooding to these properties. The capacity of this culvert was increased from 1 x 0.45 m diameter culvert to 4 x 0.45 m culverts across North Street and modelled for the 1% AEP



event.

Option A3 did not provide any significant reduction to peak flood levels for the 1% AEP event to the properties located along North Street, however minor benefits may be experienced for smaller events. As a result this measure is not recommended for further investigation.

It should be noted that the combined Option C2 / C3 does provides a significant reduction in peak flood level for this area and is therefore recommended in preference.

## SUMMARY

Major flow obstructions, such as inadequately designed culverts and bridges, restrict flow conveyance capacity and cause increased peak flood levels. These structures can also provide vital flood free access that remove isolation and reduce risk to motorists.

## RECOMMENDATIONS

The following measures are recommended:

- Recommended that detailed optimised design ensuring flood free access and costing be undertaken for Option A1.

### 4.3.5.1. Option A4 – Sutton Central Flow Path, Pipe Network

Option A4 was considered in the final stages of the study at the request of Council and the community. Due to timing and budget constraints, Option A4 has not been modelled.

Option A4 aims to mitigate flood affectation on the Sutton Central Flow Path by conveying flow in a pipe, rather than in the existing overland flow path. Preliminary calculations indicate that the pipe would need to be between 1.2 – 1.5 m in diameter (assuming 50% blockage) to convey the 1% AEP flow of 2.1 m<sup>3</sup>/s. A total pipe length of 130 m would be required to convey flow from Bywong Street to Camp Street. Downstream of Bywong Street, a swale would be required to convey flow from Camp Street to the Yass River channel. Various measures would need to be undertaken to ensure the safety of Option A4 due to the risks associated with people being sucked into the pipe during times of flow. Easements would be required at two properties to allow installation of the structure, however these two properties would be significant beneficiaries of Option A4 which would potentially simplify easement acquisition.

Option A4 could be used to significantly decrease flood affectation for properties downstream of Bywong Street (Hotspot #4, see Section 1.2.1). Initial cost of implementation estimates by WMAwater indicated that this Option would not be feasible from a financial perspective, however a cost estimate provided by Council of \$400,000 makes this a competitive Option.

The tangible benefits associated with this Option would be the same as that calculated for Option B1 (see Section 4.3.6.1), as both Options have the same objectives (i.e. mitigation of flood affectation on the Sutton Central Flow Path). An estimate of the reduction in AAD associated with implementation of Option A4 is \$42,000.



Assuming the Council cost of implementation of this Option (\$400,000) and the expected reduction in AAD of \$42,000, a B/C ratio of 1.6 is determined (assuming a 50 year lifespan).

Option A4 should be considered for detailed design alongside Option B1 / C1 (see Section 4.3.6.1) to determine which option has the most merit for implementation.

### **RECOMMENDATIONS**

The following measures are recommended:

- Recommended that detailed costing and design be undertaken for Option A4 alongside Option B1 / C1 to determine which the preferred Option.

### **4.3.5. Drainage Maintenance**

#### **DESCRIPTION**

Maintenance of the drainage network is important to ensure that it is operating with maximum efficiency and to reduce risk of blockage or failure. Maintenance involves regularly removing unwanted exotic vegetation and debris from the drainage network.

#### **DISCUSSION**

The Community Consultation process (see Section 2.1) highlighted the community's concerns about structure and channel maintenance. The introduction of maintenance protocols or policies would ensure that drainage assets are effectively managed and regularly maintained such that they will perform as required particularly on those rare occasions when they are needed.

Blockage of numerous structures throughout Sutton has been mentioned as part of the Community consultation process. In particular, the Sutton Road crossing of McLaughlin's Creek was noted to be partially blocked at the time of the study, as were culverts under Camp Street where this road intersects with the Sutton Central Flow Path (see Section Figure 1). Blockage of these structures has the potential to increase peak flood levels, the frequency of road flooding and closures, and the duration of ponding.

#### **SUMMARY**

Regular maintenance can reduce risk of blockage of structures during flood events and ensure that flood waters are drained efficiently. It would be beneficial for Council to maintain a record of drainage infrastructure within the LGA and of the authority, organisation or body responsible for its maintenance.

## RECOMMENDATIONS

The following measures are recommended:

- ▶ Identify policies for general maintenance of drains and channels and determination of protocols for ownership maintenance and development / upgrade of infrastructure.
- ▶ Develop a database of all drainage infrastructure and its owner and authority, organisation or body responsible for its maintenance.

### 4.3.6. Retarding Basins

#### DESCRIPTION

Retarding basins work by storing and controlled release of runoff after the event peak. These measures are appropriate for use in controlling flooding by mitigating the effects of increased runoff caused by development and can be either installed as part of a new development to prevent increases in runoff rates, or retrofitted into existing catchment drainage systems to alleviate existing flood problems.

#### DISCUSSION

Retarding basins can significantly reduce peak flows and are typically cost effective and easy to implement provided there is a suitable location available. Hydraulic structures, such as low flow culverts at the bottom of a basin, can be used to restrict the discharges rates from site to a variable rate, dependent on rainfall volumes and the hydraulic head in the retarding basin.

Large retarding basins can be a safety hazard. Appropriate safety controls such as fencing and signage should be included as part of the overall asset. In NSW, particularly large basins may be prescribed by the Dam Safety Committee (DSC) which means that the DSC will maintain a continuing oversight of their safety. This is applicable to basins identified as a possible threat to communities downstream in case of failure. Like the rest of the drainage system, retarding basins have maintenance requirements. Regular checks and maintenance will be required by Council or agreements put in place with the developer and land holder. This is particularly applicable to basins identified as being a threat to communities downstream in case of failure.

A proposed basin, Option B1, has been investigated to mitigate flooding for properties affected by the Central Flow Path. Details are presented below.

#### 4.3.6.1. Option B1 / C1 – Bywong Street Basin

Option B1 modelled the implementation of a basin at the corner of Victoria and Bywong Streets. The basin embankment is approximately 225 m in length with an average height of 1 m (including 0.5 m freeboard) and would be constructed largely in the Bywong Street easement and the lane easement between Bywong and Quartz Streets (further details on required easements is presented in Appendix E). An embankment accompanied by a swale situated on the lane easement between Bywong and Quartz Streets would be used to divert water south from the Sutton Central Flow Path into the Option B1 basin. A low flow discharge pipe with a 0.45 m diameter was incorporated near the corner of Bywong and Victoria Streets to discharge

flow into a drain on the northern side of Victoria Street (Option C1, see Section 4.3.3.1). This Option has only been investigated in conjunction with Option C1 and is not suitable for use in isolation.

Option B1 / C1 was modelled for a range of design events with the impact on peak flood level for the 1% AEP presented in Figure D 3. Option B1 / C1 significantly reduces 1% AEP peak flows on the Sutton Central Flow Path from 2.1 m<sup>3</sup>/s to 0.3 m<sup>3</sup>/s which leads to a significant decreases in peak flood levels and extents for properties downstream of Bywong Street (Hotspot #4, see Section 1.2.1) assuming an empty basin at the beginning of the storm. Minor increases in flood level are experienced on the 48 Quartz Street lot, however this is largely due to the relatively coarse grid resolution (5 m) which has been used in hydraulic modelling. Should Council wish to proceed with this Option, detailed design works must ensure that flood impacts are not experienced on neighbouring properties.

Option B1 / C1 was found to be an effective mitigation strategy. Table 10 presents the benefits that Option B1 / C1 provides in terms of reduced property flood affectation (yard and above floor) and the associated reduction in damages.

Table 10: Option B1 – Reduction in Property Flood Affectation and Flood Damages

Event	No. Properties No Longer Flooded	No. of Properties No Longer Flooded Over Floor	Reduction in Damages for Event
5-year ARI	1	2	\$ 45,000
10% AEP	1	2	\$ 81,000
5% AEP	3	4	\$ 182,000
2% AEP	3	3	\$ 209,000
1% AEP	5	5	\$ 333,000
0.5% AEP	3	3	\$ 286,000
PMF	-	-	-
<b>Average Annual Damages (AAD) Reduction</b>			<b>\$ 42,000</b>

The damages assessment was undertaken to determine the B/C ratio for implementation of Option B1 / C1. The cost of implementation of Option B1 / C1 is estimated to be \$325,000 with the Option expected to provide a \$42,000 reduction in AAD. By estimating the expected damages for the next 50 years assuming implementation of this Option a B/C ratio of 1.8 has been calculated.

Considering the above, Option B1 / C1 was found to be an effective mitigation strategy and is recommended for implementation to reduce flooding due to the Sutton Central Flow Path.

Information on the preliminary costing and design of Option B1 / C1 is contained in Appendix E.

## SUMMARY

Retarding basins mitigate flow by storing water for a limited period of time. Option B1 / C1 has been used to store and divert flood waters from the Central Flow Path. This measure is recommended for further investigation alongside Option A4 (see Section 4.3.5.1) to develop a

preferred option.

## **RECOMMENDATIONS**

The following measures are recommended:

- Recommended that detailed costing and design be undertaken for Option B1 / C1 alongside Option A4 to determine which the preferred Option.

## **4.4. Property Modification Measures**

Property modification measures refer to the modifications to existing development and/or development controls on property and community infrastructure for future development. Flood modification measures which apply at the individual property scale have also been included in this section.

New performance requirements for buildings in flood hazard areas were introduced in the National Construction Code (NCC) in 2013 with The Australian Building Codes Board (ABCB)'s 'Construction of Buildings in Flood Hazard Areas' and the accompanying Handbook (References 13 and 14). This Standard contains requirements to ensure new buildings and structures, located in flood hazard areas do not collapse during a flood when subjected to flood actions and includes consideration of appropriate construction, use of appropriate materials, electrical, plumbing and drainage installation as well as setting floor levels. It applies to residential buildings (Classes 1, 2, 3 and 4) and health care buildings (Classes 9a and 9c). The Standard is not intended to override any land use planning controls imposed by Council or the appropriate authority.

### **4.4.1. House Raising**

#### **DESCRIPTION**

House raising has been widely used throughout NSW to eliminate or significantly reduce flooding of habitable floors particularly in lower hazard areas of the floodplain, albeit in limited overall numbers. However it has limited application as it is not suitable for all building types being more suitable for non-brick single storey buildings. House raising is unlikely to be approved in high hazard areas.

#### **DISCUSSION**

The benefit of house raising is that it has the potential to eliminate above floor flooding and consequently reduce flood damages.

The type of construction of a house can make raising an unfeasible option as raising a brick property can be structurally difficult and also incur significantly higher costs than a timber property. Many of the residences in Sutton are brick construction or slab on ground and therefore house raising is unlikely.

For new development, floor level requirements will negate the need for future raising of properties.

## SUMMARY

A review of at-risk properties in the study area failed to identify any specific houses suitable for house raising. This is due to a combination of factors, being:

- Construction material of properties incompatible with house raising
- Large differences between 1% AEP and PMF design flood levels at properties near the Yass River and McLaughlin's Creek means that properties raised above the 1% AEP level will still incur damages in larger floods, thereby reducing the benefits of the option; and
- Raising properties comes with an associated increased risk with people staying in their houses during a flood event.

House raising is therefore not considered to be a cost effective option for Sutton and no specific houses have been identified for raising.

### 4.4.2. Voluntary Purchase

#### DESCRIPTION

Voluntary Purchase (VP) involves the acquisition and demolition of flood affected properties where significant risk to life during flood events exists. Removal of properties can not only remove this significant risk to life but restore the natural hydraulic capacity of the floodplain; the storage volume and waterway area. Voluntary purchase is utilised in hazardous locations throughout NSW, as a long term option to remove isolated hazardous areas.

Although measures such as flood proofing or raising could reduce flood damages for properties in high risk areas during smaller events, the high hazard means that conditions are unsafe for people and they would still need to be evacuated before the onset of flooding. Voluntary purchase of the properties would allow the areas to be rezoned to a high hazard flood compatible uses i.e. open public space, therefore removing the risk to life to current residents and their rescuers.

#### DISCUSSION

Voluntary purchase is an effective strategy where it is impractical or uneconomic to mitigate high flood hazard to an existing property and it is more appropriate to cease occupation to meet the above objectives and is often a measure that is used as part of a wider management strategy than on its own. Government funding for voluntary purchase schemes can be made available through the Floodplain Management Program as long as a number of complying criteria are met. Voluntary purchase areas are not classified under any specific land use in the Standard Instrument LEP. However, Council can consider creating Voluntary Purchase zones through their DCP or requiring that voluntary purchase zones apply to all flood prone areas also identified as being high hazard floodway.

No properties in the Sutton Township are eligible for VP as the township is predominately classified as low hazard flooding (see Figure 7).

## **CONCLUSION**

VP schemes generally have low B/C ratios and are only likely to obtain funding in high risk to life situations. Additionally, such schemes often take many years to obtain sufficient funding to purchase all properties eligible for the scheme. In Sutton, no properties were found to be suitable for VP.

### **4.4.3. Flood Proofing**

#### **DESCRIPTION**

Flood proofing is often divided into two categories; wet proofing and dry proofing. Wet proofing assumes that water will enter a building and aims to minimise damages and/or reduce recovery times by choice of materials which are resistant to flood waters and facilitates drainage and ventilation after flooding. Dry proofing aims to totally exclude flood waters from entering a building and is best incorporated into a structure at the construction phase.

As an alternative to retrofitting permanent flood proofing measures to existing properties, temporary flood barrier methods can also be achieved by the use of sandbags in conjunction with plastic sheeting or private flood barriers which fit over doors, windows and vents and are deployed by the occupant before the onset of flooding.

#### **DISCUSSION**

Retro fitting permanent flood proofing measures can be difficult and permanent flood proofing is best achieved during construction. Temporary flood proofing can be achieved during flooding although relies on someone to put up flood gates or similar and therefore effective flood warning times and the time of flooding can affect their efficiency.

Whilst it is a requirement of the LEP 2013 that new residential properties have their floor levels above the 1% AEP event plus a freeboard, commercial properties are not subject to such requirements unless stipulated by Councils. New commercial buildings can be required to be flood proofed to the Flood Planning Level (FPL) when constructed which would include consideration of suitable materials, electrical and other services installation and efficient sealing of any possible entrances for water. Council would make these requirements through the DCP and planning controls. It is recommended that planning controls allow some flexibility for either dry or wet flood proofing to be used, and for temporary flood gate options to also be included in building design for low risk non-habitable development.

Temporary flood barrier measures such as sandbagging and flood barriers can be a cheaper option than retrofitting to existing properties and can be useful in areas where there is frequent shallow flooding. Sandbagging, often used in conjunction with plastic sheeting, can provide a buffer for dealing with flooding in smaller areas and at individual properties. Whilst sandbags and plastic sheeting seldom prevent the ingress of floodwaters entirely, they can substantially decrease the depth of over floor flooding and decrease foulness of floodwaters, thus aiding the clean-up process.

There is little warning time in Sutton and although the use of temporary measures should not be

discouraged they should not be relied on as a solution to flood problems at individual properties.

## **SUMMARY**

Flood proofing is a good solution to reducing flood risk to commercial and industrial properties and should be encouraged for all new development of this type, particularly where floor levels may be low. Consideration of appropriate construction materials is still needed for those residential developments where floor levels will be raised above the 1% AEP flood level but structures can still become inundated below the floor level.

Temporary flood proofing techniques may be deployed although lack of warning time may limit their efficiency and they should be considered as a secondary option to more permanent measures being implemented.

## **RECOMMENDATIONS**

The following measures are recommended:

- ▶ Include requirements for flood proofing for new development, wet or dry as appropriate, in development controls. In particular this approach should be the minimal requirement for non-habitable buildings such as commercial or industrial developments where floor levels are not always required above the FPL.

### **4.4.4. Minor Property Adjustments**

#### **DESCRIPTION**

In MOF areas minor property adjustments can be used to manage MOF through private property and minimise impacts on dwellings by helping to divert local MOF away from dwellings and access points. Such adjustments can include low level bunding (small levees) around individual properties, amendments to fences or construction of fences which act as deflector levees, modifying gardens and ground levels etc. all of which can affect the local continuity of overland flow paths.

#### **DISCUSSION**

It is difficult for Council to enforce property adjustments and furthermore the issue can be complicated by requirements of s149 certificates. In addition, adjustments on one property may have knock on effects on adjoining properties, or require modifications on neighbouring properties to be effective. Some residents have commented that they believe small features on neighbourhood properties have increased flooding on their own property. Therefore any works in flood prone areas which could modify the localised flood behaviour should be shown to have no significant impact on adjoining properties and be subject to approval from Council.

## **SUMMARY**

Minor property adjustments can have localised benefits, however they should be assessed for their impact on neighbouring properties. There are no specific recommendations regarding minor property adjustments for Sutton, however Council may want to consider some controls on this due to impacts on neighbouring properties.



## **4.5. Response Modification Measures**

Response modification measures aim to reduce risk to life and property in the event of flooding through improvements to flood prediction and warning, through improvements to emergency management capabilities and planning, and through better flood-educated communities.

### **4.5.1. Flood Warning and Emergency Response Strategies**

#### **4.5.1.1. General Considerations**

The purpose of a flood warning is to provide advice on impending flooding so people can take action to minimise its negative impacts. An effective flood warning system requires integration of a number of components (Reference 7):

- monitoring of rainfall and river flows that may lead to flooding;
- prediction of flood severity and the time of onset of particular levels of flooding;
- interpretation of the prediction to determine the likely flood impacts on the community;
- construction of warning messages describing what is happening and will happen, the expected impact and what actions should be taken;
- dissemination of warning messages;
- response to the warnings by the agencies involved and community members; and
- review of the warning system after flood events.

Where effective flood warnings are provided, risk to life and property can be significantly reduced. Studies have shown that flood warning systems generally have high B/C ratios if sufficient warning time is provided and if the population at risk is aware of the threat and prepared to respond appropriately.

#### **4.5.1.2. Available Warning Time**

Flood affectation at Sutton can be due to mainstream and MOF flooding sources (see Section 1.3). Warning times for both mainstream and MOF floods at Sutton are short due to the small catchment sizes. This leads to these catchments to be classified as ‘flash flood’ catchments where the provision of an effective flood warning service is problematic.

Several challenges to an effective flood warning service have been identified for flash flood catchments (References 6 and 8):

- Flash floods are less predictable than larger scale flooding. Rainfall over small catchments is usually not well predicted by numerical weather prediction models.
- For flash floods, there is little time to develop reliable flood warnings and for effective dissemination and response to the flood warnings. More rapid user response is required, which necessitates specialised communication systems and a high level of public flood awareness and readiness.
- A reliance on rainfall triggers increases the frequency of false alarms.
- The use of water level triggers may not allow sufficient time for response.

For these reasons, the Bureau of Meteorology traditionally has not issued specific flood predictions for flash flood catchments. But it does provide more general services that may be of some benefit in alerting the emergency services and community to the threat of flooding:

- General Weather forecast. This may indicate the likelihood of heavy rain from synoptic scale events, typically with more than 24 hours' notice.
- Flood Watch. This is issued by the NSW Flood Warning Centre, typically providing 24 to 48 hours' notice that flooding is possible based upon current catchment conditions and future rainfall, which is predicted by computer models of the atmosphere.
- Severe Weather Warning. This is issued for synoptic scale events when torrential rain and/or flash flooding (or other hazardous phenomena) are forecast.
- Severe Thunderstorm Warning. This is issued by the Severe Weather Team, typically providing 0.5 to 2 hours' notice of impending severe storms. These forecasts are based upon radar and, if available, data from field stations, reports from storm spotters, as well as an analysis of the synoptic situation.

NSW SES may issue Local Flood Advices for locations like Sutton not covered by Bureau Flood Warnings. For example, during recent (2015 – 2016) intense local rainfall events, notification of SES warnings listed above were made on the Sutton SES Unit Facebook page and Twitter account (@Sutton\_SES).

Due to the comparatively minor flood risk associated with MOF, focus in the remainder of this section is predominately on mainstream flooding.

The upstream catchment areas at Sutton are small (101 km<sup>2</sup> and 34 km<sup>2</sup> for the Yass River and McLaughlin's Creek respectively) so mainstream floods tend to occur rapidly following the onset of flood-producing rainfall. It must be noted that there is no flooding of residential properties due to the Yass River at Sutton with flooding confined to rural land. However, during a McLaughlin's Creek PMF approximately 15 dwellings are expected to be flooded over floor, and the surrounding flood depths and velocities could pose a significant risk to life for people attempting to evacuate from a flooded building. Accordingly, management of the residual risk to life in very rare events requires consideration.

Available warning time for Sutton has the potential to be determined from two sources, the:

- onset of flood-producing rainfall; and for the Yass River, the
- Sutton Stream Gauge.

The available warning time to the Yass River flood peak at Sutton from the onset of flood-producing rainfall and from the Sutton Stream Gauge is presented in Table 11. Available warning times are presented for various design and historic rainfall events.

Table 11: Available Warning Time to Flood Peak at Sutton for Yass River Flooding

Event	Rainfall	Sutton Stream Gauge	
	Warning time (hours)	Warning time (hours)	Peak flow (m³/s)
2010*	5.1	1.6	97
2012*	6.6	1.6	71
0.2 EY	5.6	0.8	50
10% AEP	5.3	0.8	72
5% AEP	5.2	0.7	102
2% AEP	5.0	0.7	147
1% AEP	4.8	0.6	182
0.5% AEP	4.6	0.6	219
PMF	2.6	0.3	3,046

\* Warning times for historic events have been determined from gauge recordings and observations of flooding. These provide a more accurate idea of available warning time than those provided from the design results determined from the hydrologic model. However, it must be noted that the available warning times for larger events are likely less than those determined from the 2010 and 2012 events.

Table 11 indicates that during the 2010 and 2012 flood events (~5% - 10% AEP), the time from the onset of flood-producing rainfall to the Yass River flood peak at Sutton was approximately 5 hours. The time taken for the flood peak to travel from the Sutton Stream Gauge to Sutton was approximately 1.5 hours. Flood travel times for larger floods such as the PMF are significantly quicker with only 20 minutes warning available from the Sutton Stream Gauge and 2.5 hours for rainfall.

This above information can be used not only to provide warning for potential residential property flooding but also for early road closures to minimise risk associated with motorists travelling through flood waters. Local residents, such as those living on the eastern side of the Yass River who require the North Street Crossing (Hotspot #2), could benefit from advanced warnings of impending flood events based on the Sutton Stream Gauge.

Available warning time from the onset of flood-producing rainfall for the McLaughlin's Creek catchment is presented in Table 12. McLaughlin's Creek is the only source of mainstream flooding of residential properties in Sutton and only occurs for flood events much larger than the 0.5% AEP. The time taken for the McLaughlin's Creek flood peak after the onset of flood producing rainfall for the PMF is 2.3 hours.

Table 12: Available Warning Time to Flood Peak at Sutton for McLaughlin's Creek Flooding

Event	Rainfall
	Warning time (hours)
0.2 EY	5.0
10% AEP	4.8
5% AEP	4.5
2% AEP	4.3
1% AEP	4.0
0.5% AEP	4.0
PMF	2.3

The need for ample warning of impending mainstream flooding is generally only an issue for

events larger than the 0.5% AEP event where residences on the McLaughlin's Creek floodplain can be flood affected.

#### **4.5.1.3. Required Warning Time**

The required warning time is dependent on what it is that is trying to be achieved. Two main reasons that warning of an impending flood may be required are evacuation of the McLaughlin's Creek floodplain in the case of a PMF (or other very large flood events) and the closure of flood affected roads during smaller floods. The required warning time for these two objectives vary significantly.

#### **Evacuation of Properties Effected by McLaughlin's Creek Flooding for Large Floods**

For evacuation to be feasible, the available warning time must exceed the required warning time (see Section 4.5.1.2). The required warning time may be assessed by protocols set out in Reference 10 and since formalised in a *Guide for Using the SES Timeline Evacuation Model Standard Tool*. Calculations for this assessment are set out in Table 13. The time required for the evacuation of the 15 flood affected properties on the McLaughlin's Creek floodplain during the PMF was assessed.

Using the NSW SES Timeline Evacuation Model tool suggests that at least 4.4 hours would be required to fully evacuate flood affected areas on the McLaughlin's Creek floodplain at Sutton, including standard allowances for warning acceptance, warning lag and traffic safety factors (see Table 13). This does not include allowances for mobilisation of NSW SES personnel, for the decision to issue an Evacuation Order or for dissemination of the Evacuation Order, which adds to the time required.

Examination of Table 13 indicates that even assuming a method of rapid dissemination (e.g. SMS alerts when water reaches a pre-determined level) could be employed to avoid the need for doorknocking, the required warning time far exceeds the available warning time for evacuation purposes.

#### **Road Closures and Warning**

The Flood Study identified two key access routes (Hotspots #1 and #2) that frequently flood and the community consultation process identified a number of additional access roads outside of the study area that are susceptible to flooding, which are described as Hotspot #5 in this report (see Section 1.2.1). During flood, these access roads pose a significant risk to life to motorist that attempt to use these roads. Early road closures implemented by using available warning time, can reduce the risk to life by stopping motorist from entering flood waters.

Currently, road closures are only implemented by Council and RMS once they have been notified of flooding of an access road. This means that the road is flooded well before it is closed indicating that currently the available warning time is zero.

Table 13: Evacuation Timeline Model Calculation for McLaughlin's Creek at Sutton

Time required to evacuate		
Number of vehicles		Data source
<i>Residential</i>		
Number of dwellings	15	WMAwater
Vehicles per dwelling	2.0	2011 Census
% Census respondents not reporting	10%	2011 Census
Residential vehicles	30	Calculated
<i>Commercial</i>		
Number of business premises	1	WMAwater
Vehicles per business	~5	Estimate
Commercial vehicles	5	Calculated
Total vehicles (TV)	35	Calculated
<b>Evacuation route</b>		
Number of lanes (various routes)	2	Field trip
Evacuation route capacity (RC) (veh/hr)	1200	SES
<b>Warning Delivery (WD)</b>		
15 properties at 5 minutes per home assuming 1 teams	1.3	SES
<b>Evacuation timing (hrs)</b>		
Warning acceptance factor (WAF)	1	SES
Warning lag factor (WLF)	1	SES
Travel time (TT) =TV/RC	0.1	Calculated
Traffic safety factor (TSF)	1	SES
Total time required to evacuate (TR) = WAF+WLF+TT+TSF+WD	4.4	Calculated
<b>Time available to evacuate (hrs) – Based on rainfall estimates</b>		
BOM forecast time	0	
Flood travel time	2.3	
Total time available (TA)	2.3	
<b>Time deficit or surplus (hrs)</b>		
<b>Time = TA – TR</b>	<b>-2.1</b>	

#### 4.5.1.4. Available and Required Warning Time - Conclusion

Examination of Table 13 indicates that rainfall is not suitable for providing warning of an impending PMF event on McLaughlin's Creek as the available warning is less than the time available to evacuate. Additionally, as mentioned in the Flood Study, there are no pluviometer rainfall gauges situated in the upstream catchment suitable for providing warning.

While the Sutton Stream Gauge may not provide useful information that can be used in the evacuation of properties on the Yass River floodplain in the event of the PMF, the gauge could be used to inform of smaller flood events that can lead to the flooding of roads and isolation of rural properties such as the North Street Crossing of Yass River (Hotspot #2).

#### 4.5.1.5. Opportunities for Increasing Available Warning Time

Opportunities for increasing available warning time potentially include the installation of pluviometer rainfall gauges to provide earlier warning, however as noted above rainfall does not provide enough warning time for evacuation of the McLaughlin's Creek properties.

For Sutton, it is considered that an appropriate scale of investment for the improvement of flood predictions is alarming the existing NOW Sutton Stream Gauge, installing a pluviometer at this site, and installing a manual depth indicator at Sutton, to be monitored by NSW SES personnel when floods are threatening. The manual gauge could be used to tie predicted flood affectation to a gauge height thus providing a quantitative description of flood magnitude. Alarming the existing gauges could also be used by Council and RMS to notify when roads are cut such that road closures can be implemented. Such information would allow the NSW SES to develop a Flood Intelligence Card (FIC) for Sutton (see Section 4.5.2).

#### **4.5.1.6. Opportunities for Reducing Required Warning Time**

Opportunities to reduce the required warning time can also be considered. The Flood Warning manual (Reference 11) also makes the point that especially in catchments which have limited warning times, there is value in setting up warning messages before flooding occurs. The NSW SES could draft a series of messages for various scenarios, which would enable more rapid broadcast and dissemination during a flood emergency.

An important question is how the people affected by flooding can best be given the appropriate information. The potential for restricted road access (see Section 3.2.2.4) means that door-knocking may be too slow to reach everyone in time. An automated telephone dial-out system could be implemented for owners of buildings in the McLaughlin's Creek floodplain. The ability of such a system to quickly reach a large number of subscribers is highly beneficial for mitigating flood risk. Implementation of such a system would reduce the required warning time to 3.1 hours, however this would still not allow safe evacuation in the event of the PMF.

For flood affected access roads, automated warning signs and boom gates that signal once a trigger level has been reached at an upstream gauge could be installed to close roads and provide warning to motorists. This would significantly reduce the time taken to close roads by negating the need for Council staff to drive from Yass to the road closure site.

Another method of closing roads that warrants investigation are prototype flood gates which self-deploy during periods of high flow. The flood gates are locked in the open position at low-lying crossings and are designed to automatically unlock and close road access when floodwaters reach a pre-set depth. In flood situations the gates provide a highly visual barrier to warn motorists and discourage attempts to cross flooded waterways. When water recedes to an acceptable level the flood gate is deactivated by Council officers to allow vehicular access to the crossing.

The SES has also specifically requested that flood affected roads not only be closed at the affected creek crossing, but also warning signage be implemented at the turnoff to the affected road. The SES have noted an issue with motorists that having driven many kilometres to a flooded crossing, using the crossing in spite of obvious danger so as to avoid a lengthy return trip. Early notification and warning of closed creek crossing would allow motorists to select another route thus avoiding the creek crossing entirely.



#### 4.5.1.7. Flood Warning and Emergency Response Recommendations

Due to the short available warning times at Sutton, the provision of an effective flood warning service for mainstream flooding is difficult. Various options have been considered to improve flood prediction times, with the following measures considered most appropriate: alarming the existing NOW Sutton Stream Gauge, installing a pluviometer at this sites and installation of a manual depth indicator at Sutton. There are also opportunities to improve other aspects of the total flood warning system, including the preparation of a suite of sample warning messages ready for broadcast, the construction and maintenance of an automatic dial-out system for the efficient delivery of information/instructions during flood emergencies and automated warning signs and boom gates.

##### RECOMMENDATIONS

The following measures are recommended:

- ▶ Enhance the flood prediction capability of the existing NOW gauges at site 410851 by: alarming the existing gauge to provide SMS to SES, Council, RMS and other emergency services personnel when pre-determined triggers are reached; and installing a pluviometer (NOW, NSW SES, RMS and Council);
- ▶ Install a manual gauge at Sutton, to be monitored by NSW SES personnel when floods are threatening (NSW SES);
- ▶ Progressively develop relationships between manual depth indicator and upstream water level recorders (NSW SES);
- ▶ Introduce automated warning signs and boom gates that signal once a trigger level has been reached at an upstream gauge. A study should be undertaken to determine the required trigger levels (NOW, NSW SES, RMS and Council);
- ▶ Prepare a suite of flood warning messages (NSW SES); and
- ▶ Construct and maintain a telephone dial-out system for the rapid dissemination of flood information and instructions (NSW SES).

#### 4.5.2. Flood Emergency Management Planning

##### DESCRIPTION

Effective planning for emergency response is a vital way of reducing risks to life and property, particularly for infrequent floods that are not managed through flood or property modification.

The NSW State Emergency Service (SES) is the legislated combat agency for floods in NSW and is responsible for the control of flood operations. This role is undergirded by flood planning. NSW SES maintains the Yass Valley Local Flood Plan (Reference 15).



Residents living in and proprietors working in the floodplain can also prepare individual plans tailored to their situation.

## DISCUSSION

The Yass Valley Local Flood Plan (LFP) (Reference 15) is a sub-plan of the Yass Valley Local Emergency Management Plan. Volume 1 of the LFP was endorsed in June 2013 and outlines responsibilities and procedures for preparing for, responding to and recovering from floods within the Shire. The LFP does not currently provide information for Sutton. A number of recommendations are made, however a full revision of the Yass Valley LFP is required to include Sutton.

Clause 3.5 of Volume 1 of the LFP lists the NSW SES Yass Operations Centre but makes no mention of the Sutton SES Unit. An extreme flood would inundate many of the roads between Sutton and both Yass and Gundaroo thus hindering SES response. This risk could be noted in the LFP.

Annex F, point 9. of Volume 1 of the LFP lists two locations that are suitable for use as a flood evacuation centre, however both locations are in Yass. No suitable locations for an evacuation centre in Sutton have been listed. Review of the findings from the Flood Study indicate that the both the Sutton SES Unit and Sutton Village Centre situated on Victoria Street are above the level of the PMF. This could be noted in the LFP.

Volume 2 of the LFP again provides no Sutton specific information. This Volume includes Annexes describing the flood threat, effects on the community and response arrangements for each sector such as property protection, evacuation, rescue and resupply. Amendments to the draft LFP are recommended drawing on the results of the finalised Flood Study and the assessment of flood problems undertaken as part of this FRMS&P.

Findings of the Flood Study and FRMS&P that should be incorporated into the LFP include:

- Design flood extents, depths, velocities, hazard and travel times;
- Predicted building inundation in design floods up to PMF;
- Predicted road inundation in design floods up to PMF; and
- Evacuation constraints in design floods up to PMF.

## SUMMARY

Planning for flooding is a vital way of reducing flood risks to life and property. Plans need to be reviewed after flooding and after new information is made available from flood investigations. NSW SES has the lead role in planning for and responding to floods. There is a need to update the Yass Valley Local Flood Plan and the potential to create a Flood Intelligence Card for Sutton. But best practice teaches that people will respond more effectively when households and businesses are also engaged in planning to respond to floods.

## RECOMMENDATIONS

The following measures are recommended:

- Review and update the Yass Valley Local Flood Plan to include information pertinent to Sutton, drawing on flood intelligence from the Flood Study (Reference 2) and this FRMS&P (NSW SES);

### 4.5.3. Community Flood Education

#### DESCRIPTION

Actual flood damages can be reduced, and safety increased, where communities are flood-ready:

*'People who understand the environmental threats they face and have considered how they will manage them when they arise will cope better than people who lack such comprehension... Many people who live and work in flood liable areas have little idea of what flooding could mean to them – especially in the case of large floods of severities well beyond their experience or if a long period has elapsed since flooding last occurred. It falls to the combat agency, with assistance from councils and other agencies, to raise the level of flood consciousness and to ensure that people are made ready for flooding. In other words, flood-ready communities must be purposefully created. Once created, their flood-readiness must be purposefully maintained and enhanced.'* (Reference 9)

Based on learnings from recent disasters, the focus of community disaster education has now turned from a concentration on raising awareness and preparedness to building community resilience through learning. Simply disseminating information to the community does not necessarily trigger changed attitudes and behaviours. Flood education programs are most effective when they:

- Are participatory i.e. not consisting only of top-down provision of information but where the community has input to the development, implementation and evaluation of education activities;
- Involve a range of learning styles including experiential learning (e.g. field trips, flood commemorations), information provision (e.g. via pamphlets, DVDs, the media), collaborative group learning (e.g. scenario role plays with community groups) and community discourse (e.g. forums, post-event de-briefs);
- Are aligned with structural and other non-structural methods used in floodplain risk management and with emergency management measures such as operations and planning; and
- Are ongoing programs rather than one-off, unintegrated 'campaigns', with activities varied for the learner.

It is difficult to accurately assess the benefits of a community flood education program but the consensus is that the benefits far outweigh the costs. Nevertheless, sponsors must appreciate that ongoing funding is required to sustain gains that have been made.

## DISCUSSION

Current levels of flood awareness in Sutton for MOF flooding are relatively high, due to recent flood events. However, there have been no large riverine flood events in recent times and mainstream property flood affectation does not occur until events exceed the 0.5% AEP which leads to particularly low levels of awareness of mainstream flooding. This means that there is a need to build flood readiness for residents of Sutton and to maintain flood readiness through ongoing flood education.

Table 14 provides a list of methods to build and sustain flood readiness, which may be developed and supported by NSW SES and Council. These include methods both to inform and to prepare the community, with the objective of building resilience.

Table 14: Methods to Increase Flood Awareness and Preparedness

Method	Comment
<b>S149 certificate notifications</b>	Section 149 planning certificates should record whether the land is subject to any planning and development controls due to its flood affectation. Council also has opportunity to provide more detailed information about the land's flood affectation under S149(5) of the EP&A Act 1979. This information may be particularly valued by prospective purchasers but has a limited reach and is typically issued only upon request and payment of a fee.
<b>Letter/certificate/pamphlet from Council</b>	These may be sent annually with a rates notice or separately. A Council database of flood liable properties makes this a relatively inexpensive and effective measure. The intention of flood certificates is to inform individual property owners of the flood situation (flood levels, ground levels) at their particular property. It is the site-specific nature of this advice that offers a chance of overcoming the scepticism typical of a community that has not experienced serious flooding for some years. Only after floodplain occupants accept that they could have a problem are they ready to take on board ideas about addressing that problem. A pamphlet can inform residents of the on-going implementation of the Floodplain Risk Management Plan and provide tips to respond appropriately to flooding (e.g. evacuate early; never drive, ride or walk through floodwater). Proactive and regular issuance is desirable.
<b>Council website</b>	It is recommended that Council provides an 'emergency information' portal on its website. In particular a flood management portal would be of value to describe the floodplain management process and include Flood Studies and Floodplain Risk Management Studies, a history of flooding in the Yass Valley LGA, procedures for how to obtain flood information, answers to frequently asked questions (FAQs), and advice on becoming flood prepared. The portal could also provide links to Bureau of Meteorology warnings and NSW Office of Water gauge heights.
<b>Community Working Group</b>	Council could initiate a Community Working Group framework to provide a valuable two way conduit between the local residents and Council.
<b>School project</b>	School students can learn about historical floods by interviewing older residents and documenting what happened. A project could also involve talks from various authorities (e.g. NSW SES) and can be combined with topics relating to water quality, drainage management, etc.

Method	Comment
<b>Articles in local newspapers</b>	Ongoing articles in the newspapers will ensure that the flood issues are not forgotten. Historical features and remembrance of past events are interesting for local residents and can provoke preparedness for future events.
<b>Library display</b>	The library could collect historical flood photos and stories to prepare a display, which could be accompanied by appropriate flood safety messages.
<b>Mobile display</b>	Such a display as described above could also be used at local festivals and for school visitations, accompanied by NSW SES staff, who should be trained to encourage and equip households to prepare flood emergency plans.
<b>NSW SES FloodSafe Guide</b>	Now that a Flood Study has been prepared, and given the experiences of major floods in the recent past, once the Local Flood Plan is finalised, it would be timely to prepare a FloodSafe guide for Sutton describing flood behaviours in historical and design floods, and listing appropriate actions. If major flood mitigation works will be implemented following this FRMS&P, it would be advisable to wait until these are done.
<b>NSW SES Business FloodSafe Breakfast</b>	The NSW SES has prepared a FloodSafe Business template, which businesses can use to plan for flooding. A breakfast barbeque could be convened at an appropriate location to promote completion of plans and to provide site-specific flood information.
<b>'Meet the street' events</b>	'Meet-the-street' events involve NSW SES and Council setting up a 'stall' at an appropriate and visible location at a time that people will be at home. The event would be advertised through a specific letter box drop to the targeted neighbourhood or vulnerable site. The stall could consist of flood maps on boards, NSW SES banners, NSW SES materials (e.g. Sutton FloodSafe guide when available) to hand out. These materials are used to engage with people and make them aware of flood risk, encourage preparedness behaviours (e.g. develop emergency plans) and help them understand what to do during and after a flood. A meeting could also encourage property owners to develop self-help networks and particularly people checking on neighbours if a flood is imminent. Longer-term residents with flood experience could be used to help provide other residents with an understanding of previous floods and how to prepare for future flooding.
<b>Historical flood markers and flood depth markers</b>	Signs or marks can be prominently displayed on telegraph poles or similar to indicate the level reached in historical and design floods. Depth indicators advise of potential hazards, particularly to drivers. These are inexpensive and effective but in some flood communities are not well accepted as it is perceived that they affect property values. Flood marker poles could be installed at the end of David, Harp or Lots Streets (away from private property) to show the height flood waters reached in the 1925, 1959 and 1989 events. This marker should also present the level that the PMF is expected to achieve to provide community awareness.

## SUMMARY

As there have been no large riverine flood events in recent times there is likely to be particularly low levels of awareness due to McLaughlin's Creek flooding at Sutton. This means that there is a need to build flood readiness for residents of Sutton and to maintain flood readiness through ongoing flood education. If there are long periods without damaging flooding, it is difficult to maintain the community's interest and preparedness. Ongoing flood education will be required

to build and maintain flood resilience and to prepare the community for larger and faster-rising floods than it has previously experienced. Also, given regular loss of life in Australia from people attempting to cross floodwater, messages to discourage people from engaging in these unsafe behaviours are desirable.

Council may wish to develop a program from the above measures after taking into account the views of the local community, funding considerations and other education programs within the LGA. However, for the purposes of this FRMS&P, we recommend that the following measures be given a high priority:

- Regular issuance of flood certificates and pamphlets to landowners within the floodplain;
- Preparation of a library flood photo and story display;
- Preparation of a Sutton FloodSafe guide;
- Arrangement of a Business FloodSafe breakfast for Sutton;
- Meet-the-street meetings for properties on the floodplain; and
- Installation of a historical flood marker post in Sutton.

## **RECOMMENDATIONS**

The following measures are recommended:

- ▶ Engage with community to prepare an ongoing flood education program, with appropriate methods for program evaluation (NSW SES and Council);
- ▶ Regularly issue flood certificates and pamphlets to landowners within the floodplain (Council);
- ▶ Prepare a library photo and story display (Council and NSW SES);
- ▶ Prepare a Sutton FloodSafe guide (NSW SES and Council);
- ▶ Host a Business FloodSafe breakfast for Sutton's businesses (NSW SES and Council);
- ▶ Arrange meet-the-street meetings for Sutton (NSW SES and Council);
- ▶ Install a flood marker pole in Sutton showing the height of historical flood events and design peak flood levels (Council);

## **4.6. Planning and Future Development Control Measures**

### **4.6.1. Land Use Planning**

Appropriate zoning of flood liable land ensures development only occurs in suitable locations compatible with flood risk and hazard. As recognised in the Floodplain Development Manual (Reference 1) land use planning cannot be undertaken effectively without a good understanding of the flood risks and the associated consequences. Council's set out land use zones within their LEP.

Within Sutton there is the potential for future development. Unless planned for and carefully managed, any large developments will increase the impervious area which in turn will potentially increase catchment runoff and localised flooding.

Any changes to the land use should consider the flood risk, as presented in this study, and ensure that future development does not adversely affect that risk. This can be achieved through measures such as controlling runoff (through WSUD / on-site detention), ensuring development is located outside the floodplain (either through elevated floor levels or physically locating buildings beyond the flood extent) and that safe access and egress can be achieved in all events up to the PMF.

### **Recommendation**

Any new development proposed in the study should be compatible with the flood risk as well as ensuring it does not adversely affect the flood risk elsewhere in the catchment. To do this, consideration should be given to the flood planning levels (Section 4.6.2), controlling on-site runoff and ensuring safe access and egress routes are available so as not to increase the burden on emergency services.

Yass Valley Council does not currently have a DCP, however a draft Flood Policy (see Section 4.6.4), provided as part of this FRMSP, aims to provide sufficient controls to achieve the above stated objectives.

### **SUMMARY**

Appropriate land use planning can assist in reducing future flood risk and ensure development in flooded areas is flood compatible. Council should consider appropriate controls including floor levels and or flood proofing for commercial or industrial development to ensure that such development does not cause flood issues to be offset elsewhere.

Flood data and mapping should be used strategically in the planning process to inform existing zoned areas and proposed rezoning areas in Sutton.

### **RECOMMENDATIONS**

The following measures are recommended:

- Reconsider existing zones against current flood data and mapping, introduce flood controls where appropriate and investigate back zoning if land is identified in the floodway.

## **4.6.2. Flood Planning Levels**

### **DESCRIPTION**

Flood Planning Levels (FPLs) are an important tool in floodplain risk management. Appendix K of the Floodplain Development Manual (the Manual) provides a comprehensive guide to the purpose and determination of FPLs. The FPL provides a development control measure for managing future flood risk and is derived from a combination of a flood event and a freeboard.



The Manual states that, in general, the FPL for a standard residential development would be the 1% AEP event plus a freeboard which is typically 500 mm.

According to the Manual, the purpose of the freeboard is to provide reasonable certainty that the reduced flood risk exposure provided by selection of a particular flood as the basis of an FPL, is actually provided given the following factors:

- Uncertainty in estimating flood levels;
- Differences in water level because of local factors;
- Increases due to wave action, and
- The cumulative effect of subsequent infill development on existing zoned land.

Typically, the FPL is used to define the minimum level at which habitable floor levels should be constructed.

## DISCUSSION

The Floodplain Development Manual states that the FPL for standard residential development is usually the 1% AEP flood event plus a freeboard which is typically 500 mm. Depending on the nature of the development and the level of flood risk, individual FPLs can be adopted for a local area within a greater floodplain area. For example in areas prone only to shallow MOF flooding, application of the 500 mm freeboard can be excessive. Selecting the appropriate FPL for a particular floodplain involves trading off the social and economic benefits of a reduction in the frequency, inconvenience, damage and risk to life caused by flooding against the social, economic and environmental costs of restricting land use in flood prone areas and of implementing management measures.

The FPL can be varied depending on the use, and the vulnerability of the building/development to flooding. For example, residential development could be considered more vulnerable due to people being present, whilst commercial development could be considered less vulnerable, or it could be accepted that commercial property owners are willing to take a higher risk. For developments more vulnerable to flooding (hospitals, schools, electricity sub-stations, seniors housing and the like) consideration should be given to events rarer than the 1% AEP when determining their FPL and either consider the PMF or situating those developments outside the floodplain where possible.

For the less vulnerable commercial and industrial developments, flood proofing (see Section 4.4.3) a building can be considered where raising floor levels is not an option or not feasible, but should not be allowed for residential developments or more vulnerable uses. For example, it could be a requirement that residential dwellings are to have floor levels above the FPL, whilst commercial properties could have lower floor levels but be subject to other controls such as flood proofing to the level of the FPL.

For Sutton, the 1% AEP flood level plus 500 mm freeboard is recommended for use as the FPL. For industrial and commercial areas, the Council can either set their own floor height or require flood proofing where the FPA applies to industrial or commercial land.



More sensitive land uses such as nursing homes, hospitals and child care centres and the like should ideally be located outside of the PMF flood extent. The draft Flood Policy (Appendix C) composed as part of this FRMS&P makes recommendations in this regard.

## SUMMARY

The FPL should be used to set finished floor level requirements for residential development. Less vulnerable uses such as commercial developments could be subject to lower floor level requirements but it is recommended that they should be subject to flood proofing to the FPL where floor levels are lower. More vulnerable developments and critical infrastructure should be subject to more stringent requirements if possible. An FPL of 1% AEP plus 0.5 m is considered appropriate for Sutton.

The benefits and consequences of different criteria for setting both the FPA and FPL should be considered together as it is important both are compatible.

## RECOMMENDATIONS

The following measures are recommended:

- ▶ The FPL should be set as the 1% AEP event plus 0.5 m for residential areas within Sutton and subject to the FPA.
- ▶ Council can decide on floor level requirements for non-residential developments at their discretion but should take into account proximity to MOF routes, flood hazard at the subject site and surrounding area etc.
- ▶ For commercial or industrial developments where finished floor levels are not set at the FPL, flood proofing measures will be required to the FPL.
- ▶ More vulnerable developments within Sutton such as hospitals, schools, services including power should at the very least have floor levels and access at the FPL or PMF level, whichever is higher.

### 4.6.3. Flood Planning Area

#### DESCRIPTION

The Flood Planning Area (FPA) is an area to which flood planning controls are applied. An FPA map is a required outcome of the FRMS&P.

It is important to define the boundaries of the FPA to ensure flood related planning controls are applied where necessary and not to those lots unaffected by flood risk. The Floodplain Development Manual defines the FPA based on the flood extent formed by the 1% AEP mainstream flooding event plus freeboard (typically 0.5 m) and, therefore, extended further than the extent of the 1% AEP event. Planning controls may, therefore, be applied to development which is not necessarily within the 1% AEP flood extent but is in the FPA. The purpose of extending the FPA past the 1% AEP flood extent is to allow for any future increases in flood

extent due to uncertainties in modelling, cumulative impact etc., as well as an allowance for differences between flood behaviour during events. This method was used to produce the interim FPA as part of the Sutton Flood Study.

The NSW Standard Instrument LEP does not include a specific land use zone classification for flood prone land, rather it permits a Flood Planning Area map to be included as a layer imposed across all land use zones.

## **DISCUSSION**

The FPA as defined by the Floodplain Development Manual (1% AEP + freeboard) is suitable for imposing flood related development controls for events up to the 1% AEP flood, however residual risk for flood events larger than this is not accounted for. At Sutton the residual risk for large flood events is not a major issue as relatively minor scaling is expected for events larger than the 1% AEP flood. However for other towns within the LGA such as Gundaroo and Yass, flood risk is increased significantly for events approaching the PMF with extreme high hazard flooding experienced in areas well outside the 1% AEP flood extent.

It is recommended in the Gundaroo FRMS&P (Reference 3) that sensitive land uses be prohibited below the PMF, including those uses involving persons who cannot self-evacuate, consistent with the Standard Instrument LEP definitions. Whilst this approach is not specifically required for Sutton, the same methodology is recommended to maintain consistency between Council's flood policies across the entire LGA.

## **SUMMARY**

Defining the FPA is crucial as the FPA is a key concept referred to in the LEP. The Sutton FPA map is presented in Figure 12.

### **4.6.4. Update Flood Related Planning Policies and Development Controls**

#### **DESCRIPTION**

Planning policy and controls are important in flood risk management. Appropriate planning controls that ensure that development is compatible with flood risk can significantly reduce structural failure, material damages, loss of life, resident isolation and rescue hazards. They can also be used to develop appropriate evacuation and disaster management plans to better reduce flood risks to the existing population. Councils use Local Environmental Plans (LEPs) and Development Control Plans (DCPs) to govern control on development with regards to flooding. Existing Council Policy and overarching State legislation is discussed in Section 3.7.2 and 3.7.1 respectively.

#### **DISCUSSION**

Following a review of the LEP 2013 and noting Council's lack of current policy regarding flooding, a number of measures are recommended. Recommendations for the Yass Valley LEP 2013 are presented in Section 4.6.4.1 and recommendations for the proposed Yass Valley DCP are presented in Section 4.6.4.2.

#### **4.6.4.1. Recommended Updates for the Yass Valley Local Environmental Plan 2013**

The NSW State Government's Floodplain Development Manual 2005 (the Manual) has been prepared in accordance with the NSW Government's Flood Prone Land Policy. It guides councils in the development and implementation of detailed Floodplain Risk Management Plans to produce effective floodplain risk management outcomes.

The EP&A Act establishes that councils are responsible for the preparation of Local Environmental Plans (LEPs) under the Environmental Planning and Assessment Act 1979. Councils are encouraged to incorporate appropriate planning provisions of Floodplain Risk Management Plans into LEPs, Development Control Plans (DCP) and policies. The Manual recommends that councils exclude Complying Development from areas which require flood related development controls.

It is generally the case that councils achieve the requirements of the Manual by adopting a clause within their LEP which denotes any development shown at or below the Flood Planning Level as requiring development consent. The Flood Planning Level is identified in Floodplain Risk Management Studies and is generally translated to Flood Planning Mapping in the LEP.

The Manual states that councils are generally responsible for the investigation, design, construction and maintenance of flood mitigation works. An essential part of ongoing floodplain risk management is that each council needs to put in place a formal asset management program for management measures. This not only applies to structural mitigation works but is equally applicable to planning measures.

The Manual provides a framework for councils to prepare and implement Floodplain Risk Management Studies and Plans which control both development and activities on flood prone land. Development controls are then formulated and incorporated into the council's DCP.

In addition to the development controls within a council's DCP, there are also written provisions pertaining to flood planning within the relevant LEP. In addition to written provisions of the LEP, councils often incorporate a Flood Planning Map within their LEP.

The Standard Technical Requirements for LEP Maps (Version 2.0) defines both standard maps and local maps. Standard maps are mandatory for inclusion within new LEPs. The Flood Planning Map is not a standard map but a local map which illustrates unique local conditions or affectations. Many councils have not incorporated a flood map into their LEPs.

In cases where flood mapping has been included in a LEP, as development occurs in these areas which alters the flood affection of properties, these maps need to be updated. Flood maps might be updated to reflect, among other things, changes to flooding conditions resulting from landfill and associated subdivision works. If such development works occur on a regular basis, flood mapping in a LEP is constantly out of date. To amend LEP mapping, a planning proposal must undergo the Gateway Process and as this often takes approximately 12 months, by the time of gazettal the maps are often out of date again.

The adopted flood plain risk management study and plan undertaken by Council holds statutory weight. Flood Planning Area maps in the LEP may place undue planning provisions and insurance premiums on land where the flood risk has been reduced. Reductions in flood risk are typically associated with flood mitigation works such as those described in Section 4.3 which aim to reduce flood affectation at Sutton.

If Flood Planning Area maps are contained within the LEP, anomalies would result in inaccuracy of flooding information provided in section 149 Planning Certificates until planning proposals seeking amendment to the Flood Planning maps are gazetted. On the other hand, not having flood mapping in the LEP would allow council to immediately update the flood mapping database and relevant section 149 Planning Certificates once mapping is updated, which would provide land owners with confidence that they are receiving accurate up to date information

### **Suggestions for Yass Valley LEP**

#### **1. Engagement of Specialist Planning Consultant**

It is recommended that Council engage a specialist planning consultant to prepare advice for the recommended LEP modifications.

#### **2. Inclusion of Flood Planning Area maps in Yass Valley LEP is not recommended**

It is recommended that Flood Planning Area maps are not included in the Yass Valley LEP 2013, with instead Council referring to the proposed Yass Valley DCP and relevant adopted floodplain risk management study and plan for identification of flood risk and associated planning controls.

#### **3. Existing Yass Valley LEP Amendment**

It is recommended that clause 6.2(5) of the Yass Valley LEP 2013 be amended to delete the reference to '1:100 ARI (average recurrent interval)' and replace with '1% AEP (annual exceedance probability)' to reflect the terminology used within the flood study and be consistent with the draft guidelines prepared by Australian Rainfall and Runoff.

Additionally, a recommendation has been made as part of the Gundaroo FRMS&P (Reference 3) that a case be put to the NSW Department of Planning and Environment to justify Yass Valley's adoption of a Floodplain Risk Management Clause within the LEP as per the Planning Circular PS 07-003. Implementation of such a Clause is required to adopt the Flood Risk Precinct method within Council's DCP as described in the ensuing section.

#### **4.6.4.2. Recommended Flood Policy for Inclusion in the Proposed Yass Valley DCP**

It is noted that Council are currently working on a DCP for the Yass Valley LGA. Draft Flood Controls (Appendix C) have been composed as part of this FRMS&P to assist Council with creation of the Yass Valley DCP. It is recommended that Council engage a specialist planning consultant to prepare advice/content for the development of Council's DCP.

The draft Flood Controls presented in this FRMS&P uses the Flood Risk Precinct method which has been successfully implemented by a large number of Councils throughout NSW. The Flood

Risk Precinct method utilises the idea that the floodplain is subject to different degrees of hazard, or flood risk. The draft Flood Controls recommends that the study area be categorised into three different grades of flood risk, namely high, medium and low. This approach is similar to the categorisation of other natural risks, such as bush fire risk. Distinguishing between three categories of flood risk is done as it is considered unreasonable to apply the same types of development controls to properties that have a low risk of flooding as those that may have a high risk. Therefore, development controls that are considered in the draft Flood Controls have recognised both the type of development and the flood risk of the area where the development is located. Further discussion on the approach to floodplain planning is provided as part of the draft Flood Controls which is presented in Appendix C. The three flood risk areas, which are defined below, are shown on Figure C1, Appendix C.

- |                            |  |
|----------------------------|--|
| <b>High Flood Risk -</b>   | Land below the 1% AEP flood level that is either subject to high hydraulic hazard in the 1% AEP event as determined in Section 3.4 of this report. |
| <b>Medium Flood Risk -</b> | Land below the 1% AEP flood level that is not subject to high hydraulic hazard in the 1% AEP event as determined in Section 3.4 of this report.    |
| <b>Low Flood Risk -</b>    | All land within the floodplain (i.e. within the PMF extent) but not identified as either in a 'high flood risk' or 'medium flood risk' area.       |

The high flood risk area is where high flood damages, potential risk to life, or evacuation problems are anticipated. Most development should be restricted in this area. The medium flood risk area is where there is still a significant risk of flood damage, but where these damages can be minimised by the application of appropriate development controls. The low flood risk area is that area above the 1% AEP flood, where the risk of damage is low. Most land uses would be permitted within this area.

Other considerations for the draft Flood Controls are listed below. Many of these have been discussed within this report.

#### For developments within the FPA

- Building floor levels - consideration for different development types;
- Flood Proofing;
- Impact of development on adjacent or surrounding properties; and
- Consideration of hazard at the site and development type.

#### For all developments within the catchment regardless of flood affectation (could be in a separate On-Site Detention (OSD) or drainage policy)

- Development drainage - limit discharge to that of pre-development site;
- Water quality; and
- Responsibility for maintenance and compliance.

Additionally, it is recommended that council should engage a consultant to prepare advice/content for the Comprehensive DCP on suitable requirements for the best practice installation and operation of On-site sewage management facilities on flood prone land, taking into account the soil and hydrology of the Yass Valley.

The DCP should be prepared to be applicable to all flood prone land within the LGA, rather than only specific to Sutton to provide a consistent approach for development with the LGA. Any recommendations or suggestions in the FRMS&P with regard to planning and policy should be revised and approved by Council planners.

## SUMMARY

Planning controls are vital in managing flood risk and Council is encouraged to complete the DCP in a timely manner using the supplied draft Flood Controls. The draft Flood Controls comprises controls on development in flood prone land as well as controls to ensure development, whether or not in flood prone land, will impact on flood behaviour elsewhere. Crucial is inclusion of the FPA in the DCP as a means of determining to which property flood related development controls will apply.

## RECOMMENDATIONS

The following measures are recommended:

- ▶ Apply for Exceptional Circumstances from the Department of Planning and Environment to apply flood controls above the defined flood event to enable effective flood management for the full range of risk. This is discussed further as part of the Gundaroo FRMS&P (Reference 3).
- ▶ Introduce Flood Controls for development in flood prone land and drainage requirements from all new developments (draft Controls are included in Appendix C).
- ▶ Council should engage a specialist planning consultant to prepare advice/content for the development of Council's DCP and for LEP modifications.

### 4.6.5. Modification to the S149 Certificates

#### DESCRIPTION

The Environmental Planning and Assessment Regulation 2000 (the Regulation), at Clause 279 and Schedule 4, prescribes that Councils must provide a disclosure document whereby any interested party can learn the zone and any other planning controls that may apply to a parcel of land.

Schedule 4 of the Regulation prescribes the format of the Planning Certificate. Part 7A of Schedule 4 states:

#### ***7A Flood related development controls information***



- (1) *Whether or not development on that land or part of the land for the purposes of dwelling houses, dual occupancies, multi dwelling housing or residential flat buildings (not including development for the purposes of group homes or seniors housing) is subject to flood related development controls.*
- (2) *Whether or not development on that land or part of the land for any other purpose is subject to flood related development controls.*
- (3) *Words and expressions in this clause have the same meanings as in the standard instrument set out in the Standard Instrument (Local Environmental Plans) Order 2006.*

Legal reviews of the effectiveness of s.149 Planning Certificates have suggested it would be appropriate to also provide information as to the scale of the risk (low moderate or high) and also whether flooding applies generally to the area or more specifically to the land the subject of the certificate.

## DISCUSSION

Because of the wide range of different flood conditions across NSW, there is no standard way of conveying flood related information. As such, Councils are encouraged to determine the most appropriate way to convey information for their areas of responsibility. This will depend on:

- The type of flooding;
- Whether flooding is from major rivers or local overland flooding; and
- The extent of flooding (whether widespread or relatively confined).

It should be noted that the s.149 Planning Certificate only relates to the subject land and not any specific building on the property.

While the legislation currently does not mandate revealing the extent of flood inundation in an s.149(2) Planning Certificate, there is scope within an s.149(5) Planning Certificate for providing this additional type of information.

There can be a general perception from the public that insurance companies, lending authorities or other organisations may disadvantage flood liable properties that have only a very small part of their property inundated by floodwaters. Some Councils have addressed this concern by adding information in s.149(5) Planning Certificates to show the percentage of the property inundated as well as floor levels and other flood related information. In addition, the hazard category could be provided, and also advice regarding climate change increases in flood level.

The compulsory s.149(2) Planning Certificate should include, in terms of flood risk:

- Whether or not the property is in the FPA;
- Any development controls due to the property being within the FPA;
- Responsibility for maintenance and compliance for OSD features; and
- Highlight any drainage easements through the property and controls that apply.

Some Councils include detailed flooding information in s.149(5) Planning Certificates as

standard practice. This ensures that residents are made fully aware of flood risks before purchasing a property. However, people who are current property owners often feel that this information devalues their properties and would rather not know. Flood related information in s.149(5) Planning Certificates should include:

- Flood levels / depths over the property;
- Percentage of property which is flood affected;
- The likelihood of flooding;
- Floor levels (from Council's floor level survey if available); and
- Potential flood hazard.

## SUMMARY

As Council information for s.149 Planning Certificates and Development Restriction Certificates is obtained mainly from computerised databases and maps, Council should investigate ways to make property-based flooding information more accessible via its web-site.

Data from the hydraulic modelling used in this FRMS&P should be incorporated into Council's s.149 Planning Certificate database. All residents should be advised by personalised mail from Council if their land is affected. Council should determine the appropriate event for advising residents that the same criteria is used as in establishing the FPA.

## RECOMMENDATIONS

The following measures are recommended:

- Information on s149 certificates should be updated based on this FRMS. More detailed information should be provided in the 149(5) certificates.
- Provide a service where site specific flood related property information can be generated for residents.

## **5. DRAFT FLOODPLAIN RISK MANAGEMENT PLAN**

This section comprises the Draft Floodplain Management Plan and forms a framework identifying aims, objectives and a guide to the list of strategies by which the plan will be implemented. Any recommendations in terms of policy should be reviewed and approved by Council's planners.

### **5.1. Aims and Objectives**

The primary objective of the Draft Floodplain Management Plan is to recommend a range of property, response and flood modifications that address the existing and future flood problems, in accordance with the Floodplain Development Manual (Reference 1). The recommended works and measures presented in the Plan will:

- Reduce the flood hazard and risk to people and property in the existing community and to ensure future development is controlled in a manner consistent with the flood hazard and risk;
- Reduce private and public losses due to flooding;
- Protect and, where possible, enhance the river and floodplain environment;
- Be consistent with the objectives of relevant State policies, in particular, the Government's Flood Prone Lands and State Rivers and Estuaries Policies and satisfy the objectives and requirements of the Environmental Planning and Assessment Act, 1979;
- Ensure that the floodplain risk management plan is fully integrated with Council's existing corporate, business and strategic plans, existing and proposed planning proposals, meets Council's obligations under the Local Government Act, 1993 and has the support of the local community;
- Ensure actions arising out of the management plan are sustainable in social, environmental, ecological and economic terms;
- Ensure that the floodplain risk management plan is fully integrated with the local emergency management plan (Local Flood Plan) and other relevant catchment management plans; and
- Establish a program for implementation and a mechanism for the funding of the plan and should include priorities, staging, funding, responsibilities, constraints, and monitoring.

Table 15: Measures Recommended for Implementation – Risk Management Options Matrix

Measure	Description	Priority	Benefits	Concerns	Implementation, Costs and Funding
<b>FLOOD MODIFICATION MEASURES</b>					
Combined Option C2 / C3 (see Section 4.3.3.4)	This combined Option C2 / C3 is a combination of Option C2 (see Section 4.3.3.2) and C3 (see Section 4.3.3.3). The Option aims to reduce drainage issues in the areas defined as Hotspot #3 (see Section 1.2.1).	Low  Consider for detailed design and costing	Significant improvements to the local drainage network. Numerous lots no long flood affected in the 1% AEP event.	Due to a lack of existing over floor flood affectation, the B/C ratio associated with implementation of this Option is poor. These works would be considered as drainage works rather than flood mitigation works and accordingly funding from the State Government is unlikely to be available.	Council would be responsible for costs and implementation.
Option A1 (Section 4.3.4.1)	Option A1 is the construction of the bridge at the location of the existing Sutton Road crossing of McLaughlin's Creek.	High  Consider for detailed design and costing	The Sutton Road crossing of McLaughlin's Creek at Sutton provides an important access route to the north of the town, including to both Yass and Gundaroo. Flooding of the existing low-level crossing can cause isolation and reduced access which can impact on emergency services and increase risk to motorists. Replacing the existing crossing with a bridge that affords greater flood resilience will significantly benefit the community by reducing the risk of isolation and improving emergency response.	The estimated cost of constructing this bridge is significant (~\$2 million based on other bridges of similar size) with the associated benefits predominately intangible. Accordingly, the 'value' of implementing the Option A1 Bridge in terms of economic benefits cannot be defined. Intangible benefits, by their nature, are inherently more difficult to estimate in monetary terms.	Council would be responsible for costs and implementation. Some funding may be available through the NSW Floodplain Management Program.
Option B1 and Option A4 (Section 4.3.6.1 and 4.3.5.1)	These flood mitigation Options have been developed in order to reduce significant flood affectation on the Sutton Central Flow Path. Option B1 operates by storing a diverting flow away from its current alignment to a modified drainage channel on Victoria Street. Option A4 pipes the flow and conveys to the Yass River floodplain	High  Consider both for detailed design and costing	Option B1, B/C = 1.8. Option A4, B/C = 1.6  Option B1 significantly reduces property flood affectation due to the Sutton Central Flow Path for events up to and including the 1% AEP flood event.	The Option B1 basin is situated on private land and which will require the consideration of acquisition of private land and third party compensation during detailed design.  Option A4 requires the acquisition of easements and has safety concerns.	Council would be responsible for costs and implementation. Some funding may be available through the NSW Floodplain Management Program.
Drainage maintenance (section 4.3.5)	Council should regularly address drainage maintenance including unblocking and repairing where necessary.	High	Will maintain drainage efficiency in Sutton and prevent additional flooding caused by blockage of channels or structures.	Structures not under the jurisdiction of Council, including those maintained by RMS may not be efficiently maintained.	Council would be responsible for costs and regular maintenance apart from those structures under the jurisdiction of RMS.
Drainage Assets Database (Section 4.3.5)	Develop database of all drainage assets and notify body responsible for their maintenance.	Low	Would allow Council to better maintain the drainage in the area and reduce responsibility issues.	Needs to be maintained.	Council would be responsible for costs and implementation of the database as well as RMS to establish details of their infrastructure.
<b>PROPERTY MODIFICATION MEASURES</b>					
Flood proofing (section 4.4.3)	Prementant or temporary measures can be used. Possible to retrofit to existing buildings but can be a requirement for new development.	Low	Can reduce damages to properties in flood prone areas.	Can be difficult and costly to retrofit. Temporary measures require time for installation and warning is limited in Sutton.	Requirements for new development to be flood proofed can be included in the Flood Management DCP.

Measure	Description	Priority	Benefits	Concerns	Implementation, Costs and Funding
<b>RESPONSE MODIFICATION MEASURES</b>					
Install manual gauge at Sutton (Section 4.5.1)	Install a manual gauge at Sutton, to be monitored by NSW SES personnel when floods are threatening.	Medium	Installation of a manual gauge could be used to tie flood consequences to a gauge height which could be used by the SES for flood planning and preparedness. Additionally, gauge levels could be tied to the upstream Sutton Stream Gauge to provide flood warning and level/consequence prediction.	It may take some time to develop a relationship between the manual gauge and upstream gauges. However, additional modelling may be used to determine these relationships without observed flood behaviour.	Council would be responsible for costs and regular maintenance of the manual gauges. The NSW SES in conjunction with would be responsible monitoring these gauges in times of heavy flow.
Alarm existing NOW stream gauge at site 410851, and install a pluviometer (Section 4.5.1)	<p>The existing NSW Office of Water (NOW) stream gauge (410851), is located upstream of Sutton and could be configured such that an SMS is issued to NSW SES personnel when pre-programmed levels are reached during a rising flood. Additionally, installation of a pluviometer rainfall gauge at the site of the existing gauge is recommended.</p> <p>Implementation of these Options could be used to increase available flood warning time and of road closures.</p>	Medium	Automation of the Sutton Stream Gauge could potentially provide additional warning time of an impending flood. Installation of a pluviometer rainfall gauge at the existing gauge sites would be relatively straight forward and would be useful for future hydrologic model calibration as well as for flood prediction.	None.	Council in conjunction with NOW and NSW SES would be responsible for costs and regular maintenance.
Install warning signs and self-deploying boom gates on river and creek crossings (Section 4.5.1)	<p>Installation of automatic warning signs and self-deploying boom gates at various crossings, including but not limited to:</p> <ul style="list-style-type: none"> <li>Sutton Road crossing of McLaughlin's Creek;</li> <li>North Street crossing of Yass River;</li> <li>Murrumbateman Road crossing of Back Creek; and</li> <li>Shingle Hill Way or Yass River.</li> </ul> <p>During flood, these access roads pose a significant risk to life to motorist that attempt to use these roads. Early road closures implemented by using available warning time, can reduce the risk to life by stopping motorist from entering flood waters.</p>	High	Installation of automatic warning signs and self-deploying boom gates reduce risk to motorists driving during period of heavy rainfall. Road closures have been noted to occur many hours after flooding of crossings have occurred.	None.	<p>Council would be responsible for costs and regular maintenance of the automatic warning signs and boom gates. Council will need to work in conjunction with NOW to determine appropriate trigger levels etc.</p> <p>RMS and the NSW Floodplain Management Program could also be funding sources for initial set-up.</p>

Measure	Description	Priority	Benefits	Concerns	Implementation, Costs and Funding
<p>Preparation for potential future floods to increase flood warning:</p> <ul style="list-style-type: none"> <li>Relationships between observed levels and rainfall</li> <li>Warning messages</li> <li>Telephone dial-out system</li> </ul> <p>See Section 4.5.1 for more information.</p>	<p>Various measures can be undertaken to increase flood warning time. This includes:</p> <ul style="list-style-type: none"> <li>Progressively develop relationships between rainfall, flood depth indicators / observer stations and downstream water level recorders.</li> <li>Pre-prepare flood warning messages for communication during periods of flood.</li> <li>Construct and maintain a telephone dial-out system for the rapid dissemination of flood information and instructions.</li> </ul>	Medium	<p>Preparation for future flood events will greatly increase flood warning time and risk of error by reducing decision making requirements during an event.</p>	None.	<p>NSW SES would be the responsible for implementation and funding.</p>
<p>Review and update the Yass Valley Local Flood Plan and create a FIC for Sutton (Section 4.5.2).</p>	<p>Local Flood Plan sets out measures to take before and during flooding. FIC's provide usable flood intelligence that can be used to inform emergency procedure.</p>	Low	<p>Provide more information such that informed decision can be made during a flood and allow flood preparedness. Latest information from the Flood Study and the FRMS&amp;P can be included. FICs for the proposed manual gauge at Sutton provide emergency procedure leading to increased efficiency and reduced flood risk during extreme floods.</p>	<p>Need for strong communication with communities of concern.</p>	<p>NSW SES would be responsible for maintaining the Local Flood Plan the FICs.</p>
<p>Undertake a community flood education program (Section 4.5.3).</p>	<p>A community flood education program with the following components should be undertaken:</p> <ul style="list-style-type: none"> <li>Engage with the community to prepare an ongoing flood education program.</li> <li>Regularly issue flood certificates and pamphlets to residents on the floodplain.</li> <li>Prepare a library photo and story display about flooding.</li> <li>Prepare a Sutton FloodSafe guide.</li> <li>Host a Business FloodSafe breakfast.</li> <li>Organise community days for the NSW SES and residents of Sutton.</li> <li>Install a historic flood marker pole in Sutton.</li> </ul>	On going	<p>Continuing awareness of the community leads to better preparedness and therefore fewer damages during a flood event.</p>	<p>People begin to ignore advice and information if too much is given, particularly if they believe there is little risk of flooding.</p>	<p>Council and NSW SES. Can be variable depending on the methods used. Can be incorporated with other Council information provision to reduce costs.</p>
<p><b>PLANNING AND FUTURE DEVELOPMENT</b></p>					
<p>Investigate and update Council's LEP and DCP in line with the findings from this study (Section 4.6)</p>	<p>Various amendments to Council's current planning policies are recommended in Section 4.6 this this report. These should be addressed by Council, in consultation with a specialist planner.</p>	High	<p>Appropriate flood related development controls for flood liable land ensures development only occurs in suitable locations and are compatible with flood risk and hazard</p>	None	<p>Council would be responsible for amending the LEP and producing a DCP.</p>



Measure	Description	Priority	Benefits	Concerns	Implementation, Costs and Funding
Define the Flood Planning Level (Section 4.6.2)	A requirement of the Floodplain Development Manual. Used to set requirements for floor levels and flood proofing in development controls.	High	For residential properties it ensures habitable floor levels are above the 1% AEP flood level (plus 0.5 m freeboard) and therefore reduced flood damages. For commercial, and other less vulnerable land uses, the FPL can be used to set requirements for minimum floor level or elevation to which flood proofing must be provided.	Can have implications with requirements for maximum building heights and access to buildings for the less able.	Would be implemented through amendments to the DCP through a Flood Policy. Council to make decision on FPL for uses other than residential although recommendations have been given in this report.
Update and Re-issue S149 certificates (section 4.6.5)	Issued to residents to identify any hazards at their property and development controls that apply.	High	Can inform of the flood risk at each property and if Part 5 is also included supply additional information such as the type of flooding affecting the property or whether the property is in a high hazard area or floodway. Ensures residents aware of development controls, such as minimum floor levels, at their property. Can also inform residents of drainage easements through properties and their responsibilities.	Part 2 is compulsory. Some residents do not like the additional information provided under Part 5 and believe it can affect insurance premiums and value of land.	To be implemented by Council. Would follow on from adoption of a revised DCP for flooding.
Provide flood information on Council's website (Section 4.6.5)	Provide flood information on Council's website.	High	Easily accessible information for the community which will typically reduce Council's workload to produce such information on demand.	None.	To be implemented by Council.

## **6. ACKNOWLEDGEMENTS**

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February 2015





FIGURE 1  
STUDY AREA

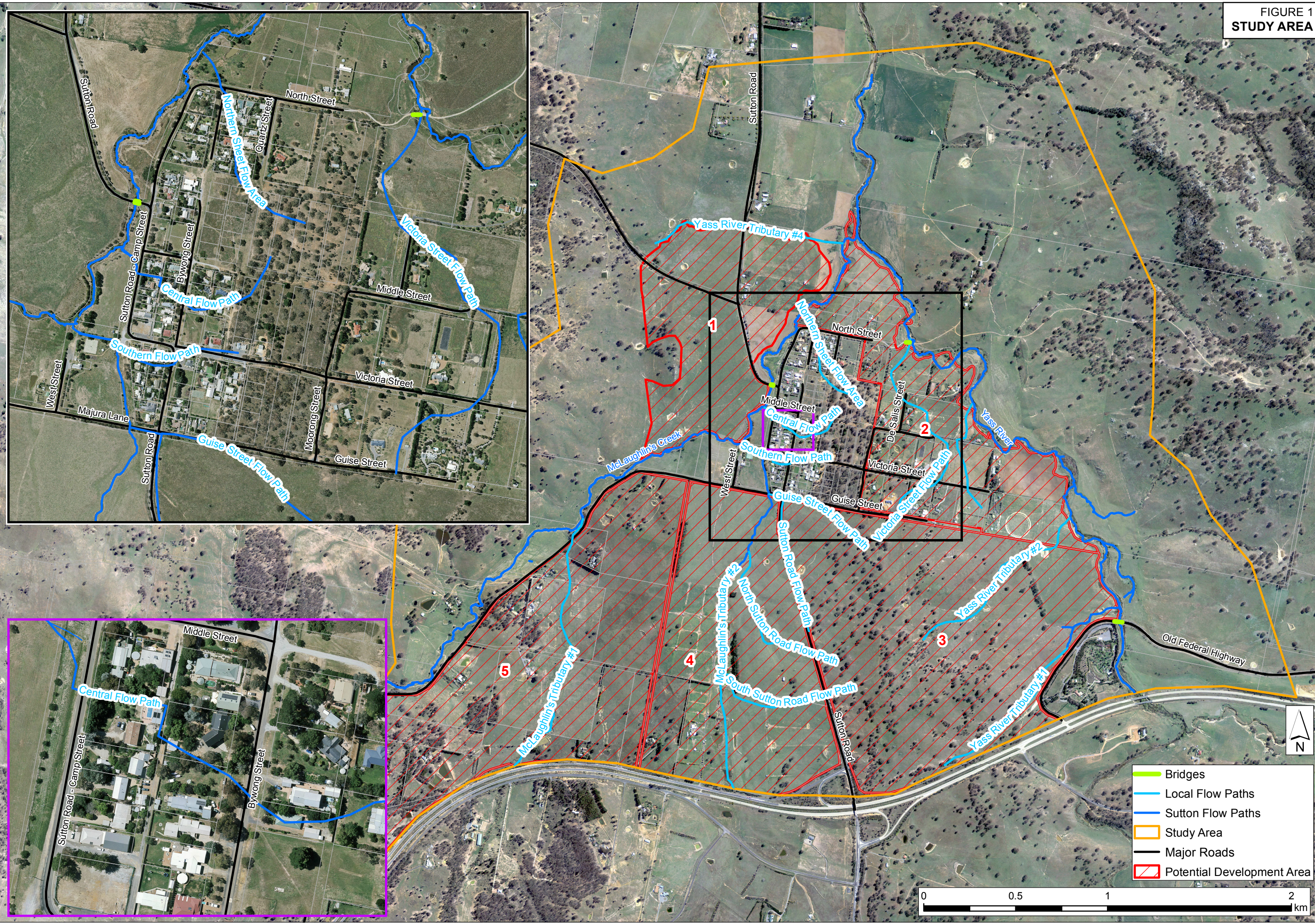








FIGURE 9  
SUTTON  
EMERGENCY RESPONSE PLANNING MAP  
PMF EVENT

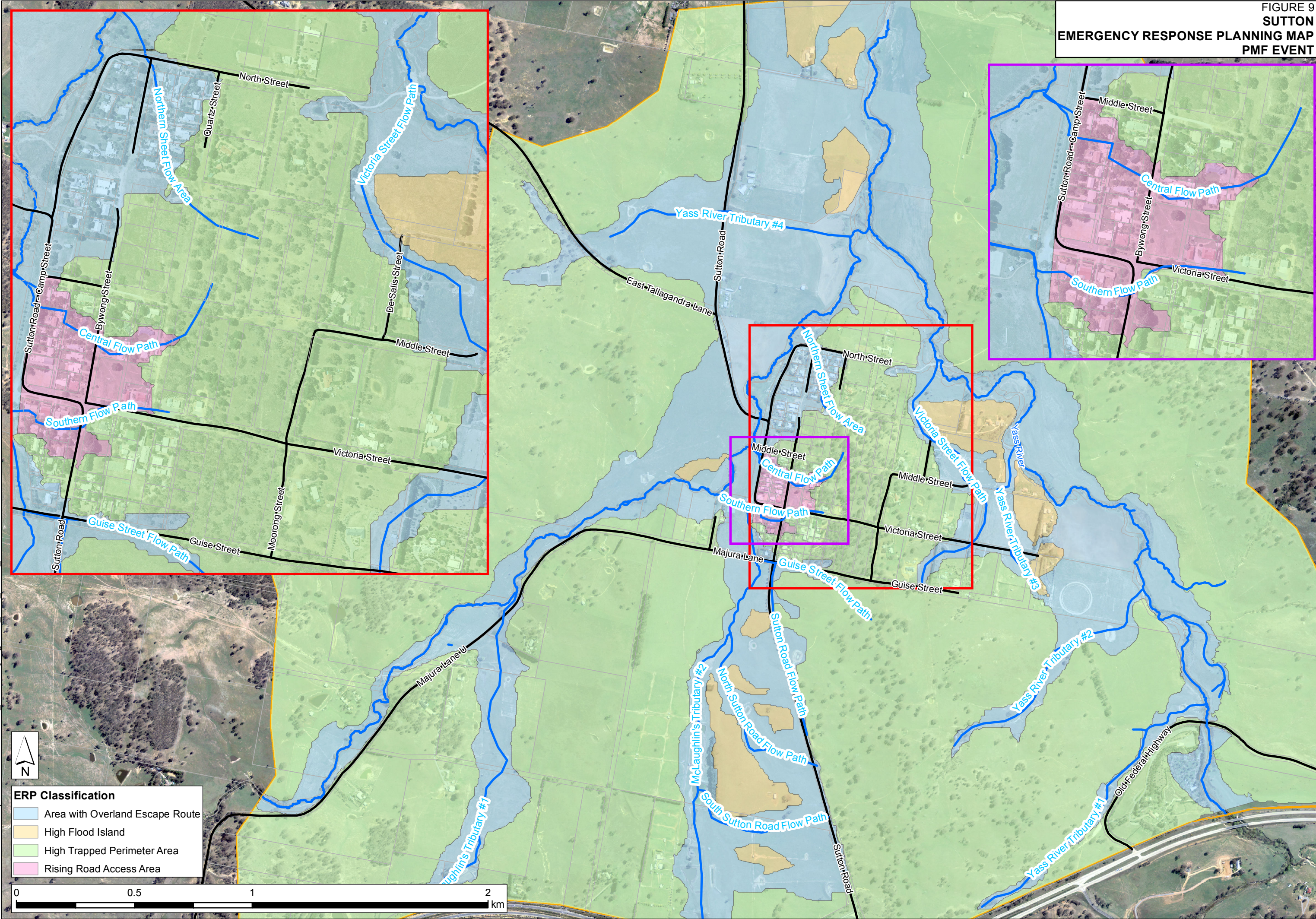




FIGURE 10  
SUTTON  
EMERGENCY RESPONSE PLANNING MAP  
1% AEP EVENT

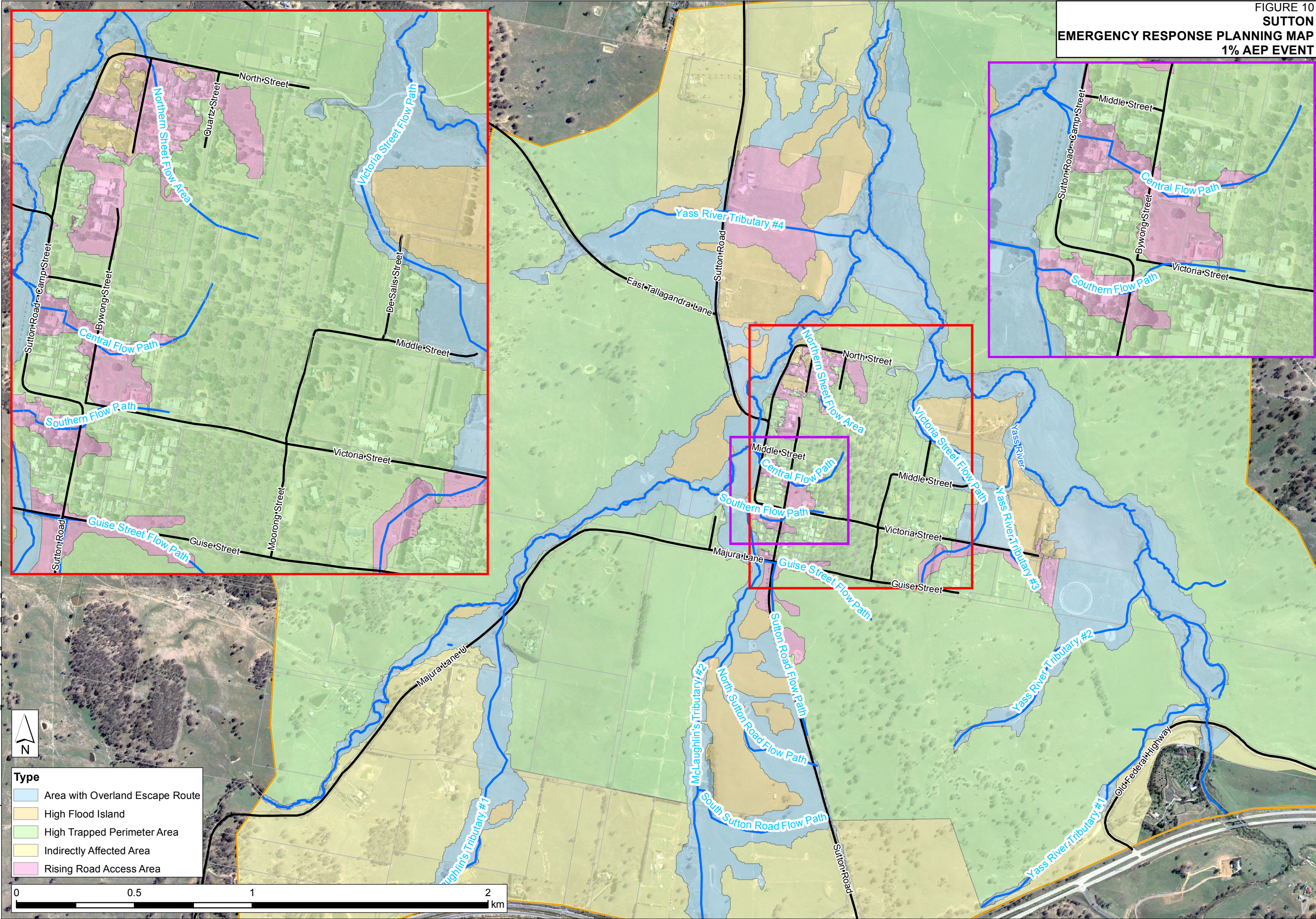
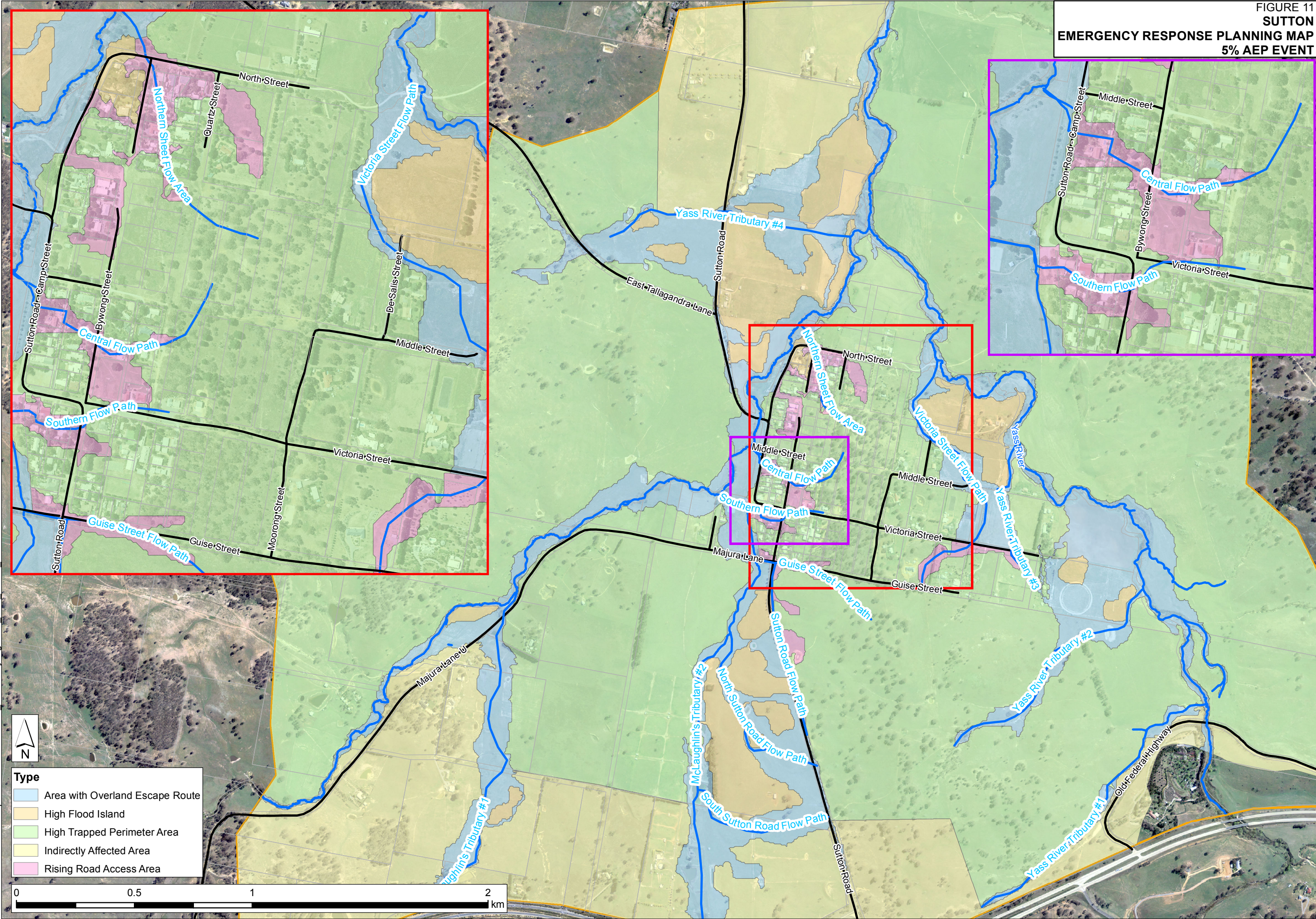




FIGURE 11  
SUTTON  
EMERGENCY RESPONSE PLANNING MAP  
5% AEP EVENT







## Appendix A: Glossary

Taken from the Floodplain Development Manual (April 2005 edition)

<b>acid sulfate soils</b>	Are sediments which contain sulfidic mineral pyrite which may become extremely acid following disturbance or drainage as sulfur compounds react when exposed to oxygen to form sulfuric acid. More detailed explanation and definition can be found in the NSW Government Acid Sulfate Soil Manual published by Acid Sulfate Soil Management Advisory Committee.
<b>Annual Exceedance Probability (AEP)</b>	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m <sup>3</sup> /s has an AEP of 5%, it means that there is a 5% chance (that is one-in-20 chance) of a 500 m <sup>3</sup> /s or larger event occurring in any one year (see ARI).
<b>Australian Height Datum (AHD)</b>	A common national surface level datum approximately corresponding to mean sea level.
<b>Average Annual Damage (AAD)</b>	Depending on its size (or severity), each flood will cause a different amount of flood damage to a flood prone area. AAD is the average damage per year that would occur in a nominated development situation from flooding over a very long period of time.
<b>Average Recurrence Interval (ARI)</b>	The long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event.
<b>caravan and moveable home parks</b>	Caravans and moveable dwellings are being increasingly used for long-term and permanent accommodation purposes. Standards relating to their siting, design, construction and management can be found in the Regulations under the LG Act.
<b>catchment</b>	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
<b>consent authority</b>	The Council, government agency or person having the function to determine a development application for land use under the EP&A Act. The consent authority is most often the Council, however legislation or an EPI may specify a Minister or public authority (other than a Council), or the Director General of DIPNR, as having the function to determine an application.
<b>development</b>	<p>Is defined in Part 4 of the Environmental Planning and Assessment Act (EP&amp;A Act).</p> <p><b>infill development:</b> refers to the development of vacant blocks of land that are generally surrounded by developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development.</p> <p><b>new development:</b> refers to development of a completely different nature to that associated with the former land use. For example, the urban subdivision of an area previously used for rural purposes. New developments involve rezoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power.</p> <p><b>redevelopment:</b> refers to rebuilding in an area. For example, as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either rezoning or major extensions to urban services.</p>
<b>disaster plan (DISPLAN)</b>	A step by step sequence of previously agreed roles, responsibilities, functions, actions and management arrangements for the conduct of a single or series of connected emergency operations, with the object of ensuring the coordinated response by all agencies having responsibilities and functions in emergencies.



<b>discharge</b>	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m <sup>3</sup> /s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
<b>ecologically sustainable development (ESD)</b>	Using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the Local Government Act 1993. The use of sustainability and sustainable in this manual relate to ESD.
<b>effective warning time</b>	The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move farm equipment, move stock, raise furniture, evacuate people and transport their possessions.
<b>emergency management</b>	A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.
<b>flash flooding</b>	Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. Often defined as flooding which peaks within six hours of the causative rain.
<b>flood</b>	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
<b>flood awareness</b>	Flood awareness is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and evacuation procedures.
<b>flood education</b>	Flood education seeks to provide information to raise awareness of the flood problem so as to enable individuals to understand how to manage themselves and their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.
<b>flood fringe areas</b>	The remaining area of flood prone land after floodway and flood storage areas have been defined.
<b>flood liable land</b>	Is synonymous with flood prone land (i.e. land susceptible to flooding by the probable maximum flood (PMF) event). Note that the term flood liable land covers the whole of the floodplain, not just that part below the flood planning level (see flood planning area).
<b>flood mitigation standard</b>	The average recurrence interval of the flood, selected as part of the floodplain risk management process that forms the basis for physical works to modify the impacts of flooding.
<b>floodplain</b>	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
<b>floodplain risk management options</b>	The measures that might be feasible for the management of a particular area of the floodplain. Preparation of a floodplain risk management plan requires a detailed evaluation of floodplain risk management options.
<b>floodplain risk management plan</b>	A management plan developed in accordance with the principles and guidelines in this manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.
<b>flood plan (local)</b>	A sub-plan of a disaster plan that deals specifically with flooding. They can exist at State, Division and local levels. Local flood plans are prepared under the leadership of the State Emergency Service.

<b>flood planning area</b>	The area of land below the flood planning level and thus subject to flood related development controls. The concept of flood planning area generally supersedes the flood liable land concept in the 1986 Manual.
<b>Flood Planning Levels (FPLs)</b>	FPLs are the combinations of flood levels (derived from significant historical flood events or floods of specific AEPs) and freeboards selected for floodplain risk management purposes, as determined in management studies and incorporated in management plans. FPLs supersede the standard flood event in the 1986 manual.
<b>flood proofing</b>	A combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages.
<b>flood prone land</b>	Is land susceptible to flooding by the Probable Maximum Flood (PMF) event. Flood prone land is synonymous with flood liable land.
<b>flood readiness</b>	Flood readiness is an ability to react within the effective warning time.
<b>flood risk</b>	<p>Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below.</p> <p><b>existing flood risk:</b> the risk a community is exposed to as a result of its location on the floodplain.</p> <p><b>future flood risk:</b> the risk a community may be exposed to as a result of new development on the floodplain.</p> <p><b>continuing flood risk:</b> the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.</p>
<b>flood storage areas</b>	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
<b>floodway areas</b>	Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flows, or a significant increase in flood levels.
<b>freeboard</b>	Freeboard provides reasonable certainty that the risk exposure selected in deciding on a particular flood chosen as the basis for the FPL is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. Freeboard is included in the flood planning level.
<b>habitable room</b>	<p><b>in a residential situation:</b> a living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom.</p> <p><b>in an industrial or commercial situation:</b> an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.</p>
<b>hazard</b>	A source of potential harm or a situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community. Definitions of high and low hazard categories are provided in the Manual.
<b>hydraulics</b>	Term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.

<b>hydrograph</b>	A graph which shows how the discharge or stage/flood level at any particular location varies with time during a flood.
<b>hydrology</b>	Term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
<b>local overland flooding</b>	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam.
<b>local drainage</b>	Are smaller scale problems in urban areas. They are outside the definition of major drainage in this glossary.
<b>mainstream flooding</b>	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
<b>major drainage</b>	<p>Councils have discretion in determining whether urban drainage problems are associated with major or local drainage. For the purpose of this manual major drainage involves: the floodplains of original watercourses (which may now be piped, channelised or diverted), or sloping areas where overland flows develop along alternative paths once system capacity is exceeded; and/or</p> <p>water depths generally in excess of 0.3 m (in the major system design storm as defined in the current version of Australian Rainfall and Runoff). These conditions may result in danger to personal safety and property damage to both premises and vehicles; and/or</p> <p>major overland flow paths through developed areas outside of defined drainage reserves; and/or</p> <p>the potential to affect a number of buildings along the major flow path.</p>
<b>mathematical/computer models</b>	The mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.
<b>merit approach</b>	<p>The merit approach weighs social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well being of the State's rivers and floodplains.</p> <p>The merit approach operates at two levels. At the strategic level it allows for the consideration of social, economic, ecological, cultural and flooding issues to determine strategies for the management of future flood risk which are formulated into Council plans, policy and EPIs. At a site specific level, it involves consideration of the best way of conditioning development allowable under the floodplain risk management plan, local floodplain risk management policy and EPIs.</p>
<b>minor, moderate and major flooding</b>	<p>Both the State Emergency Service and the Bureau of Meteorology use the following definitions in flood warnings to give a general indication of the types of problems expected with a flood:</p> <p><b>minor flooding:</b> causes inconvenience such as closing of minor roads and the submergence of low level bridges. The lower limit of this class of flooding on the reference gauge is the initial flood level at which landholders and townspeople begin to be flooded.</p> <p><b>moderate flooding:</b> low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic routes may be covered.</p> <p><b>major flooding:</b> appreciable urban areas are flooded and/or extensive rural areas are flooded. Properties, villages and towns can be isolated.</p>
<b>modification measures</b>	Measures that modify either the flood, the property or the response to flooding.
<b>peak discharge</b>	The maximum discharge occurring during a flood event.

<b>Probable Maximum Flood (PMF)</b>	The PMF is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation, and where applicable, snow melt, coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be addressed in a floodplain risk management study.
<b>Probable Maximum Precipitation (PMP)</b>	The PMP is the greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to PMF estimation.
<b>probability</b>	A statistical measure of the expected chance of flooding (see AEP).
<b>risk</b>	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
<b>runoff</b>	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
<b>stage</b>	Equivalent to water level. Both are measured with reference to a specified datum.
<b>stage hydrograph</b>	A graph that shows how the water level at a particular location changes with time during a flood. It must be referenced to a particular datum.
<b>survey plan</b>	A plan prepared by a registered surveyor.
<b>water surface profile</b>	A graph showing the flood stage at any given location along a watercourse at a particular time.
<b>wind fetch</b>	The horizontal distance in the direction of wind over which wind waves are generated.



# Sutton Flood Study & Floodplain Risk Management Study and Plan

A Flood Study for Sutton examining flooding caused by Yass River, McLaughlin's Creek and local overland flow flooding is nearing completion. A Floodplain Risk Management Study and Plan (FRMS&P) will now commence to investigate strategies to mitigate flooding in Sutton. This newsletter and questionnaire is to advise the community of the status of the Study and obtain information and ideas regarding potential mitigation works.

## The Floodplain Management Process

Yass Valley Council is carrying out a Flood Study and FRMS&P under the NSW Government's Flood Prone Land Policy. The primary objective of the Policy is to reduce the impact of flooding and flood liability on owners and occupants of flood prone land and to reduce losses from flooding. The Policy provides for technical and financial support by the State Government through four sequential stages:

1. **Flood Study** - *(Determine the nature and extent of the flood problem)*
2. **Floodplain Risk Management Study** - *(Evaluates floodplain management options)*
3. **Floodplain Risk Management Plan** - *(Council formally adopts a management plan)*
4. **Implementation of the Plan** - *(Construction of mitigation works etc.)*

The Sutton Flood Study and FRMS&P comprises phases one, two and three of the four step process listed above.

## What's happening now?

The Flood Study aimed to understand and determine the nature and extent of flood affectation due to Yass River, McLaughlin's Creek as well as overland flow flooding at Sutton. The Final Draft Flood Study was on public exhibition early this year; all submissions will be responded to and incorporated as appropriate. The Final Flood Study will be adopted by Council by June 2016.

As part of the Flood Study, detailed computer models were established to model flood behaviour, such as the map overleaf. One of the benefits of these models is that works that best mitigate flooding can be determined during the Floodplain Risk Management Study while ensuring that there are no negative impacts in the surrounding areas.

An important part of this study involves engaging with the community to find potential mitigation measures based on their valuable knowledge and experience.

## How can I have my say?

**Please complete the enclosed questionnaire and return to the WMAwater address below before 28<sup>th</sup> March 2016. If you have additional information or further comments, please attach these to your questionnaire response or alternatively email to the contacts below.**

This newsletter and questionnaire forms part of our community consultation, which aims to collect information about potential works to mitigate flooding in Sutton. The local knowledge and personal experiences of residents and business operators are an important source of information.

## Contacts



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**Kym Nixon**  
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PO Box 6, Yass, NSW 2582  
Tel: 02 6226 1477

FLOODPLAIN MANAGEMENT PROCESS

Data  
Collection

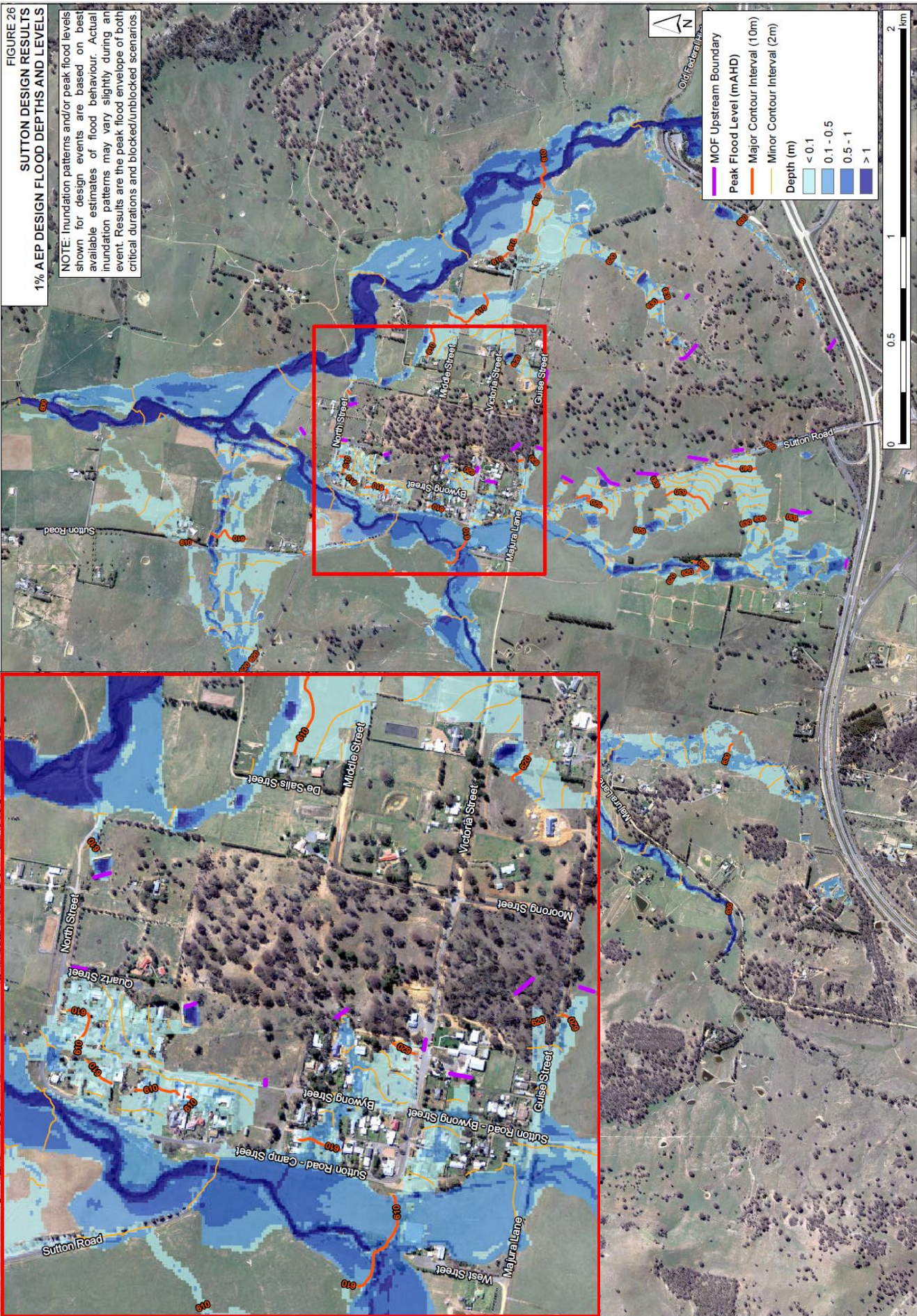
Flood Study

Floodplain Risk  
Management  
Study & Plan

Implementation  
of Plan



1 % AEP (1 in 100 Year ARI) Sutton Flood Extent





# Sutton Flood Study & Floodplain Risk Management Study and Plan

Community involvement in this Study is important. The Yass Valley Floodplain Management Committee will oversee this Study and includes members from Council, Office of Environment and Heritage, Department of Planning, the State Emergency Services and local residents. A questionnaire is enclosed with this newsletter so that your views can also be included.

Please complete this questionnaire and return before 28<sup>th</sup> March 2016.

## 1. Your details (Please note your contact details are optional, will be held confidential and only used to contact you for more information regarding this study)

Name:

Address:

Telephone:

Email:

Can we contact you directly for more information? ☐ Yes ☐ No

## 2. Is this property a residence, business, other?

☐ Residence ☐ Business ☐ Other

If business or other please provide details – e.g. Joe's Fish Shop:

## 3. How long have you lived or worked at this address?

Years  Months

## What mitigation works can help reduce flood risks?

Various types of flood mitigation works are used to reduce the effects of flooding. Not all mitigation measures are appropriate for all areas. For example, levees are often used to exclude flood water due to riverine or creek flooding from flood prone areas. However, these will often increase flood levels outside of the levee as well as stopping local runoff from entering the creek. Accordingly, a detailed investigation of all proposed flood mitigation works must be done using the Flood Study Models. Some examples of potential flood mitigation works include:

- **Levees** are used to exclude flood water from flood prone areas. Levees are often constructed from earth embankments.
- **Culverts and bridges** allow water to flow under roads, train tracks or similar obstructions. The use of bridges and culverts helps reduce upstream flood levels until the capacity of the structure is exceeded, however the downstream impacts of such works must also be taken into account.
- **Drains and channels** assist in the removal of floodwaters by increasing the rate at which flow is removed from a flood affected area. These structures are often situated in existing flow paths and are generally either earthen or concrete lined.

# Sutton Flood Study & Floodplain Risk Management Study and Plan

As a local resident who may have witnessed flooding, you may have your own ideas about how to reduce flood risks. Which of the following management options would you prefer for the Sutton catchment (1 = least preferred, 5 = most preferred)?

4. Potential Options	Preference
<b>Retarding or detention basins (these temporarily hold water and reduce peak flood flows) -</b> Suggested location/other comments:	1 2 3 4 5
<b>Improved flood flow paths such as channels and drains -</b> Suggested location/other comments:	1 2 3 4 5
<b>Culvert/bridge enlarging -</b> Suggested location/other comments:	1 2 3 4 5
<b>Pit and pipe upgrades -</b> Suggested location/other comments:	1 2 3 4 5
<b>Levee banks or flood walls -</b> Suggested location/other comments:	1 2 3 4 5
<b>Strategic planning and flood related development controls -</b> Suggested location/other comments:	1 2 3 4 5
<b>Education of the community, providing greater awareness of potential hazards -</b> Suggested location/other comments:	1 2 3 4 5
<b>Flood forecasting, flood warnings, evacuation planning and emergency response measures -</b> Suggested location/other comments:	1 2 3 4 5

**Other (please specify any other options you think are suitable):**

Please use as many details as possible to describe how flood risk may be reduced.

Please attach any additional information or comments to this questionnaire or email [Sutton@wmawater.com.au](mailto:Sutton@wmawater.com.au) by 28<sup>th</sup> March 2016





FIGURE D1  
FLOOD IMPACT 1% AEP  
OPTION C2

MODIFYING EXISTING NORTH/QUARTZ STREET DRAINAGE SYSTEM

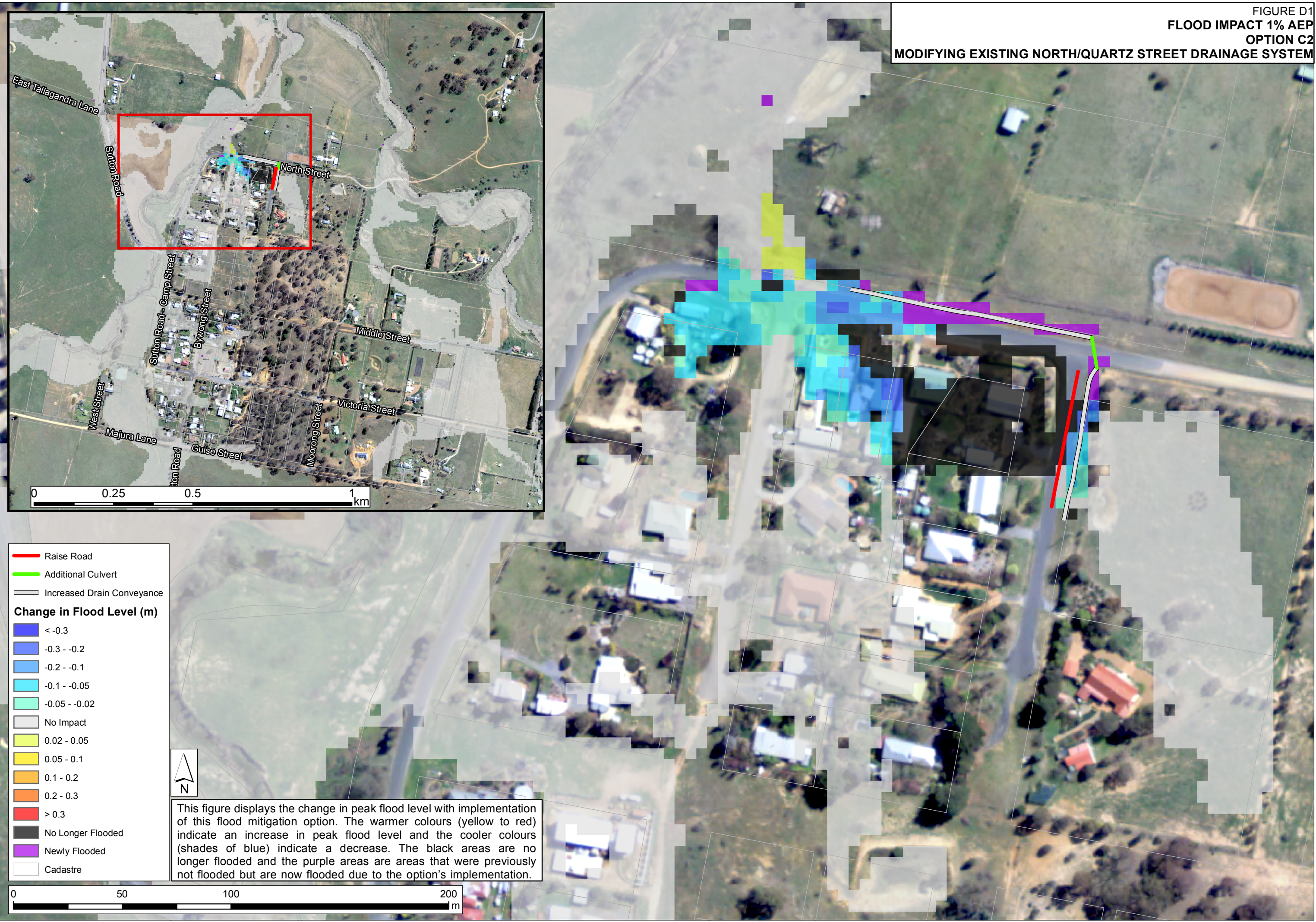
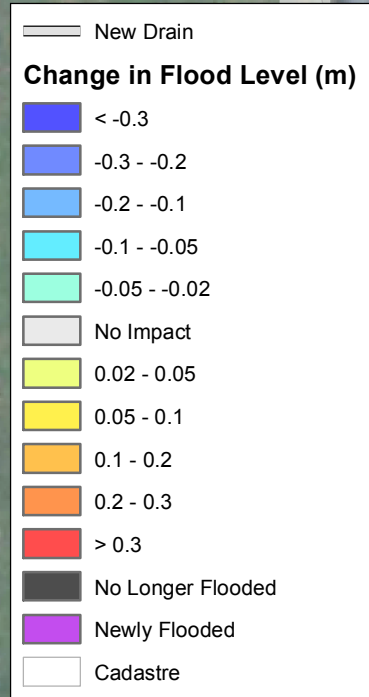
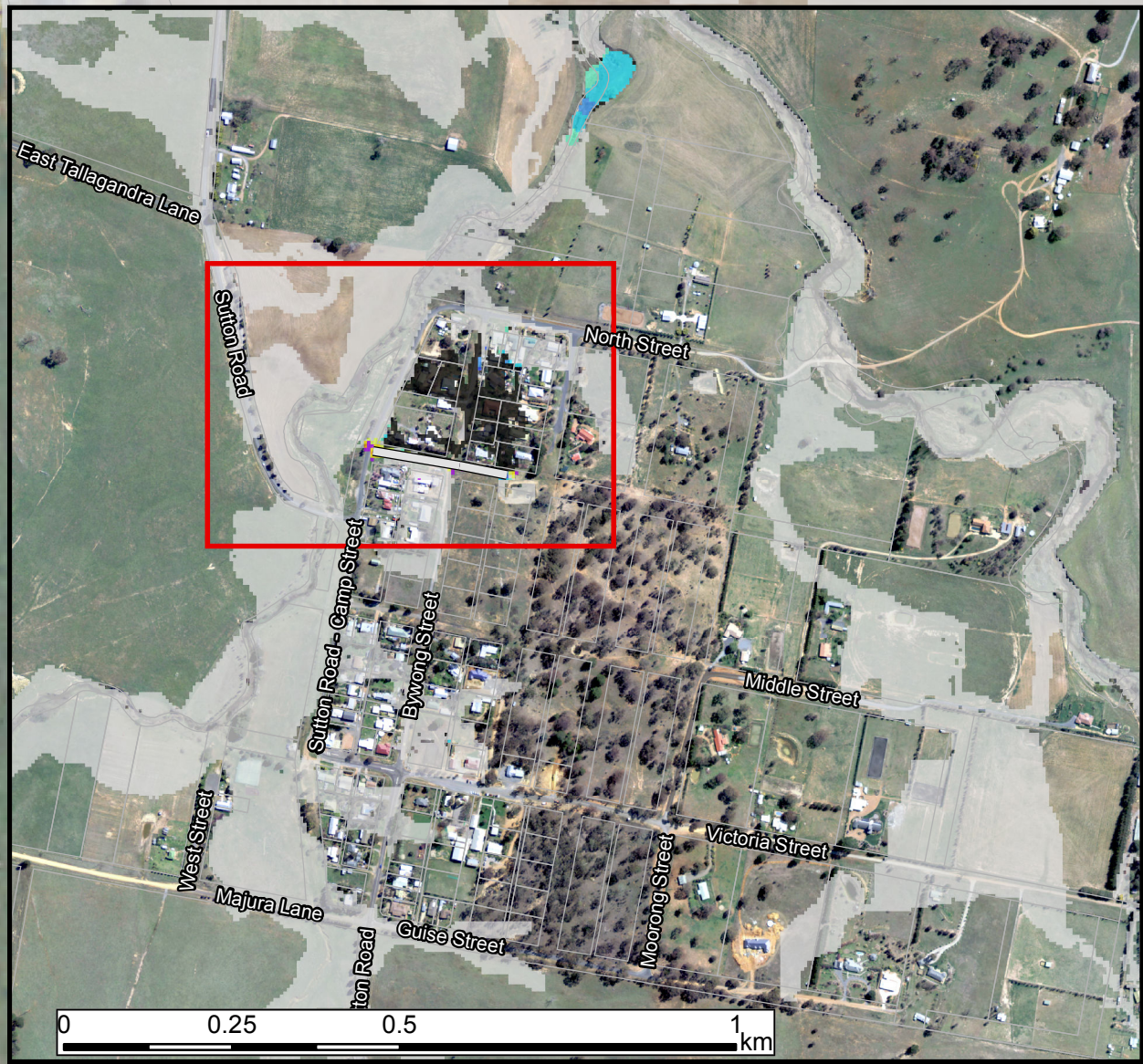




FIGURE D2  
FLOOD IMPACT 1% AEP  
OPTION C3  
DIVERSION OF NORTHERN FLOW PATH



This figure displays the change in peak flood level with implementation of this flood mitigation option. The warmer colours (yellow to red) indicate an increase in peak flood level and the cooler colours (shades of blue) indicate a decrease. The black areas are no longer flooded and the purple areas are areas that were previously not flooded but are now flooded due to the option's implementation.

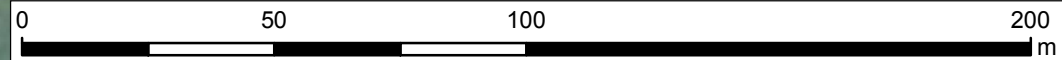




FIGURE D3  
FLOOD IMPACT 1% AEP  
OPTION B1  
BYWONG STREET BASIN

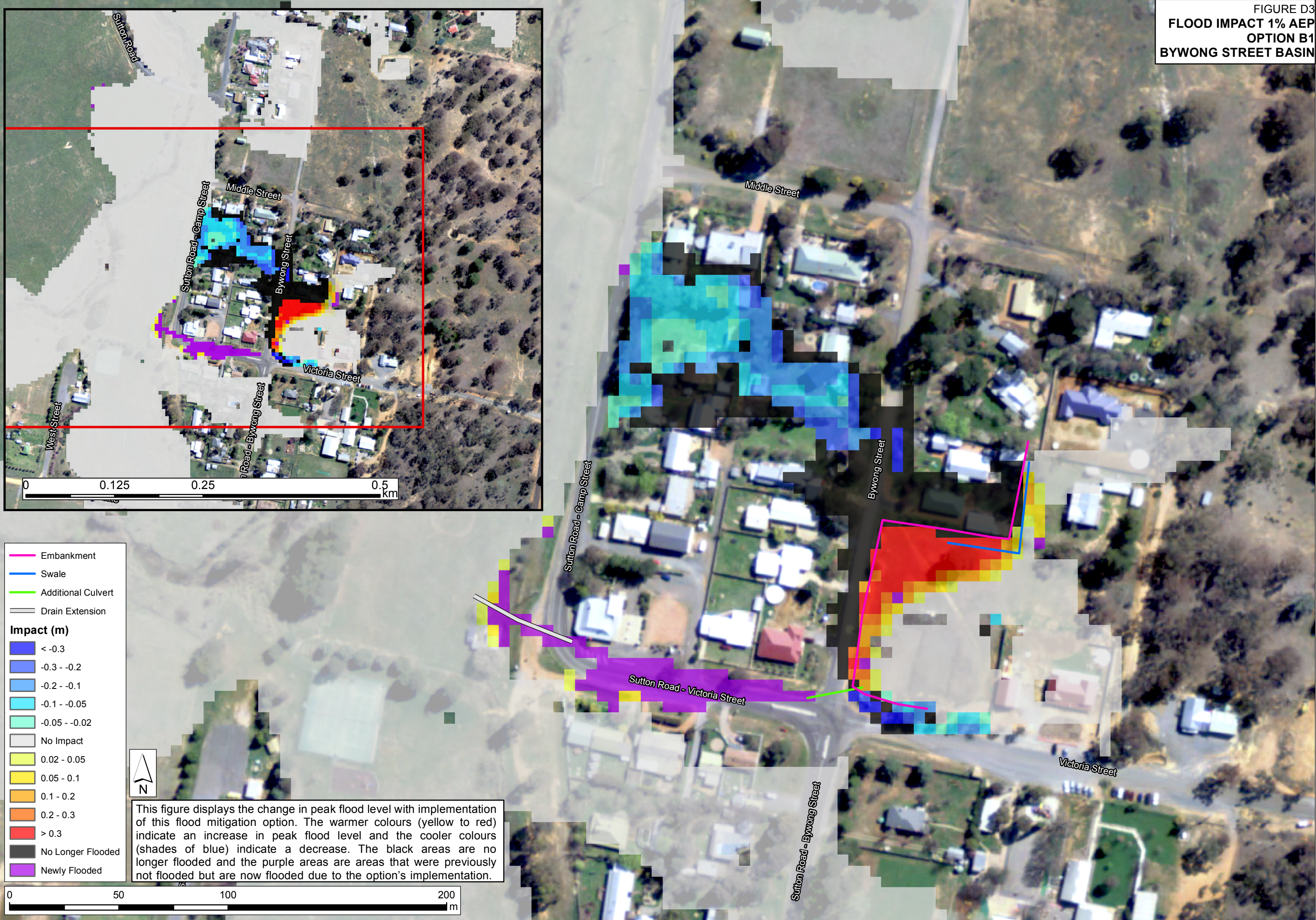
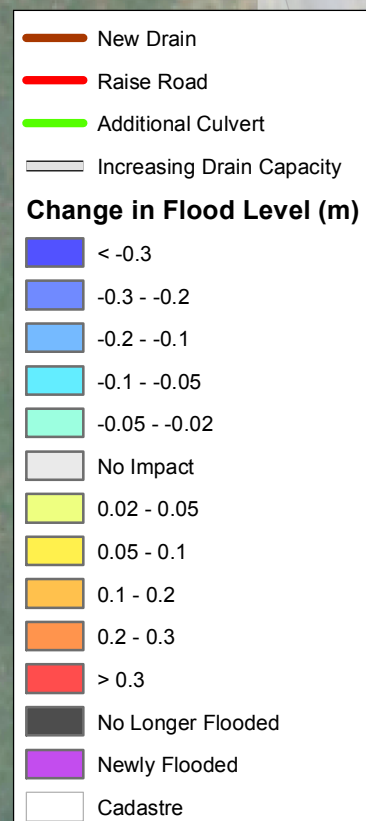
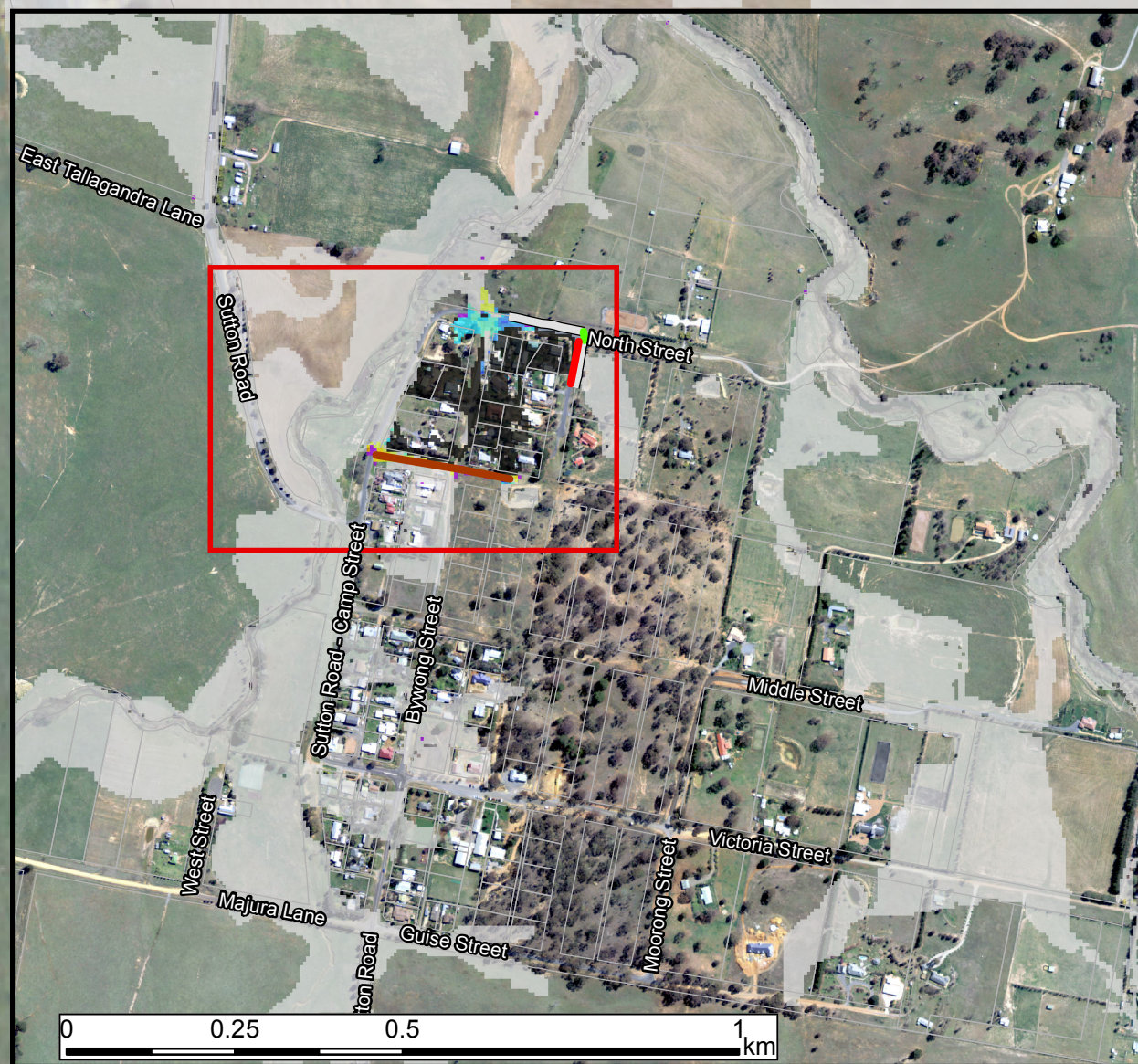
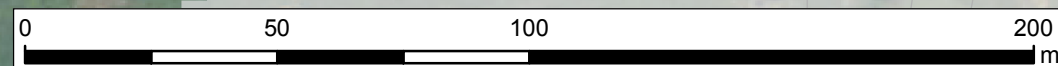




FIGURE D4  
FLOOD IMPACT 1% AEP  
COMBINED OPTION C2 / C3



This figure displays the change in peak flood level with implementation of this flood mitigation option. The warmer colours (yellow to red) indicate an increase in peak flood level and the cooler colours (shades of blue) indicate a decrease. The black areas are no longer flooded and the purple areas are areas that were previously not flooded but are now flooded due to the option's implementation.







## Appendix E: Flood Mitigation Options – Preliminary Investigation and Concept Design

This section outlines indicative costs for the investigated Sutton Options and provides drawings to assist in detail design and investigation works.

These Options include:

- Option C2 – Modification of the Existing Quartz/North Street Drainage System (see Section 4.3.3.2);
- Option C3 – Northern Flow Path Minor Drainage Channel (see Section 4.3.3.3); and
- Option B1 – Bywong Street Basin (see Section 4.3.6.1);

Note all costs are indicative and are not guaranteed. Cost will vary with contractor prices, market forces and other factors. Detailed design will enable more accurate costs to be prepared.

### Option C2 / C3 and Option B1 – Historical Context

To provide better perspective to the community, had the recommended Options C2 / C3 and B1 been implemented at the time of the December 2010 MOF flood event, there would have been no over floor flood affectation in Sutton and the number of lots that were completely flood free would have increased by approximately 14.

### Freeboard Assumptions

Freeboard is incorporated into the final design height of an embankment (i.e. retarding basin wall) and is expressed as the incremental difference in height between the level of the flood the embankment is designed to protect against, and the design crest level of the embankment. Freeboard varies dependant on uncertainties in flood level estimates, wind and wave actions, settlement, climate change etc. and therefore requirements can change significantly from embankment to embankment. Applying a standard freeboard allowance for an embankment is considered simplistic, and in many instances, overly conservative (Reference 16).

Typical levee freeboards range from 0.5 m to 1 m in the region. For example the Main City Levee upgrade at Wagga Wagga will use a freeboard of 0.9 m (Reference 16). A full freeboard assessment is beyond the scope of the current study and will be undertaken as part of the detailed design. An estimated average freeboard allowance of 0.5 m has been assumed for the Options B1 embankment in Sutton.

For modelling of design events greater than the design height of an embankment, the freeboard has been incorporated into the modelling with the assumption that the embankment will not fail until it is overtopped.

### Option B1

Preliminary concept design information for Option B1 is presented in Figure E 1. The basin wall was designed to be approximately 225 m in length with an average height of 1.0 m (including 0.5 m freeboard). A low flow discharge pipe with a 0.45 m diameter was incorporated at the low

point of the basin.

### Trustees Catholic Church

The land where the basin is proposed (45 Bywong Street) is owned and managed by the Catholic Church. The Catholic Church Trustees have been consulted and notified of this preliminary concept design, however additional consultation would be required in the detailed design phase should this Option be considered.

### Easement Requirements

The Option B1 basins would be constructed largely in the Bywong Street easement and the lane easement between Bywong and Quartz Streets. However, acquisition of a 10 m strip of land on the western and northern side of the 45 Bywong Street property would be required with implementation of this Option. The total area of land required is estimated to be 1,300 m<sup>2</sup>. The estimated land value as Sutton is \$70 / m<sup>2</sup>.

### Third Party Compensation

Increases in peak flood level inside of the Option B1 basin are experienced over an area of ~2,400 m<sup>2</sup> in the 1% AEP event. This land is owned by the Catholic Church who would be negatively impacted by construction of this basin.

An estimate of \$100,000 has been allowed for third party compensation for the Catholic Church for the acquisition of required land to facilitate basin construction and maintenance.

### Basin Behaviour and Period of Inundation

Option B1 is designed as a dry basin under normal conditions and only aims to attenuate large flows. The basin does not significantly attenuate flows for the 1EY and more frequent events. The basin's current design allows the basin to empty after approximately 1 hours post peak event rainfall for the 1% AEP event. The basin empties more rapidly for smaller events. At the peak of the 1% AEP event the Option B1 basin flood extent upstream of the basin is approximately 0.25 ha.

### Option B1 Estimated Costing

A summary of the estimated costings for Option B1 is contained in Table E 1. All costs are not guaranteed. Costs will vary with contractor's prices, market forces and competitive bids from tenderers. It has been assumed that existing culverts will not be replaced, coffer dams and dewatering will not be required and that works will be undertaken during a dry period. The costings also include prices for modifications to the downstream drainage network as per the details outlined in Section 4.3.3.1 for Option C1.

Table E 1: Option B1 – Estimated Costing

## Option B1 - Bywong Street Basin

### Basin Embankment

<u>Foundation Preparation</u>	UNIT	QUANTITY	2014 RATE RURAL NSW	COST (with factors)
-------------------------------	------	----------	------------------------	------------------------

remove top soil and vegetation (assume 0.15 m thick)	m <sup>3</sup>	150	5	\$750
compact foundation	m <sup>2</sup>	1,500	3	\$4,500
excavate foundation channel (core - assumed 10% of total)	m <sup>3</sup>	105	8	\$840
lime stabilisation (core - assumed 10% of total)	m <sup>3</sup>	105	15	\$1,575

#### **Embankment Construction**

Material	m <sup>3</sup>	1,050	12	\$12,600
shaping of batter slopes	m <sup>2</sup>	1,500	2.5	\$3,750
Compaction	m <sup>2</sup>	1,500	2.5	\$3,750
Allowance to dispose of unsuitable material (10%)	m <sup>3</sup>	105	8	\$840

#### **Finishes**

top soil placement (assume 0.15 m thick)	m <sup>3</sup>	225	8	\$1,800
seeding	m <sup>2</sup>	1,500	7	\$10,500

### **Low Flow Discharge Pipe**

Head wall	Unit	3000	1	\$3,000
Low Flow Discharge Pipe - 1 x 450mm Reinforced Concrete Pipe (Class 2)	m	24	325	\$7,800
Energy dissipation structure	Unit	3,500	1	\$10,000

#### **David Street Traffic Control**

Traffic Control	Days	2	800	\$1,600
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#### **Pavement/Rail Reinstatement**

Road resurfacing	m <sup>2</sup>	150	\$ 55	\$ 8,250
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### **Option C1 - Victoria Street Drainage Channel**

#### **Foundation Preparation**

remove top soil and vegetation and paving (assume 0.15 m thick)	m <sup>3</sup>	53	5	\$265
Excavation (removal of soil)	m <sup>3</sup>	50	10	\$500
Channel Shaping	m <sup>2</sup>	500	4	\$2,000

#### **Finishes**

top soil placement	m <sup>2</sup>	500	8	4,000
seeding	m <sup>2</sup>	500	7	3,500

### **Option C1 - Camp Street Culvert**

Head wall	Unit	3000	1	\$3,000
Low Flow Discharge Pipe - 1 x 450mm Reinforced Concrete Pipe (Class 2)	m	20	325	\$6,500



Energy dissipation structure	Unit	3,500	1	\$10,000
------------------------------	------	-------	---	----------

<b>David Street Traffic Control</b>				
Traffic Control	Days	2	800	\$1,600

<b>Pavement/Rail Reinstatement</b>				
Road resurfacing	m <sup>2</sup>	100	\$ 55	\$ 5,500

<b>Construction Cost</b>				<b>\$108,420</b>
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<b>Easement and Adjoining Property Costs</b>				
Easement Requirements (d)	m <sup>2</sup>	1,300	70	\$91,000
Third party impact compensation (e)	\$	1		\$100,000

<b>TOTAL PROJECT ESTIMATE</b>	<b>\$ 325,000</b>	
TOTAL PROJECT ESTIMATE	<b>\$ 325,000</b>	<i>a + b + c + d + e</i>
Construction Cost (a)	<b>\$ 108,000</b>	<i>See above.</i>
Design (b)	<b>\$ 11,000</b>	<i>10% of a</i>
Construction/Project Management (c)	<b>\$ 14,000</b>	<i>12% of a + b</i>

*\*All costs are not guaranteed. Costs will vary with contractor's prices, market forces and competitive bids from tenderers.*

## Option C2

Preliminary concept design information for Option C2 is presented in Figure E 2. To modify and improve the configuration and capacity of the existing drainage channel parallel to North and Quartz Streets the following changes are recommended:

- Quartz Street to be raised to a minimum level of 612.5 mAHD. This is approximately 40 m of road to be raised by 0.2 m on average (maximum of 0.4 m);
- Blockage of the existing culverts under Quartz Street;
- Drainage channel on the eastern side of Quartz Street and northern side of North Street to be increased by lowering the drains by 0.6 m on average; and
- At the intersection of Quartz and North Streets 2 x 0.6 m culverts were added to convey flows on the eastern side of Quartz Street under North Street.

### Easement Requirements

Nil. All works are undertaken within the road easement which is owned by Council.

### Third Party Compensation

Nil. No properties are adversely affected by increased flood levels associated with implementation of Option C2.

### Option C2 Estimated Costing

A summary of the estimated costings for Option C2 is contained in Table E 2. All costs are not guaranteed. Costs will vary with contractor's prices, market forces and competitive bids from tenderers. It has been assumed that existing culverts will not be replaced, coffer dams and

dewatering will not be required and that works will be undertaken during a dry period.

Table E 2: Option C2 – Estimated Costing

## Option C2 - Quartz/North Street Drain and Culverts

### Culverts under North Street

<b>Culvert Costs</b>	<b>UNIT</b>	<b>QUANTITY</b>	<b>2014 RATE RURAL NSW</b>	<b>COST (with factors)</b>
Wing Walls	per unit	2	\$1,700	\$3,400
Low Flow Discharge Pipe - 2 x 600mm Reinforced Concrete Pipe (Class 2)	m	22	\$730	\$16,060

### North Street Traffic Control

Traffic Control	Days	2	\$800	\$1,600
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### Pavement/Rail Reinstatement

Road resurfacing	m <sup>2</sup>	40	\$ 55	\$ 2,200
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### Quartz and North Streets Drainage Channel

#### Foundation Preparation

remove top soil and vegetation	m <sup>3</sup>	80	\$5	\$400
Excavation (removal of soil)	m <sup>3</sup>	400	\$10	\$4,000
Channel Shaping	m <sup>2</sup>	800	\$4	\$3,200

#### Finishes

top soil placement	m <sup>2</sup>	800	\$8	\$6,400
seeding	m <sup>2</sup>	800	\$7	\$5,600

### Raising Quartz Streets

#### Quartz Street Traffic Control

Traffic Control	Days	2	\$800	\$1,600
-----------------	------	---	-------	---------

#### Road Raising

Material	m <sup>3</sup>	170	\$12	\$2,040
Compaction	m <sup>2</sup>	50	\$2.5	\$125

### Pavement/Rail Reinstatement

Road resurfacing	m <sup>2</sup>	50	\$ 55	\$ 2,750
------------------	----------------	----	-------	----------

**Construction Cost**

**\$42,860**

**TOTAL PROJECT ESTIMATE**

**\$ 53,000**

TOTAL PROJECT ESTIMATE

**\$ 53,000**

*a + b + c*

Construction Cost (a)	\$ 43,000	See above.
Design (b)	\$ 4,000	10% of a
Construction/Project Management (c)	\$ 6,000	12% of a + b

\*All costs are not guaranteed. Costs will vary with contractor's prices, market forces and competitive bids from tenderers.

## Option C3

Preliminary concept design information for Option C3 is presented in Figure E 3. Option C3 is classified as drainage works rather than flood mitigation works and involves the construction of a 5 m wide drain with an average depth of approximately 0.5 m (maximum depth of ~1 m).

### Easement Requirements

Nil. All works are undertaken on existing road and drainage easements.

### Third Party Compensation

Nil. No properties are adversely affected by increased flood levels associated with implementation of this Option.

### Option C3 Estimated Costing

A summary of the estimated costings for Option C3 is contained in Table E 3. All costs are not guaranteed. Costs will vary with contractor's prices, market forces and competitive bids from tenderers. It has been assumed that existing culverts will not be replaced, coffer dams and dewatering will not be required and that works will be undertaken during a dry period.

Table E 3: Option C3 – Estimated Costing

## Option C3 - Northern Flow Path Minor Drainage Channel

### Northern Flow Path Minor Drainage Channel

Foundation Preparation				
remove top soil and vegetation	m <sup>3</sup>	100	\$5	\$500
Excavation (removal of soil)	m <sup>3</sup>	500	\$10	\$5,000
Channel Shaping	m <sup>2</sup>	1000	\$4	\$4,000

Finishes				
top soil placement	m <sup>2</sup>	1,000	\$8	\$8,000
seeding	m <sup>2</sup>	1,000	\$7	\$7,000

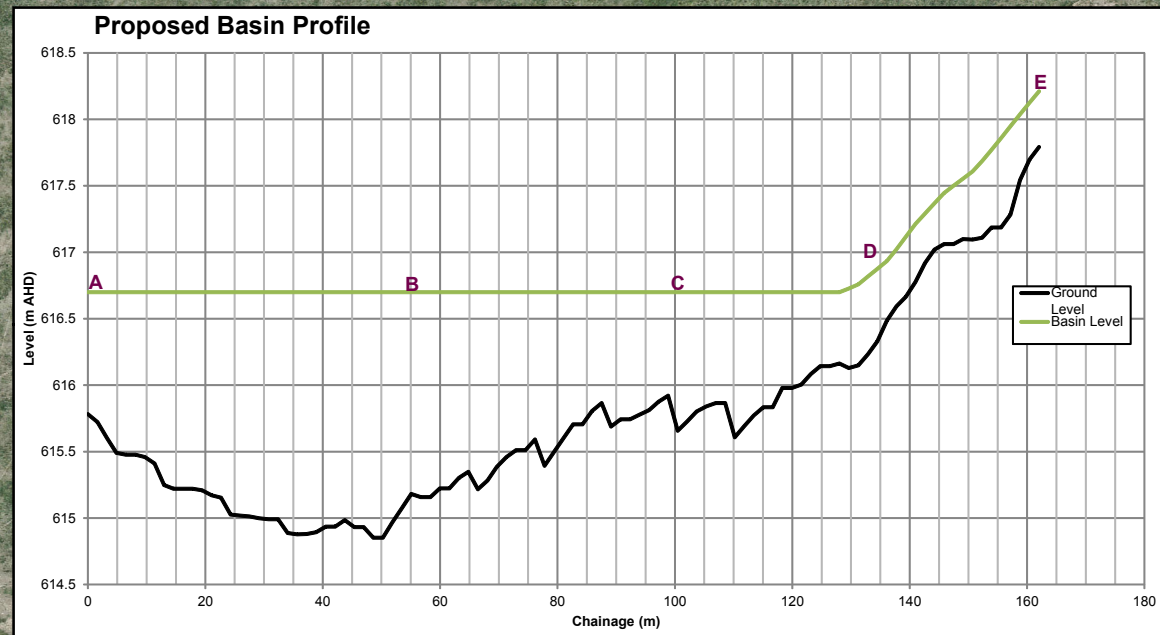
<b>Construction Cost</b>	<b>\$24,500</b>
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<b>TOTAL PROJECT ESTIMATE</b>	<b>\$ 30,000</b>	
TOTAL PROJECT ESTIMATE	\$ 30,000	a + b + c
Construction Cost (a)	\$ 25,000	See above.
Design (b)	\$ 2,000	10% of a
Construction/Project Management (c)	\$ 3,000	12% of a + b

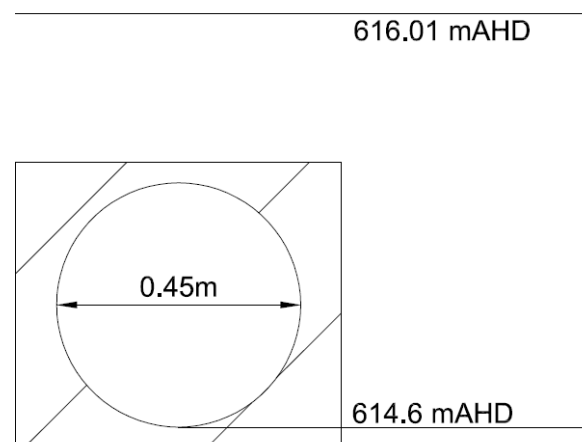
\*All costs are not guaranteed. Costs will vary with contractor's prices, market forces and competitive bids from tenderers.



FIGURE E1  
SUTTON  
OPTION B1  
FLOOD IMPACT 1% AEP  
PRELIMINARY CONCEPT DESIGN



**SECTION B: TYPICAL CULVERT CROSS-SECTION**



**SECTION A: TYPICAL BASIN EMBANKMENT CROSS-SECTION**

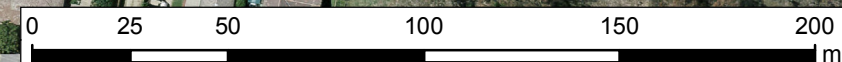
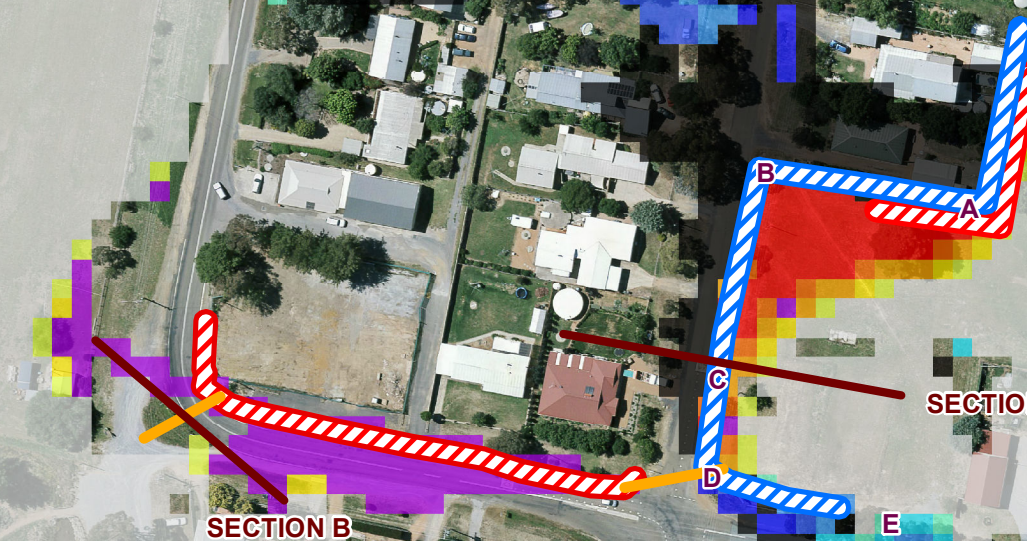
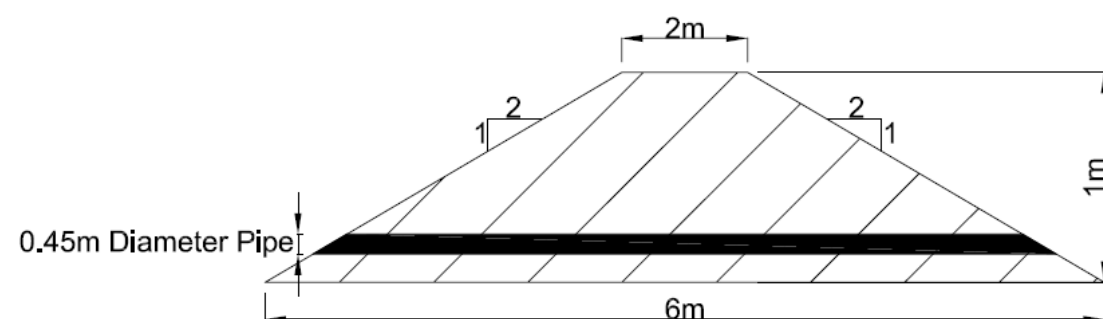




FIGURE E2  
SUTTON  
OPTION C2  
FLOOD IMPACT 1% AEP  
PRELIMINARY CONCEPT DESIGN

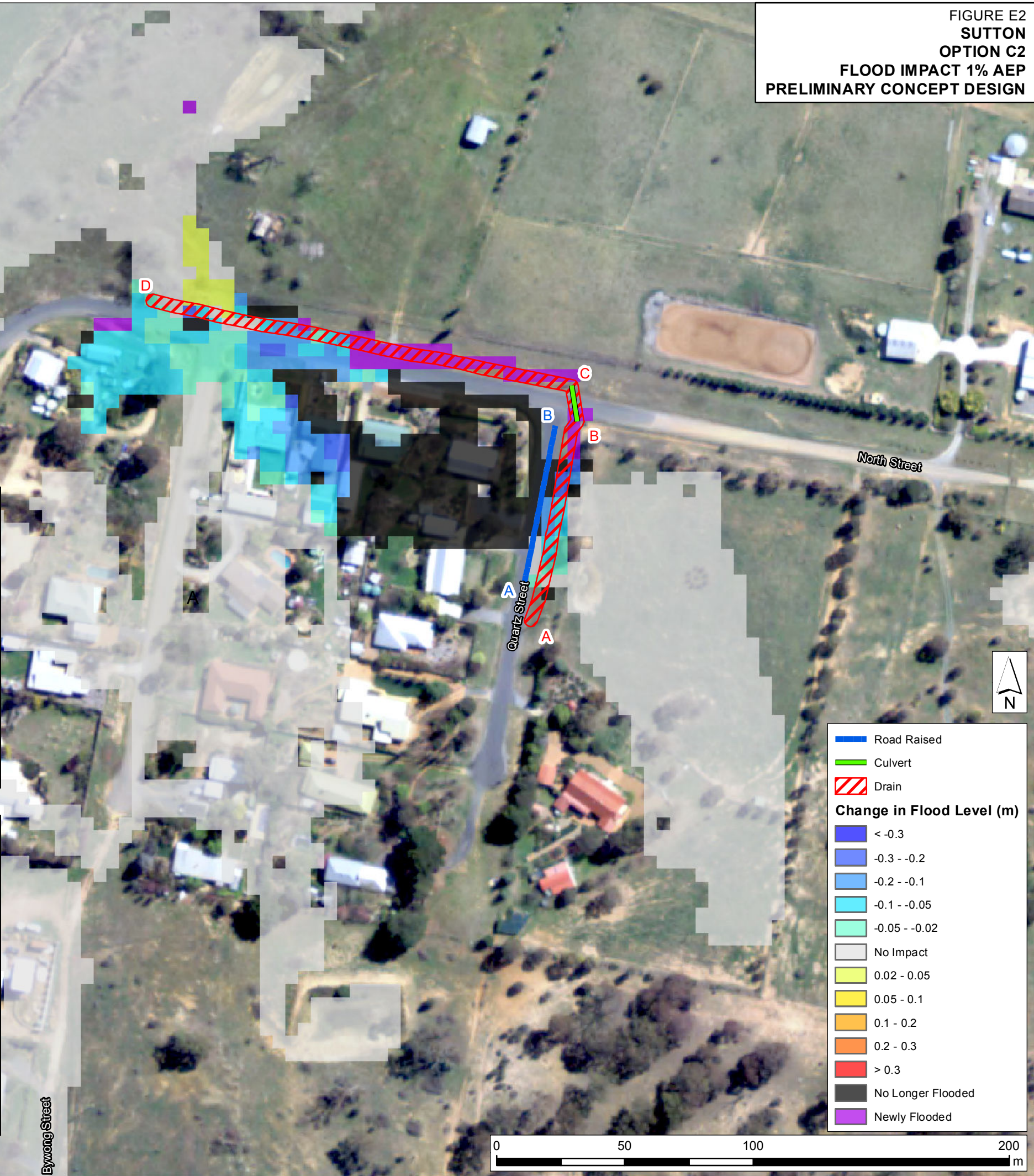
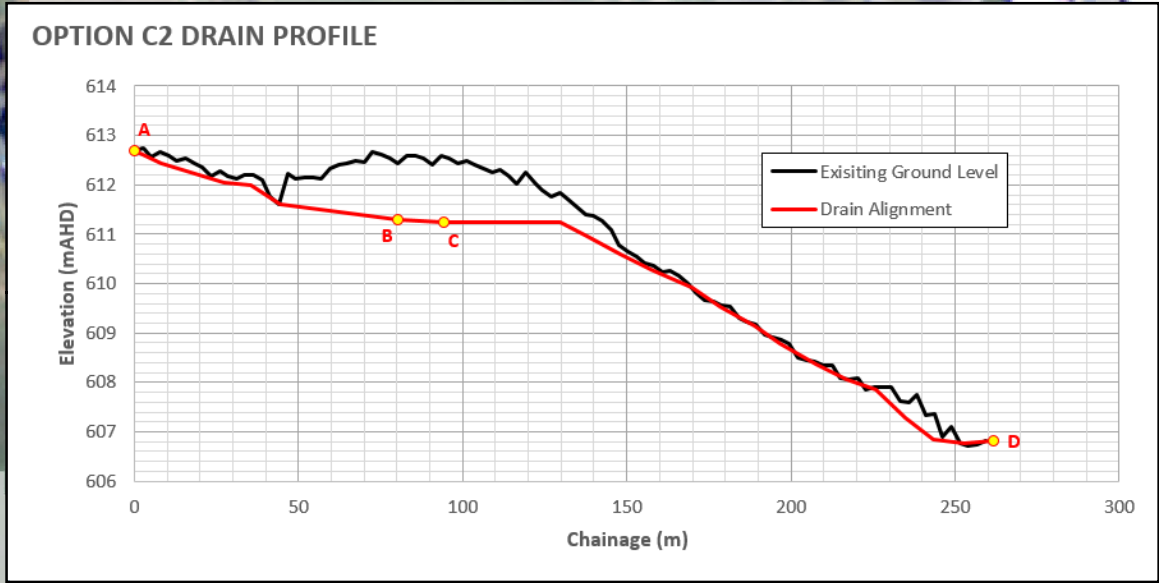
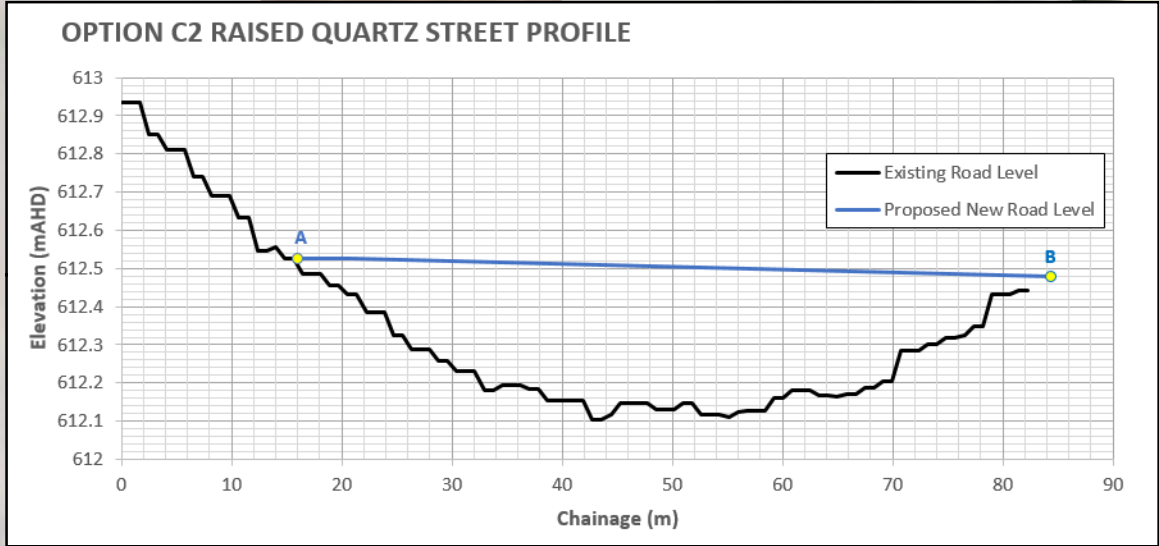
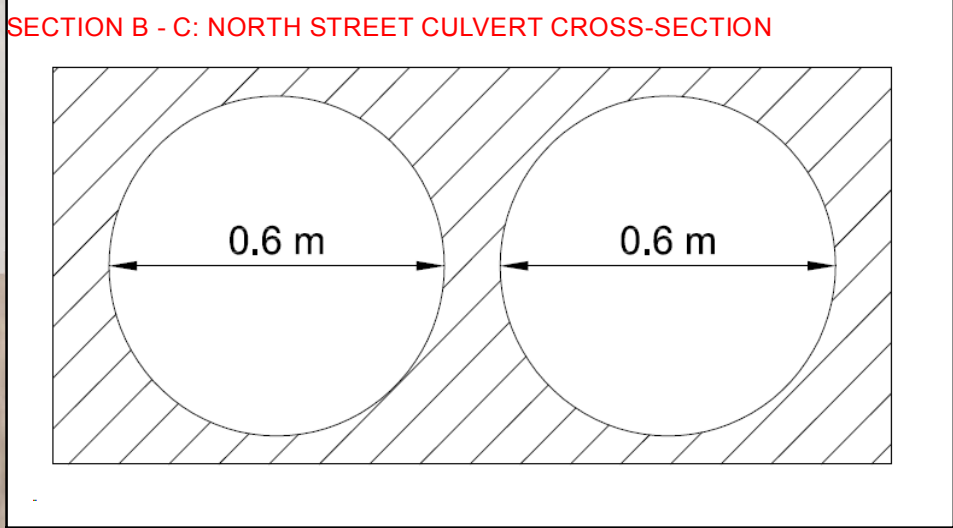
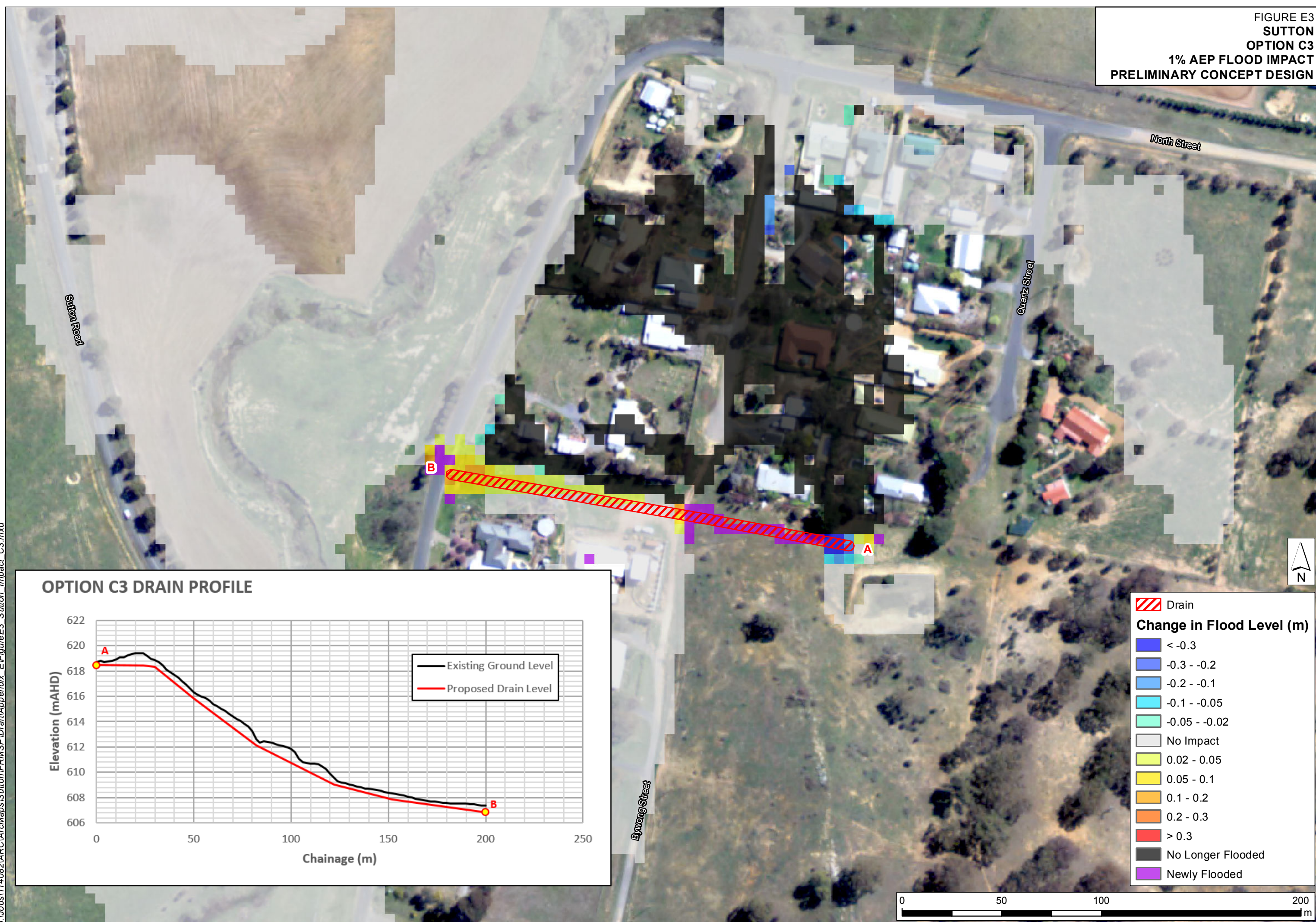
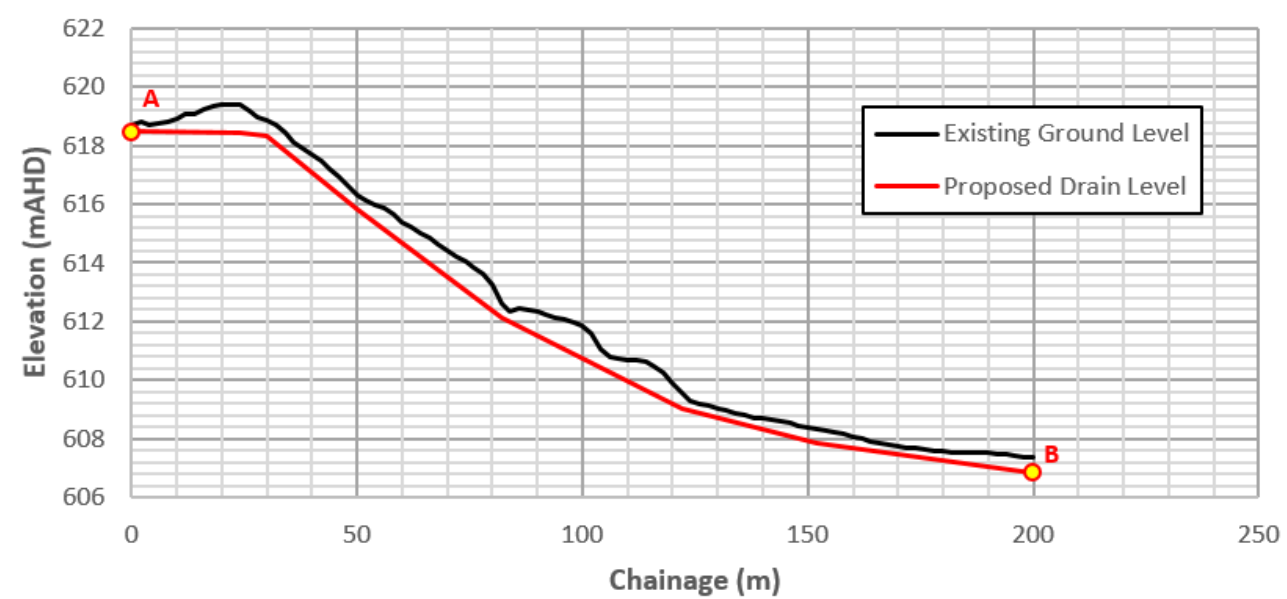




FIGURE E3  
SUTTON  
OPTION C3  
1% AEP FLOOD IMPACT  
PRELIMINARY CONCEPT DESIGN



OPTION C3 DRAIN PROFILE







## Appendix F: Public Exhibition Submissions

The Sutton Floodplain Risk Management Study and Plan Draft Final report was placed on public exhibition for a period of 4 weeks between 26<sup>th</sup> October and 24<sup>th</sup> November. Hard copies of the report were available at the Sutton Store and Sutton Public School. The report was also available online on Council's website during this period.

Four Submissions were made which are presented below with a response from WMAwater.

### Submission 1

Submission 1 is a joint submission made by the Sutton Community Association. The Submission contained a cover letter which is addressed paragraph by paragraph below, as well as Statements from 11 residents which have also been addressed below. The Submission and Statements largely agree with the findings and outcomes from both the Flood Study and Floodplain Risk Management Study and Plan, however aim to highlight flood affectation of their individual lots and Sutton as a whole.

Paragraphs 1 to 5 – taken as comment

Paragraph 6 – taken as comment whilst acknowledging the hazard associated with sewage contamination.

Paragraph 7 – taken as comment, noting community endorsement of the studies recommendations.

Paragraphs 8 to 10 – taken as comment.

Paragraph 11 – This comment is responded to as part of the Submission 2 feedback.

Paragraphs 12 to 19 – taken as comment.

Paragraphs 20 to 23 – taken as comment, noting community concerns.

Submission 1, Statement 1 – taken as comment, noting significant stormwater issues and distress of the resident.

Submission 1, Statement 2 – taken as comment, noting significant flooding issues and the distress of the resident. A recommendation to install a pit/pipe network from upstream of Quartz Street to downstream of Camp Street is noted. Such a network was briefly examined at the request of Council and noted to require a pipe with diameter between 1.2 – 1.5 m, and with a length of ~270 m. Additional downstream drainage works, such as a swale or drain, would also be required. An indicative cost estimate for such work would be +\$4 million. The proposed Options B1 will give the same benefit at a much cheaper cost. It is recommended that Option B1 be pursued instead of the described pit/pipe network.

Submission 1, Statement 3 – taken as comment, noting significant flooding issues and the distress of the resident.

Submission 1, Statement 4 – taken as comment, noting significant flooding issues and the distress of the resident.

Submission 1, Statement 5 – taken as comment, noting significant drainage issues and the distress of the resident.

Submission 1, Statement 6 – taken as comment, noting significant drainage issues and the distress of the resident.

Submission 1, Statement 7 – taken as comment, noting significant drainage issues and the distress of the resident.

Submission 1, Statement 8 – taken as comment, noting significant drainage issues and the distress of the resident.

Submission 1, Statement 9 – taken as comment, noting significant drainage issues and the distress of the resident.

Submission 1, Statement 10 – taken as comment, noting significant drainage issues and the distress of the resident.

Submission 1, Statement 11 – taken as comment, noting significant drainage issues and the distress of the resident.

## **Submission 2**

Paragraph 1 – Submission 2 notes that *‘the Sutton Flood Study Figures 1 to 3 do not represent the actual flow of water off the high Crown Land to the recognised flood area known as Bywong and North Street junction.’* WMAwater acknowledge this and refer to Section 1.1.2 of the Flood Study which notes that, *‘the flow paths presented in Figure 1 are for display purposes only and that the true distribution of flow for the various design events are presented in Figure 22 to Figure 28.’* In summary, the flow paths presented in Figures 1 to 3 of the flood study have no impact on the Flood Study results.

Paragraph 2 – the catchment area has been determined from the 1m LiDAR data and is consistent with the *‘scoop shaped’* catchment mentioned in the submission. The modelled flow path follows that displayed in Attachment 2 illustration.

Paragraph 3 – taken as comment, again noting the similarities between the Flood Study results and that observed in Attachment 3.

Paragraph 4 – the gradient is determined from the 1m LiDAR data and is accurate. Mannings roughness assumptions are consistent with the land use displayed in Attachment 4.

Paragraph 5 to 7 – taken as comment.

Paragraph 8 – Two drainage options have been considered to mitigate flooding in the northern areas of



Sutton. These are Options C2 and C3 which are discussed in Section 4.3.3.2 and 4.3.3.3. The Submission 2 recommendation to divert flow via a pipe from one catchment to another would be very costly, would not significantly reduce above floor flooding or flood damages, and would not be eligible for funding as part of the Floodplain Risk Management Program. Accordingly this is not considered to be a viable floodplain management option.

Paragraph 9 to 13 – taken as comment.

### **Submission 3**

Taken as comment, noting significant drainage issues and the distress of the resident.

### **Submission 4**

Taken as comment. Submission is largely relating to drainage issues which are outside the scope of the current study. To address concerns related to the Option C3 preliminary concept design, the following comment has been added to Section 4.3.3.3, *'Please note that Submission 4 submitted as part of the Public Exhibition Period (see Section 2.5) has several concerns related to the preliminary concept design of this option. These concerns are detailed in Submission 4 of Appendix F and can be addressed as part of the detailed design should Council implement this option.'*

## Sutton Public Exhibition – Submission 1

Yass Valley Council

PO Box 6

Yass NSW 2582

Attention of The General Manager,

### Sutton Community Association Submission

**P1** On behalf of members of the Sutton Community please find below a response to the Draft Final Sutton Floodplain Risk Management Study and Plan published October 2016 provided for public viewing/comment by the Yass Valley on 27 October – 5pm Thursday 24 November 2016 at [www.yassvalley.nsw.gov.au](http://www.yassvalley.nsw.gov.au).

**P2** This response has been submitted by our community due to the wide ranging impact on Sutton Village.

**P3** This response includes statements provided by some residents of the community whose properties are directly impacted by the flooding. It does not include all members of the community as many members were reluctant to publicly express a view. From community consultation this issue is a widespread one within the village.

**P4** As the study has identified there are numerous issues with flooding affecting Sutton with five hotspot areas highlighted and a list of recommendations to remedy the current issues.

**P5** This response primarily focuses on the impacts for the community in the southern, central and northern ends of the village.

**P6** The community is very concerned about this issue and the real likelihood the stormwater is contaminated by untreated sewerage waste.

**P7** We strongly encourage Council to continue to progress the recommendations outlined in the report through to detailed designs and implementation as soon as possible. The community welcome the opportunity to work with Council to determine a timeline to address and rectify the issues identified in the short, medium and long term. As you will appreciate the contaminated water is an issue which MUST be addressed immediately as well as the dangers posed by overflowing open drains to life. These are issues the Community and the Community Association strongly believe must be addressed in the ensuing months.

**P8** In the medium to long term we recognise there are many issues to address and resolve. Consultation with community members has identified many of these issues which are outlined in the attached signed statements from community members.

**P9** Applying a risk based approach the Community recognises these matters will need to be prioritised to address in the medium to long term.

In the draft report there are a number of hot spots identified which are assessed as a high priority to rectify. The Community urges Council to look at ways to address these hotspots in the short term.

**P10** There are, it is submitted, different risks associated with each hot spot. For example, the Central Flow causes large amounts of water to go on, over and under Camp Street, which is a major traffic thoroughfare. This is a major safety issue given light and large amounts of heavy vehicles use this road daily, which may potentially be involved in an accident directly caused by this large amounts of water flowing. We refer you to the attached photos as an example.

**P11** Within the statement a landowner Paul Kable has provided evidence that the modelling is incorrect in the northern end of the village. Please refer to his statement for further evidence.

**P12** As you are aware there has been a Master Plan process being conducted. Whilst the community has strongly participated in this existing landowners are very concerned if the current infrastructure is inadequate it is imperative this be rectified before any further development. The community is concerned that any new development will not have the same issues the existing village has which if not addressed will impact on property values for existing properties and make it very difficult for current owners to sell properties.

**P13** A key issue community owners have raised is the RANDOM nature of works that have been conducted in the village over time which has made the problem worse. This appears to have been caused by a lack of a collaborative approach to address these issues and a failure to consider the impacts of various approvals of properties and water management methods on other properties. We refer you to the statement of Andrew and Barb Corkery.

**P14** In the statements received the following issues were raised as areas of concern.

#### Financial

- Reduce the value of most people's biggest investment
- Cannot utilise land due to water running through properties – this includes adding extensions/sub dividing, rising damp, water running through sheds/garages damaging goods and/or then not being able to be used, cannot create gardens or areas for recreation
- Ongoing damage to properties including over floor flooding, damage of contents, damage to gardens/landscaping
- Loss of income due to time spent to address these continuing issues before, during and after rain

#### Health

- Septic overflow causing contamination of land and possibility of disease
- Emotional and physical stress and anxiety caused
- Mosquitoes/sterile water. This has been exacerbated by recent works with large amounts of sterile water currently in the village precinct

#### Environment

- Contamination to land, creeks and waterways in a rural area where there are for example produce growers in the immediate vicinity of the village who are likely to use water for irrigation purpose from the creek
- Erosion and general appearance of open channels
- Access issues to properties



**Safety****P18**

- Camp Street flooding and potential risks to residents and road users
- Potential for drowning due to exposure to flash flooding, open drains, lack of protection in Bywong and Camp Street
- Potential for trees to fall that could injure/kill people and damage property
- Trucks getting bogged in laneways and water not being able to be delivered

**Social****P19**

- Children, animals and adults do not feel safe on their own properties due to flash flooding, contamination, continual dampness
- Having to cut down trees which changes the landscape and feel of the village/area
- Residents feeling powerless to fix the issue
- Tension between residents trying to protect their own property and the flow on effects
- Some people cannot use up to 50% of their property due to flooding – having obvious social and wellbeing impacts

**P20**

The Community is concerned that whilst a water study has been conducted there will be minimal further efforts to progress this or there is the potential for any solution to take many years to be implemented causing continuing anxiety and angst amongst the community.

**P21**

The Community is aware of representations that have been made suggesting there is a lack of funding to address these issues within YVC. Whilst the Community understands YVC has many priority areas this issue is the most significant one for the Sutton Community. Further whilst YVC may be unable to fund this project it will not continue to make an effort to apply for funding at a State or Federal level to address this issue.

**P22**

The Sutton Public School is also affected by these water issues with the stormwater damaging landscaping, the foundations and piers of various buildings and meaning parts of the school are not usable for periods of time.

**P23**

To demonstrate the serious impacts of the flooding we will hand deliver photos and video footage to YVC within two weeks of this submission. The files were too large to email due to their size. Also please note the statements provided by community members are attached to the email of this submission.

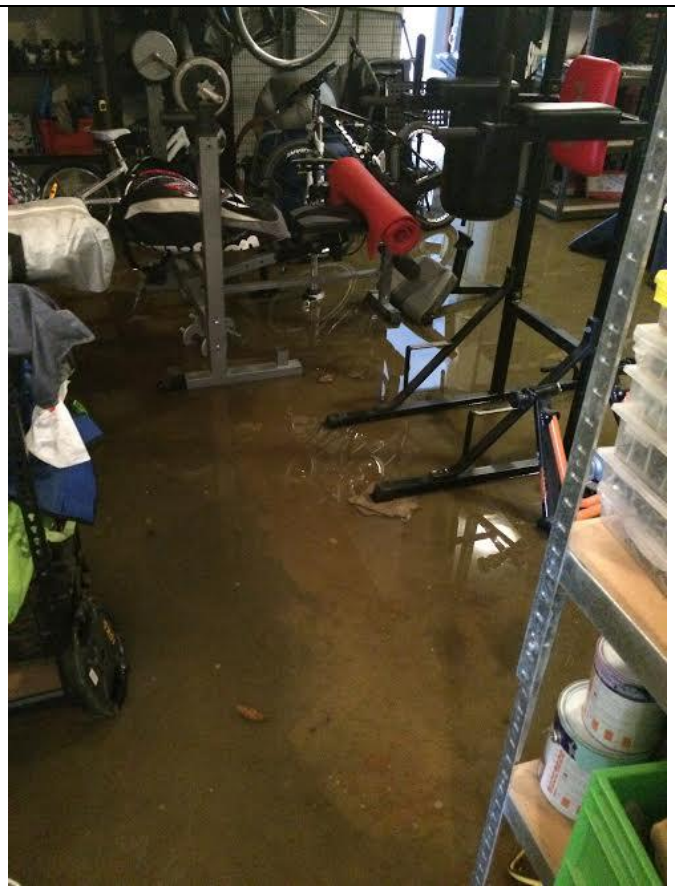
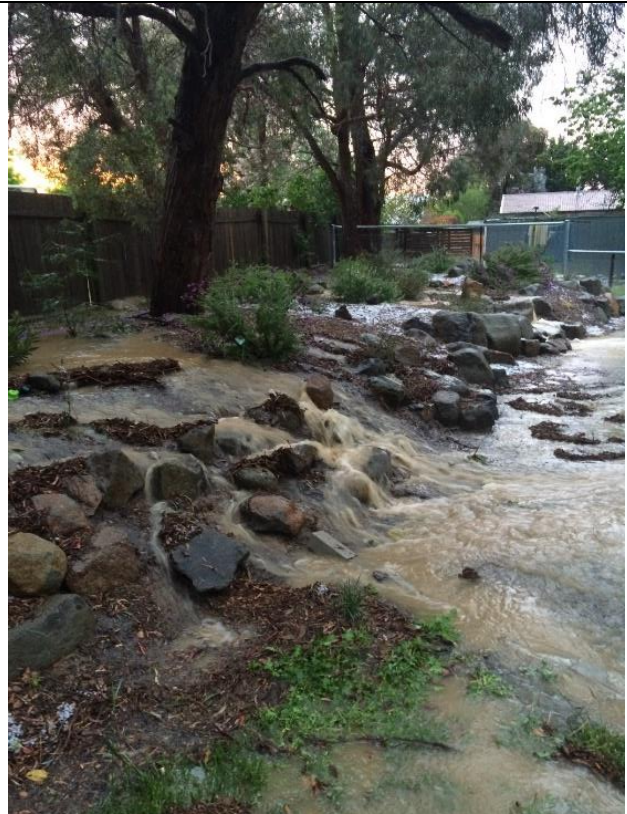
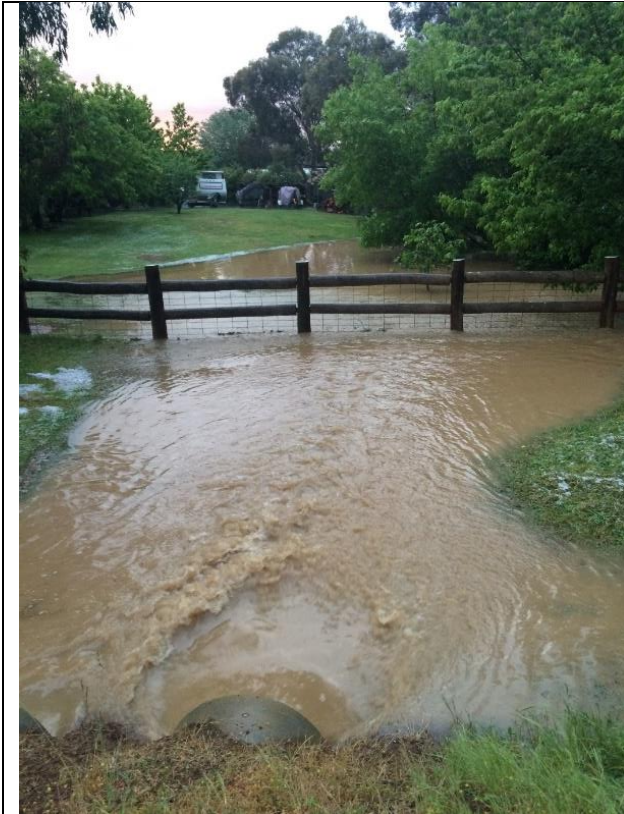
The Sutton Community Association

23 November 2016

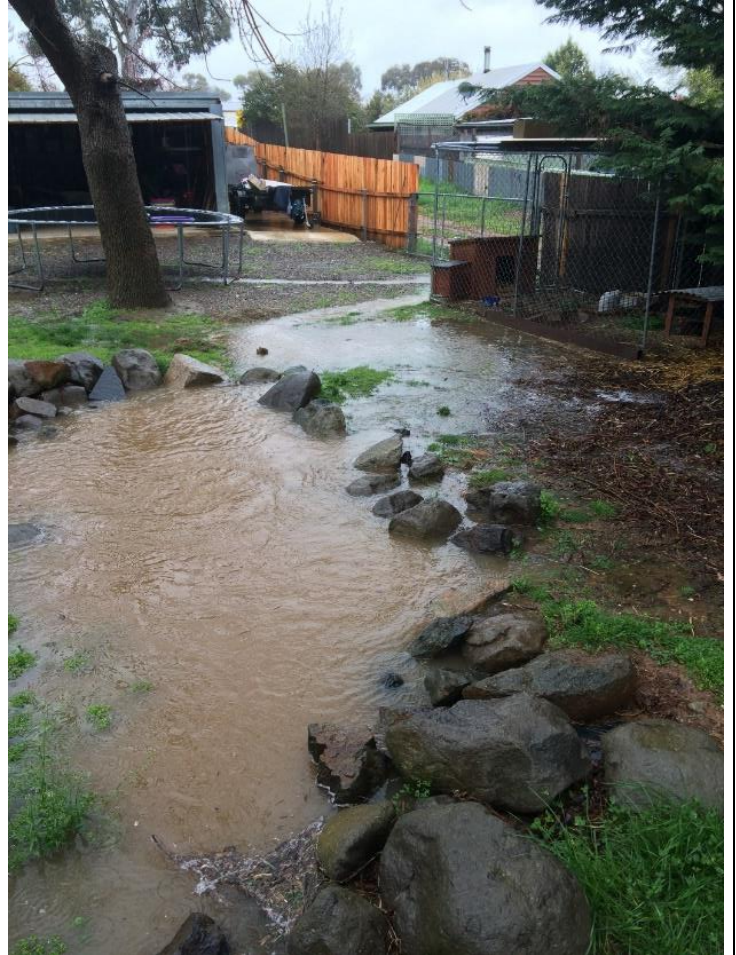


## Photographs ■ Bywong Street

Photos of flooding and damage to ■ Bywong Street and flow of water from pipes in front of neighbouring property





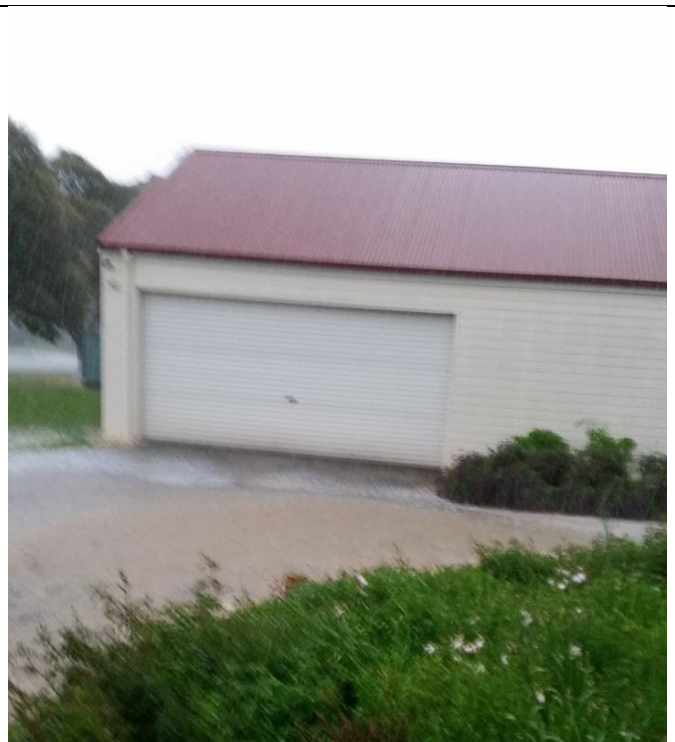


Photos of ■ Bywong Street



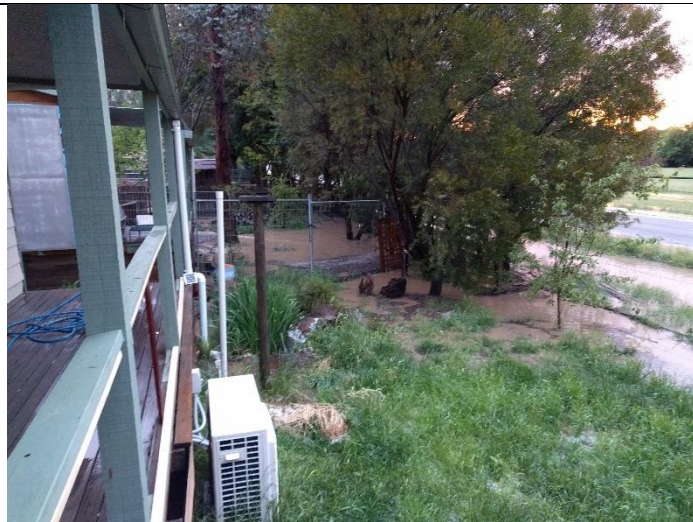


Photos of ■ Victoria Street and central flood path





Photos of Camp Street and Middle Street



**Submission 1, Statement 1****Response to Sutton Water Study**

Name: [REDACTED]

Address: [REDACTED] Quartz St, Sutton

Phone Number: [REDACTED]

Email address: [REDACTED]

1. Our names are [REDACTED] and [REDACTED] and we are the owners of [REDACTED] Quartz St, Sutton.
2. We have resided at [REDACTED] Quartz St Sutton since August 2001.
3. At the time we purchased the property we were not aware of water issues from storms and no serious storm water issues were encountered initially.
4. Since purchasing the property our experience with water issues caused by the lack of stormwater facilities in Sutton Village is that it has caused substantial flooding in our back yard and been damaging to the gardens and lawns of the property.
5. As a result of these experiences we have had to complete the following actions:  
Northern fence had to be installed with a mesh base to allow water flow and prevent fence collapse.
6. The financial cost of taking these actions since .....has been approximately .....  
Unknown.
7. The personal impact the water issues have had on us has been one of frustration that this situation has been allowed to develop.
8. This issue was raised with the council and we were advised that "stormwater should not be directed into a property". We requested a council visit to inspect the situation and have yet to receive a response.
9. Include whether have any concerns whether the water may be contaminated by waste run off from other properties.  
Not at this time.
10. We have attached photos we have taken of the water issues at various times. Please refer to photos previously provided to [REDACTED]
11. We would be prepared to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency.

Name: [REDACTED]

Signature: [REDACTED]

Date: 19 November 2016.



**Submission 1, Statement 2**

## Response to Sutton Water Study

Name: [REDACTED]

Address: [REDACTED] Bywong St, Sutton NSW

Phone Number: [REDACTED]

Email address: [REDACTED]

1. Our names are [REDACTED] and [REDACTED] and we are the owners of [REDACTED] Bywong St, Sutton.
2. We have resided at this address for the past 25 years.
3. In storm conditions we encounter various issues arising from the large volume of surrounding surface water flowing through our residence.
4. The impact of this flooding includes:
  - a. Flooding to my rear workshop shed;
  - b. Flooding to my smaller garden shed;
  - c. Extensive flooding along the southern boundary of my block;
  - d. Our Enviro-cycle becomes submerged which activates our high water alarm and potentially causes issues with effluent overflow into surrounding stormwater; and
  - e. Large volumes of debris flow along our southern fence line which has damaged the fence footings and panels.
5. The issues detailed above were exacerbated approximately 7 years ago when [REDACTED] Quartz Street was constructed behind our dwelling. This site was modified extensively with a large cut and fill excavation which completely altered the flow pattern throughout the surrounding area. As part of the construction works, the ground was graded to a concentrated sump and pipework installed which now discharges under their fence line directly into their neighbouring block ([REDACTED] Quartz St) and directly behind my property. This action significantly increased the volume of water through the rear of my block and adversely impacts both me and my neighbour ([REDACTED] Bywong St).
6. These issues were raised by me during the arranged site-visit by the individuals who undertook the recent water study.
7. At the front of my property I have two very large pipes approximately 600mm diameter (running directly under the road) which is the collection point for most of the water from the rear of my property and including the flow from [REDACTED] Quartz Street and surrounds. The contours of the surrounding area all seem to grade to this point in heavy rain and the flow through this gully is extremely high in torrential rain. It is this discharge point which impacts on all of the lower lying properties across the road including [REDACTED] and [REDACTED] Bywong St etc.
8. In order to overcome these ongoing issues, my recommendation would be to install sumps and submerged pipework from the top of the hill (near the dam and above [REDACTED] Quartz St) down to the creek along the current path of water. I recognise that this may be [REDACTED] inconvenient to some home owners who would be impacted by trenching.

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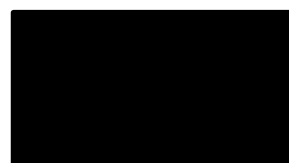
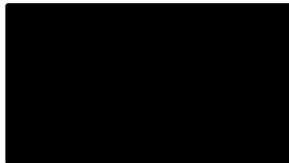
Response to Sutton Water Study

9. Exposed sumps / collection points, such as my front pit should also be appropriately constructed and covered to eliminate the risks associated with a person slipping into a raging torrent and being sucked through a stormwater pipe.
10. I would be happy to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency.

Name:

Signature:

Date:



## Submission 1, Statement 3

## Response to Sutton Water Study

Name: [REDACTED]

Address: [REDACTED] Bywong st Sutton

Phone Number: [REDACTED]

Email address: [REDACTED]

1. My name is [REDACTED] and we (me and my children) are the owners of [REDACTED] Bywong st Sutton.
2. We have resided at [REDACTED] Bywong st Sutton since July 2011.
3. At the time we purchased the property we were aware of water issues from storms but not aware of the extent of risk.
4. Since purchasing the property our experience with water issues caused by the lack of stormwater facilities in Sutton Village has been considerable but not consistent and not expected/forecast.
5. and 6. The financial expenditure in taking actions has been minimal simply because I do not have the financial capacity to make any amendments to be prepared for future freak hail storms like that one that battered NSW in November. In 2013 I financed a tradesman to make small drainage change- small works to reduce the garage flooding. This was only a few hundred dollars. I paid a few hundred (\$500+) to have the septic pumped soon after moving (after the late 2011 storm) just to reduce my anxiety in the risk of effluent flow after heavy rain.
7. The personal impact the water issues has had on the family has been considerable with my now 8 year old daughter and 10 year old son being very anxious when the water level raised and they joined me outside in gum boots to ensure the drains were clear and gates open to allow flow away from the house.
8. This matter has not been discussed with Council but has been discussed with my insurance provider to ensure I have flood protection just in case.
9. I have concerns that the water run off from other properties may be contaminated by waste (dangerous rubbish and/or effluent).
10. I have attached photos of recent water issues. Photos were also taken at various times in previous heavy storm years showing how heavy the flow was and how close it came to the house.
11. I would be prepared to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency.

Name: [REDACTED]

Signature: [REDACTED]

Date 17-11-16



**Submission 1, Statement 4****Response to Sutton Water Study**

Name: [REDACTED]

Address: [REDACTED] Bywong Street Sutton

Phone Number: [REDACTED]

Email address: [REDACTED]

Our names are [REDACTED] and [REDACTED] and we are the owners of [REDACTED] Bywong Street Sutton.

We have resided at [REDACTED] Bywong Street Sutton since 13 September 2011.

At the time we purchased the property we were not aware of water issues from flooding.

Since purchasing the property our experience with water issues caused by the lack of stormwater facilities in Sutton Village has been that the laneway that goes to the rear of our property is in a gully and becomes flooded when it rains. The laneway is the main access for our water deliveries. Last year we needed to purchase water four times during the year. The laneway has been inaccessible for vehicles since April this year due to the ground being so soft and muddy. Trucks and cars would become bogged if they attempted to drive on it.

We haven't spent any money on the laneway (such as resurfacing with roadbase) as it would only be washed away in the next flood event.

I am concerned that when we next need to buy water, that the water truck won't be able to access the laneway and our water tanks to fill them up.

We haven't discussed the matter with Yass Valley Council.

We would be prepared to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency.

Name: [REDACTED]

Signatures: [REDACTED]

Date: 22/11/2016 [REDACTED]

## Submission 1, Statement 5

## Response to Sutton Water Study

Name: [REDACTED]

Address: [REDACTED] Quartz St Sutton NSW

Phone Number: [REDACTED]

Email address: [REDACTED]

1. Our name is [REDACTED] and [REDACTED] and we are the owners of [REDACTED] and [REDACTED] Sutton.
2. We have resided at [REDACTED] Quartz St (lots [REDACTED]) since 1986.
3. At the time we purchased the property we were not concerned of possible flooding but when it did occur it was infrequent. Now with so much extra moisture in the atmosphere caused by warming oceans it is occurring more frequently and has become a problem to us and those down flood stream from us.
4. Since purchasing the property our experience with water issues caused by the lack of stormwater facilities in northern Sutton Village has been water pouring across our 100 metre boundary with higher Crown land, surrounding the house and flooding horse pasture.
5. As a result of these experiences we have had to complete the following actions: place boards to divert the water away from the house. Repair and paint brick veneer cracks caused by sodden clay sub soil expanding and then contracting. Nothing has been able to correct the problem of pasture seed being washed away but action has been taken to spray weeds from seeds that were washed into our paddocks from the Crown land.
6. The financial cost of taking these actions has been approximately \$5,000.
7. The impact the water flood has had on horse pastures cannot be remedied this season.
8. Attempts to have Council discuss the issue have led to being ignored. Council staff have not accepted the invitation by us to host them to visit Sutton to look at the problem and the source of the water.
9. We have attached photos we have taken of the water issues at various times. These photos show:
  - Plan of flood water source and path over our property
  - View uphill from lot [REDACTED] into adjacent Crown Land
  - Video of 21 seconds of flow near southern border of property
  - Resultant flood of a paddock at corner of Quartz and North Street
  - One of the Flood paths through direct drilled pasture seed
10. We would be prepared to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency or the Flood Study contractor. Onsite inspection is highly recommended.

Name: [REDACTED]

Signature: [REDACTED]

Date 21-11-2016

**Submission 1, Statement 6****Response to Sutton Water Study**

Name: [REDACTED]  
Address: [REDACTED] Victoria Street, Sutton NSW 2620  
Phone Number: [REDACTED]  
Email address: [REDACTED]

1. Our name is [REDACTED] and [REDACTED] and we are the owners of [REDACTED] Victoria Street, Sutton NSW 2620
- 2.
3. We have resided at [REDACTED] Victoria Street, Sutton for 9 Years.
4. At the time we purchased the property we were aware of the water issues from storm but did not realise how bad it was.
5. Since purchasing the property our experience with water issues caused by the lack of stormwater facilities in Sutton Village has been Victoria Street road runs through the front of our yard down through our back yard then into the paddock behind us. Then it goes onto Bywong street etc.
6. As a result of these experiences we have had to complete the following actions:
  - a. Driveway has small humps (like speed humps) at front to redirect water.
  - b. Put our own garden bed in front of the yard with sleepers and trees to redirect water
  - c. Dig out around outside of our yard to make a drain to redirect the water
  - d. Build driveway up a bit so everything doesn't wash out. (unfortunately this has not worked)
7. The financial cost of taking these actions since 2010 has been approximately \$2000.00 or more to bring in bobcats etc. Lucky we know people as this brought the cost down.
8. The personal impact the water issues has is continue concern of trying to build yard up and worrying what is in the run off into our yard
9. Before we lived at [REDACTED] Victoria Street. We lived at [REDACTED] Bywong Street Sutton. The yard was flooded numerous times. While living there we spoke to the council with not much success. The only thing they did was cut out a drain on the outside of the yard.
  - We placed pipes down the inside of the fence between us and our neighbours
  - Put large drainage at top of the yard for the water to go into the drain pipes
  - Put pipes in and brought soil in to fix the drainage on nature strip in front of house.

We have lived in Sutton over 20 years and council has never really been interested in helping.



**Submission 1, Statement 7****Response to Sutton Water Study**

10. We have attached photos we have taken from the last storm we had over two weeks ago. These photos show the water coming down from Victoria Street, through our yard and going down the back of our place.
11.
  1. Front of [REDACTED] Victoria Street, Sutton
  2. Water running down in front of our garage
  3. Run off down through our yard
  4. Run off behind our house through nature reserve.
12. We would be prepared to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency.

We do have more photos of Bywong Street and Victoria Street if needed.

Name: [REDACTED]

Date 22/11/16

**Submission 1, Statement 8**

## Response to Sutton Water Study

Name: [REDACTED]

Address: [REDACTED] Middle St Sutton NSW

Phone Number: [REDACTED]

Email address: [REDACTED]

1. Our names are [REDACTED] and [REDACTED] and we are the owners of [REDACTED] Middle St Sutton.
2. We have resided at [REDACTED] Middle St Sutton since November 2014.
3. At the time we purchased the property we were not aware of water issues from storms. We did look at flood maps from the council, which indicated levels of flooding from the creek, but nothing about water flow during storms.
4. Since purchasing the property our experience with water issues caused by the lack of stormwater facilities in Sutton Village has been difficult. Our front yard and side yard regularly flood, and take a number of days for the water to drain away. This means that we lose the use of 50% of our yard, and have nowhere dry for our dog, or for our children to play. It has also resulted in constant mud in our yard, which has stopped us being able to grow any lawn at all.  
The ditch in front of our house has been dug out to below the level of the pipe that drains under the road, which now means that we have constant water pooling in the ditch. This has created a pool of stagnant water which makes the whole front of our yard smell, and has attracted a huge number of mosquitoes.  
Our shed has regularly flooded in the rain, and we have lost everything that we had stored in it.  
In addition to this, water pools on and occasionally flows over Camp Street, which runs in front of our house. We have seen a number of cars lose traction, aquaplane and spin around on the road. Given the speed some people drive this road, we are worried a car will slide into the ditch and flip into our yard.
5. As a result of these experiences we have had to complete the following actions: The only solution we can see to mediate the storm water issue is to dig a trench through our property to redirect the water, but have not yet been able to do so. We also have concerns that we have large trees next to the house which are in the path of where the storm water flows. We are concerned that their roots may be damaged from the water, as our neighbour has recently had to remove all of his trees due to the same issue. We will need to have these trees removed by a tree surgeon if this is the case.
6. The financial cost of taking these actions: We are unsure of the financial cost of the trench and tree surgeon.
7. The personal impact the water issues has had on us has been an increase in stress because we have been unable to use our yard. We moved from a townhouse to a house with a big yard for our kids and the dog, and we have been unable to use it as it has been either wet or

## Response to Sutton Water Study

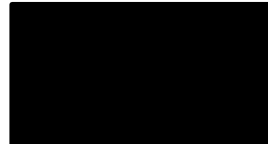
mud for most of the year. Our dog has had to be kept to the deck for most of the time, or he gets covered in mud.

8. Include whether discussed the matter with Council and the outcome. We have not yet discussed this matter with the Council.
9. Include whether have any concerns whether the water may be contaminated by waste run off from other properties. We do not know definitely if the storm water that pools in our yard is contaminated, but we have been told by neighbours that it probably is. This would then mean that most of our yard will be unsafe for children and animals for a lot of the year. We are very concerned about this, as we have two children.
10. We have attached photos we have taken of the water issues at various times. These photos show {please list photos and describe what they show}.  
The photos show storm water around our house after a short 10 minute storm. The first photos are of the water on the intersection of Camp and Middle Streets. The other images show the water pooled in our front yard.
11. We would be prepared to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency.

Name:

Signature:

Date:





**Submission 1, Statement 9**

Statement of [REDACTED] Camp Street, Sutton dated 23 November 2016 to Yass Valley Council

1. Our names are [REDACTED] and we are the owners of a property at [REDACTED] Camp Street, Sutton, NSW ([REDACTED] Camp Street).
2. We have previously made a submission to the draft water study and provide this in addition to this submission.
3. Since purchasing [REDACTED] Camp Street, in July 2011, we have had to address significant stormwater issues which are caused by the central flow hot spot. We were not aware of this issue when purchasing the property and all reasonable inquiries failed to identify such an issue including inquiries conducted by our conveyancer.
4. Due to the fact [REDACTED] Camp Street, receives all of the stormwater of the central flow as it makes its way from the Camp Street laneway to Camp Street, we have had to undertake significant earthworks and maintenance to address this issue. The works have been necessary as without this our front yard would commonly flood each time there was a heavy storm.
5. These works have been performed by civil contractors, tradesman at times and there has likewise been a significant amount of our own labour to address this issue and take this to a manageable level.
6. As Council records, will indicate we have discussed this matter many times with Council Staff over the past 5 years and the efforts Council have taken to help manage this situation is evidence of the general awareness of this issue. Council have on two occasions dug out the trench at the front of our property in Camp Street, though of relevance there has been no action taken to manage this water flow before it reaches our property.
7. The works we have completed has cost us in excess of \$30,000 in addition to many hundreds of hours of our own labour which cannot be quantified. The works we have had to undertake consist of:
  - Having purchased, transported and dumped 60 tonnes of large river stone in two different instalments to create a dry creek to channel the stormwater
  - Manually digging by hand two large 300mm holes to channel the water from our property to the Camp Street trench
  - The creation of the dry creek by a bobcat which has spent approximately 2 days building these earthworks
  - Having to dig two 1.5 metre depth trenches by 15 metres at the back of the house and filling this with gravel and agriculture pipe to stop ground water causing rising damp in the house brickwork. This was at significant financial cost in excess of \$15,000
  - Having one half of the side of the house waterproofed at significant expense



Statement of [REDACTED] Camp Street, Sutton dated 23 November 2016 to Yass Valley Council

- Waterproofing a downstairs rumpus room and garage to address rising damp issues caused by the ground water which is contributed to by the stormwater
  - Having built a levy at the back of our property to protect our property when there is a storm. The levy is 50 metres in length and against our fence and provides our first layer of flood protection
  - Having raised a pool, we had built to ensure it is well above the dry creek in the event of large amounts of stormwater
  - Having to unblock the pipe each time there is a storm due to the leaves, sticks and bark from the laneway, neighbouring properties, as well as our own
  - Having removed professionally recently 4 large trees which had started rotting due to the constant wet nature of the ground due to the stormwater.
8. We have also spent many hours interacting with Council, the Community and in with relevant parties during the recent water study to seek a resolution to this issue.
9. The water issues have caused undue stress and aggravation to our family which has been caused by the inevitable water issues which arise each time it rains. Likewise, there is the stress created by various parties in the village each undertaking their own actions to minimise their water issues which invariably impact us each time there is a storm. The flow of water has been slow at times, fast at others and of more recent days continues for a longer period after a storm.
10. We have previously submitted photos which have been included in the water study and attach some additional photos as evidence of this.
11. We are particularly concerned by the recent community suggestions there is likely to be contaminated water in the stormwater when there is a storm. As a family of six with 4 children this is particularly concerning given the water runs through our property along a dry creek which is not enclosed.
12. The continuing water issues have created tensions with neighbours and create a difficult situation for a small community given everyone's desire to protect their family and property balanced with the impact this has on other property owners. This is neatly surmised as for every action there is a reaction. A positive to come out of this situation is the shared purpose we now have with our neighbours [REDACTED] and [REDACTED] to try and resolve this issue in a way that minimise the impact to all. This shared purpose has been a key driver for the community submission to the water study that has been created.
13. As property owners who have accepted the challenges the lack of stormwater infrastructure imposes and spent a lot of time and money to channel this water we implore Council to consider the findings of the water study and make it a priority to explore these issues further and address and resolve this continuing problem.



Statement of [REDACTED] Camp Street, Sutton dated 23 November 2016 to Yass Valley Council

14. We particularly request Council to investigate as a priority the potential contaminated water and address this on a case by case basis given the health risk this creates for the community.
15. We would welcome the opportunity to discuss this statement further with relevant parties. In our view, this issue should be addressed before there is any further development of the village given the potential to create a divided community where water issues have been addressed in one section and a section of the village where it has not been resolved.

[REDACTED]

[REDACTED]

[REDACTED] Camp Street, Sutton, NSW

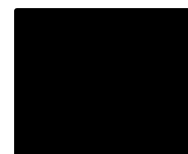
23 November 2016



Statement of [REDACTED] Camp Street, Sutton dated 23 November 2016 to Ya:  
Valley Council



Statement of [REDACTED] Camp Street, Sutton dated 23 November 2016 to Yass Valley Council



**Submission 1, Statement 10**

## Response to Sutton Water Study

Name: [REDACTED]

Address: [REDACTED] Bywong Street Sutton NSW 2620

Phone Number: [REDACTED]

Email address: [REDACTED]

1. My/ Our name is [REDACTED] and [REDACTED] and we are the owners of [REDACTED] Bywong Street Sutton NSW 2620
2. We have resided at [REDACTED] Bywong Street Sutton NSW 2620 since May 2014.
3. At the time we purchased the property we were not aware of the flooding issues through our property. We contacted the Yass Valley Council prior to the purchase of our property to ask if our house was in a flood zone and were informed that nothing was on file to indicate it was. As soon as we moved into the property the neighbours from all sides asked if we knew about the flooding issues.
4. Since purchasing the property our experience with flooding issues caused by the lack of stormwater facilities in Sutton Village has been:
  - a) Our front garage and home office has been flood over 8 times since we purchased the property causing extensive damage to personal effects such as photos, clothing and other valuable contents as well as damage to the architraves, skirting boards, door jams, storage cupboards and home office.
  - b) Our rear garage has been flooded over 8 times since we purchased the property causing significant damage to the building materials and personal contents.
  - c) Since purchasing the property we found that the door jams in our downstairs bedroom/toilet-washroom and laundry have been replaced up to the height of 30 cm, suggesting previous over floor flooding to the area. Since we have lived at the property we have seen the water come within 1cm of going over this area.
  - d) The flooding has caused significant damage to our gardens, landscaping and driveway. During flooding events our driveways, garden beds and landscaping are washed away and eroding the grounds.
  - e) We have two children ages 1 and 9. We are concerned for their safety in our own backyard due to flash flooding through our property. Further we are concerned about the dangers present in the property next to us as well as the large drain hole on the other side of Bywong Street immediately in front of our property where there is a very large current of water. Children walk home from Sutton Primary past this drain and we are concerned that someone could fall in and drown.
  - f) During flooding events and after we regularly smell septic. There are septic tanks in the direct path of the flood waters above our property. We are extremely concerned about the health implications for our animals, children, ourselves, the flow on into the creek and the wider community.



- g) We are aware of the flooding that occurs on Camp Street as a result of inadequate drainage. We have witnessed cars having to drive through at least 100mm of fast flowing water across the road. Neighbours have reported seeing cars aqua plane and as a result spinning out and ending up on the other side of the road.
- h) The flooding has caused significant tension amongst neighbours and the community as we all try and protect our properties. We are aware that council has previously made residence above install drainage on their properties which channels the water through at a faster pace than it would naturally flow. It also turns out that the pipes installed cannot cope with the volume of water that passes through these properties causing the owners damage and stress. Further the infrastructure on Victoria Street channels the water under the road towards our property as well as collects the fire stations roof run off causing further unnecessary flooding to our property.
- i) We are concerned about the water which sits out the front of the pipes which run under Bywong Street. It takes considerable time for this to dry out and as a result increases the amount of mosquitoes in the area.
- j) We have had the SES out on two occasions in 2016 to assist. Both times our front garage and home office flooded and the SES sandbagged the garage to prevent further damage.
- k) We live in the central village path – identified as a high priority flood modification measure and identified as hotspot 4.

5. As a result of these experiences we have had to complete the following actions:

Install some underground drainage through our property to try and protect our house and land. This includes having to dig out a large trench immediately behind our rear garage, install 200mm x 200mm stormwater grates in front of our front garage, sandbag our garage, the SES helped on one occasion by pumping away water with a submersible pump, evacuate our animals from their enclosure each time it rains, run a barrier along our fence line to try and move the water away from our house, built a break pond at the rear of our property to slow the rate of water flowing through, continually have to repair the erosion to gardens, driveways and reinstate garden beds. We are also considering whether we might need to cut the trees down in the immediate path as has our neighbours below due to the danger of them rotting and falling over. We have submitted an insurance claim which was approved, however until the flooding issues are rectified there is no point in getting the repairs undertaken as they will only get damaged again. We are then up for more money once again.

7. The financial cost of taking these actions since May 2014 has been in excess of \$40,000 and continue to be ongoing.

8. The personal impact the water issues has had on our family has been that it has placed a lot of financial, physical and emotional stress. Each time it rains we are anxious as to what damage is going to occur to our property. We are also worried for our animals and young children. Please refer to the attached video of the flooding which occurred on 9 November 2016.

9. We have approached the Yass Valley Council via email and phone calls on numerous occasions and have had to chase up each time due to no response. Recently the Director of Engineering visited our property and took a look at the village. We also cooperated with the WMA representatives including attending meetings, provided flood indicator levels and photos/footage of flood events.

10. As previously stated we are concerned that there is septic run off from properties above us as there is usually a strong smell of sewerage after a heavy down fall. I have also personally witnessed seeing septic tanks above under water and pumping out lots of water immediately after large downfalls.

10. We have attached photos and videos we have taken of the water issues at various times. These include:

9 November 2016 – Backyard submersed in running water – 1 minute 16 second video

9 November 2016 – Back laneway – 2 minutes 41 seconds video

9 November 2016 – Front drains video – 9 second video

9 November 2016 – Front drains on property next door to our place - photo

21 September 2016 – Front of garage flooding- photo

21 September 2016 – Front garage inside flooding – photo

21 September 2016 – Victoria Street drain which then is directed to other side of road and through our property - photo

11. We would be prepared to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency.

Name:

Signature/s:

Date: 21 November 2016

**Submission 1, Statement 11**

## Response to Sutton Water Study

Name [REDACTED]

Address: [REDACTED] North Street

Phone Number: [REDACTED]

Email address: [REDACTED]

1. Our name is [REDACTED] and [REDACTED] and we are the owners of [REDACTED] North Street.
2. We have resided at [REDACTED] North Street since June 2012
3. At the time we purchased the property we were aware of water issues from storms and heavy rain fall, and the effect it had on ours and the surrounding properties.
4. Since purchasing the property our experience with water issues caused by the lack of stormwater facilities in Sutton Village has been flooding of our property, including water through two garages on many occasions. Flooding on the driveway, limiting access to the property. Flooding of the culvert drainage along the front perimeter of the property with no where for the water to go.
5. As a result of these experiences we have had to complete the following actions:
  - a. Upgraded drainage around the property, including above and below ground solutions;
  - b. Improved a water holding area at the back of property to slow down the flow of water and reduce the risk of flooding.
  - c. Installed plumbing to catch the water overflow of water tanks from properties above us into our water tanks
  - d. Resurfaced the driveway to assist with water runoff and prevent long term damage to the property, including house foundations
6. The financial cost of taking these actions since 2012 has been approximately \$5,000
7. The personal impact the water issues has had on our family has been noticeable with the time and energy spent in coming up with solutions and then undertaking the works or finding contractors willing to do the work.
8. Include whether discussed the matter with Council and the outcome:

As we were aware of the issues we have not engaged with Council to date. As the water flows in from the neighbours place we have worked with them to design and implement solutions.
9. Include whether have any concerns whether the water may be contaminated by waste run off from other properties

We are well aware that there is a high risk of water contamination and that the rubble drain of the neighbouring property runs directly towards our block. In recent rains there has been damage caused to the septic management in the neighbouring property. We were advised of this and assisted to ensure the risks were managed.
10. We would be prepared to discuss this matter further with the appropriate representative from Yass Council or the relevant NSW State Government Agency.

Name: [REDACTED]

Signature: By email

Date: 24/11/2016



## Sutton Public Exhibition – Submission 2

██████████ Quartz Street

### Sutton Flood Study. Northern Sheet Flow area

Comments by ██████████ resident of Lot ██████████ for 31 years.

Attachment 1. This Word Script

- P1** The Sutton Flood Study figures 1 and 3 do not represent the actual flow of water off the high Crown Land (Zone E2) to the recognised flood area known as the Bywong and North Street junction.

Attachment 2 is a Plan view illustrating, with a black oval line, the catchment area best described as scoop shaped. The scoop has high sides east and west and water can only escape over the north facing lip into Lot ██████████. The red area is lot ██████████ north half and lot ██████████ south half. The study incorrectly shows the flow initially west past the deep dug and hilled dam. Firstly this would require the water to flow uphill out of the scoop shape and if it went around the dam it would require to go uphill between the dam and Bywong Street. In 31 years I have not seen the dam hold more than one metre even after the heaviest rain. After a wet 2016 winter it has less than a metre of water despite its huge capacity; visual inspection will show a very small catchment uphill from the dam. Most of the water from the western slope of the block bounded by Quartz/Bywong/Albert/Middle streets flows into the new swale along Bywong which turns ninety degrees into Albert then Camp Street.

- P2**
- P3** Attachment 3 is a video commencing at the SW red corner of lot ██████████ showing 100 metre southern fence of lot ██████████ and looking uphill into the Crown Land across the “scoop”.

- P4** Attachment 4 shows the catchment as viewed from within lot ██████████ note the steepness and lack of ground cover resulting from horse overgrazing.

- P5** Attachment 5 is a 21 second video taken at a gate just 40 metres (at Southern edge of first black arrow head on plan) from the southern boundary of lot ██████████ just a couple of hours after the start of heavy rain. Imagine the volume of water after several days of this flow.

- P6** Attachment 6 shows the NW corner of lot ██████████ after 24 hours rain, already lots of water has flowed into the North Street storm water system and the photo does not show two other paddocks also flooded. The situation is somewhat mitigated by a small dam in lot ██████████ adjacent to Quartz Street and shown in the photo; however this dam is destined to be filled in.

- P7** Impact of this flow on North Street and Bywong Street junction follows.

I contend this fast water from the steep Crown Land slope combined with storm water generated off the gentle pastured slope of lots ██████████ and ██████████ comprises the bulk of water arriving at North Street.

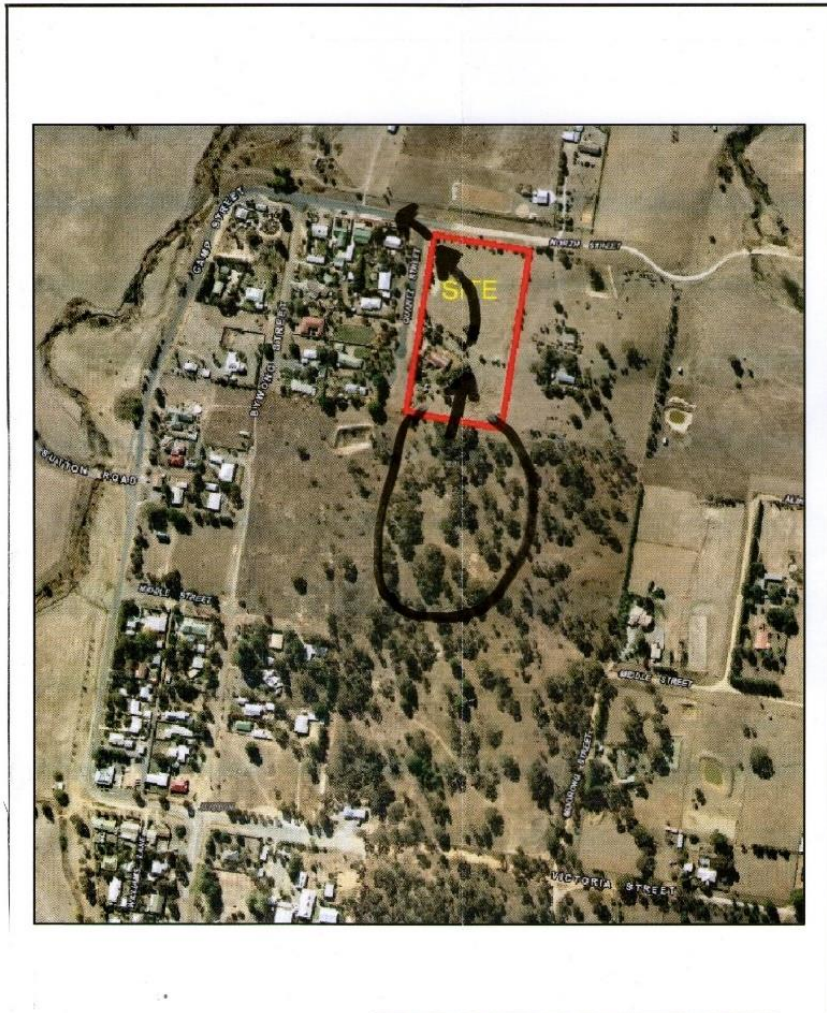
- P8** This water could be stored in the unused dam on Crown Land between Quartz and Bywong Streets. This flow could be achieved by a shallow swale running east/west at the scoop’s lip leading to an underground pipe from its western end low into the dam thus breaching the scoop’s rim whilst not impeding walkers, joggers or horses that use the Quartz Street road reserve south.

- P9** The current flow from the Crown Land has the following effect on my property:

- P10** • Surrounds my home foundations swelling the clay and causing cracks in brick veneer (partly mitigated now by a barrier of boards redirecting water away from the house) and cracks have been recently filled and the home repainted
- P11** • Washes pasture seed away leaving bare patches in horse paddocks
- P12** • Washes a variety of weed seed from the Crown Land into my horse paddocks
- P13** • Brings down a muddy layer into the paddocks which bakes hard and impedes pasture seed germination. See attachment 7



## Attachment 2



## Attachment 4





Attachment 6



Attachment 7



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## Sutton Public Exhibition – Submission 3

To whom it may concern

We are the owners of ■ Camp St, Sutton. As you are aware we receive a lot of the storm water which passes into the village and it transits our house on the way to Camp Street and the creek. We have, as you are aware spent a lot of money trying to channel this water as well as waterproof our house, pool and yard approximately \$20,000.

With the recent rains it has been identified that several large trees (about 4 at the side of the property) are very wet as the ground is not drying out which may affect their stability.

We are waiting on an arborist report. The wetness as you are aware is caused by the stormwater issues and lack of stormwater drainage in the village.

We do not have the funds to pay to remove all the trees ourselves and would appreciate advice on how you may be able to assist given the issue is due to the lack of stormwater management facilities in the village. These problems are well documented in the water study.

This assistance may be assistance by Council staff in removing the trees, access to relevant funding to meet this cost or cost sharing.

Kind regards

■■■■■■■■■■  
■■■■■■■■■■

## Sutton Public Exhibition – Submission 4

**From:** [REDACTED]

**Sent:** Monday, 7 November 2016 9:22 AM

**To:** Records <[Records@yass.nsw.gov.au](mailto:Records@yass.nsw.gov.au)>

**Subject:** comment on Sutton flood study

Thank you for the preparation of a comprehensive flood study for the village.

I generally support the recommendations with the following comments:

### Option C3 Northern Flow Path Minor Drainage Channel

1. The increase in capacity of this drain is supported HOWEVER the proposal needs to be modified to ensure drainage from Middle St is taken direct down to Camp St rather than along Bywong St to the existing drain in the Albert St road reserve. Capturing this 'additional' water into this drain unnecessarily increases its flow when minor alterations to drainage at the Middle and Bywong Sts intersection could better utilise existing drainage lines in Middle St.
2. IN ADDITION at the Camp St end of the enlarged Albert St road reserve drain there needs to be a new culvert installed to take drainage directly under Camp St towards the creek rather than along Camp St to the existing culvert at the driveway entry of [REDACTED] Camp St. Since the current drain in the Albert St road reserve was put in place, the arrangement at Camp St has caused flooding into [REDACTED] Camp St and this will be exacerbated with a larger drain with increased peak flow capacity.
3. IN ADDITION the drain in the Albert St road reserve should be moved further away from the [REDACTED] Camp St boundary. There are signs of erosion on the existing drain and I am concerned that with increased flow in this location the boundary fence will start to be undermined. In addition to being moved further south, the drain along the Albert St road reserve should be a very smooth shallow profile as this area is used by walkers, horse riders and children so a sharp bank to the drain may create a hazard. In addition, given the close proximity to homes, this area needs to be able to be readily mowed to reduce fire and snake hazard.
4. Flood maps indicate flood risk to [REDACTED] Camp St from the drainage system in Bywong St to the east (uphill) of [REDACTED] Camp St. During several recent rain events, the table drain on the eastern side of Bywong St did overflow and flowed through [REDACTED] Camp St. This was caused by garden waste being dumped in the table drain and has since been resolved, although as the study correctly identifies a risk remains. This drain (eastern side of Bywong St between Albert and North Sts) needs to be increased in capacity to eliminate this risk.
5. If the northern and southern ends of Bywong St are connected as has been discussed then the drainage system in this area should be constructed to eliminate flood risk from this source to [REDACTED] Camp St.

Thank you for the opportunity to comment on this Study.

I am happy to discuss these matters with you at any time.

[REDACTED]  
[REDACTED]



**From:** [REDACTED]  
**Sent:** Wednesday, 9 November 2016 11:12 PM  
**To:** Records <[Records@yass.nsw.gov.au](mailto:Records@yass.nsw.gov.au)>  
**Subject:** comment on Sutton flood study

Further to my submission of 7 November regarding the flood study, attached are photos from the rain event on the evening of 9 November 2016 showing the failure of the drainage system in Camp St Sutton to cope with the flows. This water backed up into [REDACTED] Camp St at the peak of the event.

In addition to this flooding, the table drain on the eastern (up hill) side of Bywong St between Albert St and North St failed to drain the storm event and overtopped leading to flow through [REDACTED] Camp St causing inflow into the septic system and erosion.

This is without the additional drainage proposed in the flood study which would divert further flows into the drainage channel located in the Albert St road reserve between Bywong and Camp Sts.

The storm event this evening further reinforces the need to separately send drainage from Middle St direct under Camp St (in the area near Middle St) and into the creek as well as for an additional culvert under Camp St to directly discharge the drainage channel in the Albert St road reserve into the creek corridor. As you can see from the photos which were taken after the storm peak had passed, there is a degree of flooding of [REDACTED] Camp St caused by a lack of adequate stormwater infrastructure in the Village.

I ask that these matters are addressed by Council asap to reduce the risk of floods impacting on [REDACTED] Camp St.

Please consider this as an addendum to my earlier submission.

[REDACTED]

