TEMORA SHIRE COUNCIL

ARIAH PARK AND SPRINGDALE FLOODPLAIN RISK MANAGEMENT STUDY AND PLAN

AUGUST 2023

VOLUME 1 – REPORT

DRAFT REPORT FOR PUBLIC EXHIBITION

Job No: FB476 File: APFRMS&P_V1_Report_[Rev 1.1].doc	Date: August 2023 Rev No: 1.1	Principals: SAB Authors: TDR/SAB

COPYRIGHT NOTICE

Further Information
For further information about the copyright in this document, please contact:
Temora Shire Council
105 Loftus Street, Temora
temshire@temora.nsw.gov.au
+61 2 6980 1138

FOREWORD

NSW Government's Flood Policy

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

Under the Policy, the management of flood liable land remains the responsibility of local government. The State subsidises flood mitigation works to alleviate existing problems and provides specialist technical advice to assist councils in the discharge of their floodplain management responsibilities. The Policy provides for technical and financial support by the State through the following four sequential stages:

1.	Data Collection and Flood Study	Collects flood related data and undertakes an investigation to determine the nature and extent of flooding.
2.	Floodplain Risk Management Study	Evaluates management measures for the floodplain in respect of both existing and proposed development.
3.	Floodplain Risk Management Plan	Involves formal adoption by Council of a plan of management for the floodplain.
4.	Implementation of the Plan	Construction of flood mitigation works to protect existing development. Use of Local Environmental Plans to ensure new development is compatible with the flood hazard. Improvements to flood emergency management procedures.

Presentation of Study Results

The results of an *Ariah Park and Springdale Flood Study* have been relied upon for preparing the *Ariah Park and Springdale Floodplain Risk Management Study and Plan*. Both the *Flood Study* and the *Floodplain Risk Management Study* have been prepared under the guidance of the Floodplain Risk Management Committee comprising representatives from Temora Shire Council, the NSW Department of Planning and Environment, the NSW State Emergency Service and community representatives.

ACKNOWLEDGEMENT

Temora Shire Council has prepared this document 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 Department of Planning and Environment.

TABLE OF CONTENTS

Page No.

Continued Over

TABLE OF CONTENTS (Cont'd)

Page No.

APPENDICES

LIST OF FIGURES
(BOUND IN VOLUME 2)

Cont'd Over

LIST OF FIGURES (Cont'd)
(BOUND IN VOLUME 2)

ABBREVIATIONS

AEP	Annual Exceedance Probability (%)
AHD	Australian Height Datum
ARI	Average Recurrence Interval (years)
ARR 2019	Australian Rainfall and Runoff (2019 Edition)
BoM	Bureau of Meteorology
Council	Temora Shire Council
DECC	Department of Environment and Climate Change
DPIE	Department of Planning and Environment
FDM	Floodplain Development Manual, 2005
FRMC	Floodplain Risk Management Committee
FPL	Flood Planning Level
FPA	Flood Planning Area
FRMS	Floodplain Risk Management Study
FRMP	Floodplain Risk Management Plan
FRMS&P	Floodplain Risk Management Study and Plan
LEP	Local Environmental Plan
LiDAR	Light Detection and Ranging (survey)
MHFL	Minimum Habitable Floor Level
NSWG	New South Wales Government
NSW SES	New South Wales State Emergency Service
PMF	Probable Maximum Flood
VP	Voluntary Purchase

SUMMARY

S1 Study Objectives

Temora Shire Council (**Council**) commissioned the preparation of a floodplain risk management study and plan for the villages of Ariah Park and Springdale. The overall objectives of the *Ariah Park and Springdale Floodplain Risk Management Study* (***Ariah Park and Springdale FRMS***) were to assess the impacts of flooding on existing development, review existing Council policies as they relate to development of land in flood liable areas, consider measures for the management of flood affected land and to develop the *Ariah Park and Springdale Floodplain Risk Management Plan* (***Ariah Park and Springdale FRMP***) which:

i) Proposes modifications to existing Council policies to ensure that the development of flood affected land is undertaken so as to be compatible with the flood hazard and risk.

ii) Sets out the recommended program of works and measures aimed at reducing over time, the social, environmental and economic impacts of flooding.

iii) Provides a program for implementation of the proposed works and measures.

The study area for *Ariah Park and Springdale FRMP* applies to areas that are zoned *RU5-Village* in Ariah Park and Springdale, in addition to their immediate surrounds. The study deals with the following two types of flooding:

- **Main Stream Flooding**, which occurs when floodwater surcharges the inbank area of the existing creek system. Main Stream Flooding is typically characterised by relatively deep and fast flowing floodwater, but may be shallower and slower moving in flood fringe areas.
- **Major Overland Flow** which occurs during storms which result in the flow of water across the land as it makes its way toward defined watercourses whether they be modified or not, as well as surcharge of the existing stormwater drainage system. Major Overland Flow is typically characterised by relatively shallow and slow moving floodwater.

Figure 1.1 in **Volume 2** of this report is a location plan, while **Figures 2.1** (3 sheets) and **2.2** (2 sheets) show the key features of the existing stormwater drainage system at Ariah Park and Springdale, respectively.

S2 Study Activities

The activities undertaken in *Ariah Park and Springdale FRMP* included:

1. Undertaking a consultation program over the course of the study to ensure that the Ariah Park and Springdale communities were informed of the objectives, progress and outcomes over the course of the study (**Chapter 1** and **Appendix A**).
2. Review of existing flood behaviour in the study area and its impact on existing development (**Chapter 2**).
3. Assessment of the potential impact that a partial blockage of hydraulic structures and future urbanisation, as well as increases in hydraulic roughness and rainfall intensity associated with future climate change could have on flood behaviour (**Chapter 2**).

4. Review of current flood related planning controls relating to the study area and their compatibility with flooding conditions (**Chapter 2**).
5. Strategic review of potential floodplain risk management works and measures aimed at reducing flood damages, including an economic assessment of the most promising measures (**Chapter 3**).
6. Ranking of works and measures using a multi-objective scoring system which took into account economic, financial, environmental and planning considerations (**Chapter 4**).
7. Preparation of *FRMP 2020* (**Chapter 5**).

S3 Summary of Flood Impacts

Figures 2.3 (2 sheets) and **2.4** show the indicate extent and depth of inundation at Ariah Park and Springdale for the 1% AEP flood event, respectively, while **Figures 2.5** (2 sheets) and **2.6** show similar information for the Probable Maximum Flood (**PMF**) event. **Figures 2.7** (2 sheets) and **2.8** show the time of rise of floodwater at key locations along the road and rail network at Ariah Park and Springdale, respectively, while **Figures 2.9** (2 sheets) and **2.10** show the indicate extent of flooding at Ariah Park and Springdale for floods of between 20% AEP and the PMF event, respectively .

At the 1% AEP level of flooding, eight dwellings, 21 commercial/industrial buildings and one public building would be subjected to above-floor inundation at Ariah Park, while seven dwellings would similarly experience above-floor inundation at this level of flooding at Springdale. As the depth of above-flood inundation at both Ariah Park and Springdale is relatively shallow at the 1% AEP level of flooding, the total flood damages in the two villages only amount to about $1.7 Million and $0.6 Million, respectively.

The *Present Worth Value* of damages likely to be experienced at Ariah Park and Springdale for all flood events up to the 1% AEP is $3.2 Million and $0.1 Million, respectively. A combination of flood mitigation measures costing up to these amounts could be economically justified if they eliminated flood damages for all flood events up to this level. While schemes costing more than this value would have a benefit/cost ratio less than 1, they may still be justified according to a multi-objective approach which considers other criteria in addition to economic feasibility.

S4 Flood Risk and Development Controls

An approach which uses the concepts of *flood hazard* and *hydraulic categorisation,* and is aimed at imposing a graded set of controls over development according to the flood risk has been recommended for incorporation into *Temora Shire Development Control Plan 2012* (***Temora Shire DCP 2012***). The delineation of flood planning constraint categories is based on the proximity to flow paths, depths and velocities of flow, the rate of rise of floodwaters and ease of evacuation from the floodplain in the event of a flood emergency.

Figures C1.1 and **C1.2** in **Appendix C** of this report are extracts from the *Flood Planning Map* relating to the study area. The extent of the Flood Planning Area (**FPA**) (the area subject to flood related development controls) has been defined as follows:

- In areas subject to Main Stream Flooding, the FPA is based on the traditional definition of the area that lies at or below by the 1% AEP plus 0.5 m freeboard.

- In areas subject to Major Overland Flow, the FPA is defined as the extent of areas which act as a floodway, as well as areas where depths of inundation exceed 0.1 m in a 1% AEP event.

Figure C1.3 and **C1.4** in **Appendix C** are extracts of the *Flood Planning Constraint Category Map* for the study area which shows the subdivision of the floodplain into four categories which have been used as the basis for developing the graded set of planning controls.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development in properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figures C1.1** and **C1.2**. The MHFLs for residential land use types is the level of the 1% AEP flood event plus freeboard, whereas for commercial and industrial land use types the MHFL is to be as close to the 1% AEP flood level plus freeboard as practical, but no lower than the 5% AEP flood level plus freeboard. In situations where the MHFL is below the 1% AEP flood level plus freeboard, a mezzanine area equal to 30% of the total habitable floor area is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard.[1]

S5 Ariah Park and Springdale Floodplain Risk Management Plan

Chapter 5 of this report presents the *Ariah Park and Springdale FRMP*, with the recommended works and measures summarised in **Table S1** at the end of this Summary. The recommended works and measures have been given a provisional priority ranking, confirmed by the Floodplain Risk Management Committee, according to a range of criteria, details of which are set out in **Section 4** of this report.

The *Ariah Park and Springdale FRMP* comprises four "non-structural" management measures which could be implemented by Council with the assistance of NSW State Emergency Service (**NSW SES**) using existing data and without requiring Government funding. The measures are as follows:

- **Measure 1** – Inclusion of a new special flood considerations clause in the *Temora Local Environmental Plan 2010 (**Temora LEP 2010**)* which would apply to land which lies between the FPA and the extent of the PMF.
- **Measure 2** - The application of a graded set of planning controls for future development that recognise the location of the development within the floodplain; to be applied through the update of *Temora Shire DCP 2012*. Suggested wording for inclusion in *Temora Shire DCP 2012* is set out in **Appendix C**.
- **Measures 3** - Improvements in the NSW SES emergency planning, including use of the flood related information contained in this study to update the *Temora Shire Local Flood Plan*. Information in this report which would be of assistance to NSW SES includes data on the nature and extent of flooding at Ariah Park and Springdale, times of rise of floodwaters, duration and depths of inundation at major road crossings for a range of flood events and properties affected by flooding.
- **Measure 4** - Council should take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplain of the flood risk. This could be achieved through the preparation of a *Flood Information Brochure* which could be prepared by Council with the assistance of NSW SES containing both general and site-specific data and distributed with rate notices.

[1] Freeboard is equal to 0.5 m for development being assessed in areas affected by Main Stream Flooding and 0.3 m for development being assessed in areas affected by Major Overland Flow.

In addition to the above measures, the *Ariah Park and Springdale FRMP* includes the following additional "non-structural" type measures which would require Government Funding:

- **Measure 5** involves the investigation, design and implementation of a flood warning system for Springdale which would comprise the installation of a telemetered stream gauge which would be linked to an automated public announcement system, as well as a set of flashing lights on Burley Griffin Way.

The *Ariah Park and Springdale FRMP* includes the investigation and design of the following flood modification type measures that would also require Government Funding:

- **Measure 6** comprises an investigation to concept design of a trunk drainage upgrade scheme which is aimed at reducing the impact that Major Overland Flow has on existing development that is located on both the northern and southern sides of the Temora-Roto railway line at Ariah Park (**Ariah Park Trunk Drainage Upgrade Scheme**), while **Measure 7** comprises its detailed design and construction.
- **Measure 8** comprises the preparation and implementation of a *Vegetation Management Pla*n for Gundibindyal Creek and one of its tributaries where they run through parts of Springdale.

S6 Timing and Funding of Measures

The total estimated cost to implement the *Ariah Park and Springdale FRMP* is **$5.5 Million**, exclusive of Council, NSW SES and Bureau of Meteorology staff costs. The timing of the measures will depend on Council's overall budgetary commitments and the availability of both Local, State and Commonwealth Government funds.

Assistance for funding qualifying projects included in *Ariah Park and Springdale FRMP* may be available upon application under Commonwealth and State funded floodplain management programs, currently administered by the NSW Department of Planning and Environment.

S7 Action Plan

1. Council to update *Temora LEP 2010* to include the NSW Government's *Special Flood Considerations* clause and also *Temora Shire DCP 2012* to incorporate the suggested form of wording set out in **Appendix C** of this report (**Measures 1** and **2** of the *Ariah Park and Springdale FRMP*).

2. NSW SES to update the *Temora Shire Local Flood Plan* using information on flooding patterns, peak flood levels, times of rise of floodwaters and flood prone areas identified in this report (**Measure 3** of the *Ariah Park and Springdale FRMP*).

3. Council to inform residents of the flood risk, based on the information presented in the *Ariah Park and Springdale FRMS* (e.g. displays of flood mapping at Council offices, preparation of *Flood Information Brochure* for distribution with rate notices, etc) (**Measure 4** of the *Ariah Park and Springdale FRMP*).

4. Council to commission the investigation, design and implementation of a flood warning system for Springdale (**Measure 5** of the *Ariah Park and Springdale FRMP*).

5. Council to commission the investigation and concept design of the Ariah Park Trunk Drainage Upgrade Scheme, followed by its detailed design and construction (**Measures 6** and **7** of the *Ariah Park and Springdale FRMP*).

6. Council to develop and implement a *Vegetation Management Plan* for Gundibindyal Creek and one of its tributaries where they run through parts of Springdale (**Measure 8** of the *Ariah Park and Springdale FRMP*).

TABLE S1
RECOMMENDED MEASURES FOR INCLUSION IN ARIAH PARK AND SPRINGDALE FLOODPLAIN RISK MANAGEMENT PLAN

Measure	Urban Centre	Required Funding	Features of the Measure	Benefit/Cost Ratio	Priority
1. Update of *Temora LEP 2010*	Ariah Park and Springdale	Council's staff costs	➢ A new *special flood considerations* clause should be incorporated in *Temora LEP 2010* which applies to land that lies between the FPA and the PMF. The new clause relates to development with particular evacuation or emergency response issues (e.g. group homes, residential aged care facilities, etc). It is also aimed at protecting the operational capacity of emergency response facilities and critical infrastructure during extreme flood events.	-	**High Priority**: this measure is designed to mitigate the flood risk to future development and has a high priority for inclusion in the *Ariah Park and Springdale FRMP*. It does not require Government funding.
2. Incorporate recommended approach to managing future development on flood prone land in *Temora Shire DCP 2012*.	Ariah Park and Springdale	(Council's staff costs)	▪ Graded set of flood controls based on the type of development and their location within the floodplain, defined as land inundated by the PMF. ▪ Floodplain divided into five zones based on the assessed flood hazard and hydraulic categorisation. ▪ The minimum floor levels for all land use types is the level of the 1% AEP flood event plus 0.5 m freeboard in the case of areas affected by Main Stream Flooding and plus 0.3 m freeboard in areas affected by Major Overland Flow. ▪ Additional controls applied to development that is located on land which lies above the Flood Planning Level where the large flood range is considered to pose a significant risk to life.	-	**High Priority**: this measure is designed to mitigate the flood risk to future development and has a high priority for inclusion in the *Ariah Park and Springdale FRMP*. It does not require Government funding.
3. Ensure flood data in the *Ariah Park and Springdale FRMS* are available to the NSW SES for improvement of flood emergency planning.	Ariah Park and Springdale	NSW SES costs	➢ NSW SES should update the *Temora Shire Local Flood Plan* using information on flooding patterns, times of rise of floodwaters and flood prone areas identified in this report.	-	**High Priority**: this measure would improve emergency response procedures and has a high priority. It does not require Government funding.
4. Implement flood awareness and education program	Ariah Park and Springdale	Council staff costs	➢ Council to inform residents of the flood risk, based on the information presented in the *Ariah Park and Springdale FRMS*. (e.g. displays of flood mapping at Council offices, preparation of *Flood Information Brochure* for distribution with rate notices, etc).	-	**High Priority**: this measure would improve the flood awareness of the community and has a high priority. It does not require Government funding.
5. Investigate, design and implement a flood warning system for Springdale	Springdale	$0.4 Million	➢ The installation of a telemetered stream gauge and its linking of a public announcement system which would warn residents in Springdale of rising water levels in Gundibindyal Creek and one of its tributaries and to take action as required. ➢ The installation of warning signs and flashing lights on Burley Griffin Way which are linked to the telemetered stream gauge.	-	**High Priority**: this measure would reduce flood damages and the risk to life in the village and prevent motorists from driving through floodwater.
6. Investigate and prepare concept design for Ariah Park Trunk Drainage Upgrade Scheme	Ariah Park	$0.6 Million	➢ Underground utilities search ➢ Geotechnical investigation to assess foundation conditions ➢ Hydraulic modelling to confirm sizes of the key elements of individual elements of the measure ➢ Prepare concept design and cost estimate ➢ Cost-benefit analysis to confirm the economics of the scheme ▪ Prepare a submission for Council and Government funding for detailed design and construction	0.21	**Medium Priority**: this measure would reduce the impact of flooding in parts of Ariah Park
7. Prepare detailed design and construct Ariah Park Trunk Drainage Upgrade Scheme	Ariah Park	$4.1 Million	➢ Tasks involved are as follows: o Prepare detailed design and documentation o Prepare a submission for Council and Government funding. ▪ Construct scheme.		
8. Develop and implement Vegetation Management Plan for Gundibindyal Creek and one of its tributaries where they run through parts of Springdale	Springdale	$0.4 Million	➢ The *Vegetation Management Plan* will identify the reaches of creek that require regular maintenance. It will also describe the scope of any rehabilitation works which would be required following the completion of any inbank works. ▪ The required funding would permit the development of the *Vegetation Management Plan*, the removal of dense vegetation from the inbank area of the watercourse and the implementation of a regular maintenance program over a five-year period.	-	**Medium Priority**: this measure would reduce the risk of a blockage being experienced at the major road crossing, as well as reduce the frequency of overbank flooding.
Total Estimated Cost		**$5.5 Million**			

1 INTRODUCTION

1.1 Study Background

Temora Shire Council (**Council**) commissioned the preparation of a Floodplain Risk Management Study and Plan for the villages of Ariah Park and Springdale (***Ariah Park and Springdale FRMS&P***) in accordance with the New South Wales Government's *Flood Prone Land* policy.

Figure 1.1 shows the location of Ariah Park and Springdale, as well as the extent of the catchments that contribute to flow in the main creek systems which control runoff in the two study areas, those being Mirrool Creek and Gundibindyal Creek.

The *Ariah Park and Springdale Floodplain Risk Management Study (**Ariah Park and Springdale FRMS**)* reviewed baseline flooding conditions, including an assessment of economic impacts and the feasibility of potential measures aimed at reducing the impact of flooding on both existing and future development. The review was based on flood behaviour which was defined as part of the *Ariah Park and Springdale Flood Study* (***Flood Study***) (Lyall & Associates, 2022). This process allowed the formulation of a Floodplain Risk Management Plan for the two villages (***Ariah Park and Springdale FRMP***).

1.2 Background Information

The following documents were used in the preparation of this report.

- *Floodplain Development Manual* (New South Wales Government (NSWG), 2005)
- *Temora Local Environmental Plan, 2010*
- *Temora Shire Development Control Plan 2012*
- *Temora Shire Local Flood Plan* (NSW State Emergency Service (**NSW SES**), 2015)
- *Ariah Park and Springdale Flood Study* (Lyall & Associates, 2022) *(**Flood Study**)*

1.3 Overview of Ariah Park and Springdale FRMS&P Report

The results of the *Ariah Park and Springdale FRMS* and the *Ariah Park and Springdale FRMP* are set out in this report. Contents of each Chapter of the report are briefly outlined below:

- **Chapter 2**, **Baseline Flooding Conditions**. This Chapter includes a description of the existing drainage system at Ariah Park and Springdale, as well as the nature of flood behaviour in the study area based on the findings of the *Flood Study*. The Chapter also summarises the economic impacts of flooding on existing urban development, reviews Council's flood planning controls and management measures and NSW SESs flood emergency planning.
- **Chapter 3**, **Potential Floodplain Management Measures**. This Chapter reviews the feasibility of floodplain management measures for their possible inclusion in *Ariah Park and Springdale FRMP*. The list of measures considered is based on input from the Community Consultation process, which sought the views of residents and business owners in the two study areas regarding potential flood management measures which could be included in *Ariah Park and Springdale FRMP*. The measures are investigated at the strategic level of detail, including indicative cost estimates of the most promising measures and benefit/cost analysis.

- **Chapter 4**, **Selection of Floodplain Management Measures**. This Chapter assesses the feasibility of potential floodplain management strategies using a multi-objective scoring procedure which was developed in consultation with the Floodplain Risk Management Committee and outlines the preferred strategy.
- **Chapter 5, Ariah Park and Springdale Floodplain Risk Management Plan**. This Chapter presents the *Ariah Park and Springdale FRMP* which comprises a number of structural and non-structural measures which are aimed at increasing the flood awareness of the community and ensuring that future development is undertaken in accordance with the local flood risk.
- **Chapter 6** contains a glossary of terms used in the study.
- **Chapter 7** contains a list of References.

Two technical appendices provide further information on the study results:

Appendix A – Community Consultation summarises residents' and business owners' views on potential flood management measures which could be incorporated in *Ariah Park and Springdale FRMP*.

Appendix B – **Suggested Wording for Inclusion in Temora Shire Development Control Plan** presents guidelines for the control of future urban development in flood prone areas in the Temora local government area. The guidelines cater for both Main Stream Flooding of the watercourses (whether or not altered or modified) which transverse the Shire, as well as Major Overland Flow which is present in the areas which drain to them.

1.4 Community Consultation

At the same time as the draft *Flood Study* was placed on public exhibition a *Community Newsletter* was prepared by the Consultants and distributed to residents and business owners by Council. A *Community Questionnaire* was also distributed by Council seeking details from residents and business owners regarding their attitudes toward potential floodplain management measures. Community responses are summarised in **Chapter 3** of this report, with supporting information in **Appendix A**. The views of the community on potential flood management measures to be considered in the study were also taken into account in the assessment presented in **Chapter 3** of this report.

1.5 Flood Frequency and Terminology

In this report, the frequency of floods is referred to in terms of their Annual Exceedance Probability (**AEP**). The frequency of floods may also be referred to in terms of their Average Recurrence Interval (**ARI**). The approximate correspondence between these two systems is set out in **Table 1.1** over the page.

The AEP of a flood represents the percentage chance of its being equalled or exceeded in any one year. Thus a 1% AEP flood, which is equivalent to a 100 year ARI, has a 1% chance of being equalled or exceeded in any one year and would be experienced, on the average, once in 100 years; similarly, a 20 year ARI flood has a 5% chance of exceedance, and so on.

TABLE 1.1
APPROXIMATE CORRESPONDENCE BETWEEN AEP AND ARI

Annual Exceedance Probability (AEP) – %	Average Recurrence Interval (ARI) – years
0.2	500
0.5	200
1	100
2	50
5	20
10	10
20	5

The 1% AEP flood (plus freeboard) is usually used to define the Flood Planning Level and Flood Planning Area for the application of flood related controls over residential and commercial/industrial development. While a 1% AEP flood is a major flood event, it does not define the upper limit of possible flooding. Over the course of a human lifetime of, say 70 years, there is a 50 per cent chance that a flood at least as big as a 1% AEP event will be experienced. Accordingly, a knowledge of flooding patterns in the event of larger flood events up to the Probable Maximum Flood (**PMF**), the largest flood that could reasonably be expected to occur, is required for land use and emergency management planning purposes. In the *Flood Study*, flooding patterns in the study area have been assessed for design floods ranging between 20% AEP event and the PMF.

2 BASELINE FLOODING CONDITIONS

2.1 Physical Setting

The village of Ariah Park is located about 30 km to the west of Temora and has a population of about 500, while the village of Springdale is located about 20 km to the east of Temora and has a population of about 150.

While the urbanised parts of Ariah Park, which includes commercial type development, are located a short distance to the north of Burley Griffin Way and are accessed via Mary Gilmore Way (refer **Figure 2.1**, 3 sheets), the urbanised parts of Springdale, which comprise solely residential type development, are principally located on either side of Burley Griffin Way (refer **Figure 2.2**, 2 sheets).

Ariah Park is located in the headwaters of the Mirrool Creek catchment, a major tributary of the Murrumbidgee River, while Springdale is located on the main arm of Gundibindyal Creek in the Lachlan River basin. While the urban parts of Ariah Park are located on gently sloping land which lies to the south of the main floodplain of Mirrool Creek, it is subject to relatively shallow overland flow which is generated by pastural land that lies to its south. By comparison, Springdale is subject to flooding from water which surcharges the banks of Gundibindyal Creek.

The Temora-Roto and Cootamundra-Lake Cargelligo railway lines run in an east-west direction through Ariah Park and Springdale, respectively. Both railway lines run normal to the direction of flow and have a significant impact on flooding patterns in the two villages.

2.2 Drainage System

2.2.1 Ariah Park

The main arm of Mirrool Creek runs in a westerly direction about 3.5 km to the north of the Ariah Park Village Centre and has a catchment area of 414 km^2 where it is crossed by Mary Gilmore Way (refer **Figure 2.1**, sheet 1).

The stormwater drainage system in Ariah Park generally comprises roadside table drains with piped crossings at road intersections. There are five culvert crossings that are located along the Temora-Roto railway line where it runs through Ariah Park (denoted Ariah Park Culvert Nos. 1 to 5), the locations of which are shown on **Figure 2.1**, sheet 3. **Table 2.1** sets out the details of the five railway culverts and the size of their contributing catchment areas.

TABLE 2.1
DETAILS OF RAILWAY CULVERTS AT ARIAH PARK

Railway Culvert No.(1)	Culvert Dimensions	Contributing Catchment Area (km^2)
1	1 off 600 ARMCO Pipe	0.01
2	6 off 450 ARMCO Pipes	15.3
3	3 off 450 ARMCO Pipes	0.01
4	1 off 600 ARMCO Pipe	2.15
5	6 off 900 ARMCO Pipes	0.36

1. Refer **Figure 2.1**, sheet 3 for location.

While there are two general low points that run along the eastern and western sides of the Ariah Park Village Centre, south (upslope) of the Temora-Roto railway line, they converge on the northern (downslope) side of the rail corridor, west of Cemetery Road. While overland flow generally follows the natural fall in the land, the presence of the railway culverts, as well as localised features such as raised driveway entrances have historically altered drainage patterns in parts of the village.

2.2.2 Springdale

The headwaters of the Gundibindyal Creek catchment are located about 10 km to the south of the Springdale Village Centre. The catchment is characterised by undulating pastoral land with pockets of state forest. Several minor gullies discharge to Gundibindyal Creek in the vicinity of the village as shown on **Figure 2.2**, sheet 2.

Sheets 1 and 2 of **Figure 2.2** show the location of six culvert crossings that are present along the Cootamundra-Lake Cargelligo railway line where it runs through Springdale (denoted Springdale Railway Culvert Nos. 1 to 6), as well as the extent of the catchments draining to each. **Table 2.2** sets out the details of the six railway culverts and their contributing catchment areas.

TABLE 2.2
DETAILS OF RAILWAY CULVERTS AT SPRINGDALE

Railway Culvert No.(1)	Culvert Dimensions	Contributing Catchment Area (km^2)
1	10 off 1500 ARMCO Pipes	18.80
2	1 off 800 ARMCO Pipe	0.16
3	3 off 2100 ARMCO Pipes	10.10
4	4 off 450 ARMCO Pipes	0.02
5	1 off 900 ARMCO Pipe	0.38
6	1 off 900 ARMCO Pipe	

1. Refer **Figure 2.2**, sheet 2 for location.

Runoff that is conveyed through Springdale Railway Culvert Nos. 1 and 2 discharge to a disused railway dam (refer **Figure 2.2**, sheet 2 for location) before continuing in a northerly direction to Burley Griffin Way. The embankment of the disused railway dam has been partially demolished along the alignment of Gundibindyal Creek.

The stormwater drainage system in the vicinity of the Springdale Village Centre generally comprises roadside table drains with piped crossings at road intersections, in addition to the aforementioned railway culverts. There are two culverts that convey flow from Gundibindyal Creek and its tributary beneath Burley Griffin Way at its low point in the Springdale Village Centre; twin 1500 mm wide by 600 mm high box culverts on the eastern side of the intersection of Burley Griffin Way and Railway Street and twin 1500 mm wide by 900 mm high box approximately 70 m to the west of the intersection.

While the main arm of Gundibindyal Creek is generally devoid of dense vegetation where it runs through the Springdale Village Centre, its tributary arm is heavily vegetated with both trees and low-level shrubs.

2.3 Recent Flood Experience

Almost half of the respondents to the *Community Questionnaire* that was disseminated at the commencement of the *Flood Study* had observed flooding in or adjacent to their property. Whilst a few respondents provided information on flooding that occurred in 1984/1985, 2005 and 2010, the majority of respondents identified more recent storm events that occurred on the following dates:

- 3 February 2011
- 21 September 2011
- 2 March 2012
- 3 September 2016
- 10 September 2016
- 21 September 2016
- 8 January 2019
- 8 February 2019
- 5 March 2020

The *Flood Study* found that the majority of the storms that were identified by the respondents to the *Community Questionnaire* were less intense than a storm that occurs once every two years on average (i.e. more frequent that 50% AEP), with the following exceptions:

- the 27 February – 5 March 2012 storm, which was equivalent to a design storm event with an Annual Exceedance Probability (**AEP**) of about 5% (1 in 20) at Young and 10% at Narrandera and Junee;
- the 21-22 September 2016 storm, which was equivalent to a design storm event with an AEP of 20-10% at Junee; and
- the 23 March 2021 storm event, which was equivalent to a 20-10% AEP design storm event at Temora, West Wyalong, Dudauman and Jindalee.

Appendix B of this report contains several photos which show historic flood behaviour in Ariah Park during storms that occurred on 3 September 2016, 21 September 2016 and 8 February 2019, and in Springdale during storms that occurred on 3 February 2011, 22 December 2011, 3 March 2012, 11 July 2016, 10 September 2016, 21 September 2016 and 8 January 2019. The flooding that was observed in the two urban centres during several of these storm events is summarised in **Table 2.3** over the page.

2.4 Design Flood Behaviour

2.4.1 Background to Flood Study

The *Flood Study* defined the nature of both Main Stream Flooding and Major Overland Flow in the two study areas for storms ranging between 20% and 0.2% AEP, as well as the Probable Maximum Flood (**PMF**) event.

Hydrologic modelling of the Mirrool Creek catchment at Ariah Park and the Gundibindyal Creek catchment at Springdale was undertaken using the DRAINS software, whereby the RAFTS sub-model was used to simulate the hydrologic response of the predominately rural parts of the study catchments, while the IL-CL sub-model was used to stimulate the hydrologic response of the urban parts of the two villages.

TABLE 2.3
SUMMARY OF OBSERVED FLOOD BEHAVIOUR IN ARIAH PARK AND SPRINGDALE

Storm Event	Urban Centre	Indicative Frequency of Storm Event[(1)]	Description of Observed Flood Behaviour
December 2011	Springdale	< 1 EY[(2)]	➢ **Plates B2.1** to B**2.9** in **Appendix B** show floodwater surcharging the banks of Gundibindyal Creek immediately downstream of Burley Griffin Way, while **Plates B2.10** to **B2.13** show that floodwater inundated a 140 m long section of Burley Griffin Way at Springdale at around 20:00 hours on 22 December 2011.
September 2016	Ariah Park	20-10%	➢ Photographic evidence provided by respondents to the *Community Questionnaire* show that flooding that was experienced on 21 September 2016 occurred between 12:00 and 18:00 hours. **Plates B7.10** to B**7.13** show floodwater inundating Burley Griffin Way at multiple locations at around 12:00 hours. ➢ **Plate B7.1** shows a temporary channel that was cut through Wellman Street in the vicinity of George Street to alleviate ponding on the southern side of the road at about 16:00 hours, while **Plate B7.41** shows a photo of the same intersection prior to excavation of the temporary channel when there was shallow flow over the road. ➢ **Plates B7.2** to **B7.9** show floodwater flowing in a northerly direction along George Street and ponding at its intersection with Back Ariah Park Road. ➢ **Plates B7.20** to **B7.28** and **B7.34** to **B7.38** show that floodwater that ponded in Coolamon Street on the southern side of the Temora-Roto railway line surcharged the road and flowed in a westerly direction along Ariah Street. ➢ **Plate B7.21** shows that Ariah Park Railway No. 2 was completely submerged at 16:45 hours. ➢ **Plates B7.42** and B**7.43** show that floodwater in Mirrool Creek overtopped Mary Gilmore Way and inundated a 120 m length of the road. The exact time that Mary Gilmore Way was overtopped was not provided by the respondents to the *Community Questionnaire*.
	Springdale		➢ **Plates B8.1** to B**8.3** show floodwater overtopping Burley Griffin Way in the vicinity of Gundibindyal Creek at 10:00 hours on 21 September 2016. Based on the photographs, floodwater inundated a 150 m long section of Burley Griffin Way at Springdale. ➢ **Plate B8.2** shows that the flood level in Gundibindyal Creek at the time of the photo was at the level of the underside of the pedestrian footbridge that crosses the creek on the upstream side of Burley Griffin Way.

Cont'd Over

TABLE 2.3 (Cont'd)
SUMMARY OF OBSERVED FLOOD BEHAVIOUR IN ARIAH PARK AND SPRINGDALE

Storm Event	Urban Centre	Indicative Frequency of Storm Event	Description of Observed Flood Behaviour
February 2019	Ariah Park	< 1 EY[(2)]	➢ Photographic evidence provided by respondents to the *Community Questionnaire* showed that flooding occurred at around 14:00 hours on 8 February 2019. ➢ **Plates B10.1** and **B10.2** show floodwater ponding on the southern side of Wellman Street but not overtopping the road. **Plates B10.4** to B**10.6** also show floodwater ponding in Coolamon Street on the southern side of the Temora-Roto railway line, albeit to a lesser degree than was observed on 22 September 2016. ➢ **Plate B10.6** shows that floodwater ponded to an elevation equivalent to the underside of the box culvert beneath the footpath at this location Way.
March 2021	Springdale	20-10%	➢ Photographic evidence provided by residents of Springdale at the drop-in session held during the public exhibition of the draft *Flood Study* shows that flooding occurred in Springdale on 23 March 2021. The residents that provided the photographs advised that the 23 March 2021 storm event caused the most severe flooding in recent memory at Springdale. ➢ **Plates B11.1** to **B11.8** show floodwater surcharged the banks of Gundibindyal Creek and inundated Railway Street and Burley Griffin Way. ➢ **Plate B11.8** shows that the flood level in Gundibindyal Creek at the time of the photo was at the level that is approximately equivalent to the deck of the pedestrian footbridge that crosses the creek on the upstream side of Burley Griffin Way.

1. As there are no pluviographic rain gauges located in the catchments which contribute to flow in the drainage systems of Ariah Park and Springdale, the frequency of the historic storm events is indicative only and may not be representative of the rain which fell over the study catchments.
2. More frequent than a storm that occurs once a year on the average, or more frequent than 1 Exceedances per Year (**EY**).

The software generated discharge hydrographs resulting from both historic and design storm events. These hydrographs were applied to two-dimensional (in plan) hydraulic models that were developed for the two study areas using the TUFLOW software.

After testing the models for the December 2011 (Springdale only), September 2016 (Ariah Park and Springdale), February 2019 (Ariah Park) and March 2021 (Springdale only) storm events, design storm rainfalls were derived using procedures set out in the 2019 edition of *Australian Rainfall and Runoff* (Geoscience Australia, 2019), as well as the publication "*The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method*" (Bureau of Meteorology (**BoM**), 2003).

Study results were presented as diagrams showing indicative extents and depths of inundation, flood hazard vulnerability and the hydraulic categorisation of the floodplain into floodway, flood storage and flood fringe areas. Sensitivity studies were also undertaken to assess the effects of variations in model parameters such as hydraulic roughness of the floodplain, the effects of a partial blockage of hydraulic structures, and the effects on flooding patterns resulting from future climate change.

2.4.2 Design Flooding Patterns

Figures 2.3 (2 sheets) and **2.4** show the indicative extent and depth of inundation at Ariah Park and Springdale, respectively for the 1% AEP event, while **Figures 2.5** (2 sheets) and **2.6** show similar information at the two urban centres for the PMF event. **Figures 2.7** (2 sheets) and **2.8** show the time of rise of floodwater at the inlet of key transverse drainage structures in Ariah Park and Springdale, respectively.

The key findings of the Flood Study in relation to Main Stream Flooding along Mirrool Creek at Ariah Park were as follows:

- Floodwater commences to surcharge the Mary Gilmore Way Bridge crossing of Mirrool Creek in a 5% AEP event, while the bridge deck would be inundated to a depth of about 1.2 m in a 1% AEP event.
- Floodwater is generally contained within the inbank area of Mirrool Creek and its anabranch for floods up to about 2% AEP in magnitude.
- Floodwater inundates Mary Gilmore Way at a location approximately 500 m to the east of its intersection with Mandamah Forest Road in a 2% AEP event.
- Floodwater commences to surcharge the left (southern) bank of Mirrool Creek between Garvins Lane and Mary Gilmore Way in a 1% AEP event. Floodwater also commences to surcharge the right (northern) bank of the creek downstream of Mary Gilmore Way in an event of this magnitude.

The key features of Major Overland Flow in Ariah Park are as follows:

- There is only one transverse drainage structure that is located along Burley Griffin Way between its intersections with Garvins Lane and Mary Gilmore Way. As a result, this section of road is inundated by shallow overland flow at four locations during storm events more frequent than a 20% AEP. Burley Griffin Way would be inundated to a depth of up to 150 mm in a 1% AEP event.

- Floodwater flows in a northerly direction through rural allotments between Burley Griffin Way and the Temora-Roto railway line. The depth of overland flow through the rural allotments is generally less than 200 mm in a 1% AEP storm event except in locations where it ponds behind berms or road crossings.
- There is a natural low point on the southern side of Wellman Street at its intersection with George Street. Floodwater commences to overtop Wellman Street in storm events more frequent than 20% AEP in intensity and flow in a northerly direction along George Street where it ponds on the southern side of Back Ariah Park Road.
- The Temora Roto Railway acts as an obstruction that redirects overland flow in a north-westerly direction towards Coolamon Street.
- There is a minor earth embankment on the southern side of Back Ariah Park Road that restricts the amount of overland flow that reaches Ariah Park Railway Culvert No. 1. **The** *Flood Study* found that Ariah Park Culvert No. 1 has a capacity of about 0.4 m^3/s.
- Overland flow ponds on the south-eastern side of the Coolamon Street crossing of the Temora Roto Railway in the vicinity of Ariah Park Railway Culvert No. 2. The *Flood Study* found that the difference between the peak 20% and 0.2% AEP flood levels at this location is only 190 mm.
- Floodwater surcharges the low point in Coolamon Street at its intersection with Ariah Street which is set about 500 mm lower than the adjacent Temora-Roto railway line, where it then flows in a westerly direction along the road reserve of Ariah Street towards Ariah Park Railway Culvert No. 4. Floodwater commences to surcharge the southern side of the road reserve into existing residential allotments in a 10% AEP storm event.
- The Temora-Roto railway line is overtopped approximately 50 m to the east of Coolamon Street and in the vicinity of Ariah Park Railway Culvert No. 5 in a 20% AEP storm event.
- Ariah Park Culvert Nos. 1, 2, 3, 4, 5 and 6 only convey a small portion of the total flow that is generated by a 1% AEP storm event, with the balance overtopping the railway at Coolamon Street, Davidson Street and the trapped low point in the vicinity of Ariah Park Railway Culvert No. 5.
- Floodwater that discharges from the Ariah Park Railway Culvert No. 2 flows in a northerly direction along a table drain that runs along the eastern side of Coolamon Street. Floodwater surcharges the table drain at multiple locations between Broughton Street and Rees Street in flood events more frequent than a 20% AEP event where it flows in a north-westerly direction following the general low point in the land.

The key features of Main Stream Flooding at Springdale are as follows:

- Floodwater commences to surcharge the Burley Griffin Way in the vicinity of its intersection with Railway Street in storm events more frequent than 20% AEP and would reach a depth of about 700 mm in a 1% AEP storm event.
- Floodwater that surcharges Springdale Railway Culvert Nos. 1 and 2 flows in a north-westerly direction towards Springdale Railway Culvert No. 3 which is located at the ultimate low point on the southern (upslope) side of the railway.
- Floodwater commences to overtop the Cootamundra-Lake Cargelligo railway line in the vicinity of Springdale Railway Culvert No. 3 in a 2% AEP storm event.

2.4.3 Existing Flood Mitigation Measures

There are no formal flood mitigations measures present in Ariah Park and Springdale.

2.5 Economic Impacts of Flooding

The economic consequences of floods are discussed in **Appendix H** of the *Flood Study*, which assesses flood damages to residential, commercial/industrial property and public buildings in areas affected by both Main Stream Flooding and Major Overland Flow. There were only limited data provided by respondents to the *Community Questionnaire* on historic flood damages to the urban sectors in the study area. Accordingly, it was necessary to use data on damages experienced as a result of historic flooding in other urban centres. The residential flood damages were based on the publication *Floodplain Risk Management Guideline No. 4, 2007* (**Guideline No. 4**) published by the Department of Environment and Climate Change (**DECC**) (now the Department of Planning and Environment (**DPE**)). Damages to industrial and commercial development, as well as public buildings were evaluated using data from previous floodplain risk management investigations in NSW.

It is to be noted that the principal objectives of the damages assessment were to gauge the severity of urban flooding likely to be experienced at Ariah Park and Springdale, and also to provide data to allow the comparative economic benefits of various flood modification measures to be evaluated in **Chapter 3** of the report. As explained in **Appendix H** of the *Flood Study*, it is not the intention to determine the depths of inundation or the damages accruing to *individual properties*, but rather to obtain a reasonable estimate of damages experienced over the extent of the urban area in the town for the various design flood events. The estimation of damages using *Guideline No. 4* (in lieu of site specific data determined by a loss adjustor) also allows a uniform approach to be adopted by Government when assessing the relative merits of measures competing for financial assistance in flood prone centres in NSW.

Damages were estimated for the design flood levels determined from the hydraulic modelling undertaken as part of the *Flood Study*. Elevations of the floors of affected properties were estimated by a “drive-by” survey which assessed the height of the floor above local natural surface elevations. These natural surface elevations were derived from the LiDAR survey data that were used to construct the hydraulic model. The number of properties predicted to experience “above-floor” inundation at Ariah Park and Springdale, together with estimated flood damages at Ariah Park and Springdale are listed in **Table 2.4** over.

A storm event more frequent than 20% AEP is the threshold at which significant tangible flood damages commence to occur at Ariah Park. For example, thirteen commercial and two public buildings that are located on the eastern side Coolamon Street south of Temora-Roto railway line are subject to above-floor inundation to depths of up to 320 mm in a 20% AEP storm event. The number of buildings at Ariah Park that would experience above-floor inundation increases to 31 (eight residential, twenty-one commercial and two public buildings) at the 1% AEP level of flooding, the locations of which are shown on **Figure 2.3**, sheet 2.

Table 2.4 shows that a total of seven individual dwellings would experience above-floor inundation in Springdale in a 1% AEP storm event, the location of which are shown on **Figure 2.4**.

TABLE 2.4
SUMMARY OF TANGIBLE FLOOD DAMAGES

Village	Design Flood Event (% AEP)	Number of Properties						Total Damage ($ Million)
		Residential		Commercial/ Industrial		Public		
		Flood Affected	Flood Above Floor Level	Flood Affected	Flood Above Floor Level	Flood Affected	Flood Above Floor Level	
Ariah Park	20	6	0	14	13	2	2	0.50
	10	9	0	18	13	2	2	0.68
	5	15	1	21	15	3	2	0.91
	2	25	4	26	19	4	2	1.39
	1	32	8	28	21	4	2	1.67
	0.5	41	10	28	22	4	2	1.96
	0.2	49	14	30	23	4	2	2.59
	PMF	123	94	30	29	6	6	10.57
Springdale	20	0	0	No Commercial Properties at Springdale		0	0	0
	10	0	0			0	0	0
	5	3	0			0	0	0.05
	2	5	3			0	0	0.25
	1	7	7			0	0	0.55
	0.5	10	8			0	0	0.71
	0.2	12	8			0	0	0.76
	PMF	21	20			0	0	2.20

During a PMF event, 94 individual dwellings, 29 commercial buildings and six public buildings would experience above-floor inundation in Ariah Park (refer **Figure 2.5**, sheet 2 for locations), while twenty individual dwellings at Springdale would experience above-floor inundation in a flood of this magnitude (refer **Figure 2.6** for locations).

The *"Present Worth Value"* of tangible damages resulting from all floods up to the magnitude of the 1% AEP at Ariah Park and Springdale for a discount rate of 7% and an economic life of 50 years is about $3.2 Million and $0.1 Million, respectively. Therefore, one or more schemes costing up to these amounts could be economically justified if they eliminated damages in the respective urban centres for all flood events up to this level. While schemes costing more than these values would have a benefit/cost ratio less than 1, they may still be justified according to a multi-objective approach which considers other criteria in addition to economic feasibility. Flood management measures are considered on a multi-objective basis in **Chapter 4**.

2.6 Impact of Flooding on Vulnerable Development and Critical Infrastructure

Figures 2.9 (2 sheets) and **2.10** show the location of vulnerable development and critical infrastructure relative to the extent of the inundation resulting from the assessed flood events at Ariah Park and Springdale, respectively, while **Tables 2.5** and **2.6** over set out the frequency of floods which would impact this type of development/infrastructure in the two urban centres.[2]

While the telephone tower that is located on Coolamon Street in Ariah Park is located on land which is impacted by storms that are more intense than about 20% AEP, the electricity substation that is located on Barnes Street impacted by storms that are more intense than 0.2% AEP.

Burley Griffin Way is inundated to the east of its intersection with Mary Gilmore Way storms that are more frequent than 20% AEP. Similarly, Mary Gilmore Way/Coolamon Street is inundated at several locations where it runs to the north of Burley Griffin Way during storms that are more frequent than 20% AEP, with the main crossing of Mirrool Creek inundated by floodwater during storms as frequent as 5% AEP.

Burley Griffin Way at Springdale is inundated by floodwater in the vicinity of its intersection with Railway Street during storms that are more frequent than 20% AEP and as mentioned in **Section 2.4.2** of this report, would reach a maximum depth of about 700 mm in a 1% AEP storm event.

While the Rural Fire Service Station at Ariah Park is impact by storms that are more intense than about 20% AEP, the Police Station is located off the floodplain. Similarly, the Rural Fire Service Station and Evacuation Centre at Springdale are also located off the floodplain.

While the Ariah Park Central School is located off the floodplain, the Ariah Park Preschool and camping ground are impact by storms that are more intense than 0.2% AEP.

2.7 Potential Impacts of a Change in Hydraulic Roughness

An analysis was undertaken as part of the *Flood Study* to assess the sensitivity of flood behaviour to potential changes in hydraulic roughness. **Figures 2.11** (2 sheets) and **2.12** show the impact that a 20% increase in the "best estimate" hydraulic roughness values would have on flood behaviour at Ariah Park and Springdale, respectively for a 1% AEP flood event.[3]

The typical increase in peak flood levels in the areas subject to Main Stream Flooding are generally in the range 20 to 200 mm, with increases of up to 220 mm at Ariah Park and up to 80 mm at Springdale. Increases in peak flood levels along the tributary arms of the watercourses at the two villages and in areas subject to Major Overland Flow are generally in the range 10 to 30 mm.

[2] Critical infrastructure has been split into two categories; community assets and emergency services.

[3] The impact that a change in hydraulic roughness has on flood behaviour is presented as "afflux", which is a measure of the difference in peak flood levels relative to baseline conditions.

TABLE 2.5
IMPACT OF FLOODING ON VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE LOCATED AT ARIAH PARK(1)

Type	Development/Structure	Location Identifier	Design Flood Event							
			20% AEP	10% AEP	5%AEP	2% AEP	1% AEP	0.5%	0.2%	PMF
Community Assets	Major Road Crossing (Burley Griffin Way)	RC1	NF	F	F	F	F	F	F	F
	Major Road Crossing (Burley Griffin Way)	RC2	F	F	F	F	F	F	F	F
	Major Road Crossing (Burley Griffin Way)	RC3	F	F	F	F	F	F	F	F
	Major Road Crossing (Burley Griffin Way)	RC4	F	F	F	F	F	F	F	F
	Major Road Crossing (Coolamon Street)	RC5	F	F	F	F	F	F	F	F
	Major Road Crossing (Mirrool Creek at Mary Gilmore Way)	RC6	NF	NF	F	F	F	F	F	F
	Temora Roto Railway (50m to the East of Coolamon Street)	R1	F	F	F	F	F	F	F	F
	Temora Roto Railway (Ariah Park Railway Culvert No. 5)	R2	F	F	F	F	F	F	F	F
	Electricity Substation	-	NF	NF	NF	NF	NF	NF	NF	F
	Telephone Exchange	-	NF	F	F	F	F	F	F	F
Emergency Services	Police Station	-	NF	NF	NF	NF	NF	NF	NF	NF
	RFS Station (Ariah Park Rural Fire Brigade)	-	F	F	F	F	F	F	F	F

Refer over for footnotes to table

TABLE 2.5 (Cont'd)
IMPACT OF FLOODING ON VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE LOCATED AT ARIAH PARK(1)

Type	Development/Structure	Location Identifier	Design Flood Event							
			20% AEP	10% AEP	5%AEP	2% AEP	1% AEP	0.5%	0.2%	PMF
Vulnerable Development	Caravan Park (Ariah Park Camping Ground)	-	NF	NF	NF	NF	NF	NF	NF	F
	Educational Facility (Ariah Park Central School)	EF1	NF	NF	NF	NF	NF	NF	NF	NF
	Educational Facility (Ariah Park Preschool)	EF2	NF	NF	NF	NF	NF	NF	NF	F

1. Refer **Figure 2.9** (2 sheets) for location of vulnerable development and critical infrastructure.
   "NF" = Infrastructure not impacted by flooding.
   "F" = Infrastructure impacted by flooding.

TABLE 2.6
IMPACT OF FLOODING ON VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE LOCATED AT SPRINGDALE(1)

Type	Development/Structure	Location Identifier	Design Flood Event							
			20% AEP	10% AEP	5%AEP	2% AEP	1% AEP	0.5%	0.2%	PMF
Community Assets	Major Road Crossing (Gundibindyal Creek at Burley Griffin Way)	RC7	F	F	F	F	F	F	F	F
	Cootamundra Lake Cargelligo Railway (Springdale Railway Culvert No. 3)	R3	NF	NF	NF	F	F	F	F	F
Emergency Services	Evacuation Centre (Springdale Hall)	EC	NF	NF	NF	NF	NF	NF	NF	NF
	RFS Station (Springdale Rural Fire Brigade)	RFS2	NF	NF	NF	NF	NF	NF	NF	NF

1. Refer **Figure 2.10** for location of vulnerable development and critical infrastructure.
   "NF" = Infrastructure not impacted by flooding.
   "F" = Infrastructure impacted by flooding.

2.8 Potential Impacts of a Partial Blockage of Hydraulic Structures

The mechanism and geometrical characteristics of blockages in hydraulic structures and piped drainage systems are difficult to quantify due to a lack of recorded data and would no doubt be different for each system and also vary with flood events. Realistic scenarios would be limited to waterway openings becoming partially blocked during a flood event (no quantitative data are available on instances of blockage of the drainage systems which may have occurred during historic flood events).

A blockage assessment was undertaken at the two urban centres as part of the *Flood Study* based on the procedures set out in ARR, 2019. **Figures 2.13** (2 sheets) and **2.14** show the impact that a partial blockage of the hydraulic structures would have on flood behaviour at Ariah Park and Springdale, respectively for a 1% AEP storm event.

The *Flood Study* found that a partial blockage of the railway culverts at Ariah Park would have a negligible impact on flood behaviour as these structures only convey a small portion of the total flow when operating at full capacity. The *Flood Study* also found that the effects of blockage at Springdale are greatest immediately upstream of the Cootamundra-Lake Cargelligo railway line where peak flood levels would increase by about 100 mm, 40 mm and 500 mm in the vicinity of the trapped low point at Springdale Railway Culvert Nos. 1, 3 and 5, respectively. The partial blockage of the railway culverts reduces peak flood levels immediately downstream of the railway embankment by up to 100 mm.

2.9 Potential Impacts of Future Urbanisation

Future urbanisation has the potential to increase the rate and volume of runoff conveyed by the various watercourses, as well as increase the frequency of surcharge of the local stormwater drainage system. It is also likely to result in changes to the existing drainage system. For example, while existing minor watercourses are likely to be retained and formalised in drainage reserves, piped drainage systems associated with urban subdivisions will result in significant amendments to existing overland flow paths leading to the watercourses.

While there is evidence that Council is requiring developers to incorporate flow control measures such as detention basins in residential subdivisions, infill development at an individual allotment scale has the potential to increase flow in the receiving drainage lines.

Figures 2.15 shows the impact that infill development could have on flood behaviour at Ariah Park for storms with intensities of 20% and 1% AEP, noting that there is limited opportunity for any meaningful infill development to occur at Springdale.[4] Note that the assessment undertaken as part of the present study is of a broad-scale and strategic nature, and that more detailed site-specific assessments would need to be undertaken as part of any future development.

Figure 2.15 shows that infill development of the nature assessed as part of the present investigation would have only a minor impact on flood behaviour. The reason for this is the confined nature of the land that is deemed to be developable, coupled with the relatively large flows which emanate from the catchment which lies to the south (upslope) of the village which are the dominate mechanism of flooding.

[4] It was assumed that the fraction impervious within developable land that is currently zoned *RU5- Village* was equal to a constant 80%.

2.10 Potential Impact of Railway Embankment Failure

An investigation was undertaken as part of the present investigation to assess the impact that a partial failure of the railway embankment at Springdale would have on flood behaviour at the 1% AEP level of flooding. The assessment assumed that the railway embankment would fail over a 10 m width centred on Springdale Railway Culvert No. 3 is located given this corresponds with the location where major overtopping occurs. The railway embankment was also assumed to fail over a 30 minute period once overtopping occurred.

The left-hand side of **Figure 2.16** shows the change in peak 1% AEP flood levels that would result from a partial failure of the rail embankment, while the right-hand side shows the resulting flood hazard vulnerability classification. Also shown on **Figure 2.16** is the location of residential dwellings that would experience above-floor inundation during a 1% AEP storm event, as well as the change in the depth of above-floor inundation in each.

The key findings of the investigation were as follows:

i. Peak 1% AEP flood levels upstream of the railway corridor would be reduced by a maximum of about 0.09 m.

ii. Peak 1% AEP flood levels would be increased by a maximum of about 0.3 m immediately downstream of the railway corridor, reducing to a maximum of about 0.1 m at Burley Griffin Way.

iii. Increases in peak 1% AEP flood levels of up to 0.1 m would extend for a significant distance downstream of Burley Griffin Way.

iv. The depth in above-floor inundation would be reduced by 0.09 m in two existing dwellings that are located upstream of the rail corridor.

v. The depth of above-floor inundation would be increased by a maximum of 0.17 m in an existing dwelling that is located on Railway Street and by a maximum 0.06 m in four existing dwellings that are located on the northern side of Burley Griffin Way.

vi. While the flood hazard would increase downstream of the breach in the railway embankment, extending to the northern side of Burley Griffin Way, it would not increase significantly in the immediate vicinity of the abovementioned flood affected dwellings.

2.11 Potential Impacts of Future Climate Change

DPE recommends that its guideline *Practical Consideration of Climate Change, 2007* be used as the basis for examining climate change in projects undertaken under the State Floodplain Management program and the *FDM, 2005*. The guideline recommends that until more work is completed in relation to the climate change impacts on rainfall intensities, sensitivity analyses should be undertaken based on increases in rainfall intensities ranging between 10 and 30 per cent.

On current projections the increase in rainfalls within the service life of developments or flood management measures is likely to be around 10 per cent, with the higher value of 30 per cent representing an upper limit which may apply near the end of the century. Under present day climatic conditions, increasing the 1% AEP design rainfall intensities by 10 per cent would produce about a 0.5% AEP flood; and increasing those rainfalls by 30 per cent would produce about a 0.2% AEP event.

For the purpose of undertaking both the *Flood Study* and the present study, the impact 10% and 30% increases in design 1% AEP rainfall intensities would have on flooding behaviour was assessed by comparing the peak flood levels which were derived from the flood modelling for design events with AEPs of 1, 0.5 and 0.2 per cent.

Figures 2.17 (2 sheets) and **2.18** show the increase in peak 1% AEP flood levels that would occur at Ariah Park and Springdale, respectively should rainfall intensities increase by 10% as a result of future climate change. The assessment found that increases in peak 1% AEP flood levels of between 150 to 400 mm would occur along Mirrool Creek at Ariah Park, while increases of up to 110 mm would occur along Gundibindyal Creek at Springdale. The assessment also found that Increases in peak flood levels of up to 60 mm would occur along Major Overland Flow paths in Ariah Park.

Figures 2.19 (2 sheets) and **2.20** show the increase in peak 1% AEP flood levels that would occur at Ariah Park and Springdale, respectively should rainfall intensities increase by 30% as a result of future climate change. The assessment found that peak 1% AEP flood levels would be increased by up to 680 mm and 220 mm along Mirrool Creek at Ariah Park and Gundibindyal Creek at Springdale, respectively, while increases in peak 1% AEP flood levels of up to 110 mm would occur along Major Overland Flow paths in Ariah Park.

Figures 2.21 (2 sheets) and **2.22** show the impact these potential changes would have on the extent of a 1% AEP flood event at Ariah Park and Springdale, respectively. The assessment found that the extent of land that is affected by floodwater increases significantly along both banks of Mirrool Creek at Ariah Park and on the right bank of Gundibindyal Creek about 1.5 km downstream of Burley Griffin Way. While outside the *RU-5-Village* zoned land at Springdale, it is noted that new flow paths form to the north and south of the village during storms more intense than 1% AEP.

2.12 Flood Hazard Vulnerability and Hydraulic Categorisation of the Floodplain

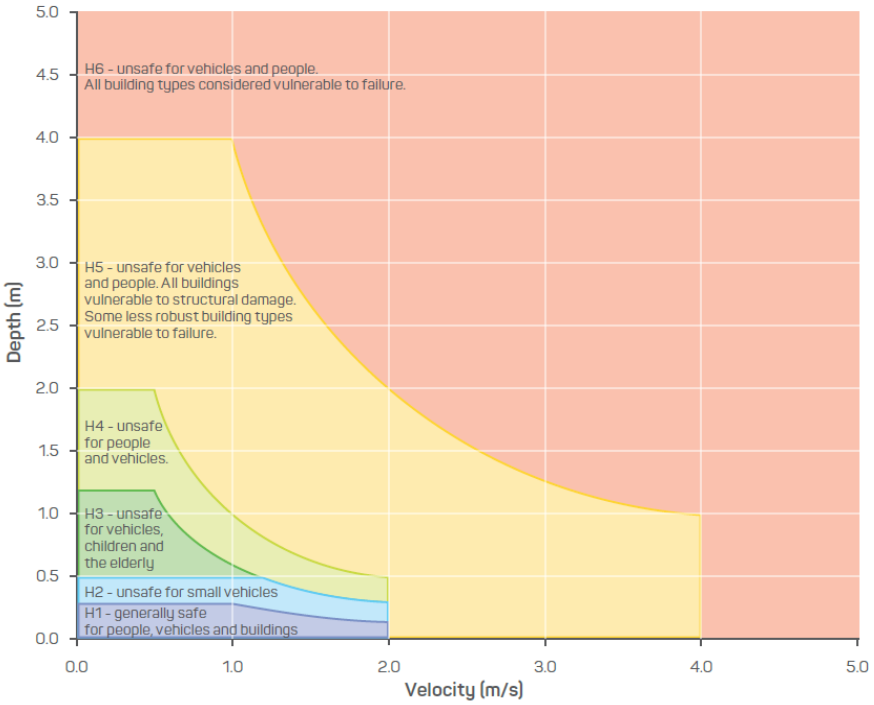
2.12.1 General

According to Appendix L of *NSWG, 2005*, in order to achieve effective and responsible floodplain risk management, it is necessary to divide the floodplain into areas that reflect:

1. The impact of flooding on existing and future development and people. To examine this impact it is necessary to divide the floodplain into *"flood hazard vulnerability"* categories, which are provisionally assessed on the basis of the velocity and depth of flow. This task was undertaken as part of the present study where the floodplain was divided six flood hazard vulnerability zones. **Section 2.12.2** below provides details of the procedure adopted.
2. The impact of future development activity on flood behaviour. Development in active flow paths (i.e. *"floodways"*) has the potential to adversely re-direct flows towards adjacent properties. Examination of this impact requires the division of flood prone land into various *"hydraulic categories"* to assess those parts which are effective for the conveyance of flow, where development may affect local flooding patterns. Hydraulic categorisation of the floodplain was also undertaken in the *Flood Study* and was reviewed and updated in this present study. **Section 2.12.3** below summarises the procedure adopted.

2.12.2 Flood Hazard Vulnerability Categorisation

Flood hazard categories may be assigned to flood affected areas in accordance with the definitions contained in the publication entitled "*Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*" (Australian Institute for Disaster Resilience (**AIDR**), 2017). Flood prone areas may be classified into six hazard categories based on the depth of inundation and flow velocity that relate to the vulnerability of the community when interacting with floodwater as shown in the illustration below which has been taken from AIDR, 2017.



Figures 2.23 (2 sheets) and **2.24** show the *Flood Hazard Vulnerability Classification* based on the procedures set out in AIDR, 2017 for the 1% AEP storm event at Ariah Park and Springdale, respectively, while **Figures 2.25** (2 sheets) and **2.26** show similar information at the two urban centres for the PMF event.

The *Flood Study* found that areas classified as H5 and H6 are generally limited to the inbank areas of the major watercourses and local farm dams that are scattered throughout the study catchments in a 1% AEP event. The Flood Study also identified that the floodwater that ponds along the southern (upslope) side of the Temora-Roto Railway at Ariah Park during a 1% AEP event is generally classified as H3 and H4.

The flooding that is experienced at the road crossings that are inundated in a 1% AEP event generally fall within the H1 category with the following exceptions:

Ariah Park

- H2 at Coolamon Street immediately south of the Temora Roto Railway;
- H2 along Ariah Street between Coolamon Street at Davidson Street;
- H2 along Back Ariah Park on the eastern side of its intersection with Little George Street;
- H2 at Davidson Street immediately south of the Temora-Roto Railway; and
- H5 at Mary Gilmore Way where it crosses Mirrool Creek.

Springdale

- H5 along Hauslers Road where it runs parallel to the Cootamundra-Lake Cargelligo Railway to the east of Springdam Road; and
- H5 at Burley Griffin Way west of its intersection with Railway Street.

Overland flow through the urbanised parts of Ariah Park is generally classified as either H1 or H2 in a 1% AEP event, except in the areas where floodwater ponds on the upstream side of roads where it is generally classified as either H3 or H4.

For the PMF event, the width of the H5 and H6 hazard zones increases significantly, mainly along the main arms of the creeks and their major tributaries. The hazard category along the majority of the remaining drainage lines increases to between H3 and H5 during a flood of this magnitude.

2.12.3 Hydraulic Categorisation of the Floodplain

According to the *FDM*, the floodplain may be subdivided into the following three hydraulic categories:

- Floodways;
- Flood storage; and
- Flood fringe.

Floodways are those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with obvious naturally defined channels. Floodways are the areas that, even if only partially blocked, would cause a significant re-distribution of flow, or a significant increase in flood level which may in turn adversely affect other areas. They are often, but not necessarily, areas with deeper flow or areas where higher velocities occur.

Flood storage areas are those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. If the capacity of a flood storage area is substantially reduced by, for example, the construction of levees or by landfill, flood levels in nearby areas may rise and the peak discharge downstream may be increased. Substantial reduction of the capacity of a flood storage area can also cause a significant redistribution of flood flows.

Flood fringe is the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.

Floodplain Risk Management Guideline No. 2 Floodway Definition, offers guidance in relation to two alternative procedures for identifying floodways. They are:

- **Approach A**. Using a *qualitative approach* which is based on the judgement of an experienced hydraulic engineer. In assessing whether or not the area under consideration was a floodway, the qualitative approach would need to consider; whether obstruction would divert water to other existing flow paths; or would have a significant impact on upstream flood levels during major flood events; or would adversely re-direct flows towards existing development.
- **Approach B**. Using the hydraulic model, in this case TUFLOW, to define the floodway based on *quantitative experiments* where flows are restricted or the conveyance capacity of the flow path reduced, until there was a significant effect on upstream flood levels and/or a diversion of flows to existing or new flow paths.

One quantitative experimental procedure commonly used is to progressively encroach across either floodplain towards the channel until the designated flood level has increased by a significant amount (for example 0.1 m) above the existing (un-encroached) flood levels. This indicates the limits of the hydraulic floodway since any further encroachment will intrude into that part of the floodplain necessary for the free flow of flood waters – that is, into the floodway.

The *quantitative assessment* associated with **Approach B** is technically difficult to implement. Restricting the flow to achieve the 0.1 m increase in flood levels can result in contradictory results, especially in unsteady flow modelling, with the restriction actually causing reductions in computed levels in some areas due to changes in the distribution of flows along the main drainage line.

Accordingly, the *qualitative approach* associated with **Approach A** was adopted, together with consideration of the portion of the floodplain which conveys approximately 80% of the total flow and also the findings of *Howells et al, 2004* who defined the floodway based on velocity of flow and depth. Based on the findings of a trial-and-error process, the following criteria were adopted for identifying those areas which operate as a "floodway" in a 1% AEP event:

- Velocity x Depth greater than 0.2 m^2/s **and** Velocity greater than 0.25 m/s; or
- Velocity greater than 1 m/s.

Flood storage areas are identified as those areas which do not operate as floodways in a 1% AEP event but where the depth of inundation exceeds 300 mm. The remainder of the flood affected area was classified as flood fringe.

Figures 2.27 (2 sheets) and **2.28** show the division of the floodplain into floodway, flood storage and flood fringe areas for the 1% AEP event at Ariah Park and Springdale, respectively.

As the hydraulic capacity of Mirrool Creek at Ariah Park and Gundibindyal Creek at Springdale is not large enough to convey the 1% AEP flow, a significant portion of the total flow is conveyed on the floodplain. As a result, areas which lie on the overbank area also function as a floodway during the 1% AEP flood event. Floodways are also present at the following locations:

- along the southern side of the Temora Roto Railway between Ariah Park Railway Culvert Nos. 1 and 6;
- along the eastern and western sides of Coolamon Street to the south of the Temora-Roto railway line;
- along the eastern and western sides of Coolamon Street and Mary Gilmore Way between the Temora-Roto railway line and Mirrool Creek; and
- on the northern side of Ariah Park Railway Culvert No. 1;
- along the southern side of Harrison Street and eastern side of Davidson Street.

As identified in **Section 2.11**, new flow paths also develop to the north and south of the village zoned land in Springdale during floods that are slightly more intense than 1% AEP, indicating increases in rainfall intensity associated with future climate change could result in newly flooded land.

Flood storage areas are confined to the major ponding areas which are located on the upstream side of the roads and railways, as well as in the local farm dams that have been constructed to capture surface runoff in different parts of the study area.

Figures 2.29 (2 sheets) and **2.30** show the division of the floodplain into floodway, flood storage and flood fringe areas for the PMF event at Ariah Park and Springdale, respectively.

The area to the east of Ashton Street south of the Temora-Rotor railway line generally functions as a floodway, while the whole of the currently urbanised area which lies to the north of the rail corridor functions as a floodway during a PMF event. The full width of the floodplain at Springdale effectively functions as a floodway during a PMF event.

2.13 Environmental Considerations

The main arms of Mirrool Creek at Ariah Park and Gundibindyal Creek at Springdale are largely in their natural state, with riparian vegetation present both within their inbank and on their immediate overbank areas.

While the relatively remote nature of Mirrool Creek means that the density of riparian vegetation does not impact flood behaviour in the urbanised parts of Ariah Park, several respondents to the Community Questionnaire expressed the view that the density of the riparian vegetation along the reach of channel which runs from Springdale Railway Culvert No. 3 to its confluence with Gundibindyal Creek has a significant impact on the conveyance capacity of the watercourse.

2.14 Council's Existing Planning Instruments and Policies

2.14.1 General

The *Temora Local Environmental Plan, 2010* (***Temora LEP 2010***) is the principal statutory planning document used by Council for controlling development by defining zoning provisions, establishing permissibility of land use and regulating the extent of development in the Temora Shire Council local government area.

The *Temora Shire Development Control Plan 2012* (***Temora Shire DCP 2012***) supplements *the Temora LEP 2010* by providing general information and detailed guidelines and controls which relate to the decision-making process.

2.14.2 Land Use Zoning – Temora Local Environmental Plan 2010

Figures 2.31 and **2.32** show the zonings that are incorporated in *Temora LEP 2010* for Ariah Park and Springdale, respectively. While the land-use zoning in the urban centre of Springdale solely comprises Village (RU5), the urban centre of Ariah Park comprises a combination of Village (RU5) and a small strip of Large Lot Residential (R5) which runs in a north-south direction along the western side of Davidson Street.

2.14.3 Flood Provisions – Temora Local Environmental Plan 2010

Clause 5.21 of *Temora LEP 2010* entitled "*Flood planning*" outlines its objectives in regard to development of land that is located within the extent of the FPA. Clause 5.21 was inserted into *Temora LEP 2010* by the NSW Government on 14 July 2021 and replaced clause 6.6 which was repealed at the time. Unlike the wording in repealed clause 6.6, the FPL is not defined in clause 5.21.

Clause 5.21 states that development consent must not be granted unless the consent authority is satisfied that the development:

(a) is compatible with the flood function and behaviour on the land, and

(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and

(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and

(d) incorporates appropriate measures to manage risk to life in the event of a flood, and

(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.

It also states that in deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters:

(a) the impact of the development on projected changes to flood behaviour as a result of climate change,

(b) the intended design and scale of buildings resulting from the development,

(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,

(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.

While the heading of clause 5.22 entitled "*Special flood considerations"* was inserted in *Temora LEP 2010* by the NSW Government on 14 July 2021, Council is awaiting the outcomes of the present study prior to making a decision on its possible adoption. It is noted that the new clause forms part of the updated *NSW Flood Prone Land Package* and has the following objectives:

- in relation to development with particular evacuation or emergency response issues (e.g. schools, group homes, residential care facilities, hospitals, etc.) to enable evacuation of land which lies above the FPL; and
- to protect the operational capacity of emergency response facilities and critical infrastructure during extreme flood events.

The new clause would apply to land that lies outside the FPA but within the extent of the PMF. The form of wording that would comprise Clause 5.22 is set out in **Section 3.5.1.4**.

While clause 6.6 has been repealed, the flood planning maps that are referenced in the clause are still contained in the *Temora LEP 2010*. While the flood planning maps show the extent of the FPA in Springdale, it is generally limited to the inbank area of Gundibindyal Creek and its unnamed tributary immediately downstream of the Cootamundra-Lake Cargelligo railway line. There is no flood planning map covering Ariah Park.

The source of the information that was relied upon for defining the extent of the FPA on the flood planning maps is not known and appears to be limited in its detail. It is recommended that these maps be removed from the *Temora LEP 2010* and updated flood mapping based on the findings of the *Flood Study* be incorporated in the *Temora Shire DCP 2012*.

2.14.4 Flood Related Development Controls

The *"Flood Prone Land"* sub-section of Section C of the *Temora Shire DCP 2012* sets out the controls that apply to development of land to which the now repealed clause 6.6 of *Temora LEP 2010* applied.[5] The stated objectives of the chapter are:

- *Provide development standards on land that is identified or is likely to be liable to flooding*
- *Reduce private and public losses resulting from flooding*
- *Minimise the risk to life and property during periods of flooding*

While the *Temora Shire DCP 2012* does not contain maps showing the extent of flood prone land, it makes reference to the flood planning maps in the *Temora LEP 2010* which identify known areas of flooding in urban areas. The *Temora Shire DCP 2012* also identifies the "local short-term flooding" can occur in Springdale. Recommendations relating to the update of the approach set out in *Temora DCP 2012* are set out in **Section 3.5.1.4**, while **Appendix C** of this report contains suggested wording for incorporation into the document.

2.15 Flood Warning and Flood Preparedness

The NSW SES is nominated as the principal combat and response agency for flood emergencies in NSW. NSW SES is responsible for the issuing of relevant warnings (in collaboration with BoM), as well as ensuring that the community is aware of the flood threat and how to mitigate its impact.

The *Temora Shire Local Flood Plan* which is dated December 2015 covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures for all levels of flooding within the Temora Shire local government area. *Temora Shire Local Flood Plan* is administered by the Temora Local Commander[6] who controls flood operations within the Temora Shire area. NSW SES maintains a local headquarters at No. 106 Vesper Street, Temora.

Volume 1 of *Temora Shire Local Flood Plan* entitled '*Temora Shire Flood Emergency Sub Plan*' includes sections on flood preparedness, response and recovery. Volume 1 follows the standard NSW SES template and is divided into the following sections:

- ***Introduction****;* this section of the document identifies the responsibilities of the NSW SES Local Commander and NSW SES members and supporting services such as the Police, BoM, Ambulance, Fire Brigades, Council, etc. It also identifies the importance for NSW SES and Council to coordinate the development and implementation of a public education program to advise the population of the flood risk.
- ***Preparedness****;* this section of the document deals with activities required to ensure the *Temora Shire Local Flood Plan* functions during the occurrence of the flood emergency. It also devotes considerable attention to flood alertness and emergency response.

[5] Clause 6.6 stated that the requirements of the clause related to land that is located at or below the FPL, which was denoted therein as the 1% AEP flood level plus 0.5 m freeboard.

[6] It is noted that the *Temora Shire Local Flood Plan* refers to the "Temora Local Controller" who has now been given the title "Temora Local Commander".

- ***Response***; The NSW SES maintains an operation centre at the Local NSW SES Headquarters at No. 106 Vesper Street. Response operations will commence: on receipt of a BoM Preliminary Flood Warning, Flood Warning, Flood Watch, Severe Thunderstorm Warning or a Severe Weather Warning for flash flooding; or when other evidence leads to an expectation of flooding within the council area.
- ***Recovery****,* involving measures to ensure the long term welfare for people who have been evacuated, recovery operations to restore services and clean up and de-briefing of emergency management personnel to review the effectiveness of the *Temora Shire Local Flood Plan.*

Annex A in Volume 2 of the *Temora Shire Local Flood Plan* deals with the existing flood risk in the Temora Shire area. The document states that warning times are invariably short in the Temora Shire, often in the order of a few hours at most.

Annex A states that at least six dwellings are prone to flooding when Gundibindyal Creek breaks its banks at Springdale. It also states that Burley Griffin Way may experience inundation where it runs through the village. In regards Ariah Park, Annex A states that inundation can occur within the village due to stormwater drainage outflows which can lead to minor flooding.

The document identifies the following storm events that caused flooding in the Temora Shire:

Date	Rainfall Recorded at Temora	Rainfall Recorded at Cootamundra
26 April 1964	111.3 mm in 24 hours	23.1 mm in 24 hours
11 January 1974	105.2 mm in 24 hours	125.2 mm in 24 hours
11 April 1974	100.5 mm in 48 hours	173.8 mm in 120 hours
26 January 1984	100.6 mm in 24 hours	66.2 mm in 24 hours

3 POTENTIAL FLOOD RISK MANAGEMENT MEASURES

3.1 Range of Available Measures

A variety of floodplain risk management measures can be implemented to reduce flood damages. They may be divided into three categories, as follows:

Flood modification measures change the behaviour of floods in regard to discharges and water surface levels to reduce flood risk. This can be done by the construction of levees, detention basins, channel improvements and upgrades of piped drainage systems in urban areas. Such measures are also known as "structural" options as they involve the construction of engineering works. Vegetation management is also classified as a flood modification measure.

Property modification measures reduce risk to properties through appropriate land use zoning, specifying minimum floor levels for new developments, voluntary purchase of residential property in high hazard areas, or raising existing residences in the less hazardous areas. Such options are largely planning (i.e. "non-structural") measures, as they are aimed at ensuring that the use of floodplains and the design of buildings are consistent with flood risk. Property modification measures could comprise a mix of structural and non-structural methods of damage minimisation to individual properties.

Response modification measures change the response of flood affected communities to the flood risk by increasing flood awareness, implementation of a flood warning system and the development of an emergency response plan for property evacuation.

3.2 Community Views

Comments on potential floodplain risk management measures were by way of the *Community Questionnaire*, which was distributed at the commencement of the study. The responses are summarised in **Appendix A** of this report. Question 8 in the *Community Questionnaire* outlined a range of potential flood management options and asked whether each respondent was in favour of the individual option or not. **Table 3.1** over the page sets out the responses that were received to Question 8 from both the Ariah Park and Springdale communities.

Based on the community's response to Question 8, as well as several written responses which were attached to the *Community Questionnaire*, the Ariah Park community strongly favoured the upgrade of the existing stormwater drainage system and the road/rail culverts, while the Springdale community strongly favoured the management of riparian vegetation and the removal of floodplain obstructions. Of the various non-structural measures, both the Ariah Park and Springdale communities were strongly in favour of the following measures:

- Flood related controls over future development in flood liable areas
- Advice of flood affectation via Planning Certificates for properties located within the *Flood Planning Area*
- Improved flood warning, evacuation and flood response procedures

TABLE 3.1
COMMUNITY VIEWS ON POTENTIAL FLOOD RISK MANAGEMENT MEASURES

Flood Management Measure	Classification	Respondent's Views								
		Ariah Park			Springdale			Unknown Address		
		Yes	No	Don't Know	Yes	No	Don't Know	Yes	No	Don't Know
Management of vegetation along creek corridors to provide flood mitigation, stability, aesthetic and habitat benefits	Flood Modification Measure	9	1	2	4	0	0	2	0	1
Widening of watercourses		6	4	1	2	1	0	2	1	0
Construct detention basins		3	3	4	1	1	1	3	0	0
Construction of permanent levees/diversion banks to contain floodwaters		8	1	1	3	0	0	3	0	0
Improve stormwater drainage system		11	1	0	3	0	0	3	0	0
Upgrade culverts beneath roads/railways		11	0	0	3	0	0	3	0	0
Removal of floodplain obstructions		8	0	2	2	0	1	0	2	1
Voluntary purchase of the most severely affected flood-liable properties	Property Modification Measure	3	6	2	2	1	1	1	1	1
Provide funding or subsidies to raise houses above major flood level in low hazard areas.		3	7	2	3	1	0	3	0	0
Flood proofing of individual properties by waterproofing walls, putting shutters across doors, etc.		1	8	2	1	2	0	2	0	1
Specify controls on future development in flood-liable areas (e.g. controls on extent of filling, minimum floor levels, etc.)		11	1	1	3	1	0	3	0	0
Provide a Planning Certificate to purchasers in flood prone areas, stating that the property is flood affected.		9	2	1	4	0	0	2	0	1
Ensuring all information about the potential risks of flooding is available to all residents and business owners		10	0	2	4	0	0	3	0	0

Cont'd Over

TABLE 3.1 Cont'd
COMMUNITY VIEWS ON POTENTIAL FLOOD RISK MANAGEMENT MEASURES

Flood Management Measure	Classification	Respondent's Views								
		Ariah Park			Springdale			Unknown Address		
		Yes	No	Don't Know	Yes	No	Don't Know	Yes	No	Don't Know
Improve flood warning and evacuation procedures both before and during a flood.	Response Modification Measure	9	0	2	3	0	0	3	0	0
Community education, participation and flood awareness programs.		5	2	4	2	1	0	3	0	0
Ensuring all residents and business owners have Flood Action Plans		6	2	4	3	0	0	3	0	0

3.3 Outline of Chapter

A range of potential flood management measures were examined at the strategic level of detail and where appropriate, tested for feasibility on a range of assessment criteria in **Chapter 4**. Following consideration of the results by the FRMC, selected measures were included in the *Ariah Park and Springdale FRMP* in **Chapter 5**.

The assessment of potential flood modification measures was limited to the upgrade of the existing stormwater drainage system at Ariah Park in the vicinity of the Temora-Roto railway line and the widening of Gundibindyal Creek and its tributary arm where they run to the north of the Cootamundra-Lake Cargelligo railway line.

The property modification measures considered as part of this study include controls over future development, voluntary purchase of residential properties and house raising. Response modification measures such as improvements to emergency planning and responses and public awareness programs have also been considered for Ariah Park and Springdale.

3.4 Flood Modification Measures

3.4.1 Ariah Park

As the primary mechanism of damaging flooding in Ariah Park is the conveyance of major overland flow through the urbanised parts of the village combined with the ponding of floodwater along the southern (upslope) side of the Temora-Roto railway line, a trunk drainage upgrade scheme (**Ariah Park Trunk Drainage Upgrade Scheme**) comprising the following key elements was assessed as part of the present investigation:

- Enlarging of the roadside table drains which run along the southern side of Back Ariah Park Road, extending south along both sides of George Street.
- Provision of a new 1200 mm wide by 600 mm high reinforced concrete box culvert (**RCBC**) across Back Ariah Park Road, the inlet of which would be located on the western side of Little George Street.
- Provision of two new 3000 mm wide by 600 mm high RCBCs across Back Ariah Park Road, the inlets of which would be located on the eastern side of Little George Street.
- Enlarging of the existing channel which runs north from Back Ariah Park Road and then west along the southern side of the Temora-Roto railway line to Coolamon Street.
- Provision of five new 3600 mm wide by 900 mm high RCBCs across Coolamon Street in combination with the raising of the road a short distance to the south of the level crossing.
- The removal of the two sets of minor transverse drainage pipes which cross the rail corridor either side of the Coolamon Street level crossing.
- The construction of a new channel extending west of Coolamon Street to a location where six new 3600 mm wide by 900 mm high RCBCs would be cross the Temora-Roto railway line.
- The construction of a new channel which would run parallel with the Temora Roto railway line along its northern side in combination with a containment bund which would run along the northern side of the new channel. The new channel and containment bund would extend west as far as the railway dam that is located on the eastern side of Cemetery Road.

- The construction of a tail-out channel which would run from the railway dam along the northern side of Mirrool Road where it would tie into natural surface levels adjacent to an existing farm dam. A short length of containment bund would also be required along the northern side of the channel extending from the railway dam to Cemetery Road.
- The construction of a concrete causeway where the aforementioned tail-out channel crosses Cemetery Road.

Figure 3.1, sheet 1 shows the location of the key features described above.

Opportunities for extending the scheme to the south of Back Ariah Park Road were assessed as part of the present investigation. However, due to constraints such as the relatively flat nature of the area, the presence of existing power poles in the road reserve and limited open space areas, meant that sufficient waterway area in a series of roadside table drains and transverse drainage culverts could not be provided to control the relatively large flow which is generated by the catchment which lies to the south (upslope) of the village.

Figure 3.1, sheets 2, 3 and 4 show the impact that the implementation of the Ariah Park Trunk Drainage Upgrade Scheme would have on floods with AEPs of 20%, 5% and 1%. By inspection, the scheme reduces the severity of local catchment flooding on the southern side of the rail corridor for the more frequent storm events, while it would generally remove flooding from areas to the north of the corridor and east of Cemetery Road for all storms up to 5% AEP in intensity and significantly reduce both the extent and depth of inundation in the same area for storms of between 5% and 1% AEP in intensity.

While the concentration of flow to the west of Cemetery Road would resulting in a minor increase in both the extent and depth of inundation for all storms up to 1% AEP in intensity, the area that is impacted is presently zoned *RU1 – Primary Production* and is used for farming purposes. There are also no buildings located in the area which would be impacted by the increase in the extent and depth of inundation that is attributable to the scheme.

Table 3.2 over the page sets out the indicative costs associated with constructing the key components elements of the Ariah Park Trunk Drainage Upgrade Scheme, noting that a more detailed breakdown of the amounts set out in the table was reviewed and agreed to by Council.

The property database that was developed as part of the *Flood Study* was used to assess the reduction in flood damages that would result from the implementation of the scheme over the full range of potential flood events up to the PMF. Based on the findings of the analysis, the *Present Worth Value* of flood damages that would be saved through the implementation of the scheme is estimated to be about $1.0 Million, resulting in a benefit/cost ratio of about 0.21.

While the benefit/cost ratio of the scheme is less than 1, indicating that it cannot be justified on economic grounds, the implementation of the scheme would remove relatively frequent and in places long-duration flooding from the centre of the village, as well as partially remove flooding from future developable areas to the north of the rail corridor. The scheme would also limit the frequency and duration Coolamon Street is inundated by floodwater, thereby reducing the time that the road would be cut by floodwater. Given the relatively large social benefits that the scheme provides for the residents and business owners of Ariah Park, it has been recommended for inclusion in the *Ariah Park & Springdale FRMP*.

TABLE 3.2
ESTIMATED COST OF ARIAH PARK TRUNK DRAINAGE UPGRADE SCHEME

Key Component	Estimated Costs
General Items	$115,500
Site Preparation	$443,300
Culvert Works	$2,107,616
Channel Works	$226,881
Road Reinstatement Works	$251,108
Sub-total	**$3,144,404**
30% Contingency for Un-estimated Costs	$943,321
Sub-total	**$4,087,726**
15% Survey, Investigation and Design	$613,159
TOTAL ESTIMATED COST (Excluding GST)	**$4,700,885**

3.4.2 Springdale

As the primary mechanism of damaging flooding in Springdale is the surcharge of Gundibindyal Creek and its tributary arm where they run through the village, a trunk drainage upgrade scheme (**Springdale Trunk Drainage Upgrade Scheme**) comprising the following key elements was assessed as part of the present investigation:

- Replacement of the three existing 2100 mm wide by 600 mm high RCBCs beneath the Cootamundra-Lake Cargelligo railway line with four new 3600 mm wide by 2100 mm high RCBCs.
- Clear the existing vegetation and enlarge the cross-sectional area of the tributary arm where it runs between the railway corridor and Burley Griffin Way.
- Replacement of the two existing 1500 mm wide by 900 mm high RCBCs beneath the Cootamundra-Lake Cargelligo railway line with four new 3600 mm wide by 1200 mm high RCBCs.
- Clear the existing vegetation and enlarge the cross-sectional area of the tributary arm where it runs north of Burley Griffin Way.
- Clear the existing vegetation and enlarge the cross-sectional area of the Gundibindyal Creek over a distance of about 100 m downstream of its confluence with its tributary arm.
- Replacement of the two existing 1500 mm wide by 600 mm high RCBCs beneath the Burley Griffin Way on Gundibindyal Creek with two new 3600 mm wide by 750 mm high RCBCs.

Figure 3.2, sheet 1 shows the location of the key features described above.

Figure 3.2, sheets 1 and 2 show the impact that the implementation of the Springdale Trunk Drainage Upgrade Scheme would have on floods with AEPs of 20%, 5% and 1%. While the scheme reduces the severity of flooding both upstream and downstream of the Cootamundra-Lake Cargelligo railway line in areas zoned *RU5 -Village* for all storms up to 1% AEP in intensity, it does not remove flooding from the worst affect property that is located on the eastern overbank of Gundibindyal Creek downstream of Burley Griffin Way.

The implementation of the scheme would remove above-floor inundation from the three dwellings that are presently impacted at the 2% AEP level of flooding (two of which are located on the southern (upstream) side of the Cootamundra-Lake Cargelligo railway line) and reduce the number of dwellings that would experience above-floor inundation during a 1% AEP flood event from seven to two (the remaining two being located on the eastern overbank of Gundibindyal Creek to the north of the *RU5-Village* zoned land). The Present Worth Value of flood damages saved through the implementation of the scheme would be about $0.2M.

By inspection, the cost of the Springdale Trunk Drainage Upgrade Scheme would be significant compared to the economic benefits that it would provide, thereby resulting in a very low benefit/cost ratio. Given the depths of above-floor inundation in existing residential development that is located on the northern (downstream) side of the rail corridor on *RU5-Village* zoned land is no greater than 0.16 m during a 1% AEP storm event, the removal of damaging flooding during relatively rare flood events cannot be justified on both economic and social grounds.

While the implementation of the scheme would reduce the flood hazard in existing residential properties that are located both upstream and downstream of the rail corridor, of greater merit would be the removal of existing residential development that is located in floodway areas and the implementation of an effective flood warning system. **Sections 3.4.4** and **3.6.1** of this report respectively contain further discussion on the merits of implementing a Voluntary Purchase Scheme and flood warning system for Springdale.

For the reasons outlined above, the implementation of the Springdale Trunk Drainage Upgrade Scheme has not been recommended for inclusion in the *Ariah Park & Springdale FRMP*.

3.4.1 Vegetation Management

Management programs in creeks typically involve maintenance of batters, the removal of sediment, removal of dense vegetation and the clearance of flood debris after significant flow events. Clearance of debris within the stream corridor reduces the potential for future capture by the flow and blockage of culverts.

While not relevant for Ariah Park, there is merit in reducing the density of riparian vegetation that is present in Gundibindyal Creek and its tributary arm where they run through the village of Springdale, as this would reduce the frequency flow surcharges the inbank area of the watercourse. It would also reduce the risk that the culverts under Burley Griffin Way experience a blockage by debris during a flood event. For this reason, the development and implementation of a *Vegetation Management Plan* for Gundibindyal Creek and its tributary arm where they run through the village of Springdale has been included in the *Ariah Park and Springdale FRMP*.

3.5 Property Modification Measures

3.5.1 Controls over Future Development

3.5.1.1 Current Government Policy

The NSW Government has recently finalised reforms of the *NSW Flood Prone Land Package*. As part of the reform, the wording in the flood planning clause of all NSW Councils was updated on 14 July 2021. As part of the reform, Council will need to nominate the FPL or levels that it wishes to define the FPA and make alternative arrangements for making flood planning maps publicly available where previously solely reliant on LEP flood overlay maps. While the reforms also included an optional clause titled *special flood considerations* which applies to land which lies between the FPA and the extent of the PMF, Council made the decision to await the outcomes of the present study before including it in *Temora LEP 2010*.

3.5.1.2 Considerations for Setting Freeboard Requirements

Selection of the FPL for an area is an important and fundamental decision as the standard is the reference point for the preparation of floodplain risk management plans. It is based on the adoption of the peak level reached by a particular flood plus an appropriate allowance for freeboard. It involves balancing social, economic and ecological considerations against the consequences of flooding, with a view to minimising the potential for property damage and the risk to life and limb. If the adopted FPL is too low, new development in areas outside the FPA (particularly where the difference in level is not great) may be inundated relatively frequently and damage to associated public services will be greater. Alternatively, adoption of an excessively high FPL will subject land that is rarely flooded to unwarranted controls. Councils are responsible for determining the appropriate FPLs within their local government area.

Freeboard provides reasonable certainty that the risk exposure selected in deciding on a particular flood is actually provided. It is a factor of safety typically used in relation to the setting of floor levels, levee crest and basement entrance levels, etc. Design variables that are typically incorporated in the derivation of freeboard typically comprise the following:

- increases in peak flood levels due to wind and wave action;
- uncertainties in the design flood level estimates due to the confidence limits associated with the design peak flow estimates for Narromine, inaccuracies in the LiDAR survey data and possible variations in key parameters such as hydraulic roughness; and
- increases in peak flood levels due to future climate change.

Table 3.1 provides a summary of a joint probability analysis which was undertaken to assess the freeboard allowance which should be incorporated in the FPL for areas at Ariah Park and Springdale that are affected by Main Stream Flooding, noting the methodology for deriving the various components of the freeboard allowance is based on the approach set out in *"Wagga Wagga Levee Upgrade – Flood Freeboard"* (Public Works (**PW**), 2010).

TABLE 3.1
SUMMARY OF FREEBOARD ANALYSIS
AREAS AFFECTED BY MAIN STREAM FLOODING

Design Variable	Probability of Occurrence	Maximum Allowance (m)		Joint Probability Allowance (m)	
		Ariah Park	Springdale	Ariah Park	Springdale
Wave Action	50%	0.18(1)	0.30(2)	0.09	0.15
Inaccuracies in Peak 1% AEP Flood Level Estimate					
- LiDAR survey data	100%	0.15	0.15	0.15	0.15
- Peak flow estimate	50%	0.40	0.10	0.20	0.05
- Hydraulic roughness	25%	0.20	0.08	0.10	0.04
Future Climate Change	50%	0.40	0.10	0.20	0.05
			TOTAL	**0.74**	**0.44**

1. Based on wind driven wave action
2. Based on vehicle driven wave action

The maximum allowance for uncertainties in the peak 1% AEP flood level estimate is comprised of the following

- inaccuracies in the LiDAR survey data;
- provision for a 10% increase in the best-estimate peak 1% AEP flow derived by comparison with the increase in peak flood levels associated with a 0.5% AEP flood event; and
- increase in peak flood levels associated with a possible 20% increase in the best-estimate hydraulic roughness values.

In regards the potential impacts of future climate change on flood behaviour at Ariah Park and Springdale, the *ARR Data Hub* gives the following interim climate change factors for Representative Concentration Pathways (**RCPs**) of 4.5 and 8.5 in the years 2050 and 2090:

Year	RCP 4.5	RCP 8.5
2050	6.3%	8.8%
2090	9.2%	20.2%

A flood with an AEP of 0.5% is commonly considered to be analogous to a flood that would result from a 10% increase in 1% AEP rainfall intensities. By comparison with the interim climate change factors, the adoption of the 0.5% AEP would provide a reasonable indicator of the potential for future climate change to impact peak 1% AEP flood levels at Ariah Park and Springdale.

While the joint probability analysis set out in **Table 3.1** indicates a freeboard slightly greater than the traditional value of 0.5 m would be appropriate in areas that are affected by Main Stream Flooding at Ariah Park, given a relatively large portion of this relates to the potential impacts of future climate change, the exact nature of which cannot yet be determined, it is considered

reasonable to adopt a freeboard of 0.5 m for setting the FPL in areas affected by Main Stream Flooding at Ariah Park. While the joint probability analysis indicates a slightly reduced freeboard value could be adopted for Springdale, it is recommended that the traditional value of 0.5 m be adopted, noting that this also provides consistency in the definition of the FPA in the two urban centres.

While the flood range in the major watercourses which traverse the study area is such that the traditional 0.5 m freeboard is appropriate for setting the FPL, its adoption in areas affected by Major Overland Flow would lead to the FPA extending onto land which would not experience damaging or hazardous flooding during a 1% AEP storm event, even allowing for all the variables which comprise freeboard.

Considerable reduction in the number of properties in Major Overland Flow areas classified as "flood affected" would result by the adoption of a threshold depth of inundation under 1% AEP conditions of 0.1 m as the criterion for defining area which would be subject to the majority of flood related development controls, compared with the traditional approach. Properties with depths of inundation 0.1 m or greater, or in a floodway (i.e. traversed by significant overland flows which may in some cases be less than 0.1 m in depth) would therefore be considered to lie within the FPA. Properties with depths of inundation under 1% AEP non-floodway conditions of less than 0.1 m would be classified as "Local Drainage" and, as such would be subject to controls such as the Building Code of Australia (**BCA**) requirements, rather than attracting a flood affectation notice. This approach is supported by NSWG, 2005 and would not adversely impact on Council's duty of care in regard to management of flood prone lands. The proposed categorisation of the floodplain, terminology and controls are shown on **Table 3.2**.

TABLE 3.2
PROPOSED CATEGORISATION OF THE FLOODPLAIN

Category (FDM, 2005)	Proposed Terminology used to define inundation in the *Ariah Park and Springdale FRMS&P* report	Are Development Controls Required?	Is Section S10.7 Notification Warranted?
Main Stream Flooding	"Main Stream Flooding"	Yes	Yes
Local Overland Flooding			
- Local Drainage	"Local Drainage"	No (ref. footnote 1).	No (ref footnote 1)
- Major Drainage	"Major Overland Flow"	Yes (ref. footnote 2).	Yes (ref footnote 3)

1. Inundation in Local Drainage areas is accommodated by the minimum floor level requirement of 0.15 m above finished surface level contained in the BCA and does not warrant a flood affectation notice in S10.7 Planning Certificates.
2. These are the deeper flooded areas with higher flow velocities. Development controls are specified in **Appendix C**.
3. Depth and velocity of inundation in Major Overland Flow areas are sufficient to warrant a flood affectation notice in S10.7 Planning Certificates. Inundation is classified as "flooding".

Figures C1.1 and **C1.2** in **Appendix C** are extracts from the *Flood Planning Map* at Ariah Park and Springdale, respectively. The figures include areas subject to both Main Stream Flooding and Major Overland Flow. The extent of the FPA (the area subject to flood related development controls) is shown in a solid mauve (Main Stream Flooding) and green (Major Overland Flow) colour in **Figures C1.1** and **C1.2**, and has been defined as follows:

- In areas subject to Main Stream Flooding, the FPA is based on the traditional definition of the area that lies at or below by the 1% AEP plus 0.5 m freeboard.

- In areas subject to Major Overland Flow, the FPA is defined as the extent of areas which act as a floodway, as well as areas where depths of inundation exceed 0.1 m in a 1% AEP event.

Also shown in **Figures C1.1** and **C1.2** is the extent of the *Special Flood Considerations Zone*, which is defined as land which lies between the extent of the FPA and PMF.

3.5.1.3 Proposed Planning Controls for Ariah Park and Springdale

While *Temora Shire DCP 2012* contains a section which deals with development on flood prone land, it is limited in its scope and is not consistent with current best floodplain risk management practice. As a result, it is recommended that Council review and update *Temora Shire DCP 2012* based on the findings of the present study, as well as the suggested wording that is set out in **Appendix C** of this report.

Annexures 2A and **2B** in **Appendix C** set out the graded set of flood related planning controls which have been developed for areas that are subject to Main Stream Flooding and Major Overland Flow, respectively, while **Figures C1.1** and **C1.2** in **Appendix C** show the areas where the graded set of flood related planning controls set out in **Annexures 2A** and **2B** apply in Ariah Park and Springdale, respectively.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development in properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figures C1.1** and **C1.2**. The MHFLs for residential land use types is the level of the 1% AEP flood event plus freeboard, whereas for commercial and industrial land use types the MHFL is to be as close to the 1% AEP flood level plus freeboard as practical, but no lower than the 5% AEP flood level plus freeboard. In situations where the MHFL is below the 1% AEP flood level plus freeboard, a mezzanine area equal to 30% of the total habitable floor area is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard. Freeboard is equal to 0.5 m for development being assessed in areas affected by Main Stream Flooding and 0.3 m for development being assessed in areas affected by Major Overland Flow.

For areas outside the FPA shown on **Figures C1.1** and **C1.2**, the MHFL for all land use types is the level of the 1% AEP flood event plus 0.5 m freeboard, with the exception of essential community facilities and utilities which are critical for flood response and recovery, as well as sensitive uses and facilities where the MHFL is the level of the PMF.

Figures C1.3 and **C1.4** in **Appendix C** are extracts of the *Flood Planning Constraint Category Map* for the Temora Shire LGA which respectively show the subdivision of the floodplains at Ariah Park and Springdale into the following four categories which have been used as the basis for developing the graded set of planning controls:

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the FPA where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.

- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the FPA but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this document.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises the area which lies above the FPL but within the extent of the PMF. Flood related controls in areas designated FPCC4 are typically limited to emergency response, although additional controls apply to essential community facilities and utilities that are critical for response and recovery, as well as sensitive uses and facilities. This area is identical to the *Special Flood Considerations Zone* shown on the *Flood Planning Map*.

The derivation of the four FPCCs firstly involved the derivation of a number of sub-regions which were based on the nature of flooding at Ariah Park and Springdale, the sub-categories of which are set out in **Table 3.3**. These sub-regions were then combined, with the resulting extents further refined in order to improve the area over which each FPCC applied.

TABLE 3.3
KEY ELEMENTS COMPRISING FLOOD PLANNING CONSTRAINT CATEGORIES AT ARIAH PARK AND SPRINGDALE

Flooding	FPCC	Sub-category	Constraint
Main Stream Flooding	1	a	1% AEP Main Stream Flooding (MSF) Floodway
		b	1% AEP MSF Flood Hazard Vulnerability Classification H6
	2	a	1% AEP MSF Flood Storage
		b	1% AEP MSF Flood Hazard Vulnerability Classification H5
		c	0.2% AEP MSF Flood Hazard Vulnerability Classification H5 and H6
		d	1% AEP Flood Emergency Response Classification (Flooded - Isolated - Submerged)
		e	1% AEP Flood Emergency Response Classification (Flooded - Isolated - Elevated)
	3	-	Flood Planning Area
	4	-	Extent of PMF
Major Overland Flow	1	-	1% AEP Floodway AND Flood Hazard Vulnerability Classification H4 - H6
	2	a	1% AEP Floodway AND Flood Hazard Vulnerability Classification H1 - H3
		b	1% AEP Flood Storage Area
		c	0.2% AEP Flood Hazard Vulnerability Classification H5 and H6
	3	-	Flood Planning Area
	4	-	Extent of PMF

3.5.1.4 Revision of Temora LEP 2010

Both *Ariah Park and Springdale FRMS* and *Ariah Park and Springdale FRMP* have been developed giving consideration to the following amended form of wording which automatically came into effect on 14 July 2021:

"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 flood function and behaviour on the land, taking into account projected changes as a result of climate change,

(c) to avoid adverse or cumulative impacts on flood behaviour and the environment,

(d) to enable the safe occupation and efficient evacuation of people in the event of a flood.

(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development—

(a) is compatible with the flood function and behaviour on the land, and

(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and

(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and

(d) incorporates appropriate measures to manage risk to life in the event of a flood, and

(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.

(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters—

(a) the impact of the development on projected changes to flood behaviour as a result of climate change,

(b) the intended design and scale of buildings resulting from the development,

(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,

(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.

(4) A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.

(5) In this clause—

Considering Flooding in Land Use Planning Guideline means the *Considering Flooding in Land Use Planning Guideline* published on the Department's website on 14 July 2021.

flood planning area has the same meaning as it has in the Floodplain Development Manual.

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

While Council chose not to include the optional new *special flood considerations* clause in *Temora LEP 2010* at the same time as the *flood planning* clause was automatically updated by the NSW Government, it is recommended that Council now look to include it as it will require consideration to be given to approving certain types of development on land that lies between the FPA and the PMF:

Special flood considerations

(1) The objectives of this clause are as follows—

(a) to enable the safe occupation and evacuation of people subject to flooding,

(b) to ensure development on land is compatible with the land's flood behaviour in the event of a flood,

(c) to avoid adverse or cumulative impacts on flood behaviour,

(d) to protect the operational capacity of emergency response facilities and critical infrastructure during flood events,

(e) to avoid adverse effects of hazardous development on the environment during flood events.

(2) This clause applies to—

(a) for sensitive and hazardous development—land between the flood planning area and the probable maximum flood, and

(b) for development that is not sensitive and hazardous development—land the consent authority considers to be land that, in the event of a flood, may—

(i) cause a particular risk to life, and

(ii) require the evacuation of people or other safety considerations.

(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) will not affect the safe occupation and efficient evacuation of people in the event of a flood, and

(b) incorporates appropriate measures to manage risk to life in the event of a flood, and

(c) will not adversely affect the environment in the event of a flood.

(4) A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.

(5) In this clause—

Considering Flooding in Land Use Planning Guideline*—see clause 5.21(5).*

flood planning area*—see clause 5.21(5).*

Floodplain Development Manual*—see clause 5.21(5).*

probable maximum flood *has the same meaning as it has in the Floodplain Development Manual.*

sensitive and hazardous development *means development for the following purposes—*

[list land uses]

Direction— Only the following land uses are permitted to be included in the list—

(a) boarding houses,

(b) caravan parks,

(c) correctional centres,

(d) early education and care facilities,

(e) eco-tourist facilities,

(f) educational establishments,

(g) emergency services facilities,

(h) group homes,

(i) hazardous industries,

(j) hazardous storage establishments,

(k) hospitals,

(l) hostels,

(m) information and education facilities,

(n) respite day care centres,

(o) seniors housing,

(p) sewerage systems,

(q) tourist and visitor accommodation,

(r) water supply systems

The steps involved in Council amending *Temora LEP 2010* following the finalisation and adoption of *Ariah Park and Springdale FRMS&P* are:

1. Council Planning Staff consider the conclusions of *Ariah Park and Springdale FRMS&P* and suggested amendments to *Temora LEP 2010*.
2. Council resolves to amend *Temora LEP 2010* in accordance with *Ariah Park and Springdale FRMS&P*.

3. Council prepares a Planning Proposal in accordance with NSW Planning and Environment Guidelines. Planning Proposal submitted to NSW Planning and Environment in accordance with section 3.33 of the EP&A Act, 1979.
4. Planning Proposal considered by DPE and determination made in accordance with section 3.34(2) of the EP&A Act, 1979 as follows:
   (a) whether the matter should proceed (with or without variation),
   (b) whether the matter should be resubmitted for any reason (including for further studies or other information, or for the revision of the planning proposal),
   (c) community consultation required before consideration is given to the making of the proposed instrument (the community consultation requirements),
   (d) any consultation required with State or Commonwealth public authorities that will or may be adversely affected by the proposed instrument,
   (e) whether a public hearing is to be held into the matter by the Planning Assessment Commission or other specified person or body,
   (f) the times within which the various stages of the procedure for the making of the proposed instrument are to be completed.
5. Planning Proposal exhibited for public comment.
6. Planning Proposal reviewed following public submissions and submissions from relevant State and Commonwealth authorities.
7. Final Local Environmental Plan with proposed amendments drafted.
8. Amending Local Environmental Plan made by the Minister and gazetted.

3.5.2 Voluntary Purchase of Residential Properties

Removal of housing from high hazard floodway areas in the floodplain is generally accepted as a cost-effective means of correcting previous decisions to build in such areas. The voluntary purchase of residential property in hazardous areas has been part of subsidised floodplain risk management programs in NSW for over 20 years.[7] After purchase, land is subsequently cleared and the site re-zoned for public open space or some other flood compatible use. A further criterion applied by State Government agencies in assessing eligibility for funding is that the property must be in a high hazard floodway area, that is, in the path of flowing floodwaters where the depth and velocity at the peak of the flood are such that life could be threatened, damage of property is likely and evacuation difficult.

Under a Voluntary Purchase scheme the owner is notified that the body controlling the scheme, Council in the present case, is prepared to purchase the property when the owner is ready to sell. There is no compulsion whatsoever to sell at any time. The price is determined by independent valuers and the Valuer General, and by negotiation between Council and the owners. Valuations are not reduced due to the flood affected nature of the site.

[7] State government funding is only available for properties where the buildings were approved and constructed prior to 1986 when the original Floodplain Development Manual was gazetted. Properties built after this date should have been constructed in accordance with the principles in the manual.

Prior to progressing to the purchase of a property, it would first be necessary to undertake a *Voluntary Purchase Feasibility Study*, especially if Council intends to apply for NSW Government grant funding. The study is to include discussions with each eligible and agreeable property owner, as well as a detailed assessment of each property to determine a priority order and costing for each.

While there are no existing dwellings subject to hazardous flooding at Ariah Park, there is a single dwelling that is located on the northern (downstream) side of Burley Griffin Way at Springdale that is located in a floodway area. While the property would qualify for inclusion in the NSW Government's Voluntary Purchase Scheme based on the high hazard nature of the flow, Council advised that the date of construction of the existing dwelling post-dates the gazetting of the original Floodplain Development Manual. As a result, the property is not eligible for inclusion in the scheme. Based on this finding, the implementation of an effective flood warning system that alerts the occupiers of the dwelling of rising water levels in Gundibindyal Creek and its tributary arm forms a key component of the *Ariah Park and Springdale FRMP* (refer **Section 3.6.1** of this report for further details).

3.5.3 Voluntary House Raising

The term "house raising" refers to procedures undertaken, usually on a property-by-property basis, to protect structures from damage by floodwaters. The most common process is to raise the affected dwelling by a convenient amount so that the floor level is at or above the MHFL. For weatherboard and similar buildings this can be achieved by jacking up the dwelling, constructing new supports, stairways and balconies and reconnecting services. Alternatively, where the dwelling contains high ceilings, floor levels can be raised within rooms without raising the dwelling. It is usually not practical to raise brick or masonry dwellings. Most of the costs associated with this measure relate to the disconnection and reconnection of services. Accordingly, dwellings may be raised a considerable elevation without incurring large incremental costs.

State and Federal Governments have agreed that flood mitigation funds will be available for house raising, subject to the same economic evaluation and subsidy arrangements that apply to other structural and non-structural flood mitigation measures. In accepting schemes for eligibility, the Government has set out the following conditions:

- House raising should be part of the adopted Floodplain Risk Management Plan.
- The scheme should be administered by the local authority.

State government funding is only available for properties where the buildings were approved and constructed prior to 1986 when the original Floodplain Development Manual was gazetted. Properties built after this date should have been constructed in accordance with the principles in the manual. The Government also requires that councils carry out ongoing monitoring in areas where subsidised voluntary house raising has occurred to ensure that redevelopment does not occur to re-establish habitable areas below the design floor level. In addition, it is expected that councils will provide documentation during the conveyancing process so that subsequent owners are made aware of restrictions on development below the design floor level.

Council's principal role in subsidised voluntary house raising would be to:

- Define a habitable floor level, which it will have already done in exercising controls over new dwellings in the area.
- Guarantee a payment to the builder after satisfactory completion of the agreed work.

- Monitor the area of voluntary house raising to ensure that redevelopment does not occur to re-establish habitable areas below the design floor level.

Prior to progressing to the raising of a dwelling, it would first be necessary to undertake a *Voluntary House Raising Feasibility Study*, especially if Council intends to apply for NSW Government grant funding. The study is to include discussions with each eligible and agreeable property owner, as well as a detailed assessment of each property to determine a priority order and costing for each.

The current cost to raise a medium sized (150 m^2) dwelling is about $150,000 based on recent experience in other centres.

While there are a number of dwellings that would experience above-floor inundation in both Ariah Park and Springdale during storms up to 1% AEP in intensity, above-floor depths are relatively shallow and therefore do not result in significant flood damages. Based on this finding, the inclusion of a *Voluntary House Raising Scheme* in the *Ariah Park and Springdale FRMP* is not recommended.

3.6 Response Modification Measures

3.6.1 Improvements to Flood Warning System

Improvements to the flood warning and response procedures were strongly favoured by the community during the community consultation process. An effective flood warning system has three key components, i.e. a flood forecasting system, a flood warning broadcast system and a response/evacuation plan. All systems need to be underpinned by an appropriate public flood awareness program.

Presently warnings regarding the potential for flooding to occur at Ariah Park and Springdale are limited to BoMs *Severe Thunderstorm Warning* and *Severe Weather Warnings for Flash Flooding* alert services which are publically available via the internet or on smart phones via free Apps.

While the urbanised parts of Ariah Park are subject to relatively shallow Major Overland Flow, the village of Springdale is subject to relatively deep and fast-moving floodwater which rises relatively quickly following the onset of flood producing rain. The residents in Springdale would therefore benefit from the installation of an automatic water level recorder linked to a loudspeaker system which provided an alert when water levels in Gundibindyal Creek and its tributary arm reached a pre-defined trigger level. The automatic water level recorder could also be used to trigger flashing lights which in combination with appropriate signage would warn motorists of the potential for floodwater across Burley Griffin Way.

Given the potential for hazardous flooding to impact existing development and occupiers of the floodplain at Springdale, the installation of an automatic water level recorder linked to a loudspeaker system and flashing lights/appropriate signage on Burley Griffin Way is recommended for inclusion in the *Ariah Park and Springdale FRMP*.

3.6.2 Improved Emergency Planning and Response

As mentioned in **Section 2.15**, the *Temora Shire Local Flood Plan* provides detailed information regarding preparedness measures, conduct of response operations and coordination of immediate recovery measures for all levels of flooding.

NSW SES should ensure information contained in this report on the impacts of flooding on urban development, as well as recommendations regarding flood warning and community education are used to update Volume 2 of the *Temora Shire Local Flood Plan*. Volume 2 should include the following sections:

1 – The Flood Risk includes the following sub-sections:

1.1 Land Forms and River Systems – refer **Sections 2.1** and **2.2** of the report for information on these topics.

1.4 Characteristics of Flooding – Indicative extents of inundation for the 1% AEP and PMF events and the typical times of rise of floodwaters at key locations on the major watercourses are shown on **Figures 2.2** to **2.8**. The location of vulnerable development and critical infrastructure relative to the flood extents is shown on **Figures 2.9** and **2.10**.

1.5 Flood History – Recent flood experience in the two villages is discussed in **Section 2.3** of the report.

1.6 Flood Mitigation Systems – There are no significant flood mitigation systems in Ariah Park and Springdale.

1.7 Extreme Flood Events – The PMF was modelled and the indicative extent and depth of inundation presented on **Figures 2.5** and **2.6**.

2 – Effects on the Community

Information on the properties affected by the 1% AEP design flood are included in this report (**Figures 2.2** to **2.6**), noting that the floor level data used in this assessment were estimated from the LiDAR survey and "drive by" survey.

Figures 2.7 and **2.8** show stage hydrographs at road crossings at Ariah Park and Springdale, respectively, the locations of which are shown on **Figures 2.3** and **2.4**.

Figures 2.9 and **2.10** show the location of vulnerable development and critical infrastructure at Ariah Park and Springdale, respectively relative to the flood extents ranging between 20% and 0.2% AEP, as well as the PMF. Refer **Section 2.6** for details of affected infrastructure.

Figures 3.3 and **3.4** show the flood emergency response planning classifications for the 5% AEP event at Ariah Park and Springdale, respectively based on the definitions set out in AIDR, 2017, while **Figures 3.5** to **3.8** show similar information for the 1% AEP and PMF events in the two villages.

3.6.3 Public Awareness Programs

Community awareness and appreciation of the existing flood hazards in the floodplain would promote proper land use and development in flood affected areas. A well-informed community would be more receptive to requirements for flood proofing of buildings and general building and development controls imposed by Council. Council should also take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplains of the flood risk.

One aspect of a community's preparedness for flooding is the "flood awareness" of individuals. This includes awareness of the flood threat in their area and how to protect themselves against it. The overall level of flood awareness within the community tends to reduce with time, as memories fade and as residents move into and out of the floodplain. The improvements to flood

warning arrangements described above, as well as the process of disseminating this information to the community, would represent a major opportunity for increasing flood awareness at Ariah Park and Springdale.

Means by which community awareness of flood risks can be maintained or may be increased include:

- displays at Council offices using the information contained in the present study and photographs of historic flooding in the area;
- talks by NSW SES officers with participation by Council and longstanding residents with first-hand experience of flooding in the area; and
- preparation of a *Flood Information Brochure* which could be prepared by Council with the assistance of NSW SES containing both general and site-specific data and distributed with rate notices.

The community should also be made aware that a flood greater than historic levels or the flood planning level can, and will, occur at some time in the future.

4 SELECTION OF FLOODPLAIN RISK MANAGEMENT MEASURES

4.1 Background

NSWG, 2005 requires a Council to develop a Floodplain Risk Management Plan based on balancing the merits of social, environmental and economic considerations which are relevant to the community. This chapter sets out a range of factors which need to be taken into consideration when selecting the mix of works and measures that should be included in the *Ariah Park and Springdale FRMP*.

The community will have different priorities and, therefore, each needs to establish its own set of considerations used to assess the merits of different measures. The considerations adopted by a community must, however, recognise the State Government's requirements for floodplain management as set out in NSWG, 2005 and other relevant policies. A further consideration is that some elements of the *Ariah Park and Springdale FRMP* may be eligible for subsidy from State and Federal Government sources and the requirements for such funding must, therefore, be taken into account.

Typically, State and Federal Government funding is given on the basis of merit, as judged by a range of criteria:

- The magnitude of damage to property caused by flooding and the effectiveness of the measure in mitigating damage and reducing the flood risk to the community.
- Community involvement in the preparation of the Floodplain Risk Management Plan and acceptance of the measure.
- The technical feasibility of the measure (relevant to structural works).
- Conformance of the measure with Council's planning objectives.
- Impacts of the measure on the environment.
- The economic justification, as measured by the benefit/cost ratio of the measure.
- The financial feasibility as gauged by Council's ability to meet its commitment to fund its part of the cost.
- The performance of the measure in the event of a flood greater than the design event.
- Conformance of the measure with Government Policies (e.g. NSWG, 2005 and Catchment Management Objectives).

4.2 Ranking of Measures

A suggested approach to assessing the merits of various measures is to use a subjective scoring system. The chief merits of such a system are that it allows comparisons to be made between alternatives using a common "currency". In addition, it makes the assessment of alternatives "transparent" (i.e. all important factors are included in the analysis). The system does not, however, provide an absolute "right" answer as to what should be included in the *Ariah Park and Springdale FRMP* and what should be left out. Rather, it provides a method by which Council can re-examine the measures and if necessary, debate the relative scoring given to aspects of the *Ariah Park and Springdale FRMP*.

Each measure is given a score according to how well the measure meets the considerations discussed above. In order to keep the scoring simple, the following system is proposed:

+2 Measure rates very highly

+1 Measure rates well

0 Measure is neutral

- 1 Measure rates poorly

- 2 Measure rates very poorly

The scores are added to get a total for each measure.

Based on considerations outlined in this chapter, **Table 4.1** presents a suggested scoring matrix for the measures reviewed in **Chapter 3**. This scoring has been used as the basis for prioritising the components of the *Ariah Park and Springdale FRMP*.

4.3 Summary

Table 4.1 indicates that there are good reasons to consider including the following elements into the *Ariah Park and Springdale FRMP*:

- An update of the *Temora LEP 2010* to allow better management of the floodplain.
- Improved planning controls through the update of *Temora Shire DCP 2012* to incorporate the recommendations set out in this report.
- Incorporation of the catchment specific information on flooding impacts contained in this study in NSW SES Response Planning and Flood Awareness documentation for the study area.
- Improvements to the flood warning system at Springdale through the installation of a telemetered stream gauge which would be linked to an automated public announcement system, as well as flashing lights on Burley Griffin Way.
- Improved public awareness of flood risk in the community.
- The commissioning of a feasibility study and concept design of the Ariah Park Trunk Drainage Upgrade Scheme.
- The detailed design and construction of the Ariah Park Trunk Drainage Upgrade Scheme.
- Development and implementation of a *Vegetation Management Plan* for Gundibindyal Creek and its tributary arm where they run through parts of Springdale.

TABLE 4.1
ASSESSMENT OF POTENTIAL FLOODPLAIN RISK MANAGEMENT MEASURES FOR INCLUSION IN ARIAH PARK AND SPRINGDALE FLOODPLAIN RISK MANAGEMENT PLAN

Measure	Impact on Flooding/ Reduction in Flood Risk	Community Acceptance	Technical Feasibility	Planning Objectives	Environ. Impacts	Economic Justification	Financial Feasibility	Extreme Flood	Government Policies and TCM Objectives	Score
Flood Modification										
Design and construction of Ariah Park Trunk Drainage Upgrade Scheme	+1	+2	+2	+1	0	-1	-1	0	+1	+5
Design and construction of Springdale Trunk Drainage Upgrade Scheme	+2	+2	+2	+1	-2	-2	-2	+1	+1	+3
Development and implementation of *Vegetation Management Plan* at Ariah	0	+1	0	0	+1	0	0	0	+1	+3
Development and implementation of *Vegetation Management Plan* at Springdale	+1	+2	0	+1	+1	0	0	0	+1	+6
Property Modification										
Inclusion of *Special Flood Consideration* clause in *Temora LEP 2010*	+2	+2	+2	+2	0	0	0	+2	+2	+12
Controls over Future Development (via update of *Temora Shire DCP 2012*)	+2	+2	+2	+2	0	0	0	+1	+2	+12
Voluntary Purchase of Scheme for Ariah Park	-2	-2	+2	-2	0	-2	-2	0	-2	-10
Voluntary Purchase of Scheme for Springdale	+2	+1	-2	-2	+1	+1	+1	+2	+2	+6
Voluntary House Raising Scheme for Ariah Park	-2	-2	+2	-2	0	-2	-2	0	-2	-10
Voluntary House Raising Scheme for Springdale	+1	+1	+1	+1	0	-1	+1	0	0	+4
Response Modification										
Improvements to Flood Warning System at Ariah Park	+1	+2	-2	+1	0	-1	-1	0	+1	+1
Improvements to Flood Warning System at Springdale	+2	+2	+2	+2	0	+1	-1	+1	+2	+11
Improved Emergency Planning and Response	+2	+1	+2	+2	0	0	0	+2	+2	+11
Public Awareness Programs	+2	+1	+2	+2	0	0	0	+1	+2	+10

5 ARIAH PARK AND SPRINGDALE FLOODPLAIN RISK MANAGEMENT PLAN

5.1 The Floodplain Risk Management Process

The *Ariah Park and Springdale Floodplain Risk Management Study (**Ariah Park and Springdale FRMS**)* and *Ariah Park and Springdale Floodplain Risk Management Plan* (***Ariah Park and Springdale FRMP***) have been prepared as part of a Government program to mitigate the impacts of major floods and reduce the hazards in the floodplain. The *Ariah Park and Springdale FRMP* which is set out in this Chapter has been prepared as part of the Floodplain Risk Management Process in accordance with NSW Government's Flood Prone Land Policy.

The first steps in the Floodplain Risk Management Process involved the preparation of the *Ariah Park and Springdale Flood Study* which was completed in 2022 (***Flood Study***) (Lyall & Associates, 2022). The findings of the *Flood Study* formed the basis of the preparation of both the *Ariah Park and Springdale FRMS* and the *Ariah Park and Springdale FRMP*.

5.2 Purpose of the Plan

The overall objectives of *Ariah Park and Springdale FRMS* were to assess the impacts of flooding, review policies and measures for management of flood affected land and to develop *Ariah Park and Springdale FRMP* which:

- Sets out the recommended program of works and measures aimed at reducing over time, the social, environmental and economic impacts of flooding and establishes a program and funding mechanism for *Ariah Park and Springdale FRMP*.
- Proposes amendments to Temora Shire Council's (**Council's**) existing policies to ensure that the future development of flood affected land in the study area is undertaken so as to be compatible with the flood hazard and risk.
- Ensures *Ariah Park and Springdale FRMP* is consistent with NSW State Emergency Services (**NSW SES's**) local emergency response planning procedures.
- Ensures that *Ariah Park and Springdale FRMP* has the support of the community.

5.3 The Study Area

The study area for *Ariah Park and Springdale FRMP* applies to areas that are zoned *RU5-Village* in Ariah Park and Springdale, in addition to their immediate surrounds. The study deals with the following two types of flooding:

- **Main Stream Flooding**, which occurs when floodwater surcharges the inbank area of the existing creek system. Main Stream Flooding is typically characterised by relatively deep and fast flowing floodwater, but may be shallower and slower moving in flood fringe areas.
- **Major Overland Flow** which occurs during storms which result in the flow of water across the land as it makes its way toward defined watercourses whether they be modified or not, as well as surcharge of the existing stormwater drainage system. Major Overland Flow is typically characterised by relatively shallow and slow moving floodwater.

Figure 1.1 in **Volume 2** of the *Ariah Park and Springdale FRMS* report is a location plan, while **Figures 2.1** (3 sheets) and **2.2** (2 sheets) show the key features of the existing stormwater drainage system at Ariah Park and Springdale, respectively.

5.4 Community Consultation

The Community Consultation process provided valuable direction over the course of the investigations, bringing together views from key Council staff, other departments and agencies, and importantly, the views of the community gained through:

- the delivery of a *Community Newsletter and Questionnaire* to residents and business owners in the study area which allowed the wider community to gain an understanding of the issues being addressed as part of the study and sort their view on a range of potential floodplain risk management measures; and
- the public exhibition of the draft *Ariah Park and Springdale FRMS* and the *Ariah Park and Springdale FRMP*.

Meetings were also held with the Floodplain Risk Management Committee to discuss the findings of *Ariah Park and Springdale FRMS* and also the recommended set of measures set out in the *Ariah Park and Springdale FRMP*.

Based on the responses to *Community Questionnaire*, the Ariah Park respondents were strongly in favour of improvements in the existing stormwater drainage system, including the road/rail culverts, while the Springdale respondents were strongly in favour of the management of vegetation along the creek corridor, as well as removal of floodplain obstructions. Both the Ariah Park and Springdale communities were in favour of the following measures:

- Flood related controls over future development in flood liable areas
- Advice of flood affectation via Planning Certificates for properties located within the *Flood Planning Area*
- Improved flood warning, evacuation and flood response procedures

5.5 Existing Flood Behaviour

The *Flood Study* found that the majority of the storms that were identified during the community consultation process were less intense than a storm that occurs once every two years on average (i.e. more frequent that 50% AEP), with the following three exceptions:

- the 27 February – 5 March 2012 storm, which was equivalent to a design storm event with an Annual Exceedance Probability (**AEP**) of about 5% (1 in 20) at Young and 10% at Narrandera and Junee;
- the 21-22 September 2016 storm, which was equivalent to a design storm event with an AEP of 20-10% at Junee; and
- the 23 March 2021 storm event, which was equivalent to a 20-10% AEP design storm event at Temora, West Wyalong, Dudauman and Jindalee.

Appendix B of this report contains several photos which show historic flood behaviour in Ariah Park during storms that occurred on 3 September 2016, 21 September 2016 and 8 February 2019, and in Springdale during storms that occurred on 3 February 2011, 22 December 2011, 3 March 2012, 11 July 2016, 10 September 2016, 21 September 2016 and 8 January 2019.

Figures 2.3 (2 sheets) and **2.4** show the indicate extent and depth of inundation at Ariah Park and Springdale for the 1% AEP flood event, respectively, while **Figures 2.5** (2 sheets) and **2.6** show similar information for the Probable Maximum Flood (**PMF**) event. **Figures 2.7** (2 sheets)

and **2.8** show the time of rise of floodwater at key locations along the road and rail network at Ariah Park and Springdale, respectively, while **Figures 2.9** (2 sheets) and **2.10** show the indicate extent of flooding at Ariah Park and Springdale for floods of between 20% AEP and the PMF event, respectively .

5.6 Existing Flood Mitigation Measures

There are no formal flood mitigations measures present in Ariah Park and Springdale.

5.7 Economic Impacts of Flooding

Tables 5.1 and **5.2** show the number of properties that would be flooded to above-floor level and the damages experienced in residential and commercial/industrial development, as well as public buildings at Ariah Park and Springdale, respectively.

At the 1% AEP level of flooding, eight dwellings, 21 commercial/industrial buildings and one public building would be subjected to above-floor inundation at Ariah Park, while seven dwellings would similarly experience above-floor inundation at this level of flooding at Springdale.

As the depth of above-flood inundation at both Ariah Park and Springdale is relatively shallow at the 1% AEP level of flooding, the total flood damages in the two villages only amount to about $1.7 Million and $0.6 Million, respectively.

For a discount rate of 7% pa and an economic life of 50 years, the *Present Worth Value* of damages at Ariah Park and Springdale for all flood events up to the 1% AEP flood is about $3.2 Million and $0.1 Million, respectively. These two amounts represent the approximate total amount that can be spent on measures which alleviate flooding up to 1% AEP event while still being economically justifiable.

TABLE 5.1
ECONOMIC IMPACTS OF FLOODING AT ARIAH PARK

Design Flood Event (% AEP)	Properties Flooded Above-Floor Level						Total Flood Damages
	Residential		Commercial/Industrial		Public		
	No.	$ Million	No.	$ Million	No.	$ Million	$ Million
20	0	0.10	13	0.36	2	0.04	0.50
10	0	0.15	13	0.48	2	0.05	0.68
5	1	0.27	15	0.58	2	0.06	0.91
2	4	0.54	19	0.78	2	0.07	1.39
1	8	0.74	21	0.85	2	0.08	1.67
0.5	10	0.97	22	0.91	2	0.08	1.96
0.2	14	1.52	23	0.99	2	0.08	2.59
PMF	94	8.28	29	2.03	6	0.26	10.57

TABLE 5.2
ECONOMIC IMPACTS OF FLOODING AT SPRINGDALE

Design Flood Event (% AEP)	Properties Flooded Above-Floor Level						Total Flood Damages
	Residential		Commercial/Industrial		Public		
	No.	$ Million	No.	$ Million	No.	$ Million	$ Million
20	0	0	No Commercial Properties at Springdale		0	0	0
10	0	0			0	0	0
5	0	0.05			0	0	0.05
2	3	0.25			0	0	0.25
1	7	0.55			0	0	0.55
0.5	8	0.71			0	0	0.71
0.2	8	0.76			0	0	0.76
PMF	20	2.20			0	0	2.20

5.8 Structure of Ariah Park and Springdale Floodplain Risk Management Plan

A summary of *Ariah Park and Springdale FRMP* proposed for the study area along with broad funding requirements for the recommended measures are shown in **Table S1** at the commencement of the *Ariah Park and Springdale FRMS* report. The measures will over time achieve the objectives of reducing the flood risk to existing and future development for the full range of floods.

Ariah Park and Springdale FRMP is based on the following mix of measures which have been given a provisional priority ranking according to a range of economic, social, environmental and other criteria that are set out in **Table 4.1** of the *Ariah Park and Springdale FRMS* report:

- **Measure 1** – Include special flood considerations clause in the *Temora Local Environmental Plan, 2010* (***Temora LEP 2010***).
- **Measure 2** – Improvements to planning and development controls for future development in flood prone areas via updates of *Temora Shire Development Control Plan 2012 (**Temora Shire DCP 2012**).*
- **Measure 3** – Improvements to emergency response planning.
- **Measure 4** – Increase public awareness of the risks of flooding in the community.
- **Measure 5** – Investigation and design of a flood warning system for Springdale.
- **Measure 6** - Investigation and concept design of Ariah Park Trunk Drainage Upgrade Scheme.
- **Measure 7** – Detailed design and construction of Ariah Park Trunk Drainage Upgrade Scheme.
- **Measure 8** - Development and implementation of a *Vegetation Management Plan* for Gundibindyal Creek and its tributary arm where they run through Springdale.

5.9 Planning and Development Controls

The results of *Ariah Park and Springdale FRMS* indicate that an important measure for Council to adopt in the floodplain would be strong floodplain risk management planning applied consistently by all of its branches.

5.9.1 Revision of Temora Local Environmental Plan 2010

Clause 5.21 of *Temora LEP 2010* entitled "Flood planning" outlines its objectives in regard to development of land which lies within the Flood Planning Area (**FPA**). The wording in the flood planning clause was updated on 14 July 2021 as part of recent reforms that have been implemented by the NSW Government.

While the wording of the *flood planning* clause was automatically updated on 14 July 2021, Council chose not to include a new *special flood considerations* clause that also formed part of the recent reform package. Based on the findings of *Ariah Park and Springdale FRMS*, it is recommended that Council now look to include this additional clause in *Temora LEP 2010* (**Measure 1**), noting that its objectives are:

a) in relation to development with particular evacuation or emergency response issues (e.g. group homes, residential care facilities, etc.), to enable evacuation of land subject to flooding in events exceeding the flood planning level; and

b) to protect the operational capacity of emergency response facilities and critical infrastructure during extreme flood events.

The new clause would apply to land which lies between the FPA and the extent of the PMF. Wording in relation to this new clause is given in **Section 3.5.1.4** of the *Ariah Park and Springdale FRMS* report.

5.9.2 Temora Shire Development Control Plan 2012

The recommended approach to managing future development in the study area uses the concepts of *flood hazard* and *hydraulic categorisation* to develop controls for future development in flood prone land (**Measure 2**). **Figures C1.1** and **C1.2** in **Appendix C** of the *Ariah Park and Springdale FRMS* report are extracts from the *Flood Planning Map* relating to the study area. The extent of the FPA has been defined as follows:

- In areas subject to Main Stream Flooding, the FPA is based on the traditional definition of the area inundated by the 1% AEP plus 0.5 m freeboard.
- In areas subject to Major Overland Flow, the FPA is defined as the extent of floodway areas, as well as areas where depths of inundation in a 1% AEP event exceed 0.1 m.

Also shown on the extract of the *Flood Planning Map* is the extent of the *Special Flood Considerations Zone*, which is defined as land which lies between the extent of the FPA and PMF.

It is proposed that properties are located either partially or wholly within the extent of the FPA would be subject to S10.7 flood affectation notification and planning controls graded according to flood hazard and hydraulic categorisation. **Annexures 2A** and **2B** in **Appendix C** set out the graded set of flood related planning controls which apply to development in areas that are affected by Main Stream Flooding and Major Overland Flow, respectively. **Figures C1.1** and **C1.2** show the areas where the graded set of flood related planning controls set out in **Annexures 2A** and **2B** apply to Ariah Park and Springdale, respectively.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development in properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figures C1.1** and **C1.2** The MHFLs for residential land use types is the level of the 1% AEP flood event plus freeboard, whereas for commercial and industrial land use types the MHFL is to be as close to the 1% AEP flood level plus freeboard as practical, but no lower than the 5% AEP flood level plus freeboard. In situations where the MHFL is below the 1% AEP flood level plus freeboard, a mezzanine area equal to 30% of the total habitable floor area is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard.[8]

Figures C1.3 and **C1.4** in **Appendix C** of the *Ariah Park and Springdale FRMS* report are extracts of the *Flood Planning Constraint Category Map* relating to the study area. The figures show the subdivision of the floodplain into the following four categories which have been used as the basis for developing the graded set of planning controls:

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the *Flood Planning Area* where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the *Flood Planning Area* but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this DCP.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises the area which lies between the extent of the *Flood Planning Area* and the PMF. Flood related controls in areas designated FPCC4 are typically limited to flood evacuation and emergency response, although additional controls apply to essential community facilities and utilities that are critical for response and recovery, as well as community hospitals, residential care facilities and group homes. This area is identical to the *Special Flood Considerations Zone* shown on the *Flood Planning Map*.

5.10 Improvements to Flood Warning, Emergency Response Planning and Community Awareness

Three measures are proposed in *Ariah Park and Springdale FRMP* to improve flood warning, emergency response planning and community awareness to the threat posed by flooding.

Measure 3 involves the update by NSW SES of the *Temora Shire Local Flood Plan* using information on flooding patterns, times of rise of floodwaters and flood prone areas identified in the *Ariah Park and Springdale FRMS* report. Figures have been prepared showing indicative extents of flooding, high hazard areas, expected rates of rise of floodwaters in key areas and locations where flooding problems would be expected. **Section 3.6.2** references the locations of key data within the *Ariah Park and Springdale FRMS* report.

[8] Freeboard is equal to 0.5 m for development being assessed in areas affected by Main Stream Flooding and 0.3 m for development being assessed in areas affected by Major Overland Flow.

Council should also take advantage of the information on flooding presented in this report, including the flood mapping, to inform occupiers of the floodplains of the flood risk (included as **Measure 4** of *Ariah Park and Springdale FRMP*). This information could be included in a *Flood Information Brochure* to be prepared by Council with the assistance of NSW SES containing both general and site-specific data and distributed with the rate notices. The community should also be made aware that a flood greater than historic levels or the planning level can, and will, occur at some time in the future. *Ariah Park and Springdale FRMP* should be publicised and exhibited at community gathering places to make residents aware of the measures being proposed.

Measure 5 involves the investigation, design and implementation of a flood warning system for Springdale which would comprise the installation of a telemetered stream gauge which would be linked to an automated public announcement system, as well as flashing lights on Burley Griffin Way. Appropriate signage would also need to be installed on Burley Griffin Way warning motorists of the potential for floodwater to be across the road when the lights are flashing.

5.11 Flood Modification Works

Measure 6 comprises the investigation and concept design of a trunk drainage upgrade scheme which is aimed at reducing the impact that Major Overland Flow has on existing development that is located on both the northern and southern sides of the Temora-Roto railway line at Ariah Park (**Ariah Park Trunk Drainage Upgrade Scheme**). The scheme would involve the upgrade of several road and rail transverse drainage structures, in combination with extensive channel and containment bunding works. While the works cannot be justified on economic grounds (i.e. because the benefit/cost ratio is less than 1), they would remove relatively frequent and in places long-duration flooding from the centre of the village, as well as partially remove flooding from future developable areas to the north of the rail corridor. The scheme would also limit the frequency and duration Coolamon Street is inundated by floodwater, thereby reducing the time that the road would be cut by floodwater. **Measure 7** comprises the detailed design and construction of the Ariah Park Trunk Drainage Upgrade Scheme.

Due to the dense nature of vegetation within the inbank area of Gundibindyal Creek and one of its tributaries where they run through parts of Springdale, the *Ariah Park and Springdale FRMP* includes the preparation and implementation of a *Vegetation Management Plan* for the village (**Measure 8**).

5.12 Implementation Program

The steps in progressing the floodplain management process from this point onwards are:

1. Consider public comment, modify the document if and as required, and submit to Council.
2. Council adopts *Ariah Park and Springdale FRMP* and submits an application for funding assistance.
3. Assistance for funding qualifying projects included in *Ariah Park and Springdale FRMP* may be available upon application under the Commonwealth and State funded floodplain management programs, currently administered by the Department of Planning and Environment.
4. As funds become available from Government agencies and/or Council's own resources, implement the measures in accordance with the established priorities.

Ariah Park and Springdale FRMP should be regarded as a dynamic instrument requiring review and modification over time. The catalysts for change could include new flood events and experiences, legislative change, alterations in the availability of funding, reviews of Council's planning strategies and importantly, the outcome of some of the studies proposed in this report as part of *Ariah Park and Springdale FRMP*. In any event, a thorough review every ten years is warranted to ensure the ongoing relevance of *Ariah Park and Springdale FRMP*.

6 GLOSSARY OF TERMS

Note: For expanded list of definitions, refer to Glossary contained within the NSW Government Floodplain Development Manual, 2005.

TERM	DEFINITION
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, for a flood magnitude having five per cent AEP, there is a five per cent probability that there would be floods of greater magnitude each year.
Australian Height Datum (AHD)	A common national surface level datum corresponding approximately to mean sea level.
Floodplain	Area of land which is subject to inundation by floods up to and including the Probable Maximum Flood (**PMF**) event, that is, flood prone land.
Flood Planning Area	The area of land that is shown to be in the Flood Planning Area on the *Flood Planning Map*.
Flood Planning Map	The *Flood Planning Map* shows the extent of land on which flood related development controls apply.
Flood Planning Constraint Category 1 (FPCC 1)	Comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding
Flood Planning Constraint Category 2 (FPCC 2)	Comprises areas which lie below the *Flood Planning Level* where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
Flood Planning Constraint Category 3 (FPCC 3)	Comprises areas which lie below the *Flood Planning Level* but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this document.
Flood Planning Constraint Category 4 (FPCC 4)	Comprises the area which lies above the *Flood Planning Level* but within the extent of the PMF. Flood related controls in areas designated FPCC4 are typically limited to flood evacuation and emergency response, although additional controls apply to essential community facilities and utilities that are critical for response and recovery, as well as community hospitals, residential care facilities and group homes. This area is identical to the *Special Flood Considerations Zone* shown on the *Flood Planning Map*.
Flood Planning Level (FPL)	Flood levels selected for planning purposes, as determined by the relevant adopted floodplain risk management study and plan, or as part of a site specific study In the absence of an adopted floodplain risk management study and plan for a particular location, the FPL is defined as the peak 1% AEP flood level plus the addition of a 0.5 m freeboard.

TERM	DEFINITION
Flood Prone/Flood Liable Land	Land susceptible to flooding by the PMF. Flood Prone land is synonymous with Flood Liable land.
Floodway	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 flow, or a significant increase in flood levels.
Flood Fringe Area	Is the remaining area of land affected by flooding, after floodway and flood storage areas have been defined. Development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.
Flood Storage Area	Those parts of the floodplain that may be important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding a particular flood chosen as the basis for the *Flood Planning Level* 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*.
Habitable Room	In a residential situation: a living or working area, such as a lounge room, dining room, kitchen, bedroom or workroom. In an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Local Drainage	Land on an overland flow path where the depth of inundation during the 1% AEP storm event is less than 0.1 m.
Main Stream Flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
Major Overland Flow	Where the depth of overland flow during the 1% AEP storm event is greater than 0.1 m.
Probable Maximum Flood (PMF)	The largest flood that could conceivably occur at a particular location. 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.
Special Flood Considerations Zone	Comprises the area where the flood risk is considered to be high enough to require additional controls to be applied to future development that is located on land which lies outside the FPA. The additional controls in this area relate to the safe and timely evacuation of people who would be occupying the floodplain at the time of a flood event and only apply in areas categorised as FPCC4.

7 REFERENCES

AIDR (Australian Institute for Disaster Resilience), 2017. **"*Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia*"**

Australian Government, 2017. ***"Australian Disaster Resilience Handbook Collection – managing the Floodplain: A Guide to best Practice in Flood Risk Management in Australia"***

BoM (Bureau of Meteorology), 2003. ***"The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method"***

DECC (Department of Environment and Climate Change, NSW), 2007a. ***"Floodplain Risk Management Guideline – Flood Emergency Response Classification of Communities"***.

DECC (Department of Environment and Climate Change, NSW), 2007b. ***"Floodplain Risk Management Guideline – Practical Considerations of Climate Change"***.

DECC (Department of Environment and Climate Change, NSW), 2007c. ***"Floodplain Risk Management Guideline No 4. Residential Flood Damage Calculation"***.

Geoscience Australia, 2019. ***"Australian Rainfall and Runoff – A Guide to Flood Estimation"***

Lyall & Associates, 2022. **"Ariah Park and Springdale Flood Study"**

NSWG (New South Wales Government), 2005. ***"Floodplain Development Manual: the Management of Flood Liable Land"***.

NSW SES (NSW State Emergency Service), 2015. **"*Temora Shire Local Flood Plan*"**

Public Works (PW), 2010. ***"Wagga Wagga Levee Upgrade – Flood Freeboard"***

APPENDIX A

COMMUNITY CONSULTATION

TABLE OF CONTENTS

ATTACHMENTS

A1 INTRODUCTION

At the commencement of the *Ariah Park and Springdale FRMS,* the Consultants prepared a *Community Newsletter* and a *Community Questionnaire*, both of which were distributed by Council to the residents and business owners in in the two urban centres (refer to **Attachment 1**). The purpose of the *Community Newsletter* was to introduce the objectives of the study and set the scene on flooding conditions so that the community would be better able to respond to the *Community Questionnair*e and contribute to the study process.

The *Community Newsletter* contained the following information:

- A plan showing the extent of the study area in the two urban centres.
- A statement of the aim of the *Ariah Park and Springdale FRMS&P*; namely the development of a strategy for reducing the flood risk and minimising the long-term impact of flooding on the community.

The *Community Questionnaire* was structured with the objectives of:

- Determining residents' and business owners' attitudes to controls over future development in flood liable areas.
- Inviting community views on possible flood management options which could be considered for further investigation in the *Ariah Park and Springdale FRMS* and possible inclusion in the resulting *FRMP*.
- Obtaining feedback on any other flood related issues and concerns which the residents and business owners cared to raise.

This Appendix to the *Ariah Park and Springdale FRMS&P* report discusses the responses to the nine questions that were included in the *Community Questionnaire* and comments made by respondents.

Chapter A2 deals with the residents' and business owners' views on the relative importance of classes of development over which flood-related controls should be imposed by Council.

Chapter A3 identifies residents' and business owners' views on the suitability of the various options which could be considered in more detail in the *Ariah Park and Springdale FRMS.*

Chapter A4 discusses the best methods by which the community could provide feedback to the consultants over the course of the study.

Chapter A5 summarises the findings of the community consultation process.

A2 RESIDENT PROFILE AND FLOOD AWARENESS

A2.1 General

Residents were requested to complete the *Community Questionnaire* and return it to the Consultants by 18 June 2021. The deadline was extended to include any submissions that were received after this date. The Consultants received 22 responses, 15 from Ariah Park, four from Springdale and three which were from unknown addresses.

The Consultants have collated the responses which are shown in graphical format in **Attachment 2**.

A2.2 Respondent Profile

The first four questions of the *Community Questionnaire* canvassed information such as whether the respondent was a resident or business owner, length of time that the respondent had occupied the property and the type of property (e.g. house, unit/flat).

Of the 22 responses, 12 indicated that they were residents and two indicated they were business owners, both of whom were located in Ariah Park. A further three indicated that they were landowners, while the remaining two respondents indicated they were a farmer and the other associated with the Ariah Park Bowling Club (**Question 2**).

The length of time respondents had been at the address was found to be varied, with approximately 27% of respondents having lived at the residence for between '1-5 years', 36% for '5 to 20 years' and 27% for 'more than 20 years' (**Question 3**). Note that 10% of respondents did not answer this question.

The majority of respondents (15) occupied residential type property (**Question 4**), while one owned a shop in Ariah Park and a further six owned vacant land. The four respondents that selected 'other' referenced a farm, cabin, garage and the club house of the Ariah Park Bowling Club.

A2.3 Controls over Development in Flood Prone Areas

The respondents were asked to rank from 1 to 6 the classes of development which they consider should receive protection from flooding (**Question 5**). Rank 1 was the most important and rank 6 the least.

The classes in decreasing order of importance to respondents ranged from:

- vulnerable residential (e.g. aged persons accommodation);
- residential property;
- essential community facilities (e.g. schools, evacuation centres);
- commercial/business type development;
- new subdivisions; and
- minor developments and additions.

These results gave a guide to the Consultants as to the appropriate location of future development of the various classes within the floodplain. For example, on the basis of community views, consideration should be given to applying flood related development controls to residential development which lies at or below the FPL, while vulnerable residential type development and essential community facilities should receive the highest level of protection by locating future development of this nature off the floodplain.

In **Question 6**, respondents were asked about the level of control Council should place on new development to minimise flood-related risks. While ten respondents were in favour of Council advising of the flood risks, but allowing the individual the choice as to whether they develop or not provided they take steps to minimise the potential flood risks, five were in favour of prohibiting all development on land with any potential to flood.

Respondents were also asked in **Question 7** about what notifications Council should give about the flood affectation of individual properties. Fourteen respondents were in favour of advising prospective purchasers of the known potential flood threat, while seven respondents favoured advising every resident and property owner on a regular basis. Three respondents favoured only advising those who enquire to Council about the known potential flood risk, while no respondents favoured not providing any notification.

A3 POTENTIAL FLOOD MANAGEMENT MEASURES

The respondents were asked for their opinion on potential flood management measures which could be evaluated in the *Ariah Park and Springdale FRMS* (and if found to be feasible included in the *FRMP*), by ticking "yes" or "no" to the sixteen potential options identified in **Question 8**.

The options comprised a range of *structural flood management measures* (e.g. programs by Council to manage vegetation along creek corridors; widening of watercourses; construction of detention basins; construction of permanent levees; improving the stormwater drainage system, upgrading existing road/railway culverts and removing of floodplain obstructions), as well as a range of *non-structural management measures* (e.g. voluntary purchase of residential properties in high hazard areas; raising floor levels of houses in low hazard areas; flood related controls over new developments; improvements to flood warning and evacuation procedures; community education on flooding; flood advice certificates). The options were not mutually exclusive, as the adopted *FRMP* could, in theory, include all of the options set out in the *Community Questionnaire*, or indeed, other measures nominated by the respondents or the FRMC.

The most popular structural measure was the improvements to the existing stormwater drainage system and the upgrade of road/railway culverts, followed by the management of vegetation along the natural reaches of creek and the construction of permanent levees/diversion banks to contain floodwaters.

In regards the above, several respondents expressed the view that the existing culverts under the railway line where it runs through Ariah Park require upgrading, as do the culverts under Coolamon Street immediately to its south. The upgrade of the existing stormwater drainage system in parts of Ariah Park was also of major concern to several respondents. Respondents at Springdale highlighted the adverse impact that dense riparian vegetation in Gundibindyal Creek and its tributary arm in combination with floodplain obstructions (both natural and man-made) has in flood behaviour in the village.

Of the non-structural measures, the most popular was ensuring all information about the potential risks of flooding is available to all residents and business owners, specifying controls on future development in flood-liable areas, providing a Planning Certificate to purchasers in flood-prone areas and improvements to flood warning and evacuation procedures both before and during a flood were other popular non-structural measures.

A mostly negative response was given to flood proofing of individual properties. The voluntary purchase of severely flood-liable properties and the provision of funding or subsidies to raise houses above major flood level in low hazard areas were also unpopular.

A4 INPUT TO THE STUDY AND FEEDBACK FROM THE COMMUNITY

In **Question 9,** residents were asked for their view on the best methods of their providing input to the study and feedback to the Consultants over the course of the investigation. Council's website and articles in the local newspaper were the most popular methods, followed by direct communications with residents.

A5 SUMMARY

Twenty-two responses were received to the *Community Questionnaire* which was distributed by Council to residents and business owners in Ariah Park and Springdale.

The issues identified by the responses to the *Community Questionnaire* support the objectives of the study as nominated in the attached *Community Newsletter,* and the activities nominated in the Study Brief. While five respondents to the *Community Questionnaire* were in favour of prohibiting all new development on land with any potential to flood, ten were in favour of Council advising of the flood risks, but allowing the individual a choice to develop so long as potential flood risks are minimised.

Of the *structural measures* which could be incorporated in the *Ariah Park and Springdale FRMP*, the most popular were the upgrading of existing stormwater drainage system and the road/rail culverts in Ariah Park and the management of riparian vegetation and the removal of floodplain obstructions (both natural and man-made) in Springdale.

Ensuring all information about the potential risks of flooding is available to all residents and business owners, specifying controls on future development in flood-liable areas, providing a Planning Certificate to purchasers in flood-prone areas and improvements to flood warning and evacuation procedures both before and during a flood were the most popular of the potential *non-structural measures* set out in the *Community Questionnaire*.

Flood proofing of individual properties, the voluntary purchase of severely flood-liable properties and the provision of funding or subsidies to raise houses above major flood level in low hazard areas were given a mostly negative response.

ATTACHMENT A1

COMMUNITY NEWSLETTER
AND QUESTIONNAIRE

Ariah Park and Springdale Flood Study and Floodplain Risk Management Study and Plan

To Residents and Business Owners of Ariah Park and Springdale:

Temora Shire Council has engaged consultants to undertake the *Ariah Park and Springdale Flood Study* and *Floodplain Risk Management Study and Plan*. The study is jointly funded by Council and the NSW Department of Planning, Industry and Environment and aims to build community resilience towards flooding through informing better planning of development, emergency management and community awareness. Council has established a Floodplain Risk Management Committee which is comprised of relevant council members, state government agencies and community representatives.

The purpose of the *Flood Study* is to define the impact that flooding has on the villages of Ariah Park and Springdale for a range of storm events. The indicative extent of the 1 in 100 year flood at Ariah Park and Springdale under present day climatic conditions as defined in the *Flood Study* are shown on the attached **Figures 1** and **2** , respectively.

The *Flood Study* is nearing completion and the community is invited to review and comment on the draft report which will be placed on public exhibition at the White Rose Cafe at Ariah Park and Council's offices in Temora between **21 May and 18 June 2021**. The draft report will also be available via Council's website (http://temora.nsw.gov.au/).

A drop-in session will be held at Council's offices in Temora between **10 am** and **12 pm** on **Wednesday 9 June 2021** where the Consultants will be available to answer any questions that you may have about the *Flood Study*.

Following the public exhibition period, the Consultants will consider the feedback from the exhibition process and embark on the next phase of the study - the preparation of the *Floodplain Risk Management Study and Plan*.

The aim of the *Floodplain Risk Management Study and Plan* is to assist Council in refining strategic plans for mitigating and managing the effects of existing flood risk (associated with existing development on flood prone land), future flood risk (associated with any new development on flood prone land) and continuing flood risk (the risk remaining in both existing and future development areas after floodplain risk management measures are implemented).

Have Your Say on Floodplain Management

An important step in the *Floodplain Risk Management Study and Plan* is to appraise what flood related issues are important to the community. The attached **questionnaire** has been provided to residents and businesses to assist the Consultant in gathering this important information. All information provided will remain confidential and for use in this study only. Please return the completed Questionnaire to Council's offices or email a scanned copy to the email address below by **Friday 18 June 2021**.

Contact: Temora Shire Council
Claire Golder | Town Planner/Strategic Projects Officer
Phone: (02) 6980 1108
Email: cgolder@temora.nsw.gov.au

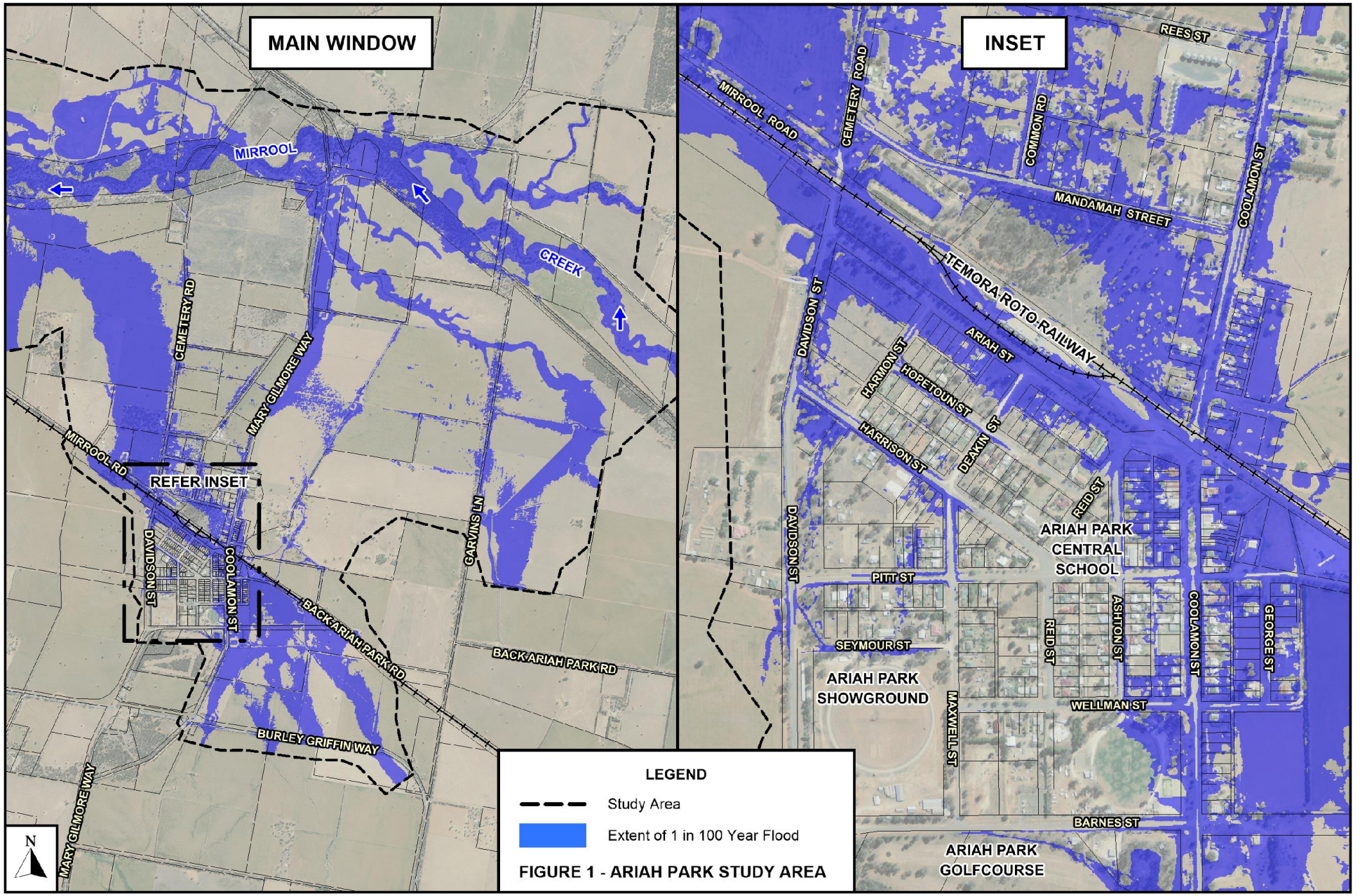


FIGURE 1 - ARIAH PARK STUDY AREA

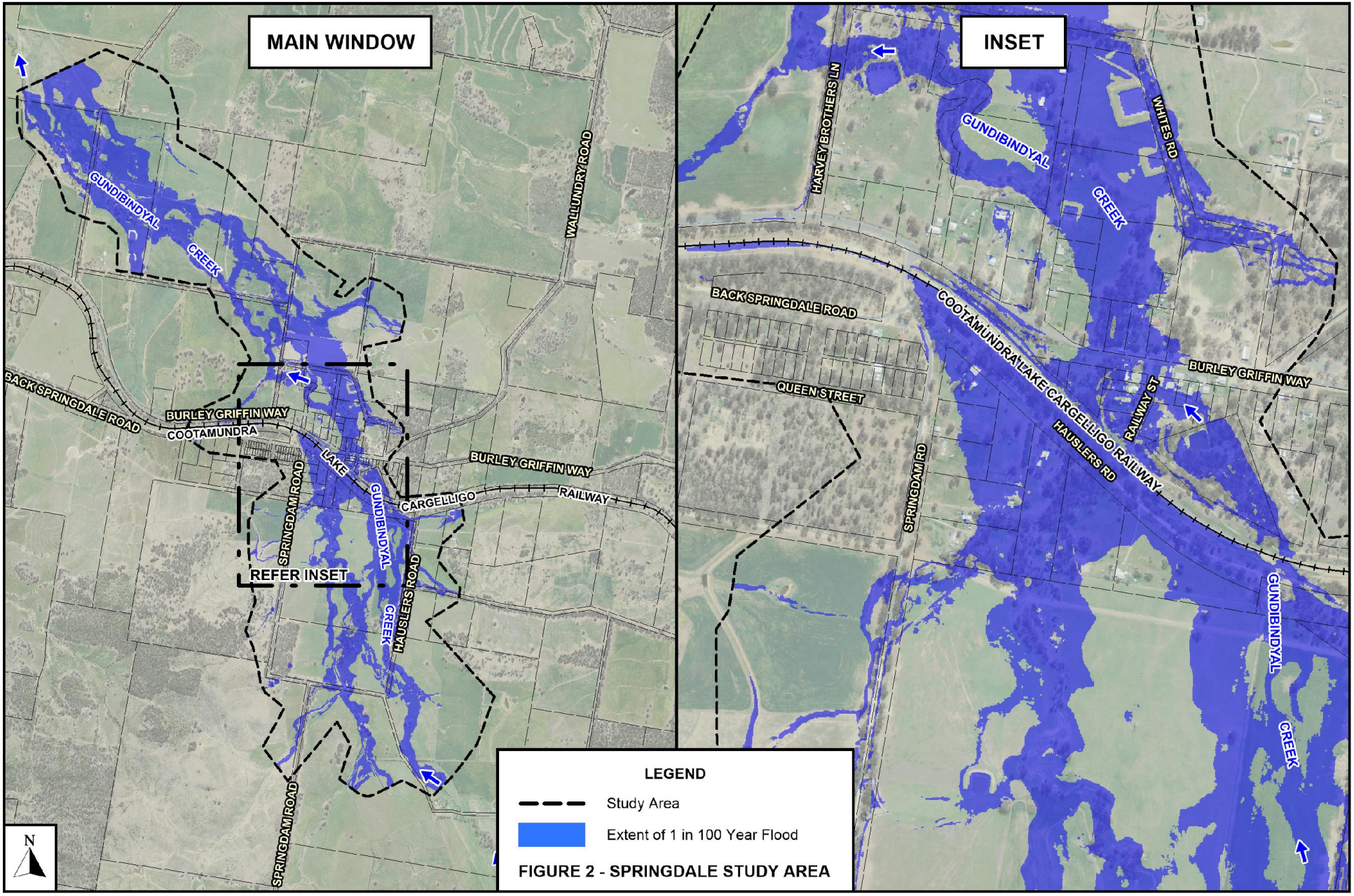


FIGURE 2 - SPRINGDALE STUDY AREA

Ariah Park and Springdale Flood Study and Floodplain Risk Management Study and Plan

Community Questionnaire

This Questionnaire is part of the *Ariah Park and Springdale Floodplain Risk Management Study and Plan* which is currently being undertaken by Temora Shire Council with the financial support of the NSW Department of Planning, Industry and Environment. Your responses to the questionnaire will help us determine the flood issues that are important to you.

Please return your completed Questionnaire to Council offices or email a scanned copy to cgolder@temora.nsw.gov.au by **Friday 18 June 2021**.

1. Your name (optional):_____

Address:_____

About your property

2. Please tick as appropriate:

- ☐ I am a resident
- ☐ I am a business owner
- ☐ Other (please specify_____)

3. How long have you been at this address?

- ☐ 1 year to 5 years
- ☐ 5 years to 20 years
- ☐ More than 20 years (… years)

4. What is your property?

- ☐ House
- ☐ Villa/Townhouse
- ☐ Unit/Flat/Apartment
- ☐ Vacant land
- ☐ Industrial unit in larger complex
- ☐ Stand alone warehouse or factory
- ☐ Shop
- ☐ Community building
- ☐ Other (_____)

Your attitudes to Council's development controls

5. Please rank the following development types according to which you think are the most important to protect from floods

(1=highest priority to 6=least priority)

Development Type	Rank
Commercial/Business	
Residential	
Vulnerable residential development (e.g. aged persons accommodation)	
Essential community facilities (e.g. schools, evacuation centres)	
Minor developments and additions	
New subdivisions	

6. What level of control do you consider Council should place on new development to minimise flood-related risks?

(Tick only one box)

(In addition to being favoured by the Community, these options would also need to comply with legislation)

- ☐ Prohibit all new development on land with any potential to flood
- ☐ Prohibit all new development only in those locations that would be extremely hazardous to persons or property due to the depth and/or velocity of floodwaters, or evacuation difficulties
- ☐ Place restrictions on developments which reduce the potential for flood damage (e.g. minimum floor level controls or the use of flood compatible building materials)
- ☐ Advise of the flood risks, but allow the individual a choice as to whether they develop or not, provided steps are taken to minimise potential flood risks
- ☐ Provide no advice regarding the potential flood risks or measures that could minimise those risks
- ☐ Don't know

7. What notifications do you consider Council should give about the potential flood affectation of individual properties?

(Tick one or more boxes)

- ☐ Advise every resident and property owner on a regular basis of the known potential flood threat
- ☐ Advise only those who enquire to Council about the known potential flood threat
- ☐ Advise prospective purchasers of property of the known potential flood threat.
- ☐ Provide no notifications
- ☐ Other (please specify below)

_____

_____

_____

_____)

Your opinions on floodplain risk management measures

8. Below is a list of possible options that may be looked at to try to minimise the effects of flooding in the study area.

This list is not in any order of importance and there may be other options that you think should be considered. For each of the options listed, please indicate "yes" or "no" to indicate if you favour the option. Please leave blank if undecided.

Option	Yes	No	Don't Know
Management of vegetation along creek corridors to provide flood mitigation, stability, aesthetic and habitat benefits			
Widening of watercourses			
Construct detention basins			
Construction of permanent levees/diversion banks to contain floodwaters			
Improve stormwater drainage system			
Upgrade culverts beneath roads/railways			
Removal of floodplain obstructions			
Voluntary purchase of the most severely affected flood-liable properties			
Provide funding or subsidies to raise houses above major flood level in low hazard areas.			
Flood proofing of individual properties by waterproofing walls, putting shutters across doors, etc.			
Specify controls on future development in flood-liable areas (e.g. controls on extent of filling, minimum floor levels, etc.)			
Provide a Planning Certificate to purchasers in flood prone areas, stating that the property is flood affected.			
Ensuring all information about the potential risks of flooding is available to all residents and business owners			
Improve flood warning and evacuation procedures both before and during a flood.			
Community education, participation and flood awareness programs.			
Ensuring all residents and business owners have Flood Action Plans - these outline WHAT people should do, WHERE they should go and WHO they should contact in a flood			

Other Information

9. What do you think is the best way for us to get input and feedback from the local community about the results and proposals from this study? (Tick one or more boxes)

- ☐ Council's website
- ☐ Articles in local newspaper
- ☐ Through Council's Floodplain Management Committee
- ☐ Other (please specify) _____

10. If you wish us to contact you so you can provide further information, please provide your details below:

Name: _____

Address: _____

_____

Phone: _____

Email: _____

Who can I contact for further information?

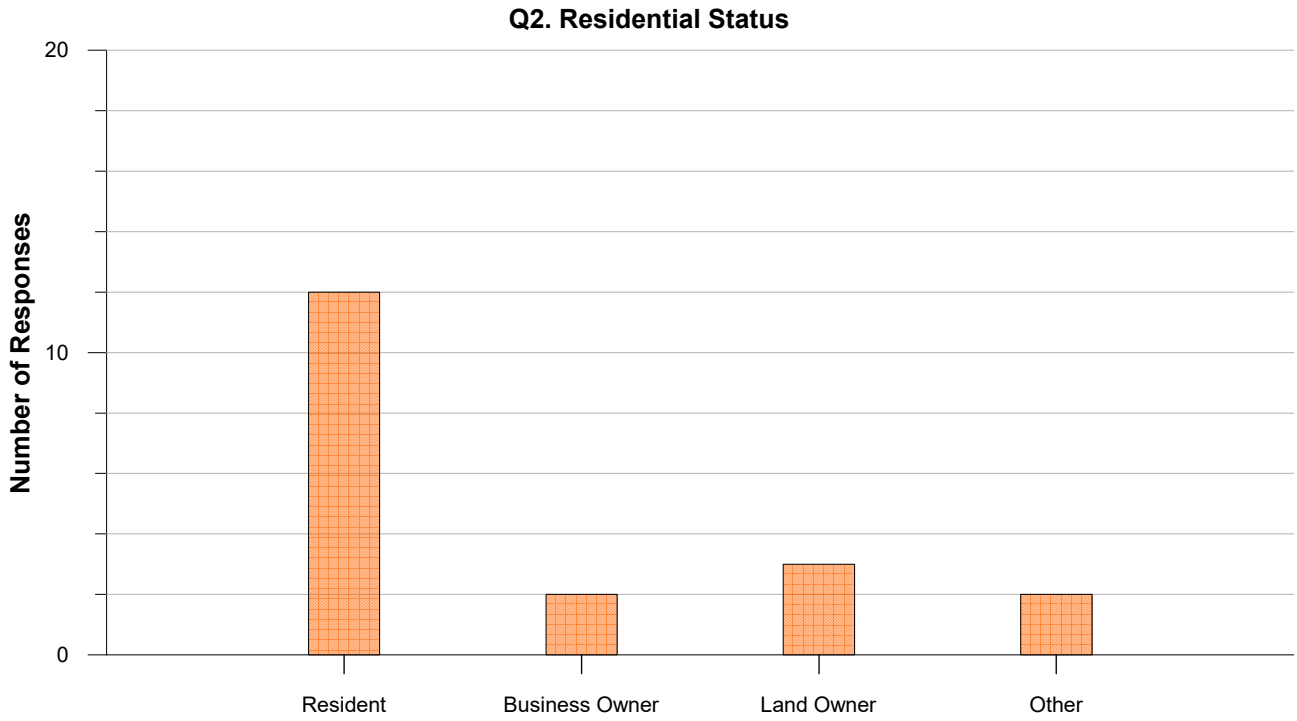
Temora Shire Council
Claire Golder | Town Planner/Strategic Projects Officer
Phone: (02) 6980 1108
Email: cgolder@temora.nsw.gov.au

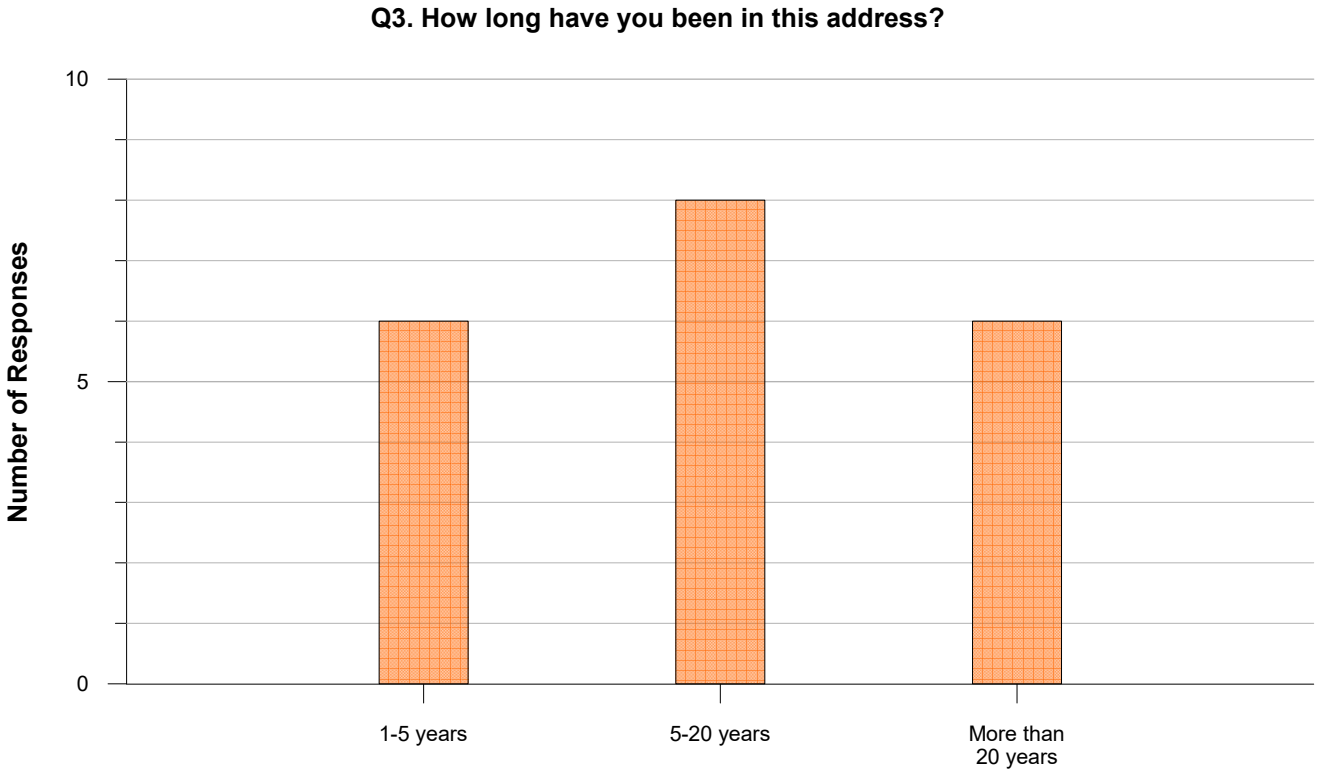
COMMENTS

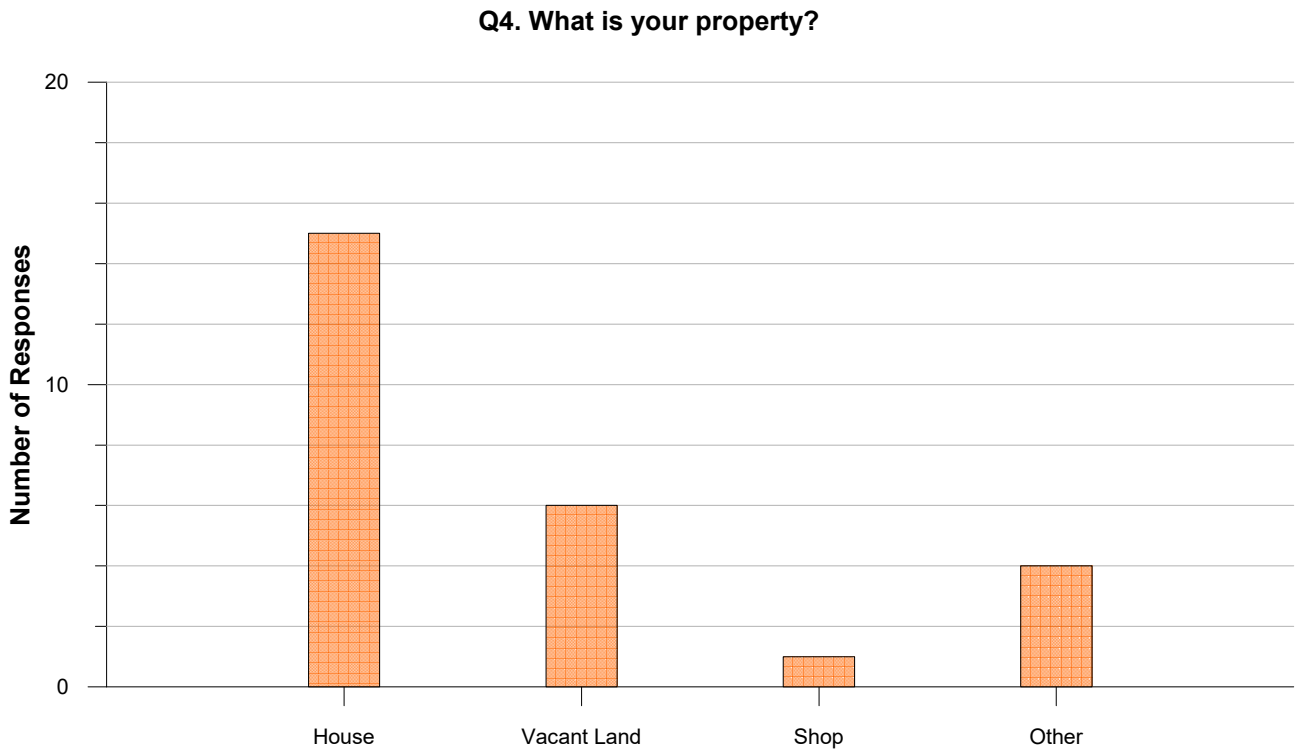
Please write any additional comments here:

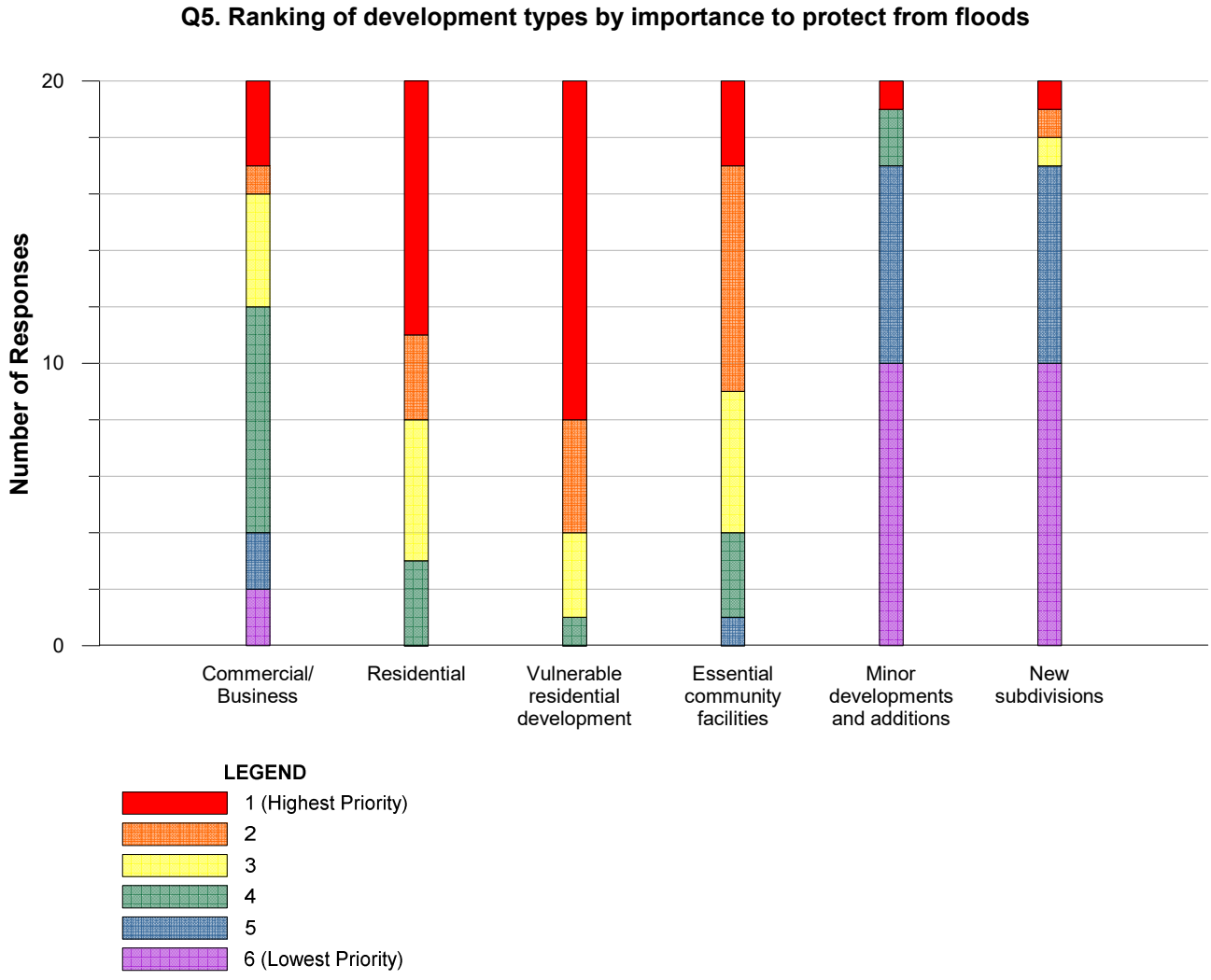
ATTACHMENT A2

RESPONSES TO COMMUNITY QUESTIONNAIRE

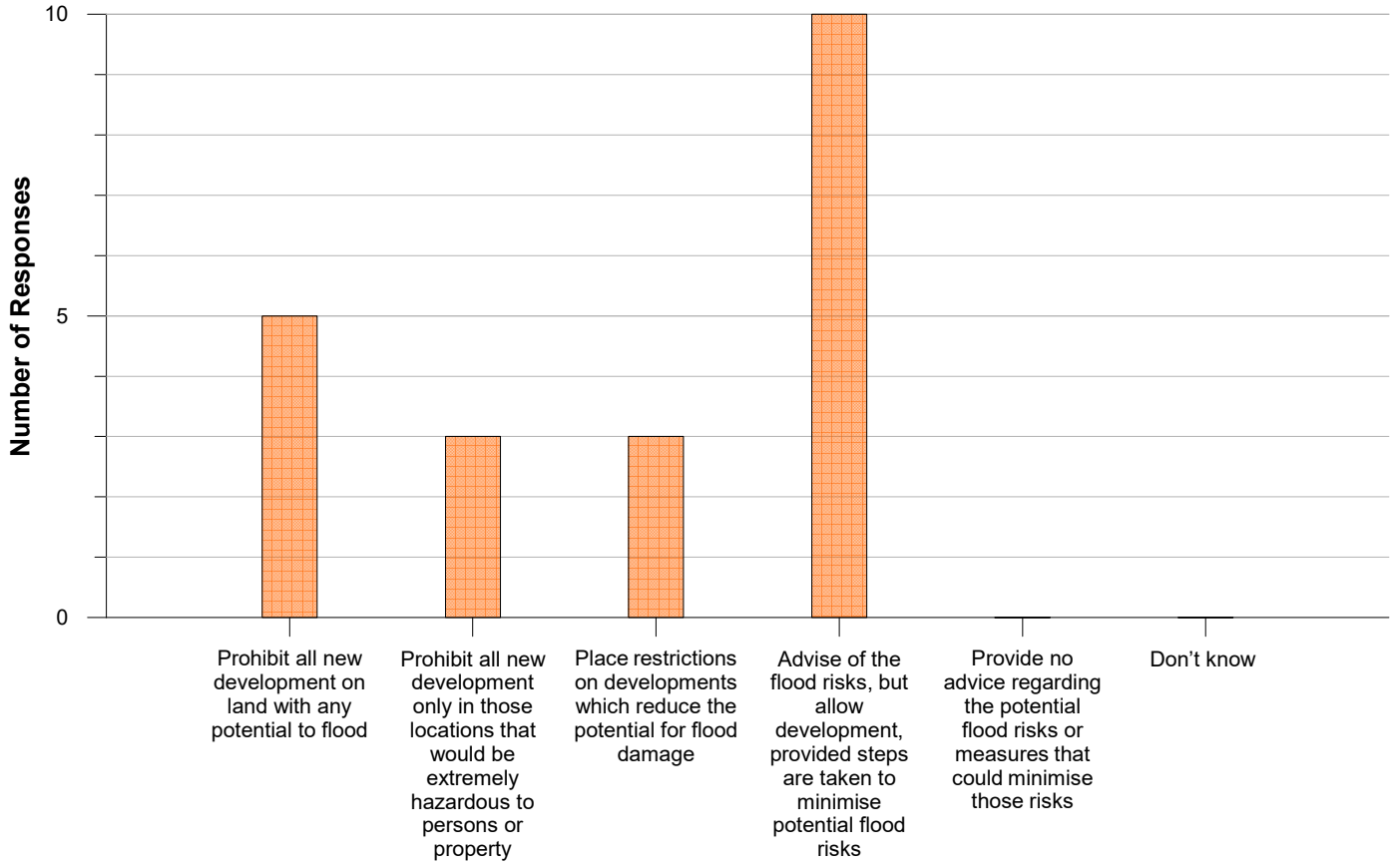

Q2. Residential Status
Number of Responses
20
10
0
Resident
Business Owner
Land Owner
Other


Q3. How long have you been in this address?
Number of Responses
10
5
0
1-5 years
5-20 years
More than
20 years

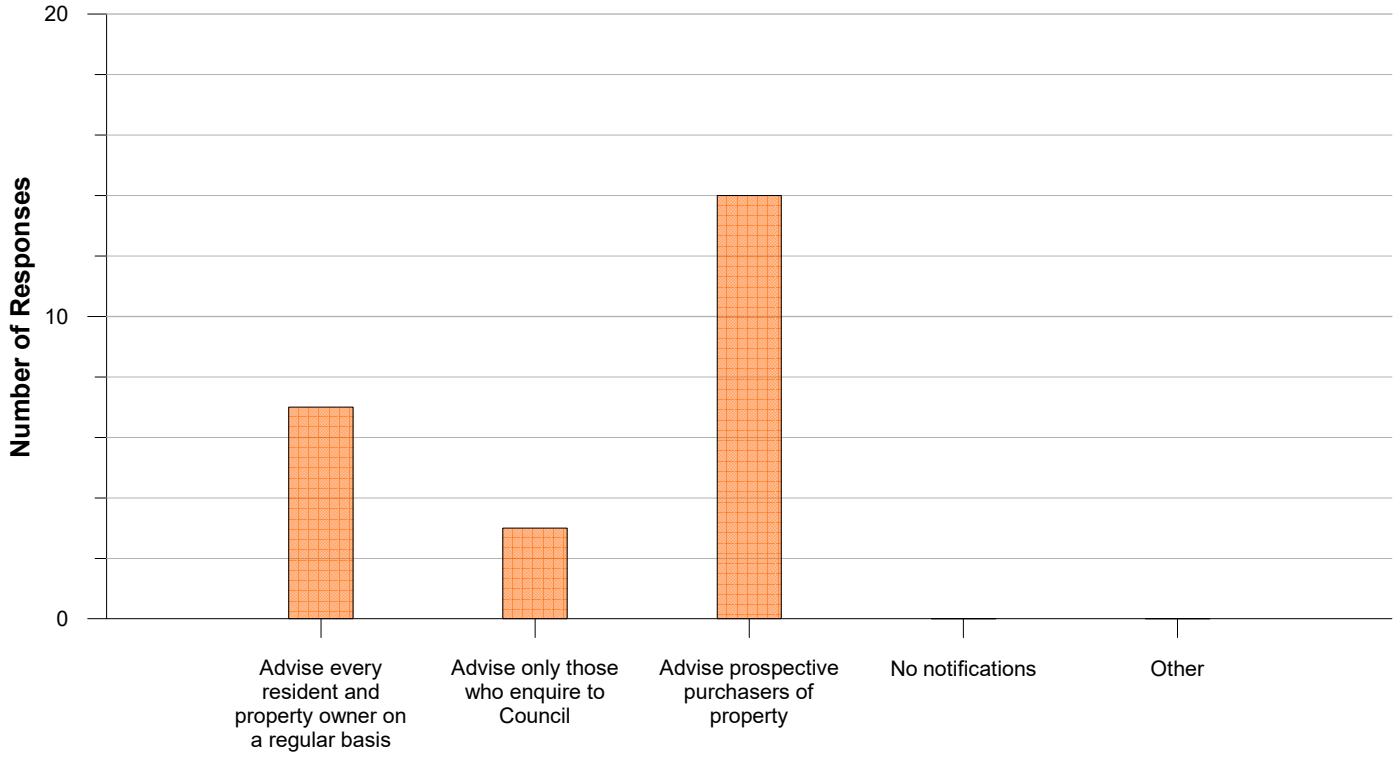

Q4. What is your property?
Number of Responses
20
10
0
House
Vacant Land
Shop
Other


Q5. Ranking of development types by importance to protect from floods
Number of Responses
20
10
0
Commercial/ Business
Residential
Vulnerable residential development
Essential community facilities
Minor developments and additions
New subdivisions
LEGEND
1 (Highest Priority)
2
3
4
5
6 (Lowest Priority)

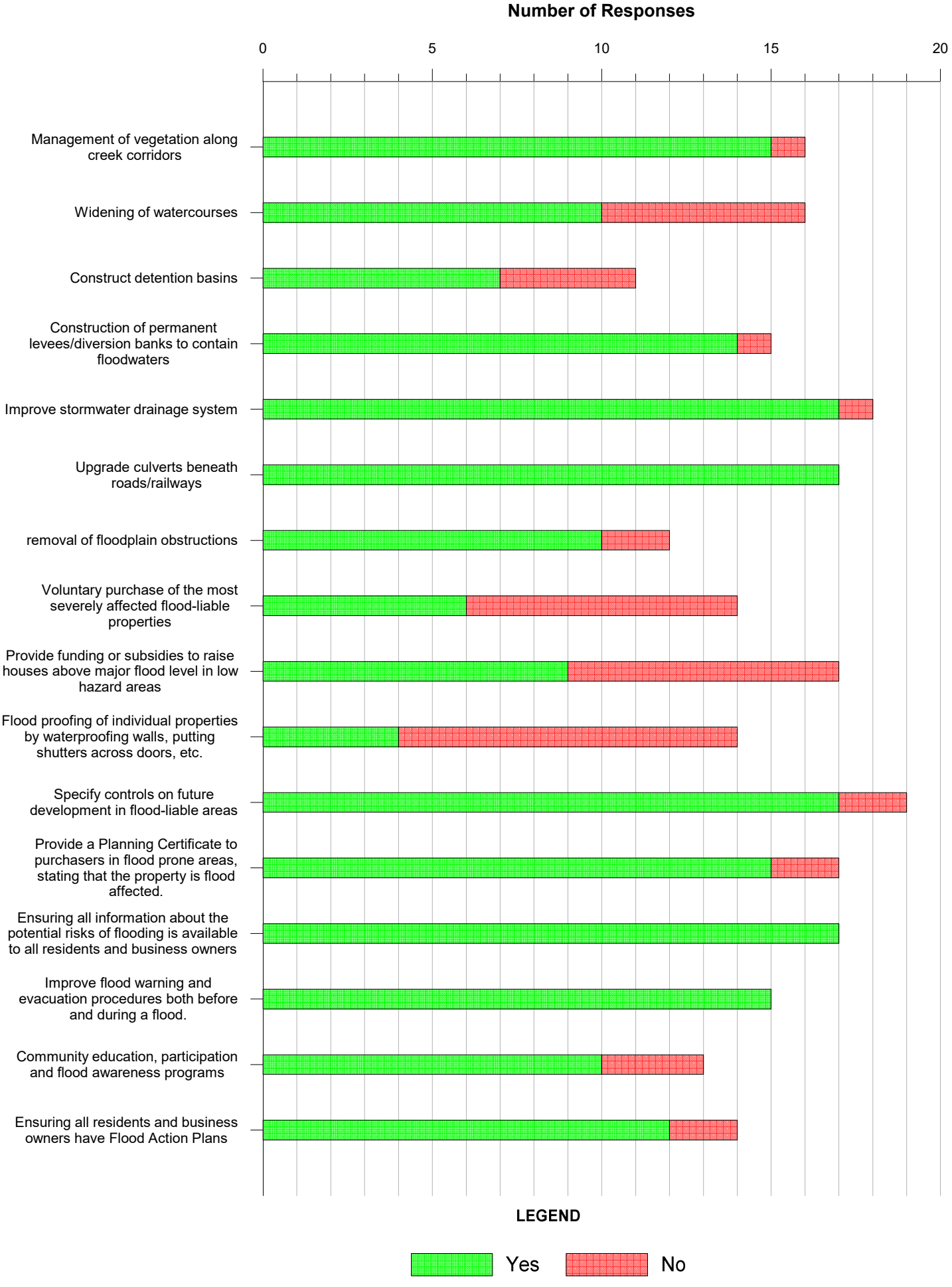
Q6. What level of control should Council place on new development to minimise flood-related risks?



Q7. What notifications should Council give about the potential flood affectation of properties?

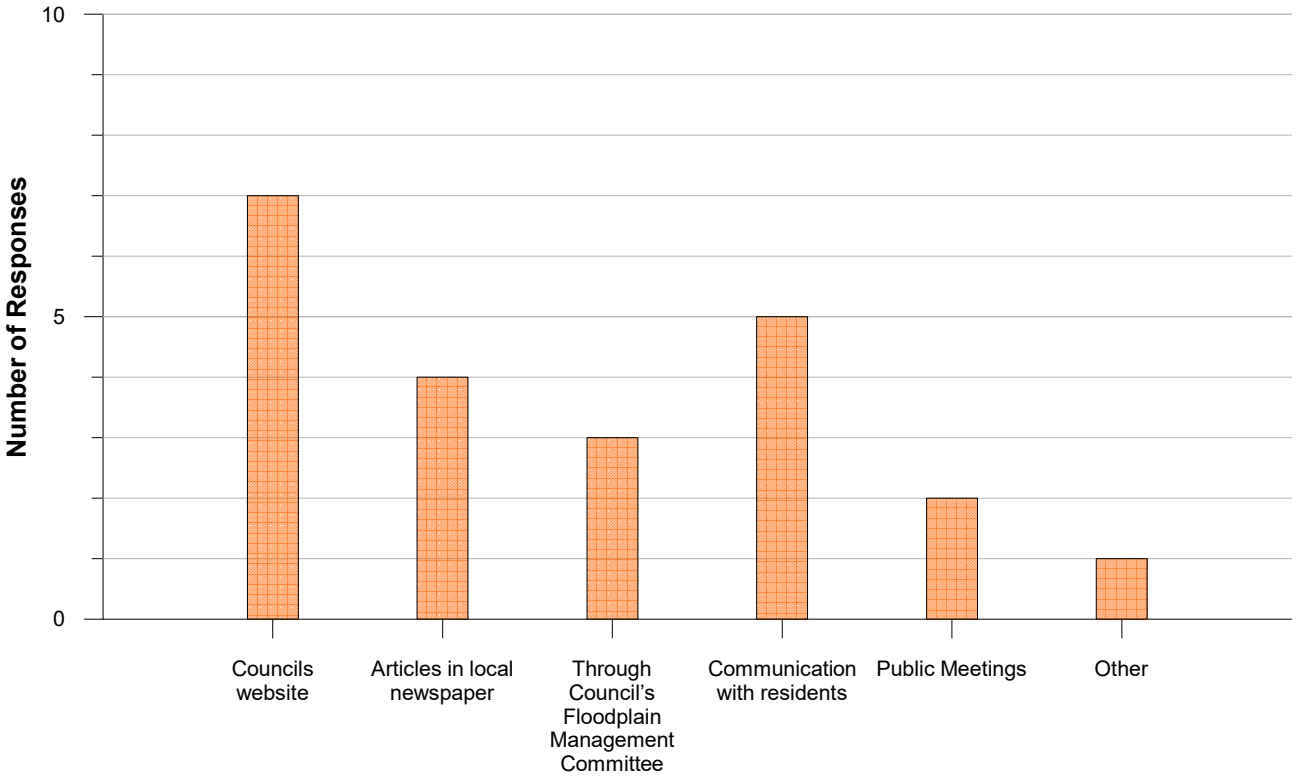


Q8. Possible Floodplain Management Measures



RESPONSE TO COMMUNITY QUESTIONNAIRE

Q9. Best methods to get input and feedback from the local community



APPENDIX B
PHOTOGRAPHS SHOWING HISTORIC FLOOD BEHAVIOUR IN ARIAH PARK AND SPRINGDALE

SPRINGDALE – 3 FEBRUARY 2011

Plate B1.1 – (Photo taken at 08:23 hrs) Looking south across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B1.2 – (Photo taken at 08:23 hrs) Looking west across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B1.3 – (Photo taken at 08:23 hrs) Looking north along Gundibindyal Creek in No. 6262 Burley Griffin Way.

SPRINGDALE – 22 DECEMBER 2011

Plate B2.1 – (Photo taken at 17:45 hrs) Looking south across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B2.2 – (Photo taken at 17:45 hrs) Looking west across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B2.3 – (Photo taken at 17:45 hrs) Looking upstream along the eastern bank of Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B2.4 – (Photo taken at 17:46 hrs) Looking west across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B2.5 – (Photo taken at 17:52 hrs) Looking west across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B2.6 – (Photo taken at 18:12 hrs) Looking south across Gundibindyal Creek in No. 6262 Burley Griffin Way.

SPRINGDALE – 22 DECEMBER 2011

Plate B2.7 – (Photo taken at 18:13 hrs) Looking west across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B2.8 – (Photo taken at 18:20 hrs) Looking west across Gundibindyal Creek confluence in No. 6262 Burley Griffin Way.

Plate B2.9 – (Photo taken at 18:21 hrs) Looking upstream across Gundibindyal Creek confluence in No. 6262 Burley Griffin Way.

SPRINGDALE – 22 DECEMBER 2011

Plate B2.10 – (Photo taken at 20:01 hrs) Looking in easterly direction at Burley Griffin Way crossing of Gundibindyal Creek.

Plate B2.11 – (Photo taken at 20:01 hrs) Looking in easterly direction at Burley Griffin Way crossing of Gundibindyal Creek.

Plate B2.12 – (Photo taken at 20:02 hrs) Looking in easterly direction at Burley Griffin Way crossing of Gundibindyal Creek.

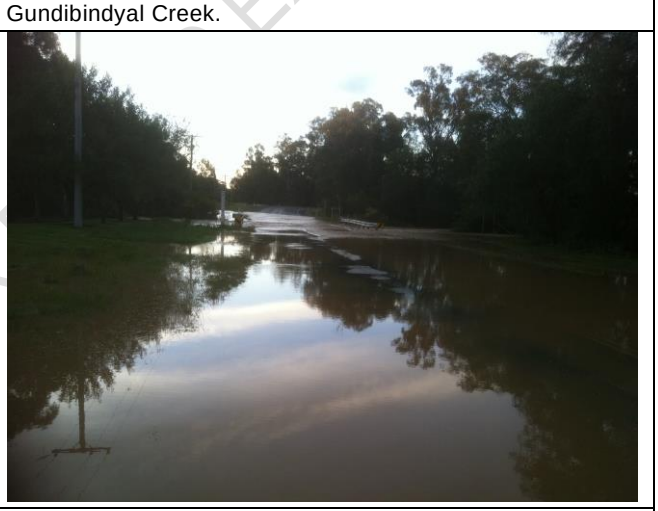


Plate B2.13 – (Photo taken at 20:06 hrs) Looking in westerly direction at Burley Griffin Way crossing of Gundibindyal Creek.

SPRINGDALE – 3 MARCH 2012

Plate B3.1 – (Photo taken at 15:46 hrs) Looking south along Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B3.2 – (Photo taken at 15:46 hrs) Looking west across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B3.3 – (Photo taken at 17:46 hrs) Looking north along Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B3.4 – (Photo taken at 17:52 hrs) Looking north along Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B3.5 – (Photo taken at 17:46 hrs) Looking west along Gundibindyal Creek in No. 6262 Burley Griffin Way.

SPRINGDALE – 11 JULY 2016

Plate B5.1 – (Photo taken at 15:46 hrs) Looking south-east along Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B5.2 – (Photo taken at 15:46 hrs) Looking north across Gundibindyal Creek in No. 6262 Burley Griffin Way.

ARIAH PARK – 3 SEPTEMBER 2016

Plate B5.1 – (Photo taken at 08:08 hrs) Looking west along Burley Griffin Way between Garvins Lane and Mary Gilmore Way.

Plate B5.2 – (Photo taken at 08:09 hrs) Looking west along Burley Griffin Way between Garvins Lane and Mary Gilmore Way.

Plate B5.3 – (Photo taken at 08:09 hrs) Looking west along Burley Griffin Way between Garvins Lane and Mary Gilmore Way.

Plate B5.4 – (Photo taken at 08:09 hrs) Looking west along Burley Griffin Way between Garvins Lane and Mary Gilmore Way.

Plate B5.5 – (Photo taken at 08:10 hrs) Looking west along Burley Griffin Way between Garvins Lane and Mary Gilmore Way.

SPRINGDALE – 10 SEPTEMBER 2016

Plate B6.1 – (Photo taken at 07:40 hrs) Looking north across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B6.2 – (Photo taken at 07:41 hrs) Looking south-west across Gundibindyal Creek in No. 6262 Burley Griffin Way.

Plate B6.3 – (Photo taken at 07:41 hrs) Looking west across Gundibindyal Creek in No. 6262 Burley Griffin Way.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.1 – (Photo taken at 18:04 hrs) Temporary channel dug out through Wellman Street in vicinity of its intersection with George Street.

Plate B7.2 – (Photo taken at 18:01 hrs) Ponding in table drain in front of No. 3 George Street.

Plate B7.3 – (Photo taken at 10:55 hrs) Ponding in rear of No. 3 George Street.

Plate B7.4 – (Photo taken at 18:02 hrs) Looking north along George Street.

Plate B7.5 – (Photo taken at 18:00 hrs) Looking south along George Street.

Plate B7.6 – (Photo taken at 18:04 hrs) Looking north along George Street, from its intersection with Wellman Street.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.7 – (Photo taken at 18:00 hrs) Ponding in vicinity of intersection of George Street and Back Ariah Park Road.

Plate B7.8 – (Photo taken at 17:59 hrs) Ponding in vicinity of intersection of George Street and Back Ariah Park Road.

Plate B7.9 – (Photo taken at 17:59 hrs) Ponding in vicinity of intersection of George Street and Back Ariah Park Road.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.10 – (Photo taken at 11:52 hrs) Looking east along Burley Griffin Way between Mary Gilmore Way and Garvins Lane.

Plate B7.11 – (Photo taken at 11:52 hrs) Looking east along Burley Griffin Way between Mary Gilmore Way and Garvins Lane.

Plate B7.12 – (Photo taken at 11:53 hrs) Looking east along Burley Griffin Way between Mary Gilmore Way and Garvins Lane.

Plate B7.13 – (Photo taken at 11:54 hrs) Looking east along Burley Griffin Way between Mary Gilmore Way and Garvins Lane.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.14 – (Photo taken at 16:36 hrs) Looking north along Mary Gilmore Way approximately 200 m to the north of Rees Street.

Plate B7.15 – (Photo taken at 16:35 hrs) Looking south along Mary Gilmore Way approximately 200 m to the north of Rees Street.

Plate B7.16 – (Photo taken at 16:38 hrs) Looking south along Coolamon Street in vicinity of its intersection with Rees Street.

Plate B7.17 – (Photo taken at 16:41 hrs) Looking south along Coolamon Street approximately 170 m to the south of Rees Street.

Plate B7.18 – (Photo taken at 16:42 hrs) Looking south along Coolamon Street in vicinity of its intersection with Wattle Street.

Plate B7.19 – (Photo taken at 16:43 hrs) Looking south along Coolamon Street approximately 150 m to the north of railway.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.20– (Photo taken at 16:25 hrs) Looking north along Coolamon Street on the southern side of the Temora Roto Railway.

Plate B7.21 – (Photo taken at 16:44 hrs) Looking east along the southern side of Temora Roto Railway from Coolamon Street.

Plate B7.22 – (Photo taken at 16:44 hrs) Looking west along Ariah Street from its intersection with Coolamon Street.

Plate B7.23 – (Photo taken at 16:51 hrs) Looking west along Ariah Street and Temora Roto Railway from its intersection with Coolamon Street.

Plate B7.23 – (Photo taken at 16:51 hrs) Looking west along Ariah Street and Temora Roto Railway from its intersection with Coolamon Street.

Plate B7.24 – (Photo taken at 16:25 hrs) Looking west along Ariah Street and Temora Roto Railway from its intersection with Coolamon Street.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.25 – (Photo taken at 16:44 hrs) Looking south along Coolamon Street from Temora Roto Railway.

Plate B7.26 – (Photo taken at 16:25 hrs) Looking south along the eastern side of Coolamon Street from its intersection with Ariah Street.

Plate B7.27 – (Photo taken at 16:48 hrs) Looking north along the eastern side of Coolamon Street from its intersection with Ariah Street.

Plate B7.28 – (Photo taken at 16:50 hrs) Looking north on the eastern side of Coolamon Street.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.29 – (Photo taken at unknown time) Looking north from No. 1 Coolamon Street, along its eastern table drain.

Plate B7.30 – (Photo taken at unknown time) Looking north from No. 1 Coolamon Street, along its eastern table drain.

Plate B7.31 – (Photo taken at unknown time) Looking north along Coolamon Street in the vicinity of its intersection with the Temora Roto Railway.

Plate B7.32 – (Photo taken at unknown time) Looking north along Coolamon Street, in vicinity of No. 124 Coolamon Street.

Plate B7.33 – (Photo taken at unknown time) Looking south along Coolamon Street, in vicinity of No. 124 Coolamon Street.

Plate B7.34 – (Photo taken at unknown time) Looking north along Coolamon Street in the vicinity of its intersection with the Temora Roto Railway.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.35 – (Photo taken at unknown time) Looking north along Coolamon Street in the vicinity of its intersection with the Temora Roto Railway.

Plate B7.36 – (Photo taken at unknown time) Looking north along Coolamon Street in the vicinity of its intersection with the Temora Roto Railway.

Plate B7.37 – (Photo taken at unknown time) Looking north along Coolamon Street in vicinity of its intersection with the Temora Roto Railway.

Plate B7.38 – (Photo taken at unknown time) Looking west along Ariah Street and Temora Roto Railway from its intersection with Coolamon Street.

Plate B7.39 – (Photo taken at unknown time) Looking north at southern side of Temora Roto Railway, in vicinity of Davey Park .

Plate B7.40 – (Photo taken at unknown time) Looking north from the intersection of Wellman Street and George Street.

ARIAH PARK – 21 SEPTEMBER 2016

Plate B7.41 – (Photo taken at unknown time) Looking west along Wellman Street in the vicinity of its intersection with George Street.

Plate B7.42 – (Photo taken at unknown time) Looking north along Mary Gilmore Way at its crossing over Mirrool Creek.

Plate B7.43 – (Photo taken at unknown time) Looking north along Mary Gilmore Way at its crossing over Mirrool Creek.

SPRINGDALE – 21 SEPTEMBER 2016

Plate B8.1 – (Photo taken at 10:13 hrs) Looking west along Burley Griffin Way from the easterly direction at Burley Griffin Way crossing of Gundibindyal Creek.

Plate B8.2 – (Photo taken at 10:13 hrs) Looking west along Burley Griffin Way from the easterly direction at Burley Griffin Way crossing of Gundibindyal Creek.

Plate B8.3 – (Photo taken at 10:14 hrs) Looking west along Burley Griffin Way from the easterly direction at Burley Griffin Way crossing of Gundibindyal Creek.

SPRINGDALE – 8 JANUARY 2019

Plate B9.1 – (Photo taken at 16:44 hrs) Floodwater flowing at "bank full" level in Gundibindyal Creek in No. 6262 Burley Grffin.

Plate B9.2 – (Photo taken at 16:45 hrs) Floodwater flowing at "bank full" level in Gundibindyal Creek in No. 6262 Burley Grffin.

ARIAH PARK – 8 FEBRUARY 2019

Plate B10.1 – (Photo taken at 15:55 hrs) Looking east along Wellman Street from its intersection with George Street.

Plate B10.2 – (Photo taken at 15:54 hrs) Looking south at floodwater ponding on the southern side of Wellman Street in vicinity of its intersection with George Street.

Plate B10.3 – (Photo taken at 14:20 hrs) Looking south along Coolamon Street from its intersection with Back Ariah Park Road.

Plate B10.4 – (Photo taken at 14:20 hrs) Looking south along Coolamon Street in front of Ariah Park Hotel.

Plate B10.5 – (Photo taken at 14:20 hrs) Looking south along Coolamon Street from the Temora Roto Railway.

Plate B10.6 – (Photo taken at 14:20 hrs) Looking east along the southern side of the Temora Roto Railway from Coolamon Street.

ARIAH PARK – 8 FEBRUARY 2019

Plate B10.7 – (Photo taken at 14:20 hrs) Looking north along Coolamon Street in vicinity of its intersection with Broughton Street.

SPRINGDALE – 23 MARCH 2021

Plate B11.1 – (Photo taken at unknown time) Looking north across Burley Griffin Way from its intersection with Railway Street.

Plate B11.2 – (Photo taken at unknown time) Looking north across Burley Griffin Way from its intersection with Railway Street.

Plate B11.3 – (Photo taken at unknown time) Looking east across Railway Street immediately to the south of its intersection with Burley Griffin Way.

Plate B11.4 – (Photo taken at unknown time) Looking east across Railway Street immediately to the south of its intersection with Burley Griffin Way.

SPRINGDALE – 23 MARCH 2021

Plate B11.5 – (Photo taken at unknown time) Looking east along Gundibindyal Creek towards the disused railway dam from Railway Street.

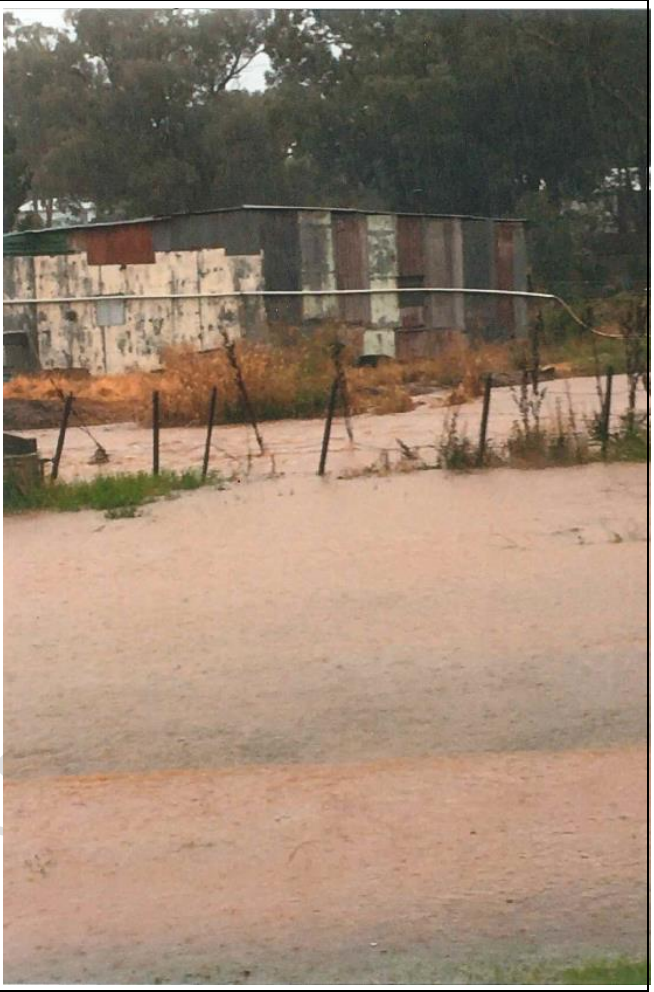


Plate B11.6 – (Photo taken at 15:54 hrs) Looking east along Gundibindyal Creek from Railway Street.

Plate B11.7 – (Photo taken at unknown time) Looking east across Railway Street which is completely inundated.

Plate B11.8 – (Photo taken at unknown time) Looking north toward footbridge crossing of Gundibindyal Creek to the west of the intersection of Railway Street and Burley Griffin Way.

SPRINGDALE – 23 MARCH 2021

Plate B11.9 – (Photo taken at unknown time) Truck driving through floodwater on Burley Griffin Way.

Plate B11.10 – (Photo taken at 15:54 hrs) Truck driving through floodwater on Burley Griffin Way.

Plate B11.11 – (Photo taken at unknown time) Car driving through floodwater on Burley Griffin Way.

Plate B11.12 – (Photo taken at unknown time) Looking north across Burley Griffin Way to the west of its intersection with Railway Street.

APPENDIX C

SUGGESTED WORDING FOR INCLUSION IN TEMORA SHIRE DEVELOPMENT CONTROL PLAN

TABLE OF CONTENTS

FIGURES
(BOUND IN VOLUME 2)

C1.1 Introduction

This section of the DCP sets out specific controls to guide development of flood liable land. The approach to managing future development that is subject to flooding supports the findings of a series of location specific floodplain risk management studies and plans that have been prepared as part of the NSW Government's program to mitigate the impact of major floods and reduce the associated hazards in the floodplain.

C1.2 Objectives in Relation to Flood Risk Management

a) To minimise the potential impact of development and other activity upon the aesthetic, recreational and ecological value of the waterway corridors.

b) To increase public awareness of the hazard and extent of land affected by all potential floods, including floods greater than the 1% Annual Exceedance Probability (AEP) flood and to ensure essential services and land uses are planned in recognition of all potential floods.

c) To inform the community of Council's controls and policy for the use and development of flood prone land.

d) To reduce the risk to human life and damage to property caused by flooding through controlling development on land affected by potential floods.

e) To provide detailed controls for the assessment of applications lodged in accordance with the *Environmental Planning and Assessment Act 1979* on land affected by potential floods.

f) To provide different guidelines, for the use and development of land subject to all potential floods in the floodplain, which reflect the probability of the flood occurring and the potential hazard within different areas.

g) To apply a "merit-based approach" to all development decisions which takes account of social, economic and ecological considerations.

h) To control development and other activity within each of the individual floodplains within the LGA having regard to the characteristics and level of information available for each of the floodplains, in particular the availability of floodplain risk management studies and plans prepared in accordance with the *Floodplain Development Manual*, issued by the NSW Government.

i) To deal equitably and consistently with applications for development on land affected by potential floods, in accordance with the principles contained in the *Floodplain Development Manual*.

C1.3 Procedure for Determining What Controls Apply to Proposed Development

The procedure Council will apply for determining the specific controls applying to proposed development in flood liable areas is set out below. Upon enquiry by a prospective applicant, Council will make an initial assessment of the flood affectation and flood levels at the site using the following procedure:

- Assess whether the development is located on flood liable land from the **Flood Planning Map**.
- Determine which set of prescriptive flood related planning controls apply to the development from the **Flood Planning Map** (i.e. Main Stream Flooding or Major Overland Flow).

- Identify the category of the development from **Schedule1: Land Use Categories.**
- Determine the appropriate flood level at the site from the results of the location specific flood or floodplain risk management study.
- Determine which part of the floodplain the development is located in from the **Flood Planning Constraint Category Map**.
- Confirm that the development conforms with the relevant performance criteria, as well as the prescriptive controls set out in either **Schedule 2A** for Main Stream Flooding affected areas and **Schedule 2B** for Major Overland Flow affected areas.

With the benefit of this initial information from Council, the applicant will:

- Prepare the documentation to support the Development Application according to the requirements of **Section C1.9**.

A survey plan showing natural surface levels over the site will be required as part of the Development Application documentation. Provision of this plan by the applicant at the initial enquiry stage will assist Council in providing flood related information.

C1.4 Land Use Categories

The policy recognises twelve different types of land use for which a graded set of flood related controls apply. They are included in **Schedule 1: Land Use Categories**.

C1.5 Flood Planning Constraint Categories

For those floodplains where Council has adopted a flood or floodplain risk management study, the identified flood liable land has been divided into the following four *Flood Planning Constraint Categories* (**FPCCs**):

- **Flood Planning Constraint Category 1 (FPCC 1)**, which comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding.
- **Flood Planning Constraint Category 2 (FPCC 2)**, which comprises areas which lie within the extent of the *Flood Planning Area* where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
- **Flood Planning Constraint Category 3 (FPCC 3)**, which comprises areas which lie within the extent of the *Flood Planning Area* but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this DCP.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises the area which lies between the extent of the *Flood Planning Area* and the Probable Maximum Flood (**PMF**). Flood related controls in areas designated FPCC4 are typically limited to flood evacuation and emergency response, although additional controls apply to essential community facilities and utilities that are critical for response and recovery, as well as community hospitals, residential care facilities and group homes. This area is identical to the *Special Flood Considerations Zone* shown on the **Flood Planning Map**.

C1.6 Development Controls

The development controls have been graded relative to the severity and frequency of potential floods, having regard to the FPCCs determined by the relevant Floodplain Risk Management Study and Plan or, if no such study or plan exists, Council's interim considerations.

The objectives of the development controls are:

a) To require developments with high sensitivity to flood risk to be designed so that they are subject to minimal risk.

b) To allow development with a lower sensitivity to the flood hazard to be located within the floodplain, provided the risk of harm and damage to property is minimised.

c) To minimise the intensification of the high flood risk areas, and if possible, allow for their conversion to natural waterway corridors.

d) To ensure design and siting controls required to address the flood hazard do not result in unreasonable social, economic or environmental impacts.

e) To minimise the risk to life by ensuring the provision of reliable access from areas affected by flooding.

f) To minimise the damage to property arising from flooding.

g) To ensure the proposed development does not expose existing development to increased risks associated with flooding.

The performance criteria which are to be applied when assessing a proposed development are:

a) The proposed development should not result in any significant increase in risk to human life, or in a significant increase in economic or social costs as a result of flooding.

b) The proposal should only be permitted where effective warning time and reliable access is available to an area free of risk from flooding, consistent with any relevant Flood Plan or flood evacuation strategy.

c) Development should not significantly increase the potential for damage or risk to other properties either individually or in combination with the cumulative impact of development that is likely to occur in the same floodplain.

d) Procedures would be in place, if necessary, (such as warning systems, signage or evacuation drills) so that people are aware of the need to evacuate and are capable of identifying the appropriate evacuation route.

e) Development should not result in significant impacts upon the amenity of an area by way of unacceptable overshadowing of adjoining properties, privacy impacts (e.g. by unsympathetic house–raising) or by being incompatible with the streetscape or character of the locality.

The prescriptive controls which apply to development that is proposed on land affected by Main Stream Flooding and Major Overland Flow are set out in **Schedules 2A** and **2B**, respectively.

C1.7 Proposals to Modify Flood Planning Constraint Categories

In certain situations it may be feasible to modify existing flood behaviour through engineering works which in turn would enable the extent of the FPCCs to be modified at a particular location. Proposals to modify an FPCC at a particular location would need to be supported by a detailed flooding investigation, further details of which are set out in **Section C1.9** below. Proposals would also need to demonstrate consistency with the flood related objectives and performance criteria of both the *Temora Local Environmental Plan 2010* and the DCP.

C1.8 Special Requirements for Fencing

The objectives are:

a) To ensure that fencing does not result in the obstruction of the free flow of floodwater.

b) To ensure that fencing does not become unsafe during floods so as to threaten the integrity of structures or the safety of people.

c) To ensure fencing is to be constructed in a manner which does not significantly increase flood damage or risk on surrounding land.

The performance criteria which are to be applied when assessing proposed fencing are:

a) Fencing is to be constructed in a manner that does not affect the flow of floodwater so as to detrimentally increase flood affection on surrounding land.

b) Fencing must be certified by an engineer specialising in hydraulic engineering stating that the proposed fencing would be constructed so as to withstand the force of floodwater, or collapse in a controlled manner to prevent the impediment of floodwater.

The prescriptive controls which apply to any proposed fencing on land designated FPCC 1 and FPCC 2 are:

a) An applicant will need to demonstrate that the fence (new or replacement fence) would not create an impediment to the flow of floodwater. Fences must satisfy the following:

- comprise pool/louvre type fencing or a collapsible hinged type fence structure;
- configured so as to allow floodwaters to equalise on both sides of the fence; and
- configured so as to minimise entrapment of flood debris.

C1.9 Explanatory Notes on Lodging Applications

The following steps must be followed in the lodgement of a development application:

a) Check the proposal is permissible in the zoning of the land by reference to any applicable environmental planning instruments.

b) Consider any other relevant planning controls of Council (e.g. controls in any other relevant part of the DCP.

c) Check whether your property is located either partially or wholly within the Flood Planning Area or Special Flood Considerations Zone, as defined on the **Flood Planning Map**.

d) Determine which set of prescriptive flood related planning controls apply to the development from the **Flood Planning Map**.

e) Determine which FPCC applies to the developable portion of your property by reference to the **Flood Planning Constraint Category Map**. Enquire with Council regarding existing flood risk mapping or whether a site–specific assessment may be warranted. A property may be located in more than one FPCC and the assessment must consider the controls that apply in each.

f) Determine the land use category relevant to the development proposal, by firstly confirming how it is defined by the relevant environmental planning instrument and secondly by ascertaining the land use category from **Schedule 1: Land Use Categories**.

g) Assess and document how the proposal will achieve the performance criteria for proposed development and associated fencing set out in **Sections C1.6** and **C1.8**.

h) Check if the proposal will satisfy the prescriptive controls for different land use categories in different FPCCs, as specified in either **Schedule 2A** or **Schedule 2B**.

i) If the proposal does not comply with the prescriptive controls, determine whether the performance criteria are nonetheless achieved.

j) Illustrations provided in this plan to demonstrate the intent of development controls are diagrammatic only. Proposals must satisfy all relevant controls contained in this plan and associated legislation.

k) The assistance of Council staff or an experienced engineer or planner may be required at various steps in the process to ensure that the flood risk management related requirements of this Plan are fully and satisfactorily addressed.

Note that compliance with all the requirements of this DCP does not guarantee that an application will be approved.

Information required with an application to address this plan is as follows:

a) Applications must include information which addresses all relevant controls listed above, and the following matters as applicable.

b) Applications for alterations and additions (see either **Schedule 2A** or **Schedule 2B**) to an existing dwelling on flood liable land must be accompanied by documentation from a registered surveyor confirming existing floor levels.

c) Development applications affected by this plan must be accompanied by a survey plan showing:

   i. The position of the existing building/s or proposed building(s);

   ii. The existing ground levels to Australian Height Datum around the perimeter of the building and contours of the site; and

   iii. The existing or proposed floor levels to Australian Height Datum.

d) Applications for earthworks, filling of land and subdivision shall be accompanied by a survey plan (with a contour interval of 0.25 m) showing relative levels to Australian Height Datum.

e) Where an existing catchment based flood study is not available, a flood study using a fully dynamic one or two dimensional computer model may be required. For smaller developments an existing suitable flood study may be used if available (e.g. it contains sufficient local detail), or otherwise a flood study prepared in a manner consistent with the latest edition of *Australian Rainfall and Runoff* and the *Floodplain Development Manual*, will be required and the following information must be submitted in plan form:

   i. water surface contours;

   ii. velocity vectors;

   iii. velocity and depth product contours;

   iv. delineation of flood risk precincts relevant to individual floodplains; and

   v. show both existing and proposed flood profiles for the full range of events for total development including all structures and works (such as revegetation/ enhancements).

   This information is required for both pre–developed and post–developed scenarios.

f) Where the controls for a particular development proposal require an assessment of structural soundness during potential floods, the following impacts must be addressed:

   i. hydrostatic pressure;

   ii. hydrodynamic pressure;

   iii. impact of debris; and

   iv. buoyancy forces.

   Foundations need to be included in the structural analysis.

C1.10 Glossary of Terms

Note: For an expanded list of definitions, refer to the Glossary contained within the NSW Government Floodplain Development Manual, 2005.

TERM	DEFINITION
Annual Exceedance Probability (AEP)	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, for a flood magnitude having five per cent AEP, there is a five per cent probability that there would be floods of greater magnitude each year.
Australian Height Datum (AHD)	A common national surface level datum corresponding approximately to mean sea level.
Floodplain	Area of land which is subject to inundation by floods up to and including the Probable Maximum Flood (**PMF**) event, that is, flood prone land.
Flood Planning Area	The area of land that is shown to be in the Flood Planning Area on the *Flood Planning Map*.
Flood Planning Map	The *Flood Planning Map* shows the extent of land on which flood related development controls apply in a given area, noting that other areas may exist which are not mapped but where flood related development controls apply.
Flood Planning Constraint Category 1 (FPCC 1)	Comprises areas where factors such as the depth and velocity of flow, time of rise, and evacuation problems mean that the land is unsuitable for most types of development. The majority of new development types are excluded from this zone due to its potential impact on flood behaviour and the hazardous nature of flooding
Flood Planning Constraint Category 2 (FPCC 2)	Comprises areas which lie below the *Flood Planning Level* where the existing flood risk warrants careful consideration and the application of significant flood related controls on future development.
Flood Planning Constraint Category 3 (FPCC 3)	Comprises areas which lie below the *Flood Planning Level* but outside areas designated FPCC1 and FPCC2. Areas designated FPCC3 are more suitable for new development and expansion of existing development provided it is carried out in accordance with the controls set out in this document.
Flood Planning Constraint Category 4 (FPCC 4)	Comprises the area which lies above the *Flood Planning Level* (**FPL**) but within the extent of the PMF. Flood related controls in areas designated FPCC4 are typically limited to flood evacuation and emergency response, although additional controls apply to essential community facilities and utilities that are critical for response and recovery, as well as community hospitals, residential care facilities and group homes. This area is identical to the *Special Flood Considerations Zone* shown on the *Flood Planning Map*.
Flood Planning Level (FPL)	Flood levels selected for planning purposes, as determined by the relevant adopted floodplain risk management study and plan, or as part of a site specific study In the absence of an adopted floodplain risk management study and plan for a particular location, the FPL is defined as the peak 1% AEP flood level plus the addition of a 0.5 m freeboard.

TERM	DEFINITION
Flood Prone/Flood Liable Land	Land susceptible to flooding by the PMF. Flood Prone land is synonymous with Flood Liable land.
Floodway	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 flow, or a significant increase in flood levels.
Flood Storage Area	Those parts of the floodplain that may be important for the temporary storage of floodwaters during the passage of a flood. Loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.
Freeboard	Provides reasonable certainty that the risk exposure selected in deciding a particular flood chosen as the basis for the *Flood Planning Level* 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*.
Habitable Room	In a residential situation: a living or working area, such as a lounge room, dining room, kitchen, bedroom or workroom. In an industrial or commercial situation: an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.
Local Drainage	Land on an overland flow path where the depth of inundation during the 1% AEP storm event is less than 0.1 m.
Main Stream Flooding	The covering of normally dry land by water that has escaped or been released from the normal confines of any lake, river, creek or other natural watercourse (whether or not altered or modified) or any reservoir, canal or dam.
Major Overland Flow	Where the depth of overland flow during the 1% AEP storm event is greater than 0.1 m.
Probable Maximum Flood (PMF)	The largest flood that could conceivably occur at a particular location. 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.
Special Flood Considerations Zone	Comprises the area where the flood risk is considered to be high enough to require additional controls to be applied to future development that is located on land which lies outside the FPA. The additional controls in this area relate to the safe and timely evacuation of people who would be occupying the floodplain at the time of a flood event and only apply in areas categorised as FPCC4.

SCHEDULE 1
LAND USE CATEGORIES

Land Use Category	Subdivision	LEP Land Uses
Critical Uses and Facilities	*Community facilities which may provide an important contribution to the notification or evacuation of the community during flood events.*	Health services facility; Electricity generating works; Emergency services facility.
Sensitive Uses and Facilities	*Uses which involve vulnerable members of the community;* *Uses which may cause pollution of a watercourse or town water supply;* *Uses which if affected, would significantly affect the ability of community to return to normal after flood event;*	Bio-solids treatment facility; Cemeteries; Child care centre; Correctional centre; Heavy industrial storage establishment; Heavy industries; Highway service centre; Group home; Passenger transport facilities; Respite day care centre; Schools; Seniors housing; Service Stations; Sewage treatment plant; Veterinary hospital; Waste or resource management facility; Water treatment facility.
Subdivision	*Subdivision of land which involves* *the creation of new allotments, with* *potential for further development;*	Camping grounds; Caravan parks; Eco-tourist facilities; Home business/ child care/occupations; Residential accommodation (excluding Group Home and Seniors housing); Tourist and visitor accommodation.
Residential		
Commercial and Industrial		Amusement centre; Commercial premises (excluding Market); Crematorium; Depots; Entertainment facility; Freight transport facilities; Function centre; General industries; Industrial retail outlet; Industrial training facility; Light industries; Mortuaries; Place of public worship; Public administration building; Recreation facility (indoor & major); Registered club; Research station;

		Restricted premises; Sex services premises; Storage premises; Transport depots; Truck depots; Warehouse or distribution centre; Wholesale suppliers; Vehicle body repair workshops; Vehicle repair stations;
Recreation and Non-Urban		Agriculture (excluding intensive livestock agriculture); Animal boarding and training establishment; Boat sheds; Charter & tourism boating facilities; Car park; Community facility; Extractive industry; Forestry; Jetties; Market; Open cut mining; Recreation area; Recreation facility (outdoor).
Alterations and additions		Residential development: i. An addition or alteration to an existing dwelling of not more than 50m² to the habitable floor area which existed at the date of commencement of this Plan; ii. The construction of an outbuilding with a maximum floor area of 30m² or Rebuilt dwellings which substantially reduce flood risk having regard to property damage and personal safety; or iii. A change of use which does not increase flood risk having regard to property damage and personal safety. iv. Alterations and additions: i. An addition to existing premises of not more than 10% of the floor area which existed at the date of commencement of this DCP; ii. Rebuilding of a development which substantially reduces the extent of flood effects to the existing development; iii. A change of use which does not increase flood risk having regard to property damage and personal safety; or iv. Subdivision which does not involve the creation of new allotments with potential for further development.

SCHEDULE 2A
PRESCRIPTIVE FLOOD RELATED DEVELOPMENT CONTROLS – MAIN STREAM FLOODING

Planning considerations	Flood Planning Constraint Category 1 (FPCC 1)							Flood Planning Constraint Category 2 (FPCC 2)							Flood Planning Constraint Category 3 (FPCC 3)							Flood Planning Constraint Category 4 (FPCC 4)						
	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions
Minimum Habitable Floor Level						A1	A2 A4				A2	A5	A1	A2 A4				A2	A5	A1	A2 A4	A3	A3					
Building Components						B2	B2				B2	B2	B2	B2				B2	B2	B2	B2	B3	B3					
Structural Soundness						C2	C2				C2	C2	C3	C2				C2	C2	C3	C2	C4	C4					
Flood Affectation						D1	D1			D1	D1	D1	D1	D2			D1	D1	D1	D1	D2							
Emergency Response						E4	E2 or E3			E4 E5	E3 E4	E3 E4	E4	E2 or E3			E4 E5	E2 E4	E2 E4	E4	E2 or E3	E2 or E3	E2 E4	E4 E5	E2 E4	E2 E4		E2 E4
Management and Design						F2 F3	F2 F3			F1	F2	F2 F3 F4	F2 F3	F2 F3			F1	F2	F2 F3 F4	F2	F2 F3	F2 F3	F2 F3 F4	F1	F2	F2 F3 F4	F2	F2
Stormwater							G2			G1 G2	G1 G2	G1 G2		G2			G1 G2	G1 G2	G1 G2		G2	G1	G1					
Parking and Driveway Access						H2 H4 H6 H7	H6 H7 H8			H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H2 H4 H6 H7	H6 H7 H8			H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H2 H4 H6 H7	H6 H7 H8	H3	H3					

	Not Relevant		Unsuitable Land Use

SCHEDULE 2B
PRESCRIPTIVE FLOOD RELATED DEVELOPMENT CONTROLS – MAJOR OVERLAND FLOW

Planning considerations	Flood Planning Constraint Category 1 (FPCC 1)							Flood Planning Constraint Category 2 (FPCC 2)							Flood Planning Constraint Category 3 (FPCC 3)							Flood Planning Constraint Category 4 (FPCC 4)						
	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions
Minimum Habitable Floor Level						A1	A2 A4				A2	A5	A1	A2 A4	A3	A3		A2	A5	A1	A2 A4	A3	A3					
Building Components						B1	B1				B1	B1	B1	B1	B3	B3		B1	B1	B1	B1	B3	B3					
Structural Soundness						C1	C1				C1	C1	C1	C1	C4	C4		C1	C1	C1	C1	C4	C4					
Flood Affectation						D1	D1			D1	D1	D1	D1	D2														
Emergency Response						E1	E1			E5					E2 orE 3	E2 E4	E5					E2 or E3	E2 E4					
Management and Design						F2	F2			F1 F3	F2	F2 F4	F2	F2	F2 F3	F2 F3 F4	F1 F3		F4			F2 F3	F2 F3 F4					
Stormwater										G1	G1	G1			G1	G1	G1	G1	G1			G1	G1					
Parking and Driveway Access						H2 H4 H6 H7	H6 H7 H8			H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H1 H3 H5 H6 H7	H2 H4 H6 H7	H6 H7 H8			H1 H3 H5 H6	H1 H3 H5 H6	H1 H3 H5 H6	H2 H4 H6	H6 H8	H3	H3					

	Not Relevant		Unsuitable Land Use

Prescriptive controls for associated planning considerations under each FPCC

Minimum Habitable Floor Level

A1 Habitable floor levels to be set no lower than the 5% AEP flood level plus freeboard[(1)] unless justified by site specific assessment.

A2 Habitable floor levels to be set no lower than the 1% AEP flood level plus freeboard[(1)].

A3 Habitable floor levels to be set no lower than the PMF flood level.

A4 Habitable floor levels to be as close to the Minimum Habitable Floor Level as practical and no lower than the existing floor level when undertaking concessional development.

A5 Habitable floor levels to be as close to the 1% AEP flood level plus freeboard[(1)] as practical, but no lower than the 5% AEP flood level plus freeboard[(1)]. In situations where the habitable floor level is set below the 1% AEP flood level plus freeboard[(1)], a mezzanine area equal to 30% of the total habitable floor area is to be provided, the elevation of which is to be set no lower than the 1% AEP flood level plus freeboard[(1)].

Building Components & Method

B1 All structures to have flood compatible building components below the 1% AEP flood level plus freeboard[(1)] (refer **Schedules 3A** and **3B**).

B2 All structures to have flood compatible building components below the 1% AEP flood level plus freeboard[(1)] or the 0.2% AEP flood level, whichever is the highest (refer **Schedules 3A** and **3B**).

B3 All structures to have flood compatible building components below the 1% AEP flood plus freeboard[(1)] or the PMF level, whichever is the highest (refer **Schedules 3A** and **3B**).

Structural Soundness

C1 Engineers report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard[(1)].

C2 Engineers report to certify that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard[(1)] or a 0.2% AEP flood, whichever is the greatest.

C3 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard[(1)] or a 0.2% AEP flood, whichever is the greatest, alternatively PMF if required to satisfy emergency response criteria (see below).

C4 Applicant to demonstrate that any structure can withstand the forces of floodwater, debris and buoyancy up to and including a 1% AEP flood plus freeboard[(1)] or a PMF, whichever is the greatest.

Flood Affectation

D1 Engineers report required to certify that the development will not increase flood affectation elsewhere.

D2 The impact of the development on flooding elsewhere to be considered.

Note: When assessing flood affectation the following must be considered:

1. Loss of storage in the floodplain (Only for development being assessed under Schedule 2A).

2. Changes in flood levels and flow velocities caused by alteration of conveyance of flood waters.

3. Impacts of urbanisation on peak flood flows and volumes.

Emergency Response

E1 Reliable egress for pedestrians and vehicles required during a 1% AEP flood.

E2 Reliable egress for pedestrians and vehicles required during a PMF.

E3 Reliable egress for pedestrians or vehicles is required from the building, commencing at a minimum level equal to the lowest habitable floor level to an area of refuge above the PMF level, or a minimum of 20 m^2 of the dwelling to be above the PMF level.

E4 The development is to be consistent with any relevant flood evacuation strategy or similar plan.

E5 Applicant to demonstrate that there is rising road egress/access from all allotments internal to the subdivision to land which lies above the PMF.

Management and Design

F1 Applicant to demonstrate that potential development as a consequence of a subdivision or development proposal can be undertaken in accord with this Plan.

F2 Flood Safe Plan (home or business or farm houses) to address safety and property damage issues (including goods storage and stock management) considering the full range of flood risk.

F3 Site Emergency Response Flood Plan required considering the full range of flood risk

F4 No external storage of materials below the Minimum Habitable Floor Level which may cause pollution or be potentially hazardous during any flood.

Stormwater

G1 Engineers report required to certify that the development will not affect stormwater drainage.

G2 The impact of the development on local overland flooding to be considered.

Parking and Driveway Access

H1 The minimum surface level of open car parking spaces or carports shall be as high as practical, but no lower than the 5% AEP flood or the level of the crest of the road at the location where the site has access. In the case of garages, minimum surface level shall be as high as practical but no lower than the 5% AEP flood.

H2 The minimum surface level of open car parking spaces, carports or garages shall be as high as practical

H3 Garages capable of accommodating more than three motor vehicles on land zoned for urban purposes, or enclosed car parking, must be protected from inundation by floods up to the 1% AEP flood plus freeboard[(1)].

H4 The driveway providing access between the road and parking space shall be as high as practical and generally rising in the egress direction.

H5 The level of the driveway providing access between the road and parking space shall be no lower than 0.3 m below the 1% AEP flood or such that the depth of inundation during a 1% AEP flood is not greater than either the depth at the road or the depth at the car parking space. A lesser standard may be accepted for single detached dwelling houses where it can be demonstrated that risk to human life would not be compromised.

H6 Enclosed car parking and car parking areas accommodating more than three vehicles (other than on Rural zoned land), with a floor level below the 5% AEP flood or more than 0.8 m below the 1% AEP flood level, shall have adequate warning systems, signage and exits.

H7 Restraints or vehicle barriers to be provided to prevent floating vehicles leaving the site during a 1% AEP flood.

H8 Driveway and parking space levels to be no lower than the design ground/floor levels. Where this is not practical, a lower level may be considered. In these circumstances, the level is to be as high as practical, and, when undertaking concessional development, no lower than existing levels.

H9 Flood related parking and access requirements to be advised by Council if necessary. Contact Council for advice as early as possible.

1. Unless stated otherwise in an adopted location specific Floodplain Risk Management Study and Plan, freeboard is equal to 0.5 m for development being assessed under Schedule 2A and 0.3 m for development being assessed under Schedule 2B.

SCHEDULE 3A
GENERAL BUILDING MATTERS

Electrical and Mechanical Equipment

For dwellings constructed on land to which this policy applies, the electrical and mechanical materials, equipment and installation should conform to the following requirements.

Main Power Supply

Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**. Means shall be available to easily isolate the dwelling from the main power supply.

Wiring

All wiring, power outlets, switches, etc, should be, to the maximum extent possible, located above the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**. All electrical wiring installed below this level should be suitable for continuous underwater immersion and should contain no fibrous components. Earth leakage circuit breakers (core balance relays) must be installed. Only submersible type splices should be used below the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**. All conduits located below the relevant designated flood level should be so installed that they will be self-draining if subjected to flooding.

Equipment

All equipment installed below or partially below the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B** should be capable of disconnection by a single plug and socket assembly.

Reconnection

Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned or replaced and checked by an approved electrical contractor before reconnection.

Heating and Air Conditioning Systems

Where viable, heating and air conditioning systems should be installed in areas and spaces of the house above the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**. When this is not feasible, every precaution should be taken to minimise the damage caused by submersion according to the following guidelines:

i) Fuel

Heating systems using gas or oil as a fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off.

ii) Installation

The heating equipment and fuel storage tanks should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B**.

iii) Ducting

All ductwork located below the relevant elevation referred to in control B1 or B2 of **Schedules 2A** and **2B** should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a watertight wall or floor below the relevant flood level, a closure assembly operated from above the relevant elevation set out under B1 or B2 of **Schedules 2A** and **2B** should protect the ductwork.

Sewer

All sewer connections to properties in flood prone areas are to be fitted with reflux valves.

SCHEDULE 3B
FLOOD COMPATIBLE MATERIALS

Building Component	Flood Compatible Material	Building Component	Flood Compatible Material
Flooring and Sub Floor Structure	• Concrete slab-on-ground monolith construction. Note: clay filling is not permitted beneath slab-on-ground construction which could be inundated. • Pier and beam construction or • Suspended reinforced concrete slab	**Doors**	• Solid panel with waterproof adhesives • Flush door with marine ply filled with closed cell foam • Painted material construction • Aluminium or galvanised steel frame
Floor Covering	• Clay tiles • Concrete, precast or in situ • Concrete tiles • Epoxy formed-in-place • Mastic flooring, formed-in-place • Rubber sheets or tiles with chemical set adhesive • Silicone floors formed-in-place • Vinyl sheets or tiles with chemical-set adhesive • Ceramic tiles, fixed with mortar or chemical set adhesive • Asphalt tiles, fixed with water resistant adhesive • Removable rubber-backed carpet	**Wall and Ceiling Linings**	• Brick, face or glazed • Clay tile glazed in waterproof mortar • Concrete • Concrete block • Steel with waterproof applications • Stone natural solid or veneer, waterproof grout • Glass blocks • Glass • Plastic sheeting or wall with waterproof adhesive
Wall Structure	Solid brickwork, blockwork, reinforced, concrete or mass concrete	**Insulation**	• Foam or closed cell types
Windows	Aluminium frame with stainless steel or brass rollers	**Nails, Bolts, Hinges and Fittings**	• Galvanised • Removable pin hinges