

PARKES SHIRE COUNCIL

COOKAMIDGERA

FLOOD RISK MANAGEMENT STUDY AND PLAN

JULY 2025

VOLUME 1 – REPORT

DRAFT REPORT FOR PUBLIC EXHIBITION

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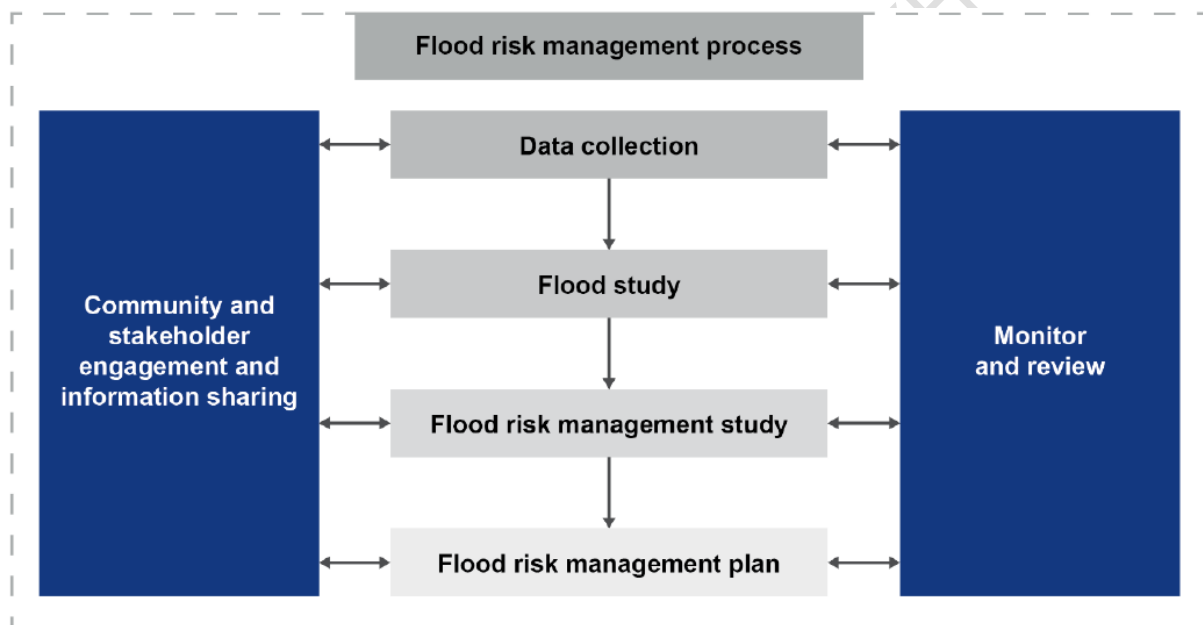
FOREWORD

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 flood risk management responsibilities.

The Policy provides for technical and financial support by the Government through the flood risk management process shown below.



Presentation of Study Results

The results of the recently completed *Cookamidgera Flood Study* (Lyll & Associates, 2024) have been used as the basis for preparing the *Cookamidgera Flood Risk Management Study and Plan*. The *Cookamidgera Flood Risk Management Study and Plan* have been prepared under the guidance of the Flood Risk Management Committee comprising representatives from Parkes Shire Council, the NSW Department of Climate Change, Energy, the Environment and Water, the NSW State Emergency Service and community representatives.

ACKNOWLEDGEMENT

Parkes 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 Climate Change, Energy, the Environment and Water.

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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	Parkes Shire Council
DECC	Department of Environment and Climate Change
DCCEEW	Department of Climate Change, Energy, the Environment and Water
FRMM	Flood Risk Management Manual, 2023
FRMC	Flood Risk Management Committee
FPL	Flood Planning Level
FPA	Flood Planning Area
FRMS	Flood Risk Management Study
FRMP	Flood Risk Management Plan
FRMS&P	Flood 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
TCM	Total Catchment Management
TWG	Technical Working Group
VP	Voluntary Purchase

SUMMARY

S1 Study Objectives

Parkes Shire Council (**Council**) commissioned the preparation of a *Flood Risk Management Study and Plan* for the village of Cookamidgera (**Cookamidgera FRMS&P**). The overall objectives of the *Cookamidgera Flood Risk Management Study (Cookamidgera FRMS)* were to assess the impacts of flooding, 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 *Cookamidgera Flood Risk Management Plan (Cookamidgera 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 which are 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 the *Cookamidgera FRMS&P* applies to areas within the village and its immediate environs that are affected by the following two types of flooding:

- **Main Stream Flooding**, which occurs when floodwater surcharges the inbank area of Quart Pot Creek and Flagstone Creek (also known as Bartleys Creek). Main Stream Flooding is typically characterised by relatively deep and fast flowing floodwater but can include shallower and slower moving floodwater on the overbank of the aforementioned creeks.
- **Major Overland Flow**, which is experienced during periods of heavy rain and is generally characterised by relatively shallow and slow-moving floodwater that is conveyed overland in an uncontrolled manner toward the abovementioned watercourses and other major drainage lines.

Figures 1.1 and 2.1 bound in **Volume 2** of this report show the extent of the 180 km² Flagstone Creek catchment at its confluence with Goobang Creek, while **Figure 2.2** (2 sheets) shows the key features of the existing stormwater drainage system in the vicinity of the urbanised parts of Cookamidgera. Also shown on **Figure 2.2** is the extent of the “Village Centre”, land internal to which is zoned *RU5-Village*.

S2 Study Activities

The activities undertaken in this present study included:

1. Review of available data and the undertaking of a consultation program to ensure that the Cookamidgera community were informed of the objectives, progress and outcomes over the course of the study (**Chapter 1** and **Appendix A**).
2. Review of historic flooding at Cookamidgera, as well as flooding patterns that are presented in the *Cookamidgera Flood Study* for flood events up to the Probable Maximum Flood (**PMF**). (**Chapter 2** and **Appendix B**).
3. Review of the economic impacts of flooding that are presented in the *Cookamidgera Flood Study*, including the numbers of affected properties and estimation of flood damages (**Chapter 2**).
4. Review of current flood related planning controls for Cookamidgera and their compatibility with flooding conditions (**Chapter 2**).

5. Strategic review of potential flood risk management measures aimed at reducing flood damages and recommended inclusions/updates to both the *Parkes Local Environmental Plan 2012 (Parkes LEP 2012)* and the *Parkes Shire Development Control Plan 2021 (Parkes Shire DCP 2021)* (Chapter 3 and Appendix C).
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 the *Cookamidgera FRMP* (Chapter 5).

S3 Summary of Flood Impacts

Figure 2.3 (2 sheets) of the *Cookamidgera FRMS* report shows the indicate extent and depth of inundation at Cookamidgera for a design flood with an AEP of 1% (1 in 100), while **Figure 2.4** (2 sheets) shows similar information for the Probable Maximum Flood (**PMF**). **Appendix B** of the *Cookamidgera FRMS* report show similar information for floods with AEPs of 20% (1 in 5), 10% (1 in 10), 5% (1 in 20), 2% (1 in 50), 0.5% (1 in 200) and 0.2% (1 in 500).

Flooding in the urbanised parts of the village (denoted herein as the “**Village Centre**”) originates from the following two primary sources:

- a) as a result of floodwater which surcharges the right (northern) bank of Flagstone Creek to the east (upstream) of the Trigg Hill Road crossing; and
- b) as a result of Major Overland Flow which discharges in a westerly direction through the northern portion of the Village Centre.

While floodwater originating from these two sources inundates both existing development and roadways shortly after the onset of flood producing rain, access into the Village Centre via Flagstone Street is effectively cut once flow is experienced in the watercourse that runs in a westerly direction along the northern side of the Orange-Broken Hill Railway. Floodwater can also inundate both private property and the road network for periods of over 12 hours.

The *Cookamidgera FRMS* found that two dwellings would be above-floor inundated in a 1% AEP flood event, resulting in flood damages totalling about \$0.27 Million, while during a PMF event, a total of 22 dwellings and one public building would be above-floor inundated, resulting in flood damages totalling about \$5.92 Million.

For a discount rate of 5% pa and an economic life of 30 years, the *Net Present Worth* of damages for all flood events up to the 1% AEP is about \$0.07 Million, while for all floods up to the PMF it is only about \$0.21 Million. Therefore, one or more schemes costing up to these two amounts could be economically justified if they eliminated all flood related damages in the study area at the two different levels of flooding. 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 *Parkes Shire DCP 2021*. 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.

Figure C1.1 in **Appendix C** of this report is an extract 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 areas where depths of inundation exceed 0.1 m in a 1% AEP event, and where identifiable floodways are present in shallower flow.

Figure C1.2 in **Appendix C** is an extract 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 of properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figure C1.1**. 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 The Flood Risk Management Plan

Chapter 5 of this report presents the *Cookamidgera 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 Flood Risk Management Committee (**FRMC**), according to a range of criteria, details of which are set out in **Section 4** of this report.

The *Cookamidgera FRMP* comprises three “non-structural” management measures which could be implemented by Council and NSW State Emergency Service (**NSW SES**) using existing data and without requiring Government funding. The measures are as follows:

- **Measure 1** – Council to consider the inclusion of the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*, noting that it would apply to land that lies between the FPA and the extent of the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations..
- **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 *Parkes Shire DCP 2021*. Suggested wording for inclusion in *Parkes Shire DCP 2021* is set out in Appendix C of this report.

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.

- **Measure 3** - Improvements in the NSW SES emergency planning, including use of the flood related information contained in this study to update the *Parkes Shire Local Flood Plan* (NSW SES, 2024). Information in this report which would be of assistance to NSW SES includes data on the nature and extent of flooding, details of which could be used to update Volume 2 of the *Parkes Shire Local Flood Plan*.
- **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.

In addition to the above measures, the *Cookamidgera FRMP* includes the investigation, design and construction of the following set of flood modification measures (denoted Potential Flood Modification Measure (**PFMM**) 6 in *Cookamidgera FRMS*), noting that this would require Government Funding (**Measures 5 and 6**):

- Construction of an engineered earthen embankment approximately 560 m in length and on average 1 m in height running along the right (northern) bank of Flagstone Creek upstream of its crossing of Trigg Hill Road.
- Construction of an engineered earthen embankment around the existing farm dam that is located 500 m to the east of the village centre, as well as a 200 m channel extending south to an overbank flood runner of Flagstone Creek.
- Construction of a grassed swale/channel along the eastern side of Flagstone Street, extending west to the location of an existing dam that is located in the rail corridor.
- Construction of new transverse drainage structures beneath both Flagstone Street and the adjacent unsealed access road (each presently assessed as 2 off 3 m wide by 1.2 m high reinforced concrete box culverts).
- Lowering of the spillway associated with the existing dam that is located in the rail corridor (current assessment assumes a spillway elevation of RL 343.7 m AHD).
- Widening and regrading of the watercourse that runs along the northern side of the rail corridor from where it crosses Cooka Hills Road to where it crosses the Orange-Broken Hill Railway, an overall length of about 550 m (current assessment assumes a 12 m base width).
- Installation of 3 off 3.6 m wide by 0.9 m high reinforced box culverts on Flagstone Street.
- Raising Flagstone Street by about 0.2 m to an elevation of RL 345.7 m AHD.
- Lowering of natural surface levels either side of Flagstone Street to facilitate the installation of the reinforced concrete box culverts and associated inlet/outlet headwall/scour protection works.

Figure 3.6 (2 sheets) bound in **Volume 2** of this report shows the key features comprising PFMM6, as well as the impact that their implementation would have on floods with AEPs of 20%, 5% and 1%.

While the implementation of the works associated with PFMM6 cannot be justified purely on economic grounds (i.e. because the benefit/cost ratio of the works is less than 0.1), they would reduce the existing flood risk within the Cookamidgera community by:

- a) significantly reducing both the extent and depth of inundation that is currently experienced within the Village Centre;

- b) removing the above-floor inundation that is currently experienced in two dwellings up to the 1% AEP level of flooding; and
- c) significantly improve the ability of people to be able to travel between the village and Parkes during times of freshes and floods.

S6 Timing and Funding of Cookamidgera FRMP Measures

The total estimated cost to implement the measures set out in the *Cookamidgera FRMP* is **\$2.1 Million**, exclusive of both local and state government agency 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 the *Cookamidgera FRMP* may be available upon application under Commonwealth and State funded floodplain management programs, currently administered by the NSW Department of Climate Change, Energy, the Environment and Water.

S7 Council Action Plan

1. Council to consider updating *Parkes LEP 2012* to include the NSW Government's *Special Flood Considerations* clause 5.22 (**Measure 1** of *Cookamidgera FRMP*).
2. Council to update *Parkes Shire DCP 2021* to incorporate the suggested form of wording set out in **Appendix C** of this report (**Measure 2** of *Cookamidgera FRMP*).
3. NSW SES to update the *Parkes 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 *Cookamidgera FRMP*).
4. Council to inform residents of the flood risk, based on the information presented in the *Cookamidgera 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 *Cookamidgera FRMP*).
5. Council to commission an investigation into the feasibility of implementing the full scope of measures comprising PFMM6, as well as the preparation of a preliminary concept design of the preferred set of measures (**Measure 5** of the *Cookamidgera FRMP*).
6. Subject to a favourable outcome of Measure 5, Council to commission the detailed design and construction of the preferred set of measures comprising PFMM6 (**Measure 6** the *Cookamidgera FRMP*).

TABLE S1
RECOMMENDED MEASURES FOR INCLUSION IN COOKAMIDGERA FLOOD RISK MANAGEMENT PLAN

Measure	Required Funding	Features of the Measure	Priority
1. Update of <i>Parkes LEP 2012</i>	Council staff costs	<ul style="list-style-type: none"> ➤ Council to consider including the optional <i>special flood considerations</i> clause 5.22 in <i>Parkes LEP 2012</i>. The optional clause applies to land that lies between the FPA and the extent of the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. ➤ While the inclusion of the optional <i>special flood considerations</i> clause 5.22 in <i>Parkes LEP 2012</i> would have limited, if any, impact on future development within Cookamidgera, it may have relevance to other urban centres in the LGA such as at Parkes. For this reason, the flood mapping and recommended set of flood related development controls that form part of the present study assume that Council includes the optional clause in <i>Parkes LEP 2012</i>. This approach ensures consistency with other study areas where the adoption of the optional clause has more relevance. 	Medium Priority: this measure is designed to mitigate the flood risk to future sensitive and hazardous type development and has a medium priority. It does not require Government funding.
2. Incorporate recommended approach to managing future development on flood prone land in <i>Parkes Shire DCP 2021</i> .	Council staff costs	<ul style="list-style-type: none"> ➤ 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 four 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. 	High Priority: this measure is designed to mitigate the flood risk to future development and has a high priority for inclusion in the <i>Cookamidgera FRMP</i> . It does not require Government funding.
3. Ensure flood data presented in the <i>Cookamidgera FRMS</i> are available to the NSW SES for improvement of flood emergency planning.	NSW SES costs	<ul style="list-style-type: none"> ➤ NSW SES should update the <i>Parkes Shire Local Flood Plan</i> 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	Council staff costs	<ul style="list-style-type: none"> ➤ Council to inform residents of the flood risk, based on the information presented in the <i>Cookamidgera FRMS</i>. (e.g. displays of flood mapping at Council offices, preparation of <i>Flood Information Brochure</i> for distribution with rate notices, etc). 	Medium Priority: this measure would improve the flood awareness of the community and has a medium priority given the relatively minor impact flooding has on existing development in the village. It does not require Government funding.
5. Investigate feasibility of implementing works comprising PFMM6 and prepare preliminary concept design	\$0.3 Million	<ul style="list-style-type: none"> ➤ Liaise with affected land owners and relevant rail authority to gain in-principle agreement to construct works and also create easements for access (where required). ➤ 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 preliminary 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 	High Priority: this measure would significantly reduce the flood risk within the Cookamidgera community.
6. Prepare detailed design and construct preferred set of measures comprising PFMM6	\$1.8 Million	<ul style="list-style-type: none"> ➤ Tasks involved are as follows: <ul style="list-style-type: none"> ○ Prepare detailed design and documentation ○ Prepare a submission for Council and Government funding. ➤ Construct preferred set of measures. 	

1 INTRODUCTION

1.1 Study Background

Parkes Shire Council (**Council**) commissioned the preparation of a flood risk management study and plan for the village of Cookamidgera in accordance with the New South Wales Government's *Flood Prone Land Policy* (**Cookamidgera FRMS&P**). **Figure 1.1** shows that the village is located about 16 km to the southeast of Parkes and lies with the Flagstone Creek catchment.

The *Cookamidgera Flood Risk Management Study* (**Cookamidgera FRMS**) reviewed baseline flooding conditions and the economic impacts of flooding that were assessed as part of the recently completed *Cookamidgera Flood Study* (Lyll & Associates, 2024). It also assessed the feasibility of potential measures which are aimed at reducing the impact of flooding on both existing and future development in the village. This process allowed the formulation of a flood risk management plan for Cookamidgera (**Cookamidgera FRMP**).

The *Cookamidgera FRMS&P* focuses on the village and its immediate environs that are affected by the following two types of flooding:

- **Main Stream Flooding**, which occurs when floodwater surcharges the inbank area of Quart Pot Creek and Flagstone Creek (also known as Bartleys Creek). Main Stream Flooding is typically characterised by relatively deep and fast flowing floodwater but can include shallower and slower moving floodwater on the overbank of the aforementioned creeks.
- **Major Overland Flow**, which is experienced during periods of heavy rain and is generally characterised by relatively shallow and slow-moving floodwater that is conveyed overland in an uncontrolled manner toward the abovementioned watercourses and other major drainage lines.

1.2 Background Information

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

- *Cookamidgera Flood Study* (Lyll & Associates, 2024) (**Cookamidgera Flood Study**)
- *Flood Risk Management Manual* (New South Wales Government (**NSWG**), 2023) (**FRMM**)
- *Parkes Local Environmental Plan, 2012* (**Parkes LEP 2012**)
- *Forbes Local Environmental Plan, 2013* (**Forbes LEP 2013**)
- *Parkes Shire Development Control Plan 2021* (**Parkes Shire DCP 2021**)
- *Parkes Shire Local Flood Plan* (NSW State Emergency Service (**NSW SES**), 2024)

1.3 Overview of Cookamidgera FRMS&P Report

The results of the *Cookamidgera FRMS* and the *Cookamidgera FRMP* are set out in this report. The 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 Cookamidgera, as well as the nature of flood behaviour in the study area based on the findings of the *Cookamidgera Flood Study*. The Chapter also summarises the economic impacts of flooding on existing urban development, reviews Council's flood planning controls and management measures, as well as NSW SESs flood emergency planning.

- **Chapter 3, Potential Flood Risk Management Measures.** This Chapter reviews the feasibility of flood risk management measures for their possible inclusion in the *Cookamidgera FRMP*, noting that the measures are investigated at the strategic level of detail.
- **Chapter 4, Selection of Flood Risk Management Measures.** This Chapter assesses the feasibility of potential flood risk management strategies using a multi-objective scoring procedure which was developed in consultation with the Flood Risk Management Committee (**FRMC**) and outlines the preferred strategy.
- **Chapter 5, Cookamidgera Flood Risk Management Plan** presents the *Cookamidgera FRMP* which comprises a number of 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.

Three technical appendices provide further information on the study results:

- **Appendix A – Photographs Showing Historic Flood Behaviour at Cookamidgera** which have been taken from the *Cookamidgera Flood Study*.
- **Appendix B - Figures Showing Design Flood Behaviour at Cookamidgera** which have also been taken from the *Cookamidgera Flood Study*.
- **Appendix C – Suggested Wording for Inclusion in Parkes Shire Development Control Plan** presents guidelines for the control of future urban development in flood prone areas in the village.

Figures referred to in this document are contained in a companion Volume 2 document that is A3 in size.

1.4 Community Consultation

A *Community Newsletter and Questionnaire* was disseminated to residents and business owners at the commencement of the *Cookamidgera Flood Study* which sort to identify information on historic flooding in the village. Respondents to the *Community Questionnaire* identified a number of notable flood events dating back to 1952, with photographic evidence provided for flooding that was experienced in the village on 23 March 2017 and 14 November 2022, copies of which are contained in **Appendix A** 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 shown 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.

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 (**FPL**) and Flood Planning Area (**FPA**) 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 *Cookamidgera 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 Cookamidgera has a population of about 150 and is located on the right (northern) overbank of Flagstone Creek about 17 km to the south-east of Parkes in the Parkes Shire Council Local Government Area. The urbanised parts of the village are located on the southern side of the Orange-Broken Hill railway line on land that is zoned *RU5-Village* (denoted herein as the “**Village Centre**”).

Figure 2.1 shows that Flagstone Creek flows in a westerly direction through Cookamidgera where it discharges to Goobang Creek approximately 12 km to the west of the village. **Figure 2.1** also shows the alignment of Quart Pot Creek which is a tributary of Flagstone Creek. Flagstone Creek and Quart Pot Creek have catchment areas of 37 km² and 55 km², respectively at their confluence, while Flagstone Creek has a total catchment area of about 180 km² where it joins Goobang Creek.

There are three road crossings of Flagstone Creek in the study area; two low level culvert and causeway crossings along Trig Hill Road and one higher level bridge crossing at the Parkes Eugowra Road.

There are two road crossings of Quart Pot Creek in the study area; one low level culvert and causeway crossing of at Trig Hill Road and one higher level road crossing at Coonambro Way.

2.2 Existing Drainage System

The inbank area of Flagstone Creek generally comprises an incised 5 m wide by 1.5-3 m deep channel which has a grade of about 0.7% where it runs between the upstream (eastern) side of the Village Centre and its confluence with Quart Pot Creek. While the inbank area of the creek is generally about 10 m wide and up to 4 m deep downstream of the confluence, there is a 1.3 km section in the vicinity of the eastern end of Wybara Lane where the width increases to a maximum of about 30 m.

Quart Pot Creek generally runs in a northerly direction through the study area and discharges to Flagstone Creek approximately 1.2 km downstream (west) of the village. Quart Pot Creek generally comprises a 5 m wide by 1 m deep channel which has a grade of about 0.3% where it runs through the study area.

The existing stormwater drainage system in the village, the layout of which is shown on **Figure 2.2** (2 sheets) generally comprises piped and culvert crossings beneath the roads and railway, and grass lined table drains that convey overland flow towards Flagstone Creek and its tributaries.

A network of earth bunds and dams have been constructed immediately to the north of the village between 1986 and 1990 as part of what was called “the Cookamidgera Project”. The aim of the Cookamidgera Project was to reduce the uncontrolled transportation of sediment from eroded drainage lines so as to reduce the impact that it has on Council and community owned assets and land. Background to the Cookamidgera Project is set out in Appendix B of the *Cookamidgera Flood Study* report.

2.3 Flood History

Respondents to the *Community Questionnaire* that was disseminated at the commencement of the *Cookamidgera Flood Study* identified a number of notably intense storm events that have been experienced in the study area, the dates of which are as follows:

- 1952 (specific date not mentioned);
- 1986 (specific date not mentioned);
- 7 November 2005;
- 6 January 2006;
- 3 November 2007;
- December 2010;
- February 2016;
- 23 March 2017;
- January 2020;
- January 2021; and
- 14 November 2022.

Respondents to the *Community Questionnaire* also provided descriptions of the patterns of overland flow in the vicinity of their properties, as well as photographic evidence of flooding that was experienced in the village on 23 March 2017 and 14 November 2022, copies of which are contained in **Appendix A** of this report.

It is understood that a flood that occurred in 1952 is considered the flood of record at Cookamidgera, although there is no information on flood behaviour during this event.

2.4 Design Flood Behaviour

Figures 2.3 and **2.4** (2 sheets each) show the nature of flooding at Cookamidgera for the 1% AEP and PMF events, respectively, while **Figures B1.1** to **B1.6** (2 sheets each) of **Appendix B** show similar information for the 20%, 10%, 5%, 2%, 0.5% and 0.2% AEP flood events. These diagrams show the indicative extent and depth of inundation along Flagstone Creek and its associated tributaries, as well as along the Major Overland Flow paths for the range of design flood events.

Note that as per the requirements of the 2019 edition of *Australian Rainfall and Runoff* (Geoscience Australia, 2019) (**ARR 2019**), the results of the design flood modelling include probability neutral blockage factors that have been applied to existing hydraulic structures, details of which are set out in the *Cookamidgera Flood Study*.

In order to create realistic results which remove most of the anomalies caused by inaccuracies in the LiDAR survey data, a filter was applied to remove depths of inundation over the natural surface less than 0.1 m. This has the effect of removing the very shallow depths which are more prone to be artefacts of the model, but at the same time giving a reasonable representation of the various overland flow paths. The depth grids shown on the figures have also been trimmed to the building polygons, as experience has shown that property owners incorrectly associate depths of above-ground inundation at the location of buildings with depths of above-floor inundation.

Figure 2.5 shows the time of rise of floodwaters at selected road and rail crossings throughout the study area, noting that time zero on the stage hydrographs represents the onset of flood producing rain (refer **Figures 2.3** and **2.4** for location of each individual stage hydrograph).

The key features of Main Stream Flooding along Flagstone Creek as identified in the *Cookamidgera Flood Study* are as follows:

- i. Floodwater surcharges Flagstone Creek in flood events as frequent as 20% AEP at the following locations:
 - a. along its left bank immediately upstream of Trigg Hill Road where it then flows in a westerly direction across rural land before discharging to Quart Pot Creek downstream of Trigg Hill Road;
 - b. along its left and right bank in the vicinity of its confluence with Quart Pot Creek;
 - c. along its left and right bank upstream of the western Trigg Hill Road crossing of Flagstone Creek; and
 - d. along its left bank on the upstream side of the Parkes Eugowra Road bridge crossing.
- ii. Floodwater commences to surcharge the banks of Flagstone Creek in a 10% AEP at the following locations:
 - a. along its right bank upstream of Trigg Hill Road, where the resulting surcharge flow discharges in a north-westerly direction towards the intersection of Flagstone Street and Haynes Street, before continuing along Flagstone Street where it rejoins flow in the main arm of the watercourse to the west of the Village Centre. It is noted that floodwater does not surcharge the right bank of Flagstone Creek upstream of this location in flood events up to 0.2% AEP in magnitude.
 - b. along its left bank approximately 600 m to the north-west of Trigg Hill Road, where the resulting surcharge flow discharges in a north-westerly direction across rural land before rejoining flow in the main arm of the watercourse upstream of its confluence with Quart Pot Creek.
- iii. The road crossings of Flagstone Creek commence to become inundated as follows:
 - a. The Trigg Hill Road crossings (refer Road Stage Hydrograph Location and Identifier (RSHLI) H01 and H02) in flood events more frequent than 20% AEP flood.
 - b. While the Parkes Eugowra Road bridge crossing of Flagstone Creek will remain flood free for events up to 0.2% AEP, the low point in the road that is located approximately 600 m to the north of the bridge (refer RSHLI H03) will be inundated in flood events as frequent as 20% AEP.
- iv. The peak PMF flow in Flagstone Creek is about nine times the corresponding peak 1% AEP flow.
- v. Existing development within the extent of the Village Centre is inundated to depths of up to 1.4 m in a PMF event.

The key features of Main Stream Flooding along Quart Pot Creek as identified in the *Cookamidgera Flood Study* are as follows:

- i. While Quart Pot Creek surcharges its banks in flood events more frequent than 20% AEP, floodwater generally flows in a northerly direction parallel to the watercourse on its immediate overbank area.
- ii. The Coonambro Way (refer RSHLI H04) and Trigg Hill Road (refer RSHLI H05) crossings of Quart Pot Creek are inundated in flood events more frequent than 20% AEP.
- iii. The peak PMF flow in Quart Pot Creek is about nine times the corresponding peak 1% AEP flow.

The key features of Major Overland Flow as identified in the *Cookamidgera Flood Study* are as follows:

- i. Runoff from a catchment that is located in the south-eastern corner of the Cookamidgera Project discharges through two drainage structures that are located beneath the Orange-Broken Hill Railway at the eastern end of McLennan Lane, where it continues in a westerly direction and discharges to the Village Centre to the east of Haynes Street.

The key features of Major Overland Flow along this flow path are as follows:

- a. Major Overland Flow that discharges to the Village Centre from the east in a 20% AEP flood event generally flows in a north-westerly direction along Railway Street and the natural low point that is located to its north.
- b. Major Overland Flow that discharges to the Village Centre from the east combines with floodwater that surcharges the right bank of Flagstone Creek upstream of Trigg Hill Road in flood events as frequent as 10% AEP.
- ii. Runoff from the remainder of the Cookamidgera Project is directed towards the intersection of Cooka Hills Road and McLennan Lane via the network of earth bunds and dams that were constructed in the 1980s, before discharging to the Village Centre along its northern boundary in the vicinity of the low level rail crossing.
- iii. Major Overland Flow that discharges to the Village Centre from the north and east combine in the vicinity of the low point in Flagstone Street that is located approximately 50 m to the south of the low level railway crossing. It then flows in a westerly direction where it discharges to Flagstone Creek to the west of the Village Centre.
- iv. Peak PMF flow in areas subject to Major Overland Flow are up to 12 times the corresponding peak 1% AEP flow.

2.5 Existing Flood Mitigation Measures

There are no formal flood mitigation measures present in the village of Cookamidgera.

2.6 Economic Impacts of Flooding

The economic consequences of floods are discussed in **Appendix I** of the *Cookamidgera Flood Study*, which assessed flood damages to residential, commercial/industrial property and public buildings in areas affected by both Main Stream Flooding and Major Overland Flow in the village. The assessment relied on the procedures set out in *Flood Risk Management Guideline MM01 – Flood Risk Management Measures* (DPE, 2023) and the associated *NSW Flood Risk Management Tool DT01* to estimate both the tangible and intangible damages resulting from flooding at Cookamidgera.

Table 2.1 over the page sets out the number of properties that are flood affected in the Village Centre, as well as the estimated damages which would occur for floods of varying magnitude.

Two dwellings would be above-floor inundated in a 1% AEP flood event, resulting in flood damages totalling about \$0.27 Million. During a PMF event, 22 dwellings and one public building would be above-floor inundated, resulting in flood damages totalling about \$5.92 Million.

For a discount rate of 5% pa and an economic life of 30 years, the *Net Present Worth* of damages for all flood events up to the 1% AEP is about \$0.07 Million, while for all floods up to the PMF it is only about \$0.21 Million.

TABLE 2.1
SUMMARY OF FLOOD DAMAGES

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	
20	1	0	0	0	0	0	0
10	3	0	0	0	0	0	0
5	6	0	0	0	0	0	0.02
2	8	1	0	0	0	0	0.08
1	11	2	0	0	0	0	0.27
0.5	13	3	0	0	0	0	0.38
0.2	16	3	0	0	0	0	0.50
PMF	26	22	0	0	1	1	5.92

2.7 Impact of Flooding on Vulnerable Development and Critical Infrastructure

Figure 2.6 (2 sheets) shows the location of vulnerable development and critical infrastructure relative to the extent of inundation resulting from the assessed design storm events, while **Table 2.2** over the page sets out the frequency of floods which would impact this type of development/infrastructure.² **Figure 2.5** also provides flood data relating to the frequency, depth and duration of overtopping of the road and rail crossings identified in **Table 2.2** and on **Figure 2.6**.

Community Assets

The Cookamidgera Memorial Hall that is located on land that generally remains flood free, with the exception that during a PMF event depths of inundation would vary between 0.3 m (southern side of building) and 1 m (northern side of building).

All nine road crossings in the study area are inundated during storms as frequent as 20% AEP. Furthermore, the road crossings are inundated within 1-2 hours following the onset of flood producing rain and generally remain inundated for a period of up to about 12 hours. The exception is the Trigg Hill Road crossing of Flagstone Creek near its intersection with the Parkes-Eugowra Road, where the duration of inundation exceeds 24 hours. It is noted that egress from the village to the north towards Parkes via Flagstone Street is cut once flow is experienced in the watercourse that runs in a westerly direction along the northern side of the rail corridor.

Emergency Services

There are no emergency service facilities in Cookamidgera.

Vulnerable Development

There is no vulnerable development presently located in Cookamidgera.

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

TABLE 2.2
IMPACT OF FLOODING ON VULNERABLE DEVELOPMENT AND CRITICAL INFRASTRUCTURE LOCATED IN THE STUDY AREA^(1,2)

Type	Development/Structure	Location Identifier ¹	20% AEP	10% AEP	5%AEP	2% AEP	1% AEP	0.50%	0.20%	PMF
Community Assets	Community Hall	-	NF	NF	NF	NF	NF	NF	NF	F
	Major Road Crossing (Trigg Hill Road)	H01	F	F	F	F	F	F	F	F
	Major Road Crossing (Trigg Hill Road)	H02	F	F	F	F	F	F	F	F
	Major Road Crossing (Parkes Eugowra Road)	H03	F	F	F	F	F	F	F	F
	Major Road Crossing (Coonambro Way)	H04	F	F	F	F	F	F	F	F
	Major Road Crossing (Trigg Hill Road)	H05	F	F	F	F	F	F	F	F
	Major Road Crossing (Railway Street)	H06	F	F	F	F	F	F	F	F
	Major Road Crossing (Cooka Hill Road)	H07	F	F	F	F	F	F	F	F
	Major Road Crossing (Cooka Hill Road)	H08	F	F	F	F	F	F	F	F
	Major Road Crossing (Flagstone Street)	H09	F	F	F	F	F	F	F	F

1. Refer **Figure 2.6** (2 sheets) for location of vulnerable development and critical infrastructure.
2. "NF" = Infrastructure not impacted by flooding.
"F" = Infrastructure impacted by flooding.

2.8 Potential Impacts of a Change in Hydraulic Roughness

An analysis was undertaken as part of the *Cookamidgera Flood Study* to assess the sensitivity of flood behaviour to potential changes in hydraulic roughness. **Figure 2.7** shows the impact that a 20% increase in the “best estimate” hydraulic roughness values in the hydraulic model would have on a 1% AEP flood event.

The investigation found that increases in peak 1% AEP flood levels in the areas subject to Main Stream Flooding are generally in the range 50 to 200 mm, while increases in peak flood levels in those parts of the Village Centre that are subject to Major Overland Flow are generally in the range 10 to 50 mm.

2.9 Potential Impacts of a Partial Blockage of Hydraulic Structures

As mentioned in **Section 2.4** of this report, as per the requirements of ARR 2019, the results of the design flood modelling include probability neutral blockage factors that have been applied to existing hydraulic structures, details of which are set out in the *Cookamidgera Flood Study*. **Figure 2.8** shows that the removal of the probability neutral blockage factors has a negligible effect on flood behaviour at the 1% AEP level of flooding.

2.10 Potential Impacts of Future Climate Change

DCCEEW currently recommends that the advice set out in Section 3.7.4 of *Floodplain Risk Management Guide - Incorporating 2016 Australian Rainfall and Runoff in studies* (Office of Environment and Heritage (OEH), 2019) be used as the basis for examining climate change in projects undertaken under the State Floodplain Management Program and the FRMM. 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.³

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 the *Cookamidgera Flood 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 AEP's of 1%, 0.5% and 0.2%.

Figure 2.9 shows that a 10% increase in 1% AEP rainfall intensities would result in increases in peak flood levels of between 50 and 200 mm along Flagstone and Quart Pot creeks, while depths of Major Overland Flow would generally be increased by between 10 to 50 mm.

Figure 2.10 shows that a 30% increase in 1% AEP rainfall intensities would result in increases in peak flood levels of between 100 and 300 mm along Flagstone and Quart Pot creeks, while depths of Major Overland Flow would generally be increased up to 200 mm.

³ While ARR 2019 updated the advice in relation to the impact that climate change will have on the BoM, 2016 design rainfall intensities, as well as initial and continuing losses for design flood estimation in late 2024, due to the timing of its release, the advice set out in OEH, 2019 has been adopted for undertaking the present study.

Figure 2.11 shows that the extent of land that would be inundated by floodwater should 1% AEP rainfall intensities increase by up to 30% is negligible due to the relatively steep sided nature of the floodplain adjacent to the relatively flat overbank areas. Furthermore, no new flow paths are formed should 1% AEP rainfall intensities increase by up to 30%.

2.11 Flood Hazard Vulnerability and Hydraulic Categorisation of the Floodplain

2.11.1 General

According to the FRMM, in order to achieve effective and responsible flood risk management, it is necessary to divide the floodplain into areas that reflect:

1. The impact of flooding on people, as well as existing and future development. 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 *Cookamidgera Flood Study* where the floodplain was divided six flood hazard vulnerability zones. **Section 2.11.2** below provides details of the procedure and its outcomes.
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 as part of the *Cookamidgera Flood Study*. **Section 2.11.3** below summarises the procedure and its outcomes.

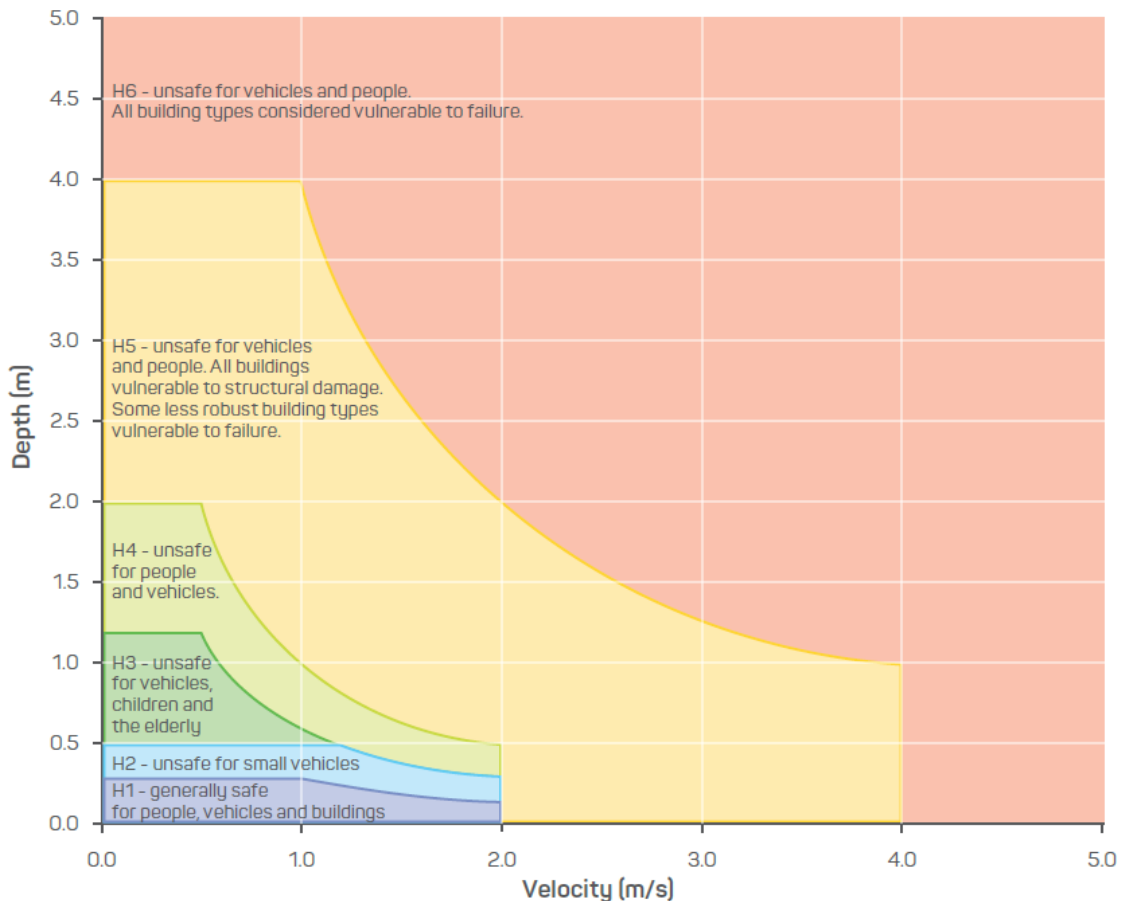
2.11.2 Flood Hazard Vulnerability Categorisation

Flood hazard categories may be assigned to flood affected areas in accordance with the definitions contained in ARR 2019. 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 over the page which has been taken from ARR 2019.

Figures 2.12 and 2.13 (2 sheets each) show the *Flood Hazard Vulnerability Classification* based on the procedures set out in ARR 2019 for the 1% AEP and PMF events at Cookamidgera, respectively.

The *Cookamidgera Flood Study* found that the majority of the Village Centre is classified as H1 and H2 in a 5% AEP flood event, with isolated pockets of H3 to H5 present along the Major Overland Flow path that runs in a westerly direction to the north of Railway Street and in the road reserve in the vicinity of the intersection of Haynes Street and Flagstone Street. The *Cookamidgera Flood Study* also found that:

- a) the extent of land classified as H1 and H2 in the Village Centre increases in for storms up to 0.2% AEP in intensity;
- b) the width of the H5 and H6 hazard zones increases significantly during a PMF event, mainly along the alignment of Flagstone Creek and Quart Pot Creek; and
- c) the hazard category in the majority of the Village Centre increases to H5 during a PMF flood.



2.11.3 Hydraulic Categorisation of the Floodplain

According to the FRMM, 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.

Flood Risk Management Guideline FB02 Floodway Function offers guidance in relation to two alternative procedures for identifying the portion of the floodplain that functions as floodways, flood storage and flood fringe areas.

The indicator technique set out in *Howells et al, 2003* was used as part of the *Cookamidgera Flood Study* to identify the preliminary extent of 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 0.25 m²/s **and** Velocity greater than 0.25 m/s; or
- Velocity greater than 1 m/s.

Manual assessment and cleaning of the raw model output data was then undertaken as recommended in *Flood Risk Management Guideline FB02 Floodway Function*.

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

Figures 2.14 to 2.15 (2 sheets each) show the division of the floodplain into floodway, flood storage and flood fringe areas for the 1% AEP and PMF events, respectively.

As the hydraulic capacity of the watercourses is not large enough to convey the flow in a 5% AEP flood, their overbank areas also function as a floodway. As the ground levels rise relatively steeply at the edge of the floodplain, the majority of the floodplain along Quart Pot Creek and the lower reaches of Flagstone Creek are classified as floodway at a number of locations.

A floodway is located along the natural low point that is present in the Village Centre on the northern side of Railway Street during a 5% AEP flood, while floodways commence to operate along Railway Street and Flagstone Street in a 1% AEP flood.

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

2.12 Environmental Considerations

While **Figures 2.16** shows that there is no environmentally zoned land in the immediate vicinity of Cookamidgera, the inbank area of Flagstone Creek, as well as its immediate overbank vegetation do have significant environmental value. This is highlighted by identification of areas of significant environmental value on the *Terrestrial Biodiversity* and *Watercourse* maps contained in both *Parkes LEP 2012* and *Forbes LEP 2013*, extracts of which are shown in the illustrations over the page.

It is noted that both areas identified as “Biodiversity” and “Watercourse” extend a short distance into the Village Centre along its southern boundary. Further discussion on the potential impacts that Council must consider when assessing a development application in these two areas is contained in **Section 2.13.2** of this report.

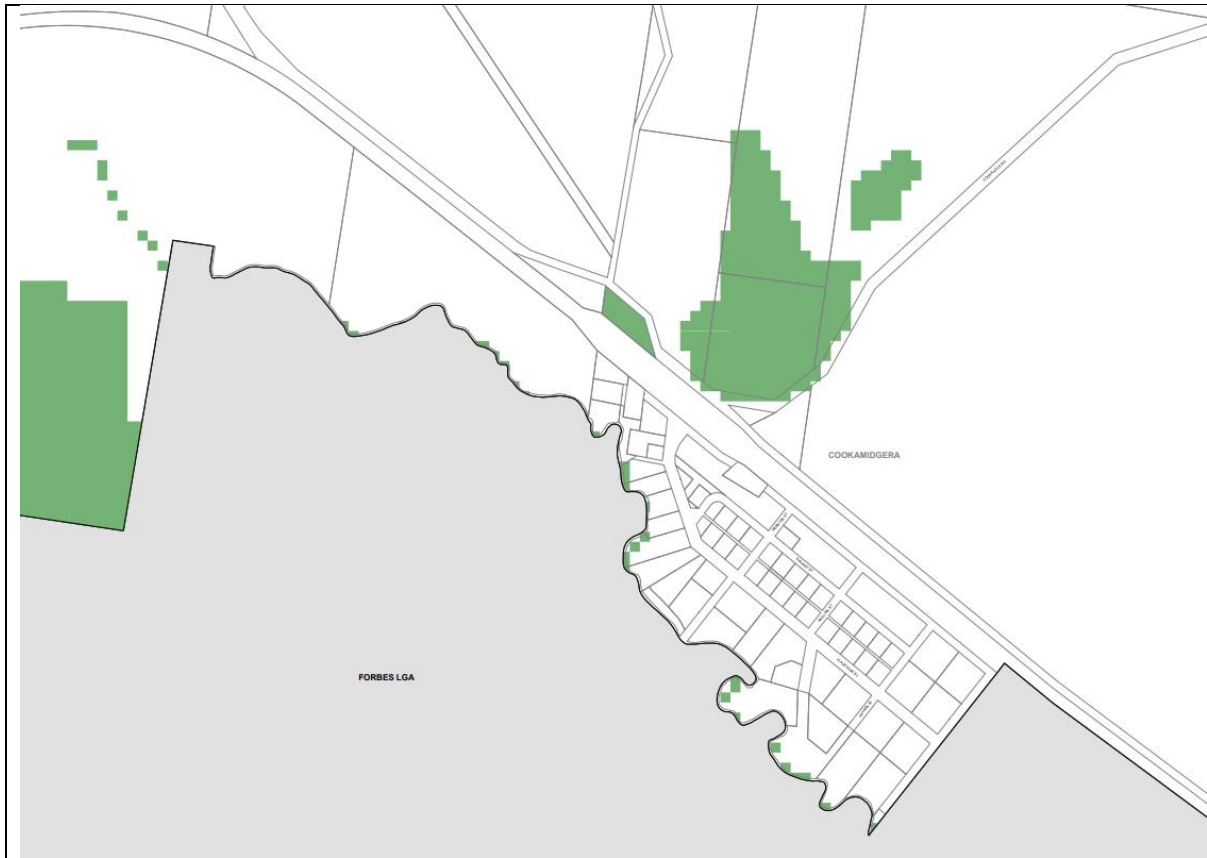


Illustration showing the extent of land identified as "biodiversity" on the "Terrestrial Biodiversity Map" contained in Parkes LEP 2012.



Illustration showing the extent of land identified as "biodiversity" on the "Terrestrial Biodiversity Map" contained in Forbes LEP 2013.

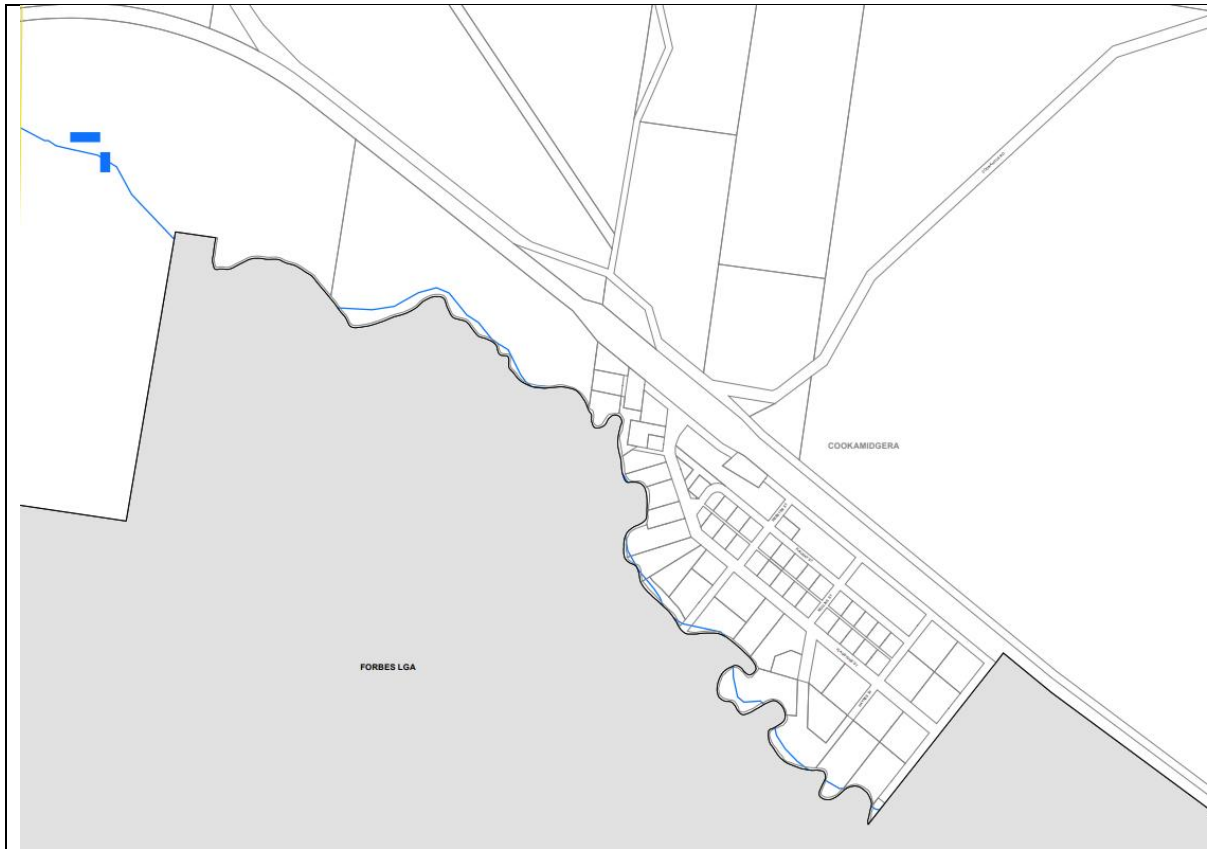


Illustration showing the extent of land identified as "watercourse" on the "Watercourse Map contained in Parkes LEP 2012.

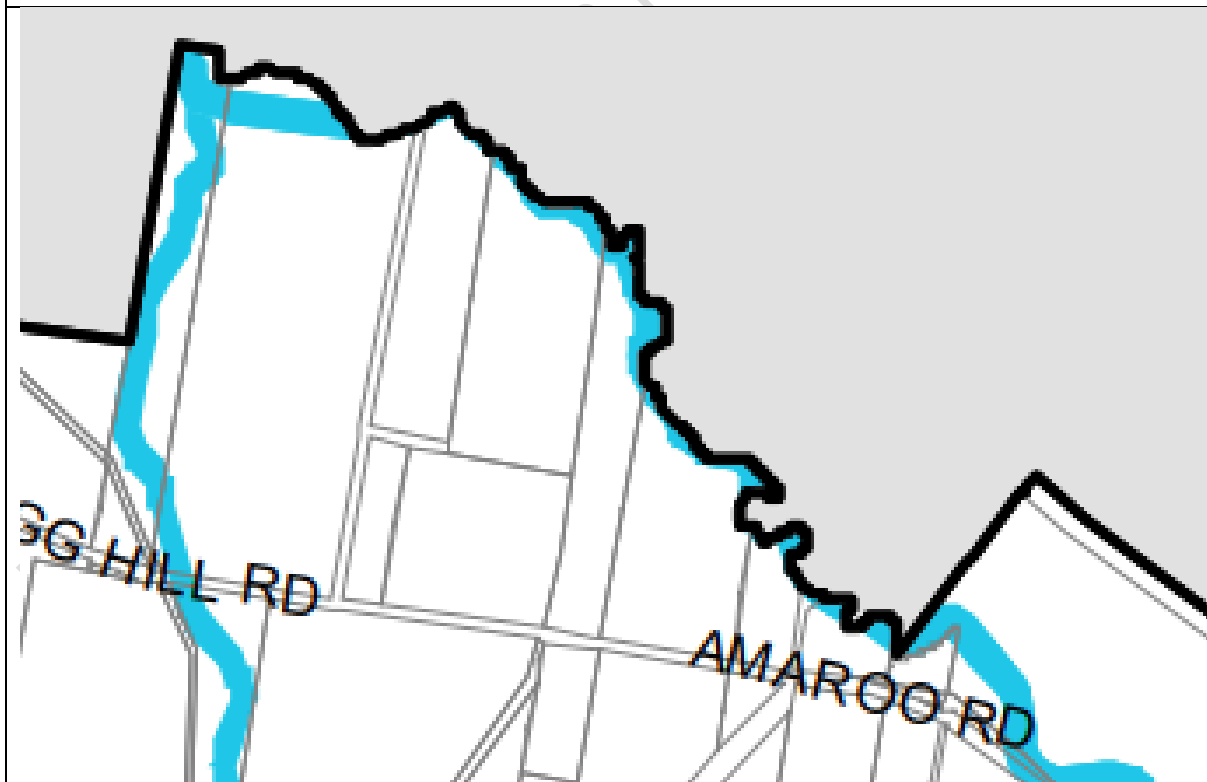


Illustration showing the extent of land identified as "watercourse" on the "Watercourse Map contained in Forbes LEP 2013.

2.13 Council's Existing Planning Instruments and Policies

2.13.1 General

The *Parkes LEP 2012* 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 Parkes Shire Council local government area.

The *Parkes Shire Development Control Plan 2021* (**Parkes Shire DCP 2021**) supplements the *Parkes LEP 2012* by providing general information and detailed guidelines which relate to the decision making process.

2.13.2 Parkes Local Environmental Plan 2012

Figures 2.16 shows the zonings that are incorporated in *Parkes LEP 2012* in the immediate vicinity of Cookamidgera. The Village Centre comprises land that is zoned *RU5-Village*, while the land surrounding it is principally zoned *RU1-Primary Production*, with the exception of the adjacent rail corridor that is zoned *SP2-Infrastructure*.

Clause 5.21 of *Parkes LEP 2012* 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 *Parkes LEP 2012* 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 *Parkes LEP 2012* 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 inclusion. 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 applies to land that lies outside the FPA but within the extent of the PMF.

As mentioned in **Section 2.12**, Council must give consideration to the impact that a proposed development would have on areas identified as “Watercourse” and “Biodiversity”, noting that both these areas affect the northern portion of the Village Centre.

Clause 6.2 of *Parkes LEP 2012* entitled “*Terrestrial biodiversity*” applies to land identified as “Biodiversity” on the *Terrestrial Biodiversity Map*. It states that before determining a development application for development on land to which this clause applies, the consent authority must consider:

- (a) *whether the development is likely to have—*
 - (i) *any adverse impact on the condition, ecological value and significance of the fauna and flora on the land, and*
 - (ii) *any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna, and*
 - (iii) *any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and*
 - (iv) *any adverse impact on the habitat elements providing connectivity on the land, and*
- (b) *any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.*

It also states that development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

- (a) *the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or*
- (b) *if that impact cannot be reasonably avoided by adopting feasible alternatives—the development is designed, sited and will be managed to minimise that impact, or*
- (c) *if that impact cannot be minimised—the development will be managed to mitigate that impact.*

Clause 6.4 of *Parkes LEP 2012* entitled “*Riparian lands and watercourses*” applies to land identified as “Watercourse” on the *Watercourse Map* and all land that lies within 40 metres of the top of bank of each watercourse identified as “Watercourse” on that map. It states that before determining a development application for development on land to which this clause applies, the consent authority must consider:

- (a) *whether or not the development is likely to have any adverse impact on the following—*
 - (i) *the water quality and flows within the watercourse,*
 - (ii) *aquatic and riparian species, habitats and ecosystems of the watercourse,*
 - (iii) *the stability of the bed and banks of the watercourse,*
 - (iv) *the free passage of fish and other aquatic organisms within or along the watercourse,*
 - (v) *any future rehabilitation of the watercourse and riparian areas, and*
 - (vi) *whether or not the development is likely to increase water extraction from the watercourse, and*
- (b) *any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.*

It also states that development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

- (a) *the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or*
- (b) *if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or*
- (c) *if that impact cannot be minimised—the development will be managed to mitigate that impact.*

The above requirements highlight that in addition to flood related constraints, the land which lies along the northern side of Flagstone Creek is also potentially constrained by environmental type considerations.

2.13.3 Flood Related Development Controls

Part B2.5 of *Parkes Shire DCP 2021* entitled “*Stormwater Design and Management*” sets out the controls that apply to new residential subdivisions that are proposed within the LGA. The stated objective of the chapter is:

“To ensure stormwater from residential subdivisions is properly drained to a legal point of discharge without causing adverse impacts on public drainage infrastructure, downslope properties or the quality of receiving waters.”

The standards that are to be applied to new subdivision development are as follows:

- a. *All stormwater generated by any subdivision development must be drained to a legal point of discharge.*
- b. *Stormwater drainage systems are designed using the Australian Rainfall and Runoff 2019 major and minor event philosophy, where the minor system shall be capable of carrying the controlling flows from frequent runoff events, while the major system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events.*
- c. *Stormwater volumes and characteristics are estimated in accordance with Australian Rainfall and Runoff 2019 by a suitably qualified engineer.*

- d. Subdivision development takes into account the stormwater management requirements of the whole site / stormwater drainage system, including stormwater from upslope areas in the catchment that is based on a fully developed scenario.
- e. Existing stormwater management infrastructure abutting the subdivision development, including road drainage and drainage reserves are upgraded / replaced where they do not meet the requirements of the Parkes Shire Council Engineering Design Minimum Standards for Subdivision and Development 2021 and AUS-SPEC #2 Stormwater Drainage.
- f. Subdivisions that are shown as requiring onsite stormwater detention under the Parkes Urban Area Stormwater Management Plan 2019 are designed so that post-development runoff rates from the new subdivision are equal to or less than pre-development runoff rates for the 1% AEP.
- g. Subdivisions are designed to accommodate all stormwater in the 20% AEP via underground drainage infrastructure.
- h. Subdivisions are designed to accommodate all stormwater above the 20% AEP up to the 1% AEP via roads and drainage reserves.
- i. All residential lots in subdivisions must be free of flooding in the 100 ARI.
- j. Subdivisions are provided with all necessary stormwater management infrastructure required to address a) to i) above, and in accordance with Parkes Shire Council Engineering Design Minimum Standards for Subdivision and Development 2021 and AUS-SPEC #2 Stormwater Drainage.
- k. Easements to drain stormwater are provided over all pipelines, pits, overland flow paths and channels (other than natural water courses).
- l. Subdivisions that cannot drain stormwater to a legal point of discharge via gravity must be supported by a site specific stormwater management system that is designed by a suitably qualified engineer.

Part C7.4 of *Parkes Shire DCP 2021* entitled “Fencing” sets out the controls that apply to new fencing that is proposed as ancillary type development. The stated objective of the chapter is:

“To ensure fencing that requires consent does not create adverse impacts on streetscape, residential amenity, public utilities or access.”

The standards that are to be applied to new fencing are as follows:

- a. Fencing must be constructed of masonry, timber or low reflective painted metal materials to manufacturer’s specifications.
- b. Fencing must not incorporate barbed or razor wire in its construction or be electrified or topped with sharp edged materials.
- c. Entrance gates in fencing shall not open outwards onto a public road reserve.
- d. Fencing must be designed so as not to restrict / redirect the flow of any floodwater or overland drainage flow-path within a legal drainage easement.
- e. Fencing complies with the maximum height standards in the following table: [Not reproduced in this report]

It is noticeable that the flood related controls that are set out in *Parkes Shire DCP 2021* only related to new subdivisions and ancillary type development in the form of new fencing, and therefore do not extend to the control of other types of development such as new single dwellings, commercial/industrial buildings and sensitive type development such as aged and child care type facilities. As a result, Council is constrained in its ability to impose suitable controls on new development that is located within the extent of the flood planning area as required by Clause 5.21 of *Parkes LEP 2012*.

2.14 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 *Parkes Shire Local Flood Plan* which is dated February 2024 covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures for all levels of flooding within the Parkes Shire LGA. *Parkes Shire Local Flood Plan* is administered by the Parkes Unit Commander who controls flood operations within the Parkes Shire LGA. NSW SES maintains a local headquarters at the corner of Clark and Alluvial streets in Parkes.

Volume 1 of *Parkes Shire Local Flood Plan* entitled '*Parkes 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:

- **Chapter 1 - Outline and Scope;** this section of the document introduces the roles and responsibilities for agencies, functional areas and organisations in relation to flooding within the Parkes Shire. It also emphasises the importance of reviewing and maintaining the currency of the *Parkes Shire Local Flood Plan*.
- **Chapter 2 - Overview of NSW Flood Hazard and Risk,** makes reference to Volume 2 of the *Parkes Shire Local Flood Plan* which outlines the existing hazard and flood risk in the Parkes Shire. It also lists the declared dams that are located either in or upstream of the Parkes Shire LGA.
- **Chapter 3 - Preparation;** this section of the document deals with activities required to ensure the *Parkes Shire Local Flood Plan* functions during the occurrence of the flood emergency. It also devotes considerable attention to flood alertness and emergency response.
- **Response;** this section states response operations will commence:
 - a. On receipt of a Bureau Severe Weather Warning or Thunderstorm Warning that includes heavy rain or storm surge; or
 - b. On the receipt of a Bureau Flood Watch or Flood Warning; or
 - c. On receipt warnings for flash flood; or
 - d. On receipt of a dam failure alert; or
 - e. When other evidence leads to an expectation of flooding.

The response strategies to be employed by NSW SES and Council are listed in Chapter 5 of the *Parkes Shire Local Flood Plan* and include information provision and warning, property protection, evacuation, rescue, and resupply.

- **Recovery Operations;** 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 *Parkes Shire Local Flood Plan*.

Volume 2 of the *Parkes Shire Local Flood Plan* deals with the existing flood hazard and risk in the Parkes Shire LGA. Section 2.4 of Volume 2 deals with the specific flood threat at Cookamidgera. Information on the village is set out under the following headings, noting that only information relating to Cookamidgera has been reproduced below:

2.4.1 Community Overview

Cookamidgera is a locality of around 215 people, located approximately 13 kilometres to the south east of Parkes.

2.4.2 Characteristics of Flooding

Cookamidgera can be flooded as a result of runoff from the Cooka Hills to the east, as well as local flooding from rainfall and flash flooding of Bartleys Creek through the town (mainly urban runoff).

2.4.3 Flood Behaviour

Flooding can occur quickly and can be quite fast and deep, particularly along Trigg Hill Road. This area is ungauged.

2.4.4 Classification of Floodplain

Insufficient [sic] information available.

2.4.5 Inundation

At least one property on the intersection of Mullins Street and Flagstone Street is at risk of inundation.

2.4.6 Isolation

Cookamidgera can become isolated when Trigg Hill Road is cut at the causeway (Quart Pot Creek) between Eugowra Road and Cookamidgera; as well as when Cookamidgera Road and Cooka Hills Road are cut from local rainfall.

Haynes Street is at risk of being cut temporarily and the northern side of the Flagstone Street is also at risk of being cut at the culvert near the Cooka Hills Road intersection. This can further isolate rural residents to the north (approximately 15 properties) and east (<20 residents) of the town.

2.4.7 Flood Mitigation Systems

No known flood mitigation systems.

2.4.8 Dams

There are no prescribed dams near Cookamidgera.

2.4.9 At Risk Facilities

[No Cookamidgera specific information provided]

2.4.10 Other Considerations

No other considerations have been identified.

In Section 2.6 of Volume 2 which deals with road closures within the Parkes Shire LGA it is noted that Cookamidgera Road was closed in July 2016 due to local rainfalls of 53 mm.

While Annex 2 of Volume 2 lists the facilities at risk of flooding and/or isolation in the Lachlan Valley, there are no listings for Cookamidgera.

Volume 3 of the *Parkes Shire Local Flood Plan* deals with NSW SES response arrangements for the Parkes Shire and is set out as follows:

- **Chapter 1: Flood Warning Systems and Arrangements**, which deals with dissemination options for NSW SES flood information and warning products, as well as gauges monitored by NSW SES within the LGA.
- **Chapter 2: SES Locality Response Arrangements**, which deals with NSW SES flood response arrangements by individual sector within the LGA. It is noted that the village of Cookamidgera is not assigned a sector within the *Parkes Shire Local Flood Plan*.
- **Chapter 3: SES Dam Failure Arrangements**, which is not applicable to the Parkes Shire LGA.
- **Chapter 4: SES Caravan Park Arrangements**, which deals with arrangements for the evacuation of flood liable caravan parks within the LGA, as well as specific arrangements for individual parks likely to be affected by flooding. It is noted that no caravan parks are presently located within the village of Cookamidgera.

3 POTENTIAL FLOOD RISK MANAGEMENT MEASURES

3.1 Range of Available Measures

A variety of flood 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 both transverse and longitudinal drainage systems. 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 Outline of Chapter

A range of potential flood risk 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 *Cookamidgera FRMP*, details of which are set out in **Chapter 5**.

The potential flood modifications which were assessed as part of this study comprised the channel and flood protection levee works, as well as improvements to the hydrologic standard of Flagstone Street on either side of the Orange-Broken Hill Railway level crossing, details of which are set out in **Section 3.3** of this Chapter.

The property modification measures considered as part of this study include controls over future development, voluntary purchase of residential properties and house raising (refer **Section 3.4** of this Chapter for details). Response modification measures, such as improvements to the severe weather/flood warning system, emergency planning and responses, and public awareness programs have also been considered, details on which are set out in **Section 3.5** of this Chapter.

3.3 Flood Modification Measures

Table 3.1 over the page sets out the key features of six potential flood modification measures (PFMMs) which were assessed as part of the present investigation. Also set out in **Table 3.1** are the advantages and disadvantages of each PFMM, as well as their indicative capital cost.

While the implementation of the works associated with PFMM6 cannot be justified purely on economic grounds (i.e. because the present worth value of damages saved as a result of the works would be less than \$0.2 Million, resulting in a benefit cost ratio of less than 0.1), they would reduce the existing flood risk within the Cookamidgera community by:

TABLE 3.1
DETAILS OF ASSESSED POTENTIAL FLOOD MODIFICATION MEASURES

Potential Flood Modification Measure	Key Features	Advantages	Disadvantages	Indicative Capital Cost
PFMM1	<ul style="list-style-type: none"> ➤ Construction of an engineered earthen embankment approximately 560 m in length and on average 1 m in height running along the right (northern) bank of Flagstone Creek upstream of its crossing of Trigg Hill Road. ➤ Figure 3.1 (2 sheets) shows the key features comprising PFMM1, as well as the impact that their implementation would have on floods with AEPs of 20%, 5% and 1%. 	<ul style="list-style-type: none"> ➤ Prevents floodwater originating from Flagstone Creek impacting on existing development in the Village Centre for all floods up to 1% AEP in magnitude. ➤ Effectively removes flooding from existing development in the southern portion of the Village Centre for all floods up to 1% AEP in magnitude. 	<ul style="list-style-type: none"> ➤ Only has a minor impact on peak flood levels in existing development that is located in the northern portion of the Village Centre. ➤ Does not prevent flooding of existing development resulting from the major overland flow path that is present in the northern portion of the Village Centre. ➤ Does not result in a significant improvement in the hydrologic standard of Flagstone Street at the western end of the Village Centre. ➤ Increases both the depth and extent of inundation that would be experienced in privately owned land that lies between the Village Centre and Trigg Hill Road, noting that there are no buildings located in the affected area. ➤ Would require agreement with private land owners and the creation of an easement to facilitate access by Council for maintenance. 	\$0.6 Million
PFMM2	<ul style="list-style-type: none"> ➤ Same as PFMM1. ➤ Construction of an engineered earthen embankment around the existing farm dam that is located 500 m to the east of the village centre, as well as a 200 m channel extending south to an overbank flood runner of Flagstone Creek. ➤ Figure 3.2 (2 sheets) shows the key features comprising PFMM2, as well as the impact that their implementation would have on floods with AEPs of 20%, 5% and 1%. 	<ul style="list-style-type: none"> ➤ Same as PFMM1. ➤ Significantly reduces the extent and depth of inundation that is currently experienced in the northern portion of the Village Centre, with the resulting depths of inundation generally less than 0.3 m during storms up to 1% AEP in intensity. 	<ul style="list-style-type: none"> ➤ Does not result in a significant improvement in the hydrologic standard of Flagstone Street at the western end of the Village Centre. ➤ Increases both the depth and extent of inundation that would be experienced in privately owned land that lies between the Village Centre and Trigg Hill Road, noting that there are no buildings located in the affected area. ➤ Further to the above, the increases in both the depth and extent of inundation occurs within the adjacent LGA of Forbes Shire. ➤ Would require agreement with private land owners and the creation of an easement to facilitate access by Council for maintenance. 	\$0.8 Million
PFMM3	<ul style="list-style-type: none"> ➤ Construction of a grassed swale/channel along the eastern side of Flagstone Street, extending west to the location of an existing dam that is located in the rail corridor. ➤ Construction of new transverse drainage structures beneath both Flagstone Street and the adjacent unsealed access road (each presently assessed as 2 off 3 m wide by 1.2 m high reinforced concrete box culverts). ➤ Lowering of the spillway associated with the existing dam that is located in the rail corridor by about 0.7 m over a 14 m length (current assessment assumes a spillway elevation of RL 343.7 m AHD). ➤ Figure 3.3 (2 sheets) shows the key features comprising PFMM3, as well as the impact that their implementation would have on floods with AEPs of 20%, 5% and 1%. 	<ul style="list-style-type: none"> ➤ Removes flooding from existing development that is located on the western side of Flagstone Street for all floods up to 20% AEP magnitude. ➤ Significantly improves the hydrologic standard of Flagstone Street immediately to the south of the rail corridor for all floods up to 20% AEP magnitude. 	<ul style="list-style-type: none"> ➤ Flood mitigation benefits of the measure reduce with increasing flood magnitude. ➤ Requires works in the rail corridor. 	\$0.5 Million
PFMM4	<ul style="list-style-type: none"> ➤ Widening and regrading the watercourse that runs along the northern side of the rail corridor from where it crosses Cooka Hills Road to where it crosses the Orange-Broken Hill Railway, an overall length of about 550 m (current assessment assumes a 12 m base width). ➤ Installation of 3 off 3.6 m wide by 0.9 m high reinforced box culverts on Flagstone Street. ➤ Raising Flagstone Street by about 0.2 m to an elevation of RL 345.7 m AHD. ➤ Lowering of natural surface levels either side of Flagstone Street to facilitate the installation of the reinforced concrete box culverts and associated inlet/outlet headwall/scour protection works. ➤ Figure 3.4 (2 sheets) shows the key features comprising PFMM4, as well as the impact that their implementation would have on floods with AEPs of 20%, 5% and 1%. 	<ul style="list-style-type: none"> ➤ Increases the hydrologic standard of Flagstone Street on the northern side of the rail corridor to a minimum of 20% AEP. ➤ Reduces the magnitude of flow which surcharges the rail corridor and discharges to the Village Centre at its very western end. 	<ul style="list-style-type: none"> ➤ Increases both the end and depth of inundation existing immediately downstream of the existing railway culverts, albeit over a localised area. 	\$0.8 Million
PFMM5	<ul style="list-style-type: none"> ➤ Same as PFMM1, PFMM3 and PFMM4. ➤ Figure 3.5 (2 sheets) shows the key features comprising PFMM5, as well as the impact that their implementation would have on floods with AEPs of 20%, 5% and 1%. 	➤ Same as PFMM1, PFMM3 and PFMM4.	➤ Same as PFMM1, PFMM3 and PFMM4.	\$1.9 Million
PFMM6	<ul style="list-style-type: none"> ➤ Same as PFMM2, PFMM3 and PFMM4. ➤ Figure 3.6 (2 sheets) shows the key features comprising PFMM6, as well as the impact that their implementation would have on floods with AEPs of 20%, 5% and 1%. 	➤ Same as PFMM2, PFMM3 and PFMM4.	➤ Same as PFMM2, PFMM3 and PFMM4.	\$2.1 Million

- a) significantly reducing both the extent and depth of inundation that is currently experienced within the Village Centre;
- b) removing the above-floor inundation that is currently experienced in two dwellings up to the 1% AEP level of flooding
- c) significantly improving the ability of people being able to travel between the village and Parkes during times of freshes and floods.

While subject to agreement with affected land owners and the relevant rail authority, it is recommended that Council seek to implement the full scope of works associated with PFMM6 given they maximise the flood mitigating benefits afforded to the Cookamidgera community.

3.4 Property Modification Measures

3.4.1 Controls over Future Development

3.4.1.1 Current Government Policy

The NSW Government has recently implemented 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 5.22 titled “*special flood considerations*” which applies to land which lies between the FPA and the extent of the PMF, Council chose not to include it in *Parkes LEP 2012* at the time.

3.4.1.2 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 flood 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. As set out in *Flood Risk Management Guideline FB01 – Understanding and Managing Flood Risk* (DPE, 2023), design variables that are typically incorporated in the derivation of freeboard typically comprise the following:

- uncertainties in the design flood level estimates due to the confidence limits associated with the design peak flow estimates, inaccuracies in the LiDAR survey data and possible variations in key parameters such as hydraulic roughness;
- local factors that can result in differences in water levels across the floodplain; and
- increases in peak flood levels due to wave action.

Depending on the design life of a structure, potential increases in peak flood levels associated with future climate change may also need to be taken into consideration when assessing an appropriate freeboard.

Table 3.2 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 Cookamidgera 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 Public Works, 2010.

TABLE 3.2
SUMMARY OF FREEBOARD ANALYSIS
AREAS AFFECTED BY MAIN STREAM FLOODING

Design Variable	Probability of Occurrence/Level of Certainty	Maximum Allowance (m)	Joint Probability Allowance (m)
Wave Action	50%	0.20 ⁽¹⁾	0.10
Uncertainties in Peak 1% AEP Flood Level Estimate			
- LiDAR survey data	100%	0.15	0.15
- Peak flow estimate	50%	0.20 ⁽²⁾	0.10
Future Climate Change	50%	0.20 ⁽²⁾	0.10
	TOTAL		0.45

1. Based on vehicle driven wave action

2. Based on the difference between peak 1% and 0.5% AEP flood levels on Gunningbland Creek at Cookamidgera.

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

- inaccuracies in the LiDAR survey data; and
- 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.

In regards the potential impacts of future climate change on flood behaviour at Cookamidgera, the *ARR Data Hub* previously gave the following interim climate change factors for Representative Concentration Pathways (**RCPs**) of 4.5 and 8.5 in the years 2050 and 2090:⁴

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 Cookamidgera.

Based on the joint probability analysis set out in **Table 3.2** the adoption of the traditional value of 0.5 m for setting the FPL in areas affected by Main Stream Flooding would provide a reasonable level of flood protection to future development at Cookamidgera.

⁴ While the climate change factors in the *ARR Data Hub* were updated in late 2024, the current study has been prepared in accordance with DCCEEWs current advice in relation to the approach that is to be adopted for assessing the potential impacts on climate change on flood behaviour.

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 the FRMM 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 3.3**.

TABLE 3.3
PROPOSED CATEGORISATION OF THE FLOODPLAIN

Category	Proposed Terminology used to define inundation in the Cookamidgera 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 - Major Drainage	“Local Drainage” “Major Overland Flow”	No (ref. footnote 1). Yes (ref. footnote 2).	No (ref footnote 1) 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”.

Figure C1.1 in **Appendix C** is an extract from the *Flood Planning Map* for Cookamidgera. The figure includes 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 **Figure C1.1**, 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 areas where depths of inundation exceed 0.1 m in a 1% AEP event, and where identifiable floodways are present in shallower flow.

Section 3.5.1.4 sets out the recommended approach to managing future development that is located within the extent of the FPA.

3.4.1.3 Special Flood Considerations

As previously mentioned, in July 2021 Council chose not to adopt the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*. The objectives of the optional clause are:

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

The optional clause in its current form applies to:

- a) for sensitive and hazardous development, land between the flood planning area and the probable maximum flood, or as otherwise defined in an adopted flood risk management study and plan that has been prepared in accordance with the Flood Risk Management Manual, 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.

While the clause applies to all land that lies between the FPA and the extent of the PMF, Council is only required to apply flood affectation notices to S10.7 certificates where it considers flood related controls need to be applied to specific types of development.

While there is a significant amount of land within the Village Centre that is subject to H5 type flooding conditions during a PMF event (refer **Figure 2.13**, sheet 2), its limits are contained wholly within the extent of the FPA and therefore any future development would be subject to the requirements of clause 5.21 of *Parkes LEP 2012*.

While the adoption of the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012* would have limited, if any, impact on future development within the Village Centre, the approach to defining the extent of land that lies between the FPA and PMF where flood related development controls would apply as part of the present study is the same as that presented in the *Bogan Gate Flood Risk Management Study and Plan* (Lyll & Associates, 2025),

Based on this understanding, **Figure C1.1** shows the extent of land that lies between the FPA and PMF where the flood hazard vulnerability condition in a PMF is H3 or greater and therefore where flood related development controls should be applied to future development in accordance with the requirements of clause 5.22 (denoted thereon as the *Special Flood Considerations Zone*). **Figure C1.1** also shows the extent of land that lies between the FPA and PMF where the flood hazard vulnerability condition in a PMF is either H1 or H2 and therefore where no flood related development controls would need to be applied to future development in accordance with the requirements of clause 5.22 (denoted thereon as the *Outer Floodplain Zone*).

Note that prior to making the decision to include the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*, it is recommended that Council obtain legal advice to confirm that the above approach of pre-determining the extent of land to which the requirements of the clause apply is legally binding.

3.4.1.4 Proposed Planning Controls for Cookamidgera

While *Parkes DCP 2021* deals with subdivision type development at Cookamidgera, it is limited in its scope and is not consistent with current best flood risk management practice. As a result, it is recommended that Council review and update *Parkes DCP 2021* based on the findings of the present study, as well as the suggested wording that is set out in **Appendix C** of this report.

Schedules 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 **Figure C1.1 in Appendix C** shows the areas where the graded set of flood related planning controls set out in **Schedules 2A and 2B** apply in Cookamidgera.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development of properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figure C1.1**. 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.⁵

For areas outside the FPA shown on **Figure C1.1**, the MHFL for essential community facilities and utilities which are critical for flood response and recovery, as well as sensitive uses and facilities is the level of the PMF.

Figure C1.2 in Appendix C is an extract of the *Flood Planning Constraint Category Map* for the Parkes Shire LGA which respectively show the subdivision of the floodplain at Cookamidgera 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 **Appendix C** of this report.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises areas which lie between the FPA and the extent of the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the

⁵ 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.

event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the *Special Flood Considerations Zone* shown on **Figure C1.1**.

- **Flood Planning Constraint Category 5 (FPCC 5)**, which comprises areas that lie between the FPA and the extent of the PMF where Council does not consider flood related development controls need to be applied to all types of development. This area is identical to the *Outer Floodplain Zone* shown on **Figure C1.1**.

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 Cookamidgera, the sub-categories of which are set out in **Table 3.4**. These sub-regions were then combined, with the resulting extents further refined in order to improve the area over which each FPCC applied.

TABLE 3.4
KEY ELEMENTS COMPRISING FLOOD PLANNING CONSTRAINT CATEGORIES

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 (Low Flood Island)
		e	1% AEP Flood Emergency Response Classification (Low Flood Island)
		f	0.2% AEP Main Stream Flooding (MSF) Floodway
	3	-	Flood Planning Area (1% AEP + 0.5 m)
	4	-	PMF Flood Hazard Vulnerability Classification H3-H6
	5	-	PMF Flood Hazard Vulnerability Classification H1-H2
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 (1% AEP where depths greater than 100 mm)
	4	-	PMF Flood Hazard Vulnerability Classification H3-H6
	5	-	PMF Flood Hazard Vulnerability Classification H1-H2

3.4.1.5 Revision of Parkes LEP 2012

While Council chose not to adopt the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012* in July 2021, there is merit in doing so, if not in direct relation to future development within the Village Centre, then possibly in relation to other urban centres within the LGA.

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).

Flood Risk Management Manual—see clause 5.21(5).

probable maximum flood has the same meaning as it has in the Flood Risk Management Manual.

sensitive and hazardous development means development for the following purposes—

- (a) *[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 *Parkes LEP 2012* following the finalisation and adoption of *Cookamidgera FRMS&P* are:

1. Council Planning Staff consider the conclusions of *Cookamidgera FRMS&P* and suggested amendments to *Parkes LEP 2012*.
2. Council resolves to amend *Parkes LEP 2012* in accordance with *Cookamidgera 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 Department of Planning 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.

3.4.2 Potential Voluntary House Purchase Scheme

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 the NSW Government's Floodplain Management Program for over 20 years, with the recently released *Guideline for the voluntary purchase scheme* (DCCEEW, 2024a) setting out the key eligibility criteria and funding requirements should a council wish to incorporate such a scheme into one of its flood risk management plans.⁶

Voluntary purchase is a recognised and effective flood risk management measure for existing residential properties in areas where:

- there are highly hazardous flood conditions from riverine or overland flooding and the principal objective is to remove people living in the properties and reduce the risk to life of residents and potential rescuers
- a property is located within a floodway and the removal of a building may be part of a floodway clearance program that aims to reduce significant impacts on flood behaviour elsewhere in the floodplain, by enabling the floodway to more effectively perform its flow conveyance function
- purchase of a property enables other flood mitigation works (such as channel improvements or levee construction) to be implemented because the property will impede construction or may be adversely affected by the works with impacts notable to be offset.

Prior to progressing to the purchase of a property that has been identified as being eligible under the scheme, it would first be necessary to undertake a scoping study, especially if the intention is for a council to apply for NSW Government grant funding. The study would involve 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.

Following the completion of the scoping study, the subject owner is notified that Council is prepared to purchase the property when the owner is ready to sell. Ultimately, the purchase price of the property is determined by independent valuers and the Valuer General, and by negotiation between Council and the owners, noting that valuations are not reduced due to the flood affected nature of the site.

After purchase, land is subsequently cleared and the site re-developed and 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.

⁶ 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.

Assessment Outcome

As there are no residential properties located in high hazard floodway areas at Cookamidgera, the inclusion of a voluntary house purchase scheme in the *Cookamidgera FRMP* is not an option that is available to Council.

3.4.3 Potential Voluntary House Raising Scheme

Voluntary house raising is recognised as an effective floodplain risk management measure for both riverine and overland flood conditions. It is generally undertaken to:

- a) reduce the frequency of exposure to flood damage of the house and its contents and reduce the frequency of household disruption and associated trauma and anxiety; or
- b) as a compensatory measure where flood mitigation works adversely affect a house, which is generally considered part of the mitigation work rather than a separate VHR scheme.

Voluntary house raising can be an effective strategy for existing properties in low flood hazard areas where mitigation works to reduce flood risk to properties are impractical or uneconomic, noting that it must form part of a broader floodplain risk management strategy for an area rather than as a stand-alone option, as it does not deal with issues such as risk to life. The recently released *Guideline for voluntary house raising schemes* (DCCEEW, 2024b) sets out the key eligibility criteria and funding requirements should a council wish to incorporate such a scheme into one of its flood risk management plans.

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, noting that houses built after this date should have been constructed in accordance with the principles in the manual.

Following the adoption of a voluntary house raising scheme as part of a flood risk management plan, the next step is for a council to undertake a scoping study, especially if the intention is 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. Following the completion of the scoping study, the subject owner is notified that Council is prepared to cover the cost of raising the existing house to the FPL or higher.

Assessment Outcome

While there are two dwellings that would experience above-floor inundation in a 1% AEP flood event at Cookamidgera, the implementation of PFMM6 would remove prevent this from occurring. As the preference is for Council to implement the works associated with PFMM6, the option of implementing a voluntary house raising scheme at Cookamidgera has not been included in the *Cookamidgera FRMP*.

3.5 Response Modification Measures**3.5.1 Flood and Severe Weather/Thunderstorm Warning Systems**

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 Cookamidgera are limited to BoMs *Severe Thunderstorm Warning* and *Severe Weather Warnings for Flash Flooding* alert services which are publicly available via the internet via the following links or on smart phones via free Apps such as Hazards Near Me which is linked to the Australian Warning System:

- <http://www.bom.gov.au/nsw/warnings/>
- <https://hazardwatch.gov.au/>

Due to the flashy nature of flooding combined with the non-hazardous nature of flooding in the Village Centre for floods up to 0.2% AEP in magnitude, there is limited benefit in installing a formal flood warning system at Cookamidgera. Furthermore, the implementation of the works associated with PFMM6 would not only reduce the impact that flooding has on existing development in the Village Centre, but it would also significantly improve the hydrologic standard of Flagstone Street at its western end, thereby reducing the disruption that flooding currently has on traffic movements between Cookamidgera and Parkes.

3.5.2 Improved Emergency Planning and Response

As mentioned in **Section 2.14**, the *Parkes 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 *Parkes Shire Local Flood Plan*. Volume 2 should include the following sections:

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

1.2 Land Forms and River Systems – ref. **Sections 2.1** and **2.2** of this report for information on these topics.

1.5 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 2.3, 2.4** and **2.5**. The location of vulnerable development and critical infrastructure relative to the flood extents is shown on **Figure 2.6**.

1.6 Flood History – Recent flood experience at Cookamidgera is discussed in **Section 2.3** of the report.

1.8 Extreme Flood Events – The PMF was modelled and the indicative extent and depth of inundation presented on **Figure 2.4**.

2 – Effects on the Community

Information on the properties affected by the 1% AEP design flood are included in this report (**Figure 2.3**). As floor level data used in this assessment were estimated from the LiDAR survey and “drive by” survey they are indicative only. While fit for use in estimating the economic impacts of design floods, the data should not be used to provide specific details of the degree of flood affectation of individual properties.

Figure 2.5 shows stage hydrographs at road and rail crossings of various watercourses and drainage lines at Cookamidgera, the locations of which are shown on **Figures 2.3, 2.4** and **2.4** and **2.6**.

Figure 2.6 shows the location of vulnerable development and critical infrastructure at Cookamidgera relative to the flood extents of the 20, 10, 5, 2, 1, 0.5 and 0.2% AEP flood events, as well as the PMF. Refer **Section 2.7** for details of affected infrastructure.

Figures 3.7, 3.8 and 3.9 show the flood emergency response planning classifications for the 5% AEP, 1% AEP and PMF events, respectively, based on the definitions set out in the *Flood Risk Management Guideline EM01 – Support for Emergency Management Planning*.

In regards the above, the Village Centre is generally classified as **Rising Road Access** for all floods up to about 5% AEP in magnitude, with areas of **High** and **Low Flood Islands** gradually increasing with flood magnitude. During a PMF event, the majority of the Village Centre is classified as a **Low Flood Island**, with an area of **High Flood Island** located in its south-west corner. The illustrations below are taken from *Flood Risk Management Guideline EM01 – Support for Emergency Management Planning* describing the nature of these two classifications.

High flood island. The flood island has land higher than the limit of flooding for the event being considered (Figure 7 shows a high flood island in the PMF). During a flood these high islands are isolated from other areas of the community by floodwater, terrain, development, or infrastructure. However, there is an opportunity for people to retreat to higher ground within the island, and therefore, the direct risk to life is reduced. The area may require resupply by boat or air if not evacuated before the road is cut. If it is not possible to provide adequate support (such as community and medical facilities) during the period of isolation, evacuation will have to take place before isolation occurs. Isolation without these services is more likely to result in fatal decisions to cross floodwaters.

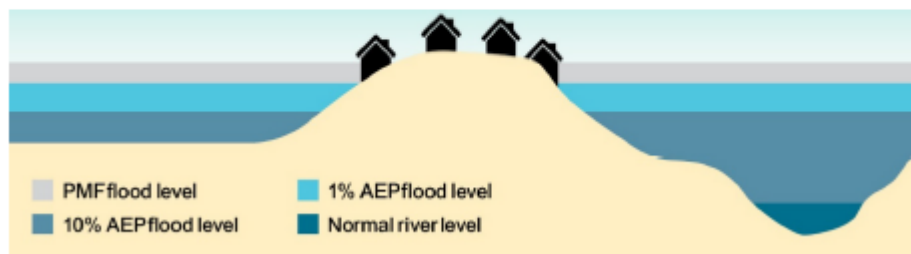


Figure 7 High flood island

Low flood island. The flood island is lower than the limit of flooding for the event being considered (Figure 8 and Figure 9 show a low flood island in the PMF). During a flood event the area initially becomes isolated by floodwater, terrain, development or infrastructure. If floodwater continues to rise after it is isolated, the land on the island will eventually be completely inundated by floodwaters. Evacuation of the community will be required prior to evacuation routes being closed as people left stranded on the island may drown.

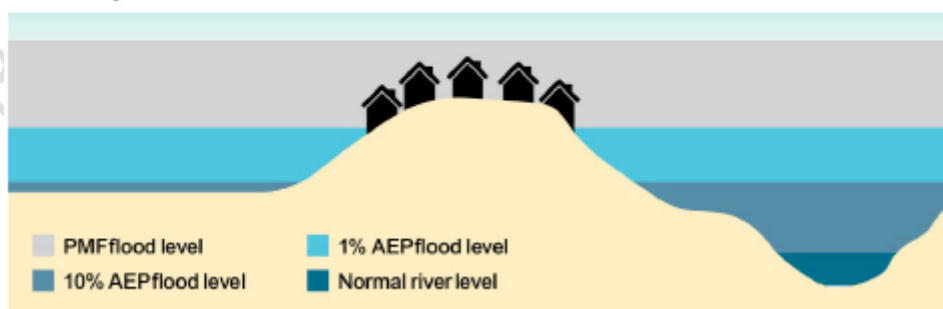


Figure 8 Low flood island

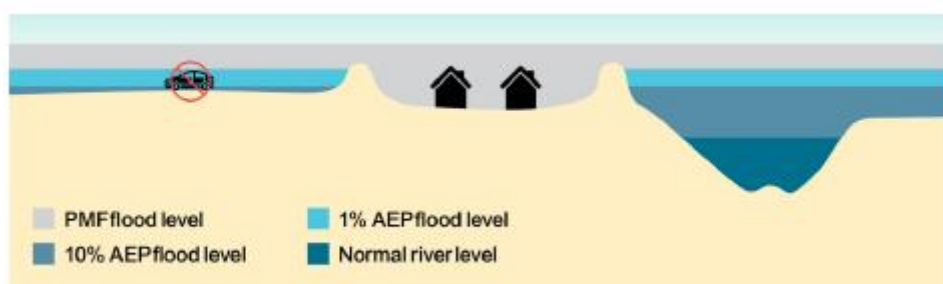


Figure 9 Low flood island created by a ring levee

Areas with rising road access are those areas where access roads rise steadily uphill and away from the rising floodwaters (Figure 12 and Figure 13). The community will not be completely isolated before inundation reaches its maximum extent, even in the PMF. Evacuation can take place by vehicle or on foot along the road as floodwater advances. People should not be trapped unless they delay their evacuation from their homes, for example, people living in 2-storey homes may initially decide to stay but reconsider after water surrounds them.

These communities contain low-lying areas from which people will be progressively evacuated to higher ground as the level of inundation increases. This inundation could be caused either by direct flooding from the river system or by localised flooding from creeks.

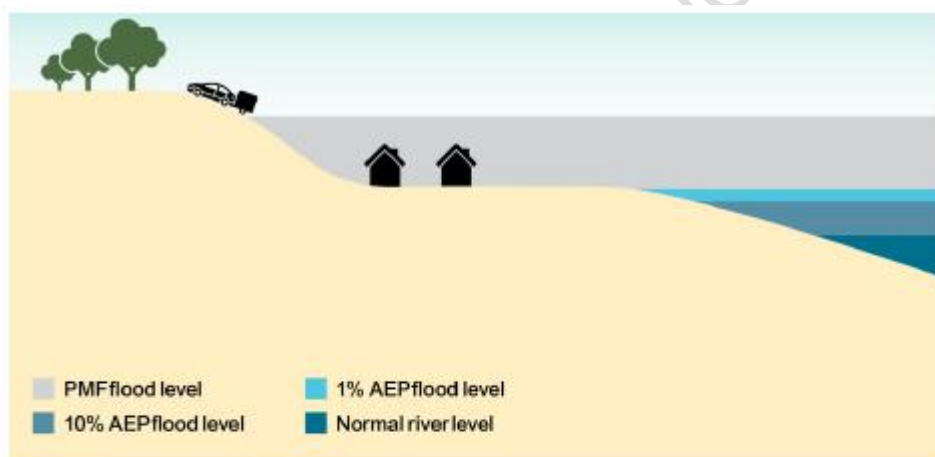


Figure 12 Area with rising road access

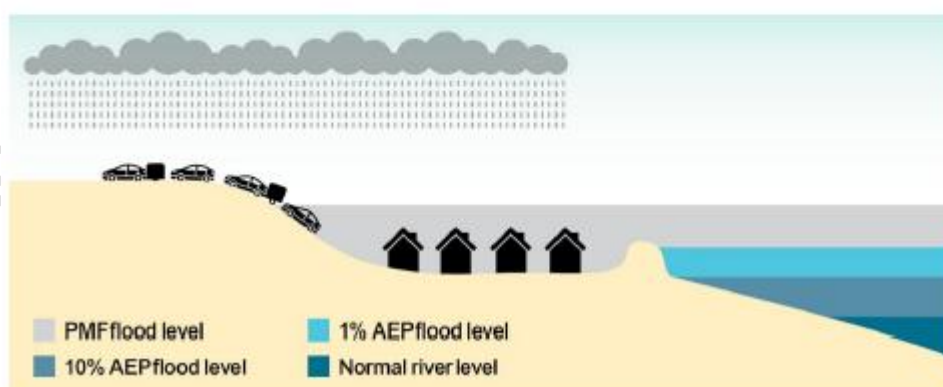


Figure 13 Area protected by a levee with rising road access

3.5.3 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 ability to access free location-based severe weather and thunderstorm warnings via the internet or smart phone via would therefore represent a major opportunity for improving flood warning and preparedness times for people living at Cookamidgera.

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 FLOOD RISK MANAGEMENT MEASURES

4.1 Background

The FRMM requires a Council to develop a Flood 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 *Cookamidgera FRMP*.

Due to differing priorities, individual communities need to establish their own set of considerations in which to assess the merits of different measures. The considerations adopted by a community must, however, recognise the State Government's requirements for flood risk management as set out in FRMM and other relevant policies. A further consideration is that some elements of the *Cookamidgera 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 Flood 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. FRMM and Catchment Management objectives).

4.2 As 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 *Cookamidgera 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 *Cookamidgera 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**, noting that the green shading indicates that the measure has merit and could be considered for inclusion in *Cookamidgera FRMP*. The scoring has also been used as the basis for prioritising the components of the *Cookamidgera FRMP*.

4.3 Summary

Table 4.1 indicates that there are good reasons to consider including the following elements into the *Cookamidgera FRMP*:

- Improved planning controls through the development of a flood related development control plan or policy.
- Incorporation of the catchment specific information on flooding impacts contained in this study in NSW SES Response Planning and Flood Awareness documentation for Cookamidgera.
- Improved public awareness of flood risk in the community.
- Investigation into the feasibility of implementing the works associated with PFMM6 and the preparation of a preliminary concept design.
- Detailed design of works associated with PFMM6, as well as their implementation.

TABLE 4.1
ASSESSMENT OF POTENTIAL FLOOD RISK MANAGEMENT MEASURES FOR INCLUSION IN
COOKAMIDGERA FLOOD 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										
Implementation of works comprising PFMM1	+1	+1	+1	+1	0	-1	-1	0	0	+2
Implementation of works comprising PFMM2	+1	+2	+1	+2	0	+1	-1	0	+2	+8
Implementation of works comprising PFMM3	+1	+2	+1	0	0	-1	-1	+1	+1	+4
Implementation of works comprising PFMM4	+2	+2	-1	+1	0	-2	-2	+2	+1	+3
Implementation of works comprising PFMM5	+2	+2	+1	+1	0	+1	-1	+1	+1	+8
Implementation of works comprising PFMM6	+2	+2	+1	+2	0	+1	-1	+1	+2	+10
Property Modification										
Inclusion of the optional <i>Special Flood Considerations</i> clause in <i>Parkes LEP 2012</i>	+1	+2	+2	+1	0	0	0	+2	+2	+10
Controls over Future Development (via update of <i>Parkes Shire DCP 2021</i>)	+2	+2	+2	+2	0	0	0	+1	+2	+12
Voluntary Purchase of Scheme	-2	-2	+2	-2	0	-2	-2	+2	-2	-8
Voluntary House Raising Scheme	-2	-2	+2	-2	0	-2	-2	+2	-2	-8
Response Modification										
Severe Weather/Thunderstorm and Flood Warning System	+1	+2	+2	+1	0	+1	+1	0	+1	+9
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 COOKAMIDGERA FLOOD RISK MANAGEMENT PLAN

5.1 The Flood Risk Management Process

The *Cookamidgera Flood Risk Management Study (Cookamidgera FRMS)* and *Cookamidgera Flood Risk Management Plan (Cookamidgera 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 *Cookamidgera FRMP* which is set out in this Chapter has been prepared as part of the Flood Risk Management Process in accordance with NSW Government's Flood Prone Land Policy.

The *Cookamidgera FRMS* reviewed baseline flooding conditions and the economic impacts of flooding that were assessed as part of the recently completed *Cookamidgera Flood Study* (Lyll & Associates, 2024). The findings of the *Cookamidgera Flood Study* formed the basis of the preparation of both the *Cookamidgera FRMS* and the *Cookamidgera FRMP*.

5.2 Purpose of the Plan

The overall objectives of the *Cookamidgera FRMS* were to assess the impacts of flooding, review policies and measures for management of flood affected land and to develop the *Cookamidgera 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 the *Cookamidgera FRMP*.
- Proposes amendments to Parkes 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 the *Cookamidgera FRMP* is consistent with NSW State Emergency Services (**NSW SESs**) local emergency response planning procedures.
- Ensures that the *Cookamidgera FRMP* has the support of the community.

5.3 The Study Area

The study area for the *Cookamidgera FRMP* principally applies to the urbanised areas at Cookamidgera (denoted herein as the "**Village Centre**"). The study deals with the following two types of flooding:

- **Main Stream Flooding**, which occurs when floodwater surcharges the inbank area of Quart Pot Creek and Flagstone Creek (also known as Bartleys Creek). Main Stream Flooding is typically characterised by relatively deep and fast flowing floodwater but can include shallower and slower moving floodwater on the overbank of the aforementioned creeks.
- **Major Overland Flow**, which is experienced during periods of heavy rain and is generally characterised by relatively shallow and slow-moving floodwater that is conveyed overland in an uncontrolled manner toward the abovementioned watercourses and other major drainage lines.

Figures 1.1 and 2.1 bound in **Volume 2** of this report show the extent of the 180 km² Flagstone Creek catchment at its confluence with Goobang Creek, while **Figure 2.2** (2 sheets) shows the key features of the existing stormwater drainage system in the vicinity of the urbanised parts of Cookamidgera. Also shown on **Figure 2.2** is the extent of the "Village Centre", land internal to which is zoned *RU5-Village*.

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 at the commencement of the *Cookamidgera Flood Study* which sort to identify information on historic flooding in Cookamidgera.
- The public exhibition of the draft *Cookamidgera FRMS* and *Cookamidgera FRMP*.
- Public meetings held by Council representatives.

Meetings were also held with the Flood Risk Management Committee to discuss the findings of the *Cookamidgera FRMS* and also the recommended set of measures set out in the *Cookamidgera FRMP*.

Respondents to the *Community Questionnaire* identified a number of notable flood events dating back to 1952, with photographic evidence provided for flooding that was experienced in the village on 23 March 2017 and 14 November 2022, copies of which are contained in **Appendix A** of the *Cookamidgera FRMS* report.

5.5 Existing Flood Behaviour

Figure 2.3 (2 sheets) of the *Cookamidgera FRMS* report shows the indicate extent and depth of inundation at Cookamidgera for a design flood with an AEP of 1%, while **Figure 2.4** (2 sheets) shows similar information for the Probable Maximum Flood (PMF). **Appendix B** of the *Cookamidgera FRMS* report show similar information for floods with AEPs of 20%, 10%, 5%, 2%, 0.5% and 0.2%.

Figure 2.5 of the *Cookamidgera FRMS* report shows the time of rise of floodwaters at selected road crossings throughout the study area, noting that time zero on the stage hydrographs represents the onset of flood producing rain (refer **Figures 2.3** and **2.4** for location of each individual stage hydrograph).

Flooding in the Village Centre originates from the following two primary sources:

- c) as a result of floodwater which surcharges the right (northern) bank of Flagstone Creek to the east (upstream) of the Trigg Hill Road crossing; and
- d) as a result of Major Overland Flow which discharges in a westerly direction through the northern portion of the Village Centre.

While floodwater originating from these two sources inundates both existing development and roadways shortly after the onset of flood producing rain, access into the Village Centre via Flagstone Street is effectively cut once flow is experienced in the watercourse that runs in a westerly direction along the northern side of the Orange-Broken Hill Railway. Floodwater can also inundate both private property and the road network for periods of over 12 hours.

5.6 Existing Flood Mitigation Measures

There are no formal flood mitigation measures present in the village of Cookamidgera.

5.7 Economic Impacts of Flooding

Table 5.1 shows 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 Cookamidgera.

TABLE 5.1
ECONOMIC IMPACTS OF FLOODING IN VILLAGE CENTRE

Design Flood Event (% AEP)	Properties Flooded Above-Floor Level						Total Flood Damages
	Residential		Commercial/Industrial		Public		\$ Million
	No.	\$ Million	No.	\$ Million	No.	\$ Million	
20%	0	0	0	0	0	0	0
10%	0	0	0	0	0	0	0
5%	0	0.02	0	0	0	0	0.02
2%	1	0.07	0	0	0	0	0.08
1%	2	0.27	0	0	0	0	0.27
0.5%	3	0.39	0	0	0	0	0.38
0.2%	3	0.50	0	0	0	0	0.50
PMF	22	5.90	0	0	1	0.02	5.92

Two dwellings would be above-floor inundated in a 1% AEP flood event, resulting in flood damages totalling about \$0.27 Million, while during a PMF event, 22 dwellings and one public building would be above-floor inundated, resulting in flood damages totalling about \$5.92 Million.

For a discount rate of 5% pa and an economic life of 30 years, the *Net Present Worth* of damages for all flood events up to the 1% AEP is about \$0.07 Million, while for all floods up to the PMF it is only about \$0.21 Million. Therefore, one or more schemes costing up to these two amounts could be economically justified if they eliminated all flood related damages in the study area at the two different levels of flooding. 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.

5.8 Structure of Cookamidgera Flood Risk Management Plan

A summary of the *Cookamidgera 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 *Cookamidgera 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.

The *Cookamidgera 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 *Cookamidgera FRMS* report:

- **Measure 1** – Consider the inclusion of the optional *special flood considerations* clause 5.22 in the *Parkes LEP 2012*.

- **Measure 2** – Improvements to planning and development controls for future development in flood prone areas via updates of *Parkes Shire DCP 2021*.
- **Measure 3** – Improvements to emergency response planning.
- **Measure 4** – Increase public awareness of the risks of flooding in the community.
- **Measure 5** – Investigation and preliminary concept design of works comprising Potential Flood Modification Measure (PFMM) 6.
- **Measure 6** – Detailed design and construction of works comprising PFMM6.

5.9 Planning and Development Controls

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

5.9.1 Revision of Parkes Local Environmental Plan 2012

Clause 5.21 of *Parkes LEP 2012* 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 the optional *special flood considerations* clause 5.22 that also formed part of the recent reform package in *Parkes LEP 2012*. The objectives of the optional clause are:

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

The optional clause in its current form applies to:

- a) for sensitive and hazardous development, land between the flood planning area and the probable maximum flood, or as otherwise defined in an adopted flood risk management study and plan that has been prepared in accordance with the Flood Risk Management Manual, 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:
 - iii. cause a particular risk to life, and
 - iv. require the evacuation of people or other safety considerations.

While the clause applies to all land that lies between the FPA and the extent of the PMF, Council is only required to apply flood affectation notices to S10.7 certificates where it considers flood related controls need to be applied to specific types of development.

While there is a significant amount of land within the Village Centre that is subject to H5 type flooding conditions during a PMF event (refer **Figure 2.13**, sheet 2), its limits are contained wholly within the extent of the FPA and therefore any future development would be subject to the requirements of clause 5.21 of *Parkes LEP 2012*.

While the adoption of the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012* would have limited, if any, impact on future development within the Village Centre, the approach to defining the extent of land that lies between the FPA and PMF where flood related development controls would apply as presented in the *Cookamidgera FRMS* report is the same as that presented in the *Bogan Gate Flood Risk Management Study and Plan* (Lyll & Associates, 2025),

Based on this understanding, the area of land that lies between the FPA and the PMF has been divided into the following two zones, the extents of which are shown on **Figure C1.1** in **Appendix C**:

- **Special Flood Considerations Zone**, it being the area of land that lies between the FPA and PMF where the flood hazard vulnerability condition in a PMF is H3 or greater and therefore where flood related development controls should be applied to future development in accordance with the requirements of clause 5.22
- **Outer Floodplain Zone**, it being the area of land that lies between the FPA and PMF where the flood hazard vulnerability condition in a PMF is either H1 or H2 and therefore where no flood related development controls would need to be applied to future development in accordance with the requirements of clause 5.22.

Based on the findings of the *Cookamidgera FRMS*, it is recommended that Council consider including the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012* (**Measure 1**).⁷

5.9.2 Parkes Shire Development Control Plan 2021

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**). **Figure C1.1** in **Appendix C** of the *Cookamidgera 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 areas where depths of inundation exceed 0.1 m in a 1% AEP event, and where identifiable floodways are present in shallower flow.

It is proposed that properties that 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. **Schedules 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. **Figure C1.1** shows the areas where the graded set of flood related planning controls set out in **Schedules 2A** and **2B** apply to Cookamidgera.

⁷ Note that prior to making the decision to include the optional *special flood considerations* clause 5.22 in *Parkes LEP 2012*, it is recommended that Council obtain legal advice to confirm that the above approach of pre-determining the extent of land to which the requirements of the clause apply is legally binding.

Minimum habitable floor level (**MHFL**) requirements would be imposed on future development of properties that are identified as lying either partially or wholly within the extent of the FPA shown on **Figure C1.1**. 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

Figure C1.2 in **Appendix C** of the *Cookamidgera 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 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 DCP.
- **Flood Planning Constraint Category 4 (FPCC 4)**, which comprises areas that lie between the FPA and the extent of the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the *Special Flood Considerations Zone* shown on **Figure C1.1**.
- **Flood Planning Constraint Category 5 (FPCC 5)**, which comprises areas that lie between the FPA and the extent of the PMF where Council does not consider flood related development controls need to be applied to all types of development. This area is identical to the *Outer Floodplain Zone* shown on **Figure C1.1**.

5.10 Improvements to Emergency Response Planning and Community Awareness

Two measures are proposed in the *Cookamidgera FRMP* to improve emergency response planning and community awareness to the threat posed by flooding.

Measure 3 involves the update by NSW SES of the *Parkes Shire Local Flood Plan* using information on flooding patterns, times of rise of floodwaters and flood prone areas identified in the *Cookamidgera FRMP* report. Figures have been prepared showing indicative extents of flooding,

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.

high hazard areas, expected rates of rise of floodwaters in key areas and locations where flooding problems would be expected. **Section 3.5.2** references the locations of key data within the *Cookamidgera FRMS* report.

Council should also 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 (included as **Measure 4** of the *Cookamidgera FRMP*). Council should also advise residents of the web sites and smart phone Apps that currently provide real-time *Severe Thunderstorm Warning* and *Severe Weather Warnings for Flash Flooding* alerts.

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. The *Cookamidgera FRMP* should be publicised and exhibited at community gathering places to make residents aware of the measures being proposed.

5.11 Flood Modification Measures

The *Cookamidgera FRMS* found that there is significant merit in Council implementing the following set of flood modification measures which are collectively referred to as PFMM6:

- Construction of an engineered earthen embankment approximately 560 m in length and on average 1 m in height running along the right (northern) bank of Flagstone Creek upstream of its crossing of Trigg Hill Road.
- Construction of an engineered earthen embankment around the existing farm dam that is located 500 m to the east of the village centre, as well as a 200 m channel extending south to an overbank flood runner of Flagstone Creek.
- Construction of a grassed swale/channel along the eastern side of Flagstone Street, extending west to the location of an existing dam that is located in the rail corridor.
- Construction of new transverse drainage structures beneath both Flagstone Street and the adjacent unsealed access road (each presently assessed as 2 off 3 m wide by 1.2 m high reinforced concrete box culverts).
- Lowering of the spillway associated with the existing dam that is located in the rail corridor (current assessment assumes a spillway elevation of RL 343.7 m AHD).
- Widening and regrading of the watercourse that runs along the northern side of the rail corridor from where it crosses Cooka Hills Road to where it crosses the Orange-Broken Hill Railway, an overall length of about 550 m (current assessment assumes a 12 m base width).
- Installation of 3 off 3.6 m wide by 0.9 m high reinforced box culverts on Flagstone Street.
- Raising Flagstone Street by about 0.2 m to an elevation of RL 345.7 m AHD.
- Lowering of natural surface levels either side of Flagstone Street to facilitate the installation of the reinforced concrete box culverts and associated inlet/outlet headwall/scour protection works.

While the implementation of the works associated with PFMM6 cannot be justified purely on economic grounds (i.e. because the benefit cost ratio of the works is less than 0.1), they would reduce the existing flood risk within the Cookamidgera community by:

- d) significantly reducing both the extent and depth of inundation that is currently experienced within the Village Centre;
- e) removing the above-floor inundation that is currently experienced in two dwellings up to the 1% AEP level of flooding; and
- f) significantly improve the ability of people to be able to travel between the village and Parkes during times of freshes and floods.

Based on this finding, **Measure 5** comprises the investigation into the feasibility of implementing the full scope of works comprising PFMM6, as well as the preparation of a preliminary concept design, while **Measure 6** comprises the detailed design of the preferred set of measures, as well as their construction.

5.12 Implementation Program

The steps in progressing the flood risk 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 the *Cookamidgera FRMP*.
3. Assistance for funding qualifying projects included in the *Cookamidgera FRMP* may be available upon application under the Commonwealth and State funded floodplain management programs, currently administered by the Department of Climate Change, Energy, the Environment and Water.
4. As funds become available from Government agencies and/or Council's own resources, implement the measures in accordance with the established priorities.

The *Cookamidgera 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 the *Cookamidgera FRMP*. In any event, a thorough review every ten years is warranted to ensure the ongoing relevance of the *Cookamidgera FRMP*.

6 GLOSSARY OF TERMS

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 <i>Flood Planning Map</i> .
Flood Planning Map	The <i>Flood Planning Map</i> 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 <i>Flood Planning Level</i> 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 <i>Flood Planning Level</i> 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 areas that lie between the extent of the FPA and the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the <i>Special Flood Considerations Zone</i> shown on the <i>Flood Planning Map</i> .
Flood Planning Constraint Category 5 (FPCC 5)	Comprises areas that lie between the extent of the FPA and the PMF where Council does not consider flood related development controls need to be applied to all types development. This area is identical to the <i>Outer Floodplain Zone</i> shown on the <i>Flood Planning Map</i> .
Flood Planning Level (FPL)	<p>Flood levels selected for planning purposes, as determined by the relevant adopted flood risk management study and plan, or as part of a site specific study</p> <p>In the absence of an adopted flood 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.</p>

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 <i>Flood Planning Level</i> 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 <i>Flood Planning Level</i> .
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 certain types of development that is located on land which lies outside the FPA. This area is identical to the FPCC4 affected land shown on the <i>Flood Planning Constraint Category Map</i> .

7 REFERENCES

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APPENDIX A
PHOTOGRAPHS SHOWING OBSERVED FLOOD BEHAVIOUR
AT COOKAMIDGERA

23 MARCH 2017



Plate C1.1 - Looking south at Flagstone Street level crossing of the railway (*Photo taken at 08:17 hours*)



Plate C1.2 - Looking south at Flagstone Street level crossing of the railway (*Photo taken at 08:17 hours*)



Plate C1.3 - Looking south at railway to the west of the Flagstone Street level (*Photo taken at 08:20 hours*)



Plate C1.4 - Looking south at Flagstone Street level crossing of the railway (*Photo taken at 08:21 hours*)



Plate C1.5 – Looking west along northern (upstream) side of railway from Flagstone Street (*Photo taken at 08:34 hours*)



Plate C1.6 – Looking west along southern (downstream) side of railway from Flagstone Street (*Photo taken at 08:21 hours*)

23 MARCH 2017



Plate C1.7 - Looking east along Flagstone Street at low point that is located approximately 50 m to the south of the railway (Photo taken at 08:24 hours)



Plate C1.8 – Looking south along channel on eastern side of Flagstone Street (Photo taken at 08:38 hours)



Plate C1.9 – Floodwater ponding on eastern side of Flagstone Street (Photo taken at 08:40 hours)



Plate C1.10 - Looking north along channel on eastern side of Flagstone Street (Photo taken at 08:40 hours)



Plate C1.11 – Upstream side of Trig Hill Road crossing of Flagstone Creek (Photo taken at 08:46 hours)



Plate C1.12 – Looking south along Trig Hill Road from its crossing of Flagstone Creek (Photo taken at 08:51 hours)

23 MARCH 2017



Plate C1.13 - Looking south along Trig Hill Road from its crossing of Flagstone Creek (Photo taken at 08:51 hours)



Plate C1.14 – Looking east along Railway Street from its intersection with Mullins Street (Photo taken at 09:03 hours)



Plate C1.15 – Looking west along Railway Street from its intersection with Mullins Street (Photo taken at 09:03 hours)



Plate C1.16 – Looking west along Railway Street from Haynes Street (Photo taken at 09:06 hours)



Plate C1.17 – Looking east at the intersection of Railway Street and Haynes Street (Photo taken at 09:06 hours)



Plate C1.18 – Downstream side of the three 1050 mm diameter corrugated pipes beneath the railway to the east of Haynes Street (Photo taken at 09:12 hours)

23 MARCH 2017



Plate C1.19 – Flooding on the unnamed lane that runs parallel to the railway to its south (*Photo taken at 09:14 hours*)



Plate C1.20 – Flooding on the unnamed lane that runs parallel to the railway to its south (*Photo taken at 09:14 hours*)



Plate C1.21 – Flooding on the unnamed lane that runs parallel to the railway to its south (*Photo taken at 09:17 hours*)



Plate C1.22 – Looking south along Haynes Street from its northern end (*Photo taken at 09:29 hours*)



Plate C1.23 – Floodwater discharging to the northern end of Haynes Street from the railway (*Photo taken at 09:30 hours*)



Plate C1.24 – Looking north along Haynes Street from its intersection with Railway Street (*Photo taken at 09:32 hours*)

14 NOVEMBER 2022



Plate C2.1 – Flooding in Flagstone Street adjacent to the low point that is located 50 m to the south of the railway
(Time unknown)



Plate C2.2 – Flooding in Flagstone Street adjacent to the low point that is located 50 m to the south of the railway
(Time unknown)



Plate C2.3 – Looking east along Flagstone Street adjacent to the low point that is located 50 m to the south of the railway (Time unknown)

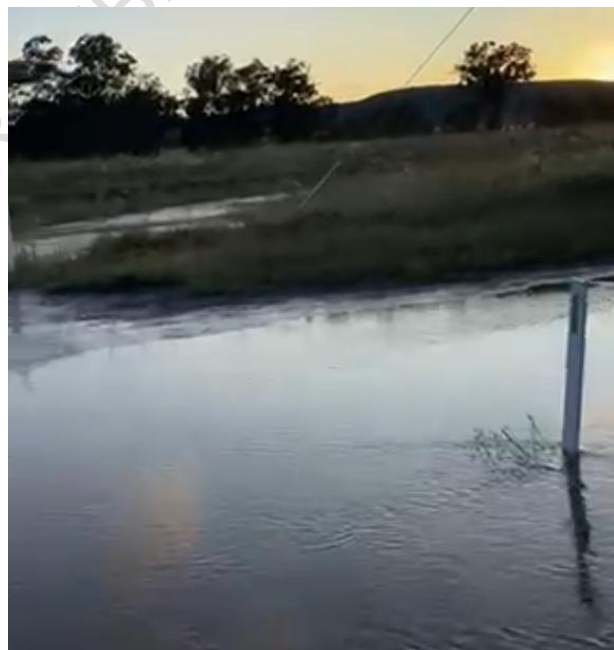


Plate C2.4 – Flooding in the low point in Flagstone Street that is located 50 m to the south of the railway (Time unknown)

14 NOVEMBER 2022



Plate C2.5 – Looking west along Flagstone Street adjacent to the low point that is located 50 m to the south of the railway (*Time unknown*)



Plate C2.6 – Flooding in the low point in Flagstone Street that is located 50 m to the south of the railway (*Time unknown*)

APPENDIX B

FIGURES SHOWING DESIGN FLOOD BEHAVIOUR AT COOKAMIDGERA

(BOUND IN VOLUME 2)

APPENDIX C

SUGGESTED WORDING FOR INCLUSION IN PARKES SHIRE DEVELOPMENT CONTROL PLAN

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- C1.1 Extract of Parkes Shire Flood Planning Map at Cookamidgera
- C1.2 Extract of Parkes Shire Flood Planning Constraint Category Map at Cookamidgera

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 flood 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 flood risk management studies and plans prepared in accordance with the *Flood Risk Management 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 *Flood Risk Management 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 flood 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 flood 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 that 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 areas that lie between the extent of the *Flood Planning Area* and the Probable Maximum Flood (PMF) where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the *Special Flood Considerations Zone* shown on the **Flood Planning Map**.

- **Flood Planning Constraint Category 5 (FPCC 5)**, which comprises areas that lie between the *Flood Planning Area* and the extent of the PMF where Council does not consider flood related development controls need to be applied to all types of development. This area is identical to the *Outer Floodplain 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 Flood 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 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 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 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 *Parkes Local Environmental Plan 2012* 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 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 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;
 - be configured so as to allow floodwaters to equalise on both sides of the fence; and
 - be 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 the 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 the 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 should 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 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 is as follows:

- a) Applications must include information which addresses all relevant controls.
- 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 must be accompanied by a survey plan showing:
 - i. The position of the existing building(s) and/or proposed building(s);
 - ii. The existing ground levels to Australian Height Datum around the perimeter of the existing and/or proposed building(s) and contours of the site; and
 - iii. The existing and/or proposed floor levels to Australian Height Datum.
- d) Applications for earthworks, filling of land or 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 *Flood Risk Management 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

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 <i>Flood Planning Map</i> .
Flood Planning Map	The <i>Flood Planning Map</i> 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 <i>Flood Planning Level</i> 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 <i>Flood Planning Level</i> 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 areas that lie between the extent of the <i>Flood Planning Area</i> and the PMF where Council considers flood related development controls need to be applied to sensitive and hazardous type development but can also include other types of development where Council considers that the land, in the event of a flood, may cause a particular risk to life, or require the evacuation of people or other safety considerations. This area is identical to the <i>Special Flood Considerations Zone</i> shown on the <i>Flood Planning Map</i> .
Flood Planning Constraint Category 5 (FPCC 5)	Comprises areas that lie between the extent of the <i>Flood Planning Area</i> and the PMF where Council does not consider flood related development controls need to be applied to all types development. This area is identical to the <i>Outer Floodplain Zone</i> shown on the <i>Flood Planning Map</i> .
Flood Planning Level (FPL)	<p>Flood levels selected for planning purposes, as determined by the relevant adopted flood risk management study and plan, or as part of a site specific study</p> <p>In the absence of an adopted flood 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.</p>

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 <i>Flood Planning Level</i> 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 <i>Flood Planning Level</i> .
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 certain types of development that is located on land which lies outside the FPA. This area is identical to the FPCC4 affected land shown on the <i>Flood Planning Constraint Category Map</i> .

SCHEDULE 1 LAND USE CATEGORIES

Land Use Category	Subdivision	LEP Land Uses
Critical Uses and Facilities	<i>Community facilities which may provide an important contribution to the notification or evacuation of the community during flood events.</i>	Health services facility; Electricity generating works; Emergency services facility.
Sensitive Uses and Facilities	<i>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;</i>	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	<i>Subdivision of land which involves the creation of new allotments, with potential for further development;</i>	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		Attached dwellings Dwelling houses Multi dwelling housing Residential flat buildings Semi-detached dwellings Shop top housing
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;

		<p>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;</p>
Recreation and Non-Urban		<p>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).</p>
Alterations and additions		<p>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;</p> <p>ii. Rebuilding of a development which substantially reduces the extent of flood effects to the existing development;</p> <p>iii. A change of use which does not increase flood risk having regard to property damage and personal safety; or</p> <p>iv. Subdivision which does not involve the creation of new allotments with potential for further development.</p>

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

		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)							Flood Planning Constraint Category 5 (FPCC 5)								
		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	Critical Uses and Facilities	Sensitive Uses and Facilities	Subdivision	Residential	Commercial and Industrial	Recreational and Non-Urban	Alterations and Additions		
Planning considerations																																						
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 or C3				C3	C3	C2	C2				C2	C2	C2	C2	C4	C4														
Flood Affection							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	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)							Flood Planning Constraint Category 5 (FPCC 5)							
		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	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 Affection							D1	D1				D1	D1	D1	D1	D2																					
Emergency Response							E1	E1				E5				E2 or E3	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 Affection D1 Engineers report required to certify that the development will not increase flood affection elsewhere. D2 The impact of the development on flooding elsewhere to be considered. Note: When assessing flood affection 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 Flood 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Foam or closed cell types
Windows	Aluminium frame with stainless steel or brass rollers	Nails, Bolts, Hinges and Fittings	<ul style="list-style-type: none"> Galvanised Removable pin hinges