



NSW GOVERNMENT
Department of Natural Resources

Tuppal and Bullatale Creeks

Floodplain Management Plan



MAY 2004



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DEPARTMENT OF NATURAL RESOURCES

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Preamble

The NSW Government's Flood Prone Land Policy is aimed at providing solutions to existing flooding problems as well as ensuring that new development within flood prone areas is compatible with the prevailing flood risk and does not create additional flooding problems in other areas.

Under this Policy, the rural flood risk within NSW for those areas west of the Great Dividing Range is managed by the Department of Natural Resources (DNR). This is through the administration of *Part 8 of the Water Act 1912*, under which the Tuppal and Bullatale Creeks Floodplain Management Plan (hereafter the Tuppal and Bullatale Creeks FMP) is to be adopted and gazetted.

The development of the Tuppal and Bullatale Creeks FMP has progressed through the following three stages:

- Flood Study –technical assessment of the nature and extent of flooding;
- Floodplain Management Study – evaluates management options for the floodplain giving consideration to hydraulic, environmental, social and economic issues;
- Floodplain Management Plan – outlines strategies to manage flood risk and flood management issues, and support the natural functions of the floodplain environment.

The Tuppal and Bullatale Creeks Flood Study report (March 2002) and the Tuppal and Bullatale Creeks Floodplain Management Study (FMS) report (April 2004) document in detail all of the investigations leading to the preparation of the Floodplain Management Plan.

The Tuppal and Bullatale Creeks FMP will replace the *Guidelines for Floodplain Development – Tuppal and Bullatale Creeks* prepared in 1978 (hereafter the 1978 Guidelines). The 1978 Guidelines have served as the basis for floodplain management for the past 26 years. Current legislative requirements and natural resource management principles meant that the 1978 Guidelines had become outdated and therefore required revision. The revision process has culminated in the preparation of this FMP.

Tuppal and Bullatale Creeks

Floodplain Management Plan

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1. Introduction

1.1 Vision and Objectives

The Tuppal and Bullatale Creeks FMP has been prepared to replace the 1978 Guidelines. The FMP will serve as the future basis for the management of the Tuppal and Bullatale Creeks floodplain.

The vision for the management of the Tuppal and Bullatale Creeks floodplain is as follows:

To manage the floodplain of Tuppal and Bullatale Creeks in an equitable and sustainable manner through careful use of parts of the floodplain for agricultural activities whilst allowing for the floodplain's natural flood distribution and storage functions and enhancing its environmental values.

The objectives linked to the above vision statement for the Tuppal and Bullatale Creeks FMP are as follows:

- *To achieve a coordinated balanced approach to floodplain management taking into account hydraulic, environmental and economic considerations, and legislative requirements.*
- *To ensure the sustainable and equitable use of floodplain resources.*

The process leading to the preparation of the Tuppal and Bullatale Creeks FMP commenced in 1999. This process has consisted of a data collection and flood study followed by a floodplain management study. Extensive community consultation activities have taken place including public meetings, community workshops, distribution of newsletters and questionnaires, and on-site meetings with individual landholders to discuss specific issues.

The Tuppal and Bullatale Creeks FMP has been prepared under the direction of the Central Murray Floodplain Management Committee (hereafter the CMFMC). The CMFMC consists of 41 members with a mixture of representatives of government agencies, landholder groups and individual landholders and is responsible for overseeing the development of floodplain management plans for the Central Murray System (refer Figure 1.1). The Tuppal and Bullatale Creeks floodplain represents the upstream section of the Central Murray System.

1.2 Tuppal and Bullatale Creeks Floodplain Overview

General

The Tuppal and Bullatale Creeks FMP applies to the Tuppal and Bullatale Creeks floodplain. Both creeks are effluent streams which convey breakaway flows from the Murray River downstream of Tocumwal to the Edward River upstream of Deniliquin (refer Figure 1.2). The upstream and downstream limits of the floodplain are therefore the northern boundary of the Murray River floodplain and the eastern boundary of the Edward River floodplain respectively. The existing Murray, Edward and Wakool designated floodplain under section 166(1) of *Part 8 of the Water Act 1912*, will be amended to designate the Tuppal and Bullatale Creeks floodplain.

The floodplain extends into three local government areas (Murray Shire, Berrigan Shire and the Conargo Shire). Cropping is common within the floodplain (rice, wheat, barely oats and conola) in addition to grazing. Cropping is particularly sensitive to flooding with inundation durations of a few days sufficient to kill most crops.

Terrain conditions within the floodplain are relatively flat with the exception of some scattered sand hills located in the southern portion of the floodplain. Ground elevations fall by 16 metres over a distance of 48 km between the upstream and downstream limits of the floodplain (average straight line grade of 1 in 3,000).

In response to the flood risk, numerous flood protection levees have been erected within the floodplain. Since 1978, the majority of levee construction activity has been carried out in accordance with the 1978 Guidelines.

Flooding Characteristics

Flooding characteristics within the Tuppal and Bullatale Creeks floodplain are largely influenced by the Murray River Barmah choke. The choke has an upper limiting capacity of 30 to 35,000 ML/day. This results in a significant portion of Murray River flood flows being directed into the Central Murray system via the Edward River itself and additionally via the Tuppal and Bullatale Creek systems. The distribution of flood flows varies from event to event depending on the following key influences:

- Peak Murray River flow downstream of Tocumwal;
- Volume of floodwaters downstream of Tocumwal; and
- The water level in the Murray River downstream of the Barmah choke which is largely dependent on Goulburn River flooding behaviour.

The Tuppal Creek system includes the anabranch streams of Native Dog Creek and Taylors Creek. Tuppal Creek receives local runoff inflows from the Lalaly Drain out of the Berriquin Irrigation District. Local runoff has however no influence on flooding behaviour within the Tuppal Creek system.

Murray River breakaway flood flows into the Tuppal Creek system enter via a series of bridges and causeways located on Lower River Road. These flows are then conveyed by the Tuppal Creek and Native Dog Creek floodways which join approximately 25 km further downstream. Tuppal Creek ultimately discharges into the Edward River approximately 2 km south of the Mulwala Canal siphon. The threshold Murray River flow for breakaways flows to commence into the Tuppal Creek system is 50,000 ML/day.

Murray River breakaway flood flows into Bullatale Creek enter via an opening at the upstream mouth of the creek, via a man made channel (Woperana Channel) close to the natural mouth and via three creek inflow points (Deep Creek, Seven Mile Creek and Aluminy Creek). Bullatale Creek itself ultimately discharges into the Edward River approximately 4 km south of the Mulwala Canal siphon. The threshold Murray River flow for breakaway flows to commence in the upstream end of the Bullatale Creek system is approximately 30,000 ML/day.

Please refer to the Tuppal and Bullatale Creeks Flood Study and FMS reports for detailed information regarding the flooding characteristics of the Tuppal and Bullatale Creek floodplains.

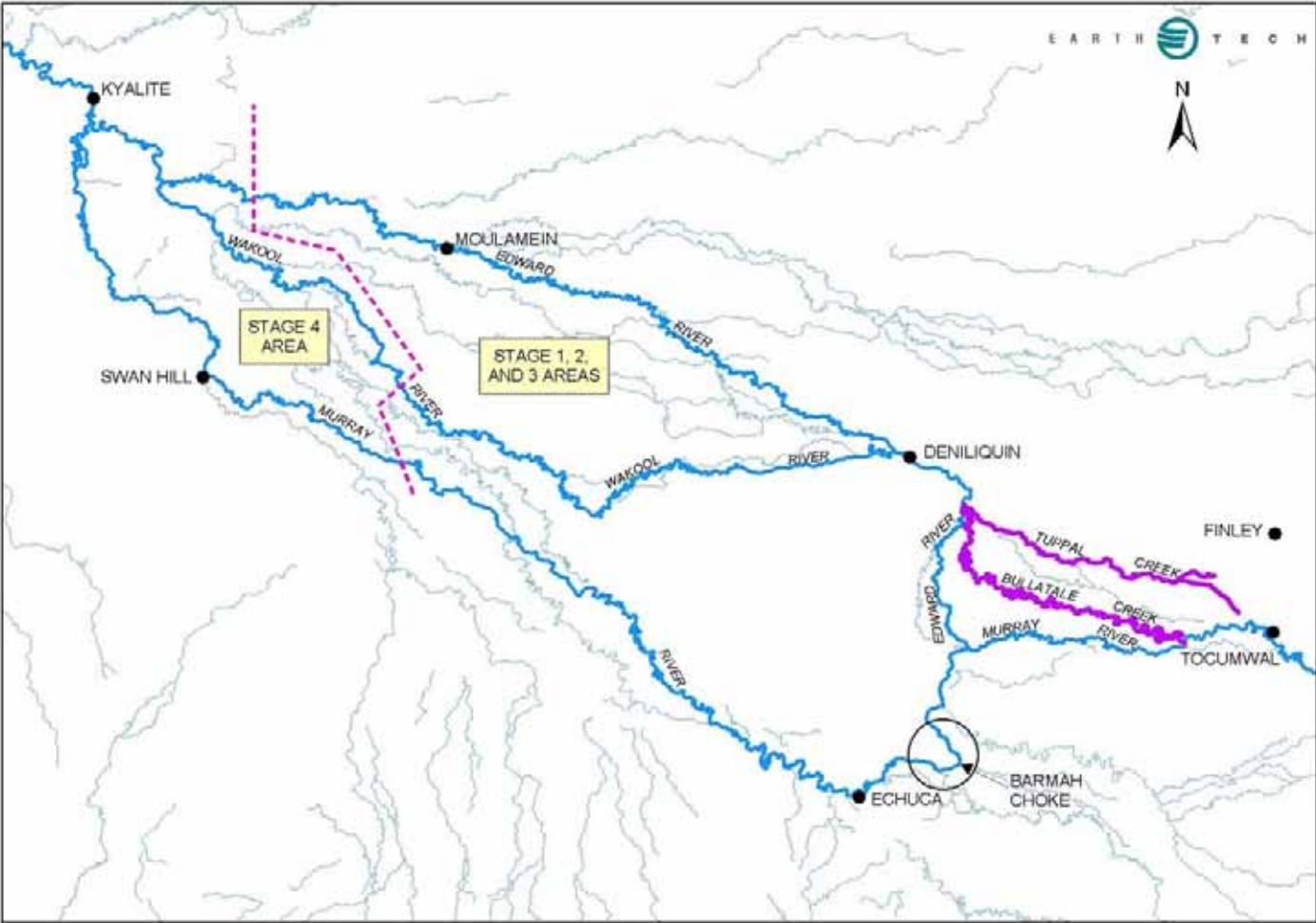


Figure 1.1 Central Murray System

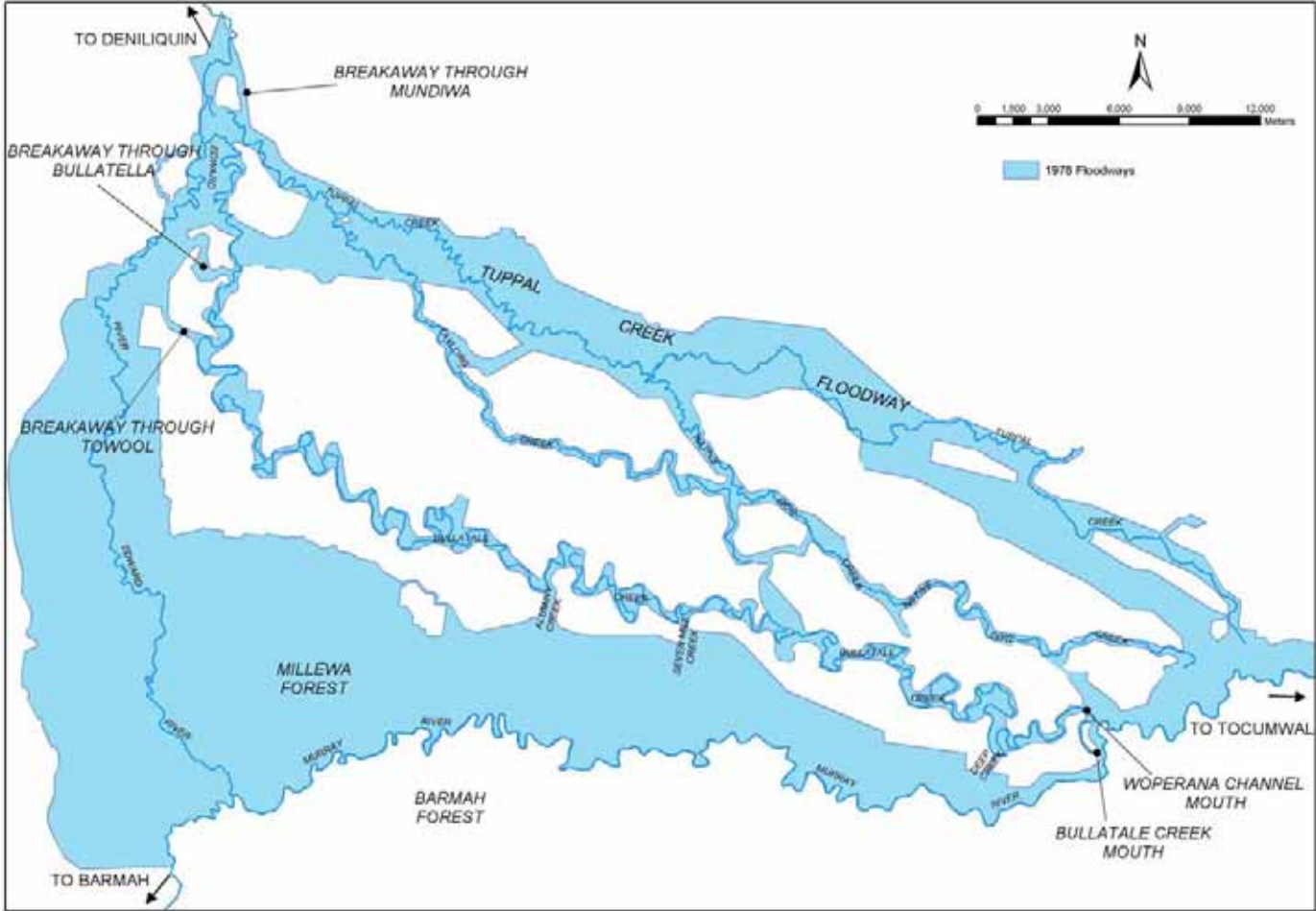


Figure 1.2 Tuppall and Bullatale Creeks Floodplain

2. Development of the FMP

2.1 Legislative and Policy Framework

Management of the Tuppall and Bullatale Creeks floodplain needs to be undertaken in accordance with the current legislative and policy framework. An overview of the relevant legislation and policy is provided as follows.

2.1.1 Policy

The **NSW Government's Flood Prone Land Policy** aims, to in addition to addressing existing flooding problems, ensure that new development within flood prone areas is compatible with the prevailing flood risk and does not create additional flooding problems in other areas. The NSW Floodplain Management Manual (2001), which supports the Flood Prone Land Policy, outlines how the consideration of social, economic and ecological attributes of flood prone areas need to be taken into account when floodplain management plans are being developed.

The **NSW Wetlands Policy** (1998) gives explicit consideration to the biophysical requirements of wetlands with the goal of ensuring their sustainable management. The Policy defines wetlands as "*areas that are wet enough for a long enough period such that plants and animals living in them are adapted to, and often dependent on, living in wet conditions for at least part of their life cycle*". The policy definition includes wetland sites which may contain water only temporarily. This is relevant to the Tuppall and Bullatale Creeks floodplain where many wetland sites are subject to short periods of inundation followed by long periods of drying out.

2.1.2 Legislative Controls

The management of the flood risk in rural areas of NSW west of the Great Dividing Range is undertaken by DNR through its administration of **Part 8 of the Water Act 1912**. Part 8 was gazetted in 1984 and makes provisions to control rural works that affect, or are likely to affect, flooding and / or floodplain functions. Part 8 was then amended in 1999 to allow for more strategic control of rural floodplain works through the making of floodplain management plans and a more streamlined and resource efficient approval process.

The NSW Government is implementing wide ranging water reforms. The culmination of this reform process is the **Water Management Act (WMA) 2000** consolidating most of the Acts previously covering water management in NSW. While the water licensing and flood control provisions of the WMA are not yet in operation, the new WMA will eventually replace Part 8 of the old Act.

Murray Regional Environmental Plan No. 2 (REP2), which applies to riverine lands of the Murray River and its effluents, was gazetted in 1994. Murray REP2 establishes the process for a consistent and coordinated approach to environmental planning and assessment along the River Murray. It requires development consent from the local council for the construction of "flood control works". REP2 also places controls on the clearing of native vegetation and the management of wetlands. It requires development consent for wetland subdivision, and wetland clearing, dredging, draining or filling.

DNR intends to make the Tuppall and Bullatale Creeks FMP into a river management plan under Murray REP2. A river management plan made under Murray REP2 can be a development control plan, plan of management, strategy or guideline, which:

- Has undergone a community consultation process;
- Is consistent with the aims, objectives and principles of Murray REP2; and
- Is endorsed by the Murray- Darling Basin Commission (hereafter MDBC).

The benefits of making the Tuppall and Bullatale Creeks FMP into a river management plan include:

- Streamlining the consultation process so that multiple referrals to agencies required by Murray REP2 as part of the development application process can be handled more simply;
- Speeding up the consideration of development applications for flood control works;
- Applying the principles of Murray REP2 to the management of flood control works on the Tuppall and Bullatale Creeks floodplain;
- Reducing uncertainty, risk and cost; and
- Providing planning recognition and the need to consider the river management plan in any future management decisions.

Native vegetation legislation relevant to this Plan includes the **Native Vegetation Conservation Act (1997)** which sets out a consistent approach to the management of native vegetation in NSW. The newly drafted **Native Vegetation Act (2003)** will supersede the 1997 Act when it comes into effect most likely later in 2004. Other relevant legislation includes the **Natural Resources Commission Act (2003)** and the **Catchment Management Authorities Act (2003)**.

2.1.3 Other Relevant Management Plans

The Tuppall and Bullatale Creeks FMP is only part of the catchment and land use planning picture. Following recent natural resource reforms in NSW, catchment action plans that consolidate existing natural resource management plans and provide long term direction for investment in natural resources will be prepared. The Tuppall and Bullatale Creeks FMP should be viewed as one component of the integrated planning process, with other linked components including:

- NSW Murray-Lower Darling Regulated Rivers Water Sharing Plan;
- Berriquin Land and Water Management Plan; and
- State Water Management Outcomes Plan (Target 25 of the SWMOP aims to provide floodwater access to 60% of the natural 1 in 5 year flooded area).

2.2 Community Consultation

Community consultation formed an integral component in the development of the Tuppal and Bullatale Creeks FMP. The immediate consultative committee responsible for overseeing the plan's preparation was the CMFMC. The composition of the CMFMC is as follows:

- DNR (previously DIPNR) – 2 members.
- Local government representatives for Murray Shire Council (3 members), Berrigan Shire Council (3 members), Conargo Shire (5 members), Deniliquin Council (4 members) and the Wakool Shire Council (2 members).
- NSW State Government agencies from State Forest NSW (1 member), RTA (1 member), Murray Darling Association (1 member) and the SES (1 member).
- Victorian State Government representatives from catchment management authorities (3 members).
- Landholder groups and individual landholder representatives (15 members).

The CMFMC generally met on average at two monthly intervals during the course of the plan's preparation and was responsible for signing off on important documents (e.g. Flood Study report, FMS report) and for adopting assessment principles and criteria).

A summary of other consultation activities undertaken is provided as follows:

- Public meetings held at the commencement of both the flood study and the FMS.
- Questionnaires distributed to landholders at the commencement of both the flood study and the FMS.
- Community newsletter updates distributed to landholders during the FMS.
- Community workshops held during the course of the FMS to provide a forum for community discussion and input into the plan (three rounds of workshops held for each of three sub-areas).
- Numerous on-site meetings with landholders to discuss floodplain management issues.

2.3 Floodplain Management Principles

A set of floodplain management principles was adopted by the CMFMC at a committee meeting held on the 5 July 2001.

The adopted principles were used as a guide for the purpose of making decisions when assessing management strategies and options during the FMS. The adopted floodplain management principles are given in Table 2.1 and conform with the general matters for consideration with respect to flood control work approvals set out in section 166C(1) of *Part 8 of the Water Act 1912*.

The hydraulic category principles are targeted towards preserving the primary function of the floodway areas (to convey and store floodwaters). Most of the hydraulic principles are the same as those used when developing the 1978 Guidelines and those most recently used for the downstream Central Murray system Stage 4 area. The major difference is the addition of the environmental category principles. This is consistent with the requirement that floodplain management plans made under *Part 8 of the Water Act* must take into account the protection of the environment.

The social and economic principles are present to take into account the impact of potential floodplain management strategies and options on agricultural operations, which in turn impact directly on social issues.

The legislative category principles reflect the need to comply with the current government policy relevant to the preparation of a floodplain management plan.

Table 2.1 Adopted Floodplain Management Principles

Principle Category	Principle Number	Principle Description
Hydraulic Principles	H1	Adopted floodways should conform as near as possible to the natural drainage pattern.
	H2	Flood levels and velocities should not be unduly increased and where possible maintained below the maximum recorded levels.
	H3	Floodwater velocities and depths should be as close as possible to the natural situation within adopted floodways.
	H4	Floodways should have adequate design capacity and be maintained free of restrictions.
	H5	Development on the Floodplain should not cause significant redistribution of floodwater nor significant increases in flood levels and flood flow velocities.
	H6	Floodplain storage should be optimised by the inclusion of lakes, wetlands and the floodplain generally to minimise increases in downstream flooding.
	H7	The design capacity of the floodway should be based on flood hazard taking into account social, economic and environmental considerations.
	H8	The adopted floodway design should consider controlled overtopping and include it in the modelling.
	H9	The design and drainage of waters within the protected areas remains the responsibility of the landholders.
Environmental Principles	E1	Floods are a natural occurrence with many benefits. This should be promoted within the Plan and to the community at large.
	E2	Significant flood dependent ecosystems need to be identified and strategies developed to maintain a suitable balance of flooding to these areas.
	E3	Velocities in creeks and floodways should be minimised to reduce erosion wherever possible.
	E4	When designing floodways and flood storage areas consideration must be given to appropriate management of groundwater recharge areas.
Social & Economic Principles	S1	Floodwater should be fairly distributed.
	S2	Maximise the area of land that can be protected to predetermined flood level.
	S3	Information on flooding and the Plan should be made available to all landholders.
	S4	Minimise any adverse impacts on farms, other properties and public infrastructure.
	S5	The Plan should condone as many existing works as possible and permit a reasonable economic use of the land.
	S6	Where a licensed work needs to be adjusted all avenues should be explored to provide financial assistance.
Legislative Principles	L1	The Plan should be consistent with Government policy and legislation (<i>Floodplain Management Manual, Water Act (Part 8), E P&A Act, Murray REP2, Water Management Act etc</i>).
	L2	The Management Principles should have legislative backing.

3. Hydraulic Assessment Overview

3.1 Floodway Network Purpose

The central element of the Tuppall and Bullatale Creeks FMP is the floodway network. The floodway network represents that area reserved for the discharge of the adopted design flow. The delineation of the floodway areas provides the basis by which authorities limit future development to ensure that the primary function of the floodway network (to convey and store floodwaters) is not compromised.

All forms of new development including farm infrastructure works located on a floodplain that affect the flow of floodwaters require approval from DNR. This requirement has been administered under *Part 8 of the Water Act, 1912*.

Decisions relating to the delineation of floodway areas were largely driven by the floodplain management principles adopted by the CMFMC as listed in Table 2.1. The hydraulic, environmental, social and economic, and legislative principles are all relevant to the delineation of the floodway areas.

In many cases, the respective management principle categories conflict with each other (e.g. a trade off between hydraulic concerns, environmental concerns and maximising the area that can be protected for agricultural purposes).

Decisions ultimately have been made based on a balanced viewpoint taking into account all of the relevant issues under considerations.

3.2 Design Flood Event

The design flood is the event to be used for the hydraulic design of the floodway network.

The 1978 Guidelines floodway network was based on the 1975 flood. The 2002 Tuppall and Bullatale Creeks Flood Study Report attributes the 1975 flood as follows:

- Peak flow recorded at the Murray River Tocumwal gauge of 249,000 ML/day coinciding with a gauge height of 7.53 metres.
- Equivalent frequency based on peak flow records at Tocumwal of 39 years ARI.
- Highest peak Murray River flow experienced at Tocumwal since the 1917 flood and the second highest experienced since the 1870 flood.
- Peak flow recorded at the Edward River Deniliquin gauge of 116,000 ML/day coinciding with a gauge height of 9.04 metres.
- Equivalent frequency based on peak flow records at Deniliquin of 18 years ARI.
- Highest peak Edward River flow experienced at Deniliquin since the 1956 flood and the third highest experienced since the 1870 flood (after the 1917 and 1956 events).

The adoption of a design flood of the magnitude of the 1975 flood event was favourable for the following reasons:

- It is more compatible with the existing floodway network in comparison to the adoption of a larger event (e.g. equivalent to a 100 year ARI event such as the 1917 flood).

- Existing levee crest heights have commonly been fixed in relation to 1975 flood levels including the adjoining Victorian side Murray River levee.
- More gauged flow data and flood level data is available for the 1975 flood in comparison to the 1956 and 1917 events allowing for more reliable design discharges for the network and greater confidence in the hydraulic basis.
- The level of protection would appear reasonable given the scheme applies to the protection of rural areas and the 1975 event peak flow is the second highest recorded at Tocumwal and the third highest recorded at Deniliquin since the 1870 flood.

The CMFMC made a decision to adopt the 1975 flood event as the design flood event at a committee meeting held on 25 March 2003. Landholders were supportive of this approach during discussions at the community workshops.

The floodway network has consequently been designed to discharge 1975 event conditions flows whilst maintaining flood levels and velocities compatible with those experienced in 1975.

The adopted of the 1975 event as the design flood event should not be confused with the level of protection achieved against flooding. The level of protection achieved is dependant on the height flood protection levees are constructed to. The crest height for a privately funded / constructed levee is selected by the individual landholder. In some instances, the levee crest height chosen may be lower than the resulting flood height if an event equivalent to the 1975 event occurred. The level of protection achieved in this instance is less. Alternatively the constructed levee crest height may be higher than the 1975 event flood height. The level of protection achieved in this circumstance is greater.

3.3 Hydraulic Modelling

Hydraulic modelling of flooding behaviour was undertaken during the flood study and FMS using a MIKE 11 hydraulic model. The model is able to simulate flooding behaviour in looped flow networks providing quasi two-dimensional simulation of flooding behaviour.

The MIKE 11 model was set up using survey data from previous studies in addition to survey data collected for the current study. The survey data consisted of cross sections at varying intervals of up to 5 km. The data was sufficient to produce a layout capable of simulating flow distributions within the study area.

Hydraulic modelling was undertaken for the following conditions:

- Existing conditions as present during the initial stages of the Flood Study (i.e. during 1999/2000)
- Pre-development conditions (i.e. with all Tuppal and Bullatale Creek system levees excluded from the model).

In overall terms, the hydraulic model was concluded to be predicting flooding behaviour satisfactorily for both the existing conditions and pre-development conditions cases. The hydraulic model provided a valid tool during the FMS phase for analysing the impacts of potential floodplain management options on flood behaviour.. The hydraulic model was not created to make absolute flood height predictions.

Please refer to the Tuppal and Bullatale Creeks Flood Study and FMS report for detailed information regarding the hydraulic modelling of the Tuppal and Bullatale Creeks floodplain including input data and calibration methods.

3.4 Floodway Assessment Considerations

Hydraulic

The assessment of issues associated with the review of the floodway network and flood control works involved the following tasks and considerations associated with hydraulic considerations:

- Consideration of the adopted floodplain management principles (refer Table 2.1).
- The hydraulic adequacy and impacts of the floodway in varying flood events, but most notably the adopted 1975 flow conditions design event.
- The use of the MIKE 11 hydraulic model to assist in quantifying the hydraulic impacts of different options / scenarios and existing flood control works.
- The use of the LIDAR terrain data for establishing the presence and height of natural and man made structures / features.
- Review of documentation in relation to floodway network and flood control works decisions by DNR and its predecessors.
- On-site discussions and inspections with landholders regarding their views on the floodway network and flood control works issues including joint inspections of the feature / area subject to assessment.

Additional assessment criteria were used to ensure a consistent approach to the application of the adopted floodplain management principles. Specific hydraulic assessment criteria were as follows:

- Floodway capacity – floodways should be established and / or retained if their closure has or would result in a significant redistribution of peak flow flows for 1975 flow conditions (i.e. more than a 5% redistribution of the adopted 1975 design peak flood flows).
- To limit the potential for floodplain erosion to occur, out of channel floodway velocities should not exceed more than 0.8 m/s as a result of constrictions caused by flood control works for 1975 flow conditions.
- Flood control works should not lead to an increase in upstream flood level of more than 0.1 metre encroaching onto an adjoining landholders property for 1975 flow conditions.

In general, the application of the above criteria were focused on those flood control works which:

- Are wholly or partly intruding into the floodway system.
- Were raised by landholders at the community workshops or through returned questionnaires as being of concern.

In general, works complying with the 1978 Guidelines and any additional approval conditions were accepted. This is consistent with the management principle adopted to condone as many existing works as possible.

Environmental

Floodplain management plans must take into account principles relating to the protection of the environment.. In particular, floodplain management plans must contain strategies to manage flood control works so that the natural functions of the floodplain environment are supported.

The review of the Tuppal and Bullatale Creeks floodway network included an assessment of issues associated with the present status of flood access to identified flood dependent ecosystem areas. The 1978 Guidelines and associated floodway network was prepared with less emphasis given to environmental considerations.

The environmental assessment was undertaken taking into account the environmental assessment principles given in Table 2.1 and using a set of assessment criteria adopted by the CMFMC. The criteria were developed with the objective of identifying those flood dependent ecosystems possessing moderate or high environmental values and for which the restoration of floodwater access is practical after taking into account social and economic impacts.

Social / Economic

Social and economic considerations were an ever present factor when assessing the hydraulic and environmental related floodway issues. The impact of decisions on farm operations in relation to the layout and extent of the floodway was discussed at length with landholders during the various community consultation activities, notably the three rounds of community workshops and at numerous on-site meetings with individual landholders.

The decision to adopt the 1975 event was in large part based on avoiding significant adverse social and economic impacts associated with the adoption of a larger design flood. It was also consistent with the level of protection generally sought by rural landholders for protection against flooding (i.e. 20 to 40 years ARI). It is also generally seen to represent an appropriate balance between achieving an acceptable flood risk and not unnecessarily tying up an excessively large floodway area for hydraulic reasons associated with rare floods.

The assessment of environmental assessment issues explicitly required social and economic considerations to be taken into account through the adopted practicality assessment criteria. The criteria encompassed factors including the cost of any recommended works, land use impacts and land use compatibility. Field assessments where possible were carried out in the company of landholders to ensure these considerations were adequately understood and taken into account in reaching decisions.

4. Floodway and Flood Control Works – Adopted Outcomes

4.1 Design Event Flows

The adopted 1975 design event flow distributions derived from the hydraulic model are shown on Figure 4.0. Detailed descriptions of flooding behaviour are provided in the Flood Study report (2002) and the FMS report (2004).

The design flows were used for the assessment of the hydraulic adequacy of the floodway network.

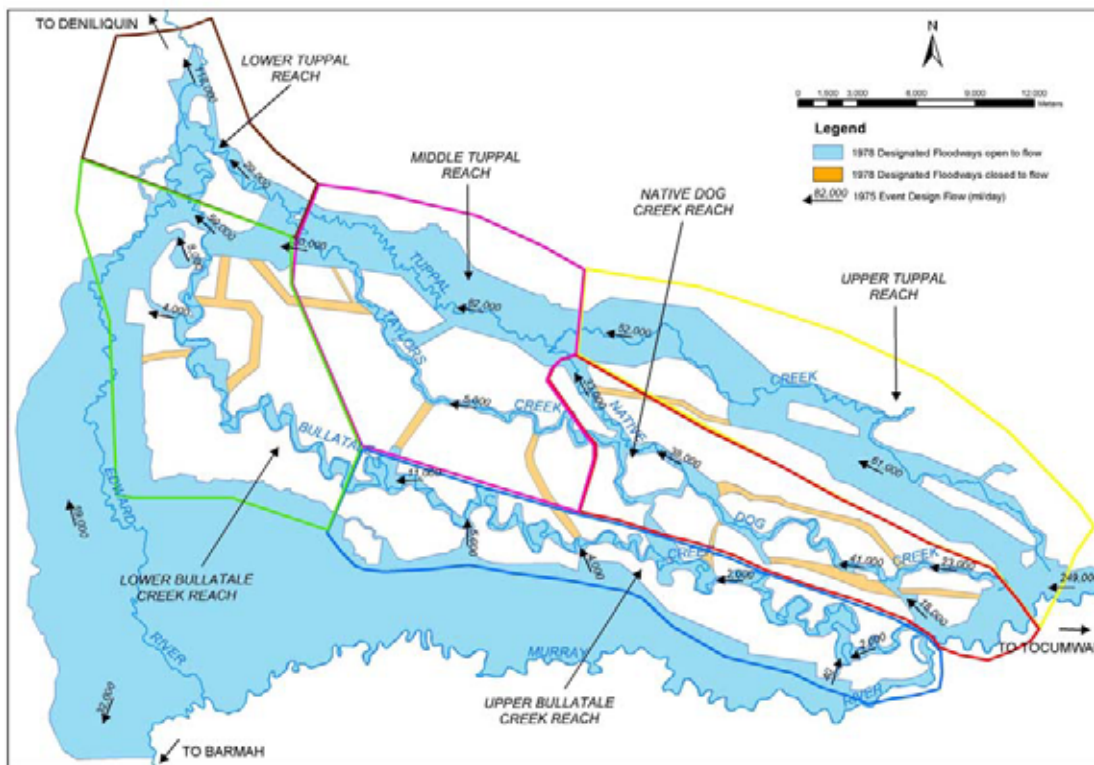


Figure 4.0 Floodway Design Flood Flows

4.2 Floodway Network

The proposed floodway network is shown on Figures 4.1 to 4.4. The floodway network differs in some areas in comparison to the 1978 Guidelines network. These differences have arisen in response to:

- Existing flood control works considerations.
- Hydraulic considerations.
- Environmental considerations.

In assessing the above considerations, social and economic impacts on landholders and other stakeholders were taken into account as required by the adopted floodplain management principles (refer Table 2.1). Partly as a consequence, the resulting floodway network is not significantly different to the previous network in place. This also reflects the decision to retain the same design flood event used for the 1978 Guidelines (1975 event) and the considerable flood control work activity which has taken place in accordance with the 1978 Guidelines.

Numerous minor changes to floodway boundaries have been made to coincide with the location of licensed flood control works. Changes to floodway boundaries have also been made to encompass flood dependent ecosystem sites as discussed further in Section 5.

Flood control works in floodway areas are generally not permitted. If however the applicant can demonstrate that the proposed works do not result in any significant adverse impacts on flooding behaviour and / or flood dependent ecosystems, then the works may be approved.

Please refer to Section 7 for further details regarding approval of flood control works and administration of the Tuppal and Bullatale Creeks FMP under *Part 8 of the Water Act 1912*.

There are no restrictions on agricultural land use within floodway areas providing flood conveyance and / or storage is not reduced and flood dependent ecosystems are not damaged. Landholders need to make their own assessment regarding the risk of flooding within floodway areas if they decide to utilise portions of the floodway for cropping or other flood sensitive agricultural activities. Landholders also need to bear in mind that the erection of temporary flood control works within floodway areas in the event of impending flooding is not permitted.

4.3 Flood Control Works - Required Modifications

General

In order to finalise the adopted Tuppal and Bullatale Creeks FMP floodway network, identified floodplain management issues needed to be investigated and resolved. These issues included existing flood control works that were identified during the consultation phase as possibly resulting in flooding problems. The required modifications to existing flood control works are given in Table 4.1. In order to minimise social and economic impacts licensed works consistent with the 1978 Guidelines were generally condoned.

It is important to remember that all proposed and existing flood control works within the Tuppal and Bullatale Creeks floodplain require approval under *Part 8 of the Water Act 1912* and where applicable development consent from the local council under *Murray REP2*. Where no approval exists, DNR may take the relevant action(s) under the Act.

With regard to the issues outlined in Table 4.1, please note the following:

- Specific structural modifications to existing works will be administered under the relevant sections of Part 8;
- Minor modifications to existing approved works identified to be necessary in Table 4.1 will be administered through modifying the Part 8 approval conditions under Section 176A of the *Water Act 1912*; and

- With regard to unapproved works, directions for remedial work(s) may be used as a means of encouraging landholders to bring the subject work(s) within the *Water Act 1912* by lodging an application for approval that is complying (refer to Section 7.5) with the FMP. It is envisaged that the approval process for complying works will be more expedient including development consent from the local council under *Murray REP2* (where applicable).

Please refer to Section 7 for further details regarding approval of flood control works and administration of the Tuppal and Bullatale Creeks FMP under *Part 8 of the Water Act 1912*.

Staging

Implementation priorities for the required changes to flood control works are assigned in Table 4.1. The priorities are defined as follows:

- Highest priority - within 12 months of plan's adoption. These measures are considered very important in relation to the performance of the floodway system and should as a consequence be implemented quickly.
- Medium priority – within 3 years of plan's adoption. These measures are desirable for hydraulic and / or environmental reasons.
- Further investigation – these issues have not been fully resolved and require further investigation.

Table 4.1 Required Modifications to Existing Flood Control Works

Issue	Description of Issue	Required Modifications	Priority	Responsibility
1.1	Future status of ring levee alignments downstream of Lower River Road	No changes required to levees. Floodway boundaries to be realigned to coincide with levee alignments.	n/a	DNR
1.2	Future status of 1.1 km unlicensed levee bank downstream Lower River Road within the Tuppall floodway. Levee is in a sensitive hydraulic location.	Whole of levee to be removed.	Medium	Landholder
1.3	Future status of two unlicensed levees located downstream of Lower River Road. One levee is protruding partly (1.4km) into floodway whilst second levee (1.2km) is located wholly within floodway.	Whole of levee bank sections within floodway to be removed.	Medium	Landholders
1.4	Future status of non floodway island within Tuppall floodway.	No change to floodway extent.	n/a	n/a
1.5	Levee across drainage depression entry point into Tuppall floodway. Drainage depression carries local runoff. Primary consideration is floodwater access status of depression and adjoining red gum forest areas.	No changes to levee. Drainage inlet structure to be modified to improve environmental flows access (i.e. capacity upgrade to drainage inlet structure to allow for more rapid flooding of adjoining forest area).	Medium	DNR / landholder
1.6	Future status of ring levee alignments.	No changes required to levees. Floodway boundary to be realigned to coincide with levee alignments.	n/a	DNR
1.7	Potential floodway link from Tuppall Creek to Native Dog Creek.	Floodway link not recommended.	n/a	n/a
1.8	Raising of Lower River Road causeways to improve road protection against flooding. Five of the eight causeways will require modifications to improve the road's level of protection against closure due to flooding.	Recommendation to pursue raising of relevant causeways. Any modifications to be designed so as to maintain the existing causeway stage discharge characteristics.	Medium	Berrigan Shire / landholders

Issue	Description of Issue	Required Modifications	Priority	Responsibility
2.1	Adequacy of floodway width entering Native Dog Creek system.	No changes required to levees. Floodway boundary to be realigned to coincide with levee alignments.	n/a	DNR
2.2	Future status of Taylors Road floodway.	Floodway not required.	n/a	n/a
2.3	Spoil bank (400 metres) arising from drain construction is obstructing flood flows on the north side of Native Dog Creek.	Whole of spoil bank between Native Dog Creek and ring levee alignment to be removed.	High	Landholder
2.4	Adequacy of Native Dog Creek floodway width downstream of Taylors Road.	No changes required to levees. Floodway boundary to be realigned to coincide with levee alignments.	n/a	DNR
2.5	Future status of one time northern anabranch floodway to Native Dog Creek.	Reinstatement of floodway not required.	n/a	n/a
2.6	Future status of one time southern anabranch floodway to Native Dog Creek.	Reinstatement of floodway not required.	n/a	n/a
2.7	Constriction in Native Dog Creek caused by levee intrusion into floodway. Application by landholder to construct levee on opposite side of creek has been assessed in conjunction with this issue.	Section of levee (350 metres) to be realigned to maintain 450 metre minimum opening width. Floodway boundaries to be realigned to coincide with final levee alignments.	Medium	Landholder
2.8	Constriction in Native Dog Creek caused by levee intrusions into floodway on both sides of the creek (opening width reduced to 200 metres). South side bank is a supply channel bank, north side bank is a levee bank.	South side bank to be realigned along past floodway alignment, convenient for landholder as south side bank has recently been removed for later reinstatement. North side bank to be realigned to provide 300 metre opening width (requires realignment approx. 300 m of bank).	Medium	Landholder / DNR
2.9	Constriction at mouth Taylors Creek at Native Creek offtake caused by unlicensed levee banks within floodway. Levee banks restrict inflows into Taylors Creek.	Levee banks to be removed. Floodway alignment has been slightly realigned on south side of the mouth.	High	Landholder

Issue	Description of Issue	Required Modifications	Priority	Responsibility
2.10	Constriction at mouth of unnamed anabranch at Native Dog Creek offtake caused by protrusion of levee bank into floodway.	200 metre section of levee bank to be removed from floodway.	High	Landholder
3.1	Future status of Woperana Channel.	Retain in existing condition.	n/a	n/a
3.2	Future status of major Lower River Road culverts east of Yantara property.	Culverts to be retained for discharging local runoff and flood flows in event levee failures.	n/a	n/a
3.3	Future status of major Lower River Road culverts at Berrigan / Murray shire boundary.	Culverts to be retained for discharging local runoff and flood flows in event levee failures.	n/a	n/a
3.4	Future status of minor depression between Bullatale Creek and Native Dog Creek.	Not required to be added to floodway network.	n/a	n/a
3.5	Future status of one time floodway link from Bullatale Creek to Native Dog Creek.	Not required to be reinstated to floodway network	n/a	n/a
3.6	Future status of floodway link from Bullatale Creek to Native Dog Creek.	Floodway to be retained.	n/a	n/a
3.7	Levee intrusion into Deep Creek floodway. Results in 60 metre minimum opening width. Floodway minimum opening width is 100 metres. Levee is not along a recorded approved alignment.	90 metre section of levee bank to be removed from floodway. Floodway alignments have been realigned to coincide with remaining levee bank alignments.	Medium	Landholder
3.8	Levee intrusion into Seven Mile Creek floodway. Levee is not along a recorded approved alignment.	170 metre section of levee bank to be removed from floodway. Floodway alignments have been realigned to coincide with remaining levee bank alignments.	Medium	Landholder
4.1	Potential floodway link from Bullatale Creek to Taylors Creek.	Not recommended.	n/a	n/a
4.2	Potential floodway link from Bullatale Creek to Taylors Creek.	Not recommended.	n/a	n/a

Issue	Description of Issue	Required Modifications	Priority	Responsibility
4.3	Potential floodway link from Tuppall Creek to Taylors Creek.	Recommended for addition to floodway network.	High	DNR
4.4	Future status of levee within Tuppall / Taylors Creek floodway. Levee (3.6 km) is redundant. Levee has been present since pre 1978.	Whole of levee to be removed.	Medium	Landholder / DNR
4.5	Future status of one time potential floodway link from Taylors Creek to the west.	Not required.	n/a	n/a
4.6	Levee intrusion into Taylors Creek floodway by up to 110 metres. Adjoining north side of creek is open.	Levee can remain as is. Adjoining north side floodway alignment has been moved to compensate.	High	DNR
5.1	Potential floodway link from Bullatata Creek to Edward floodplain.	Not recommended.	n/a	n/a
5.2	Future status of levees and floodway alignments lining breakaway floodway through Towool. Minimum levee opening is 20 metres.	Section of levee to be realigned to provide minimum 32 metre minimum opening width. Other levees can remain on existing alignments, with condition that crest height be retained. Floodway boundary alignments to be adjusted to coincide with licensed levee alignments.	High	Landholder
5.3	Future status of Cumbagunda floodway anabranch. Anabranch not required hydraulically. Cumbagunda lagoon floodwater access issue yet to be resolved.	Pending subject to further discussions with landholder.	Further investigation	Landholder / DNR
5.4	Future status of levees and floodway alignments lining breakaway floodway through Bullatella.	150 metre section of levee at flood runner mouth area to be removed. Floodway boundaries to be altered to maintain minimum opening width of 100 metres.	Medium	Landholder
5.5	Floodway constriction in vicinity of Prairie Home homestead. Levee alignments pre-date 1978 Guidelines.	130 metre section of levee to be removed. Floodway boundaries to be adjusted to coincide with remaining levee alignments.	Medium	Landholder / DNR

Issue	Description of Issue	Required Modifications	Priority	Responsibility
6.1	Future status of redundant levee intruding into Tuppal Creek floodway. Levee pre-dates the 1978 Guidelines.	Levee to be removed.	Medium	Landholder
6.2	Supply channel embankment blocking well defined depression within floodway.	Embankment to be modified / removed to restore flood conveyance in depression. Likely to be achieved through provision of a siphon, similar to that located 200 metres to the east.	High	Landholder
6.3	Supply channel embankment obstructing flood flows adjacent to Tuppal Creek / Edward River junction.	Supply channel embankment to be modified to restore flood conveyance. Likely to be achieved through provision of a pipeline replacing the 200 metre subject channel.	High	Landholder

Note:

1. Issue locations are shown on Figures 4.2, 4.3 and 4.4.

5. Environmental Assessment – Adopted Outcomes

5.1 Overview

Flood dependent ecosystems are areas supporting plant and animal communities that are adapted to wetting (flooding) and drying and depend on flooding to remain healthy.

Flood control works undertaken in the past have in some instances resulted in the exclusion or restriction of floodwater access to some flood dependent ecosystem areas. Other sites, although retaining floodwater access to date, have been located outside the floodway areas for the 1978 Guidelines and as such could be isolated by flood control works in the future.

Environmental assessment activities during the preparation of the FMP were therefore orientated towards:

- Identifying those flood dependent ecosystem sites of moderate or high environmental value affected or potentially affected by flood control works.
- Subsequently identifying those sites suitable for the restoration or preservation of flood access after taking into account social and economic impacts arising from the measures necessary to restore or preserve such access.

Flood dependent ecosystem sites located within the floodway network for the 1978 Guidelines and known not to be affected by flood control works were not subject to assessment. All of these sites have been retained within the proposed floodway network, thereby ensuring that future floodwater access to these ecosystems is maintained.

5.2 Assessment Approach / Criteria

A set of environmental assessment criteria were developed for the assessment of selected flood dependent ecosystem sites within the Tuppal and Bullatale Creeks floodplain. The assessment criteria were developed with the objective of identifying those flood dependent ecosystems with moderate or high environmental value for which the restoration of floodwater access is practical after taking into account any social and economic impacts. The criteria were adopted by the CMFMC.

The criteria involved the application of the following two stage assessment process:

- Step 1 Environmental Value Assessment – assessment of the environmental values of flood dependent ecosystems affected by existing or potential flood control works. Factors taken into account were the site size, ecological condition / habitat value, representativeness of ecosystem type, cultural / historical significance, rehabilitation potential, hydrology, hydrological connectivity and any special features.
- Step 2 Practicality Assessment – assessment of the practicality of restoring flood access to those areas of moderate or high environmental value taking into account social and economic factors. Factors taken into account were the cost of works involved in restoring flood access, complexity of ownership, land use compatibility, land use impacts and demonstration value.

Where possible (i.e. where landholders gave permission), sites assessed by the environmental consultant engaged by DNR were subject to field based assessments.

A number of landholders objected to DNR engaged environmental consultant carrying out field based assessments. These same landholders privately engaged a consultant to undertake field based environmental assessments on their behalf.

Sites not accessible to DNR engaged environmental consultant were subsequently assessed based on desk-top assessments, including a review of the privately engaged consultant's reports which were made available.

5.3 Adopted Outcomes

General

A summary of environmental outcomes and associated implementation priorities is provided in Table 5.1.

Outcomes are divided into the following two categories:

- Works to restore floodwater access to sites currently with either restricted or no access to floodwaters due to flood control works (two sites).
- Adjustments to the floodway boundaries to encompass sites previously located outside the floodway network to ensure that future access for floodwaters to these sites is maintained (seven sites).

With regard to the issues outlined in Table 5.1, please note the following:

- Specific structural modifications to existing works will be administered under the relevant sections of Part 8;
- Minor modifications to existing approved works identified to be necessary in Table 5.1 will be administered through modifying the Part 8 approval conditions under Section 176A of the *Water Act 1912*; and
- With regard to unapproved works, directions for remedial work(s) may be used as a means of encouraging landholders to bring the subject work(s) within the *Water Act 1912* by lodging an application for approval that is complying (refer to Section 7.5) with the FMP. It is envisaged that the approval process for complying works will be more expedient including development consent from the local council under *Murray REP2* (where applicable).

It is important to remember that all proposed and existing flood control works within the Tuppal and Bullatale Creeks floodplain require approval under *Part 8 of the Water Act 1912* and development consent from the local council under *Murray REP2* (where applicable).

Where no approval exists, DNR may take the relevant action(s) under the Act.

Please refer to Section 7 for further details regarding approval of flood control works and administration of the Tuppal and Bullatale Creeks FMP under *Part 8 of the Water Act 1912*.

Staging

Implementation priorities are consistent with the previously specified descriptions given for the required flood control works modifications (e.g. high priority – implement within 12 months, medium priority – implement within 3 years, further investigation – requires further investigations / consultation to reach an outcome).

Table 5.1 Adopted Environmental Outcomes

Site No.	Description of Issue	Recommendation/Required Modifications	Priority	Responsibility
3/32	8 ha lentic channel site. Has access to floodwaters. Located partly outside of previous floodway network.	Realign floodway boundary to encompass this site. No physical works required.	High	DNR
3/43	34 ha lentic channel site. Has access to floodwaters. Located partly outside of previous floodway network.	Realign floodway boundary to encompass this site. No physical works required.	High	DNR
3/45	12 ha lentic channel site. Has access to floodwaters. Located outside of previous floodway network.	Realign floodway boundary to encompass this site. No physical works required.	High	DNR
3/48	48 ha lentic channel site. Part of site does not have access to floodwaters due to complying levee. Located partly outside of previous floodway network.	Recommendation pending outcome of further investigations / consultation with landholder.	Further investigation	
3/49	5 ha lentic channel site. Does not have access to floodwaters due to complying levee. Located outside of previous floodway network.	Adverse farm operation impacts arising from restoration of floodwater access outweigh environmental benefits. No changes to existing arrangements.	n/a	n/a
3/50	60 ha lagoon site (Cumbagunda lagoon). Does not have access to floodwaters due to complying levee.	Recommendation pending outcome of further investigations / consultation with landholder.	Further investigation	
3/53	1 ha floodplain depression site. Floodwater access status uncertain.	Recommendation pending outcome of further investigations / consultation with landholder.	Further investigation	
3/56	3 ha lentic channel site. Has access to floodwaters. Located partly outside of previous floodway network.	Realign floodway boundary to encompass this site. No physical works required.	High	DNR
3/81	5 ha lentic channel site. Does not have access to floodwaters due to complying levee. Located outside of previous floodway network.	Reinstate floodwater access through pipe installed at upstream end of site. Realign floodway boundary to encompass site. Levee can stay on existing alignment.	Medium	DNR / landholder

Site No.	Description of Issue	Recommendation/Required Modifications	Priority	Responsibility
3/83	6 ha lentic channel site. Does not have access to floodwaters due to complying levee. Located outside of previous floodway network.	Adverse farm operation impacts arising from restoration of floodwater access outweigh environmental benefits. No changes to existing arrangements.	n/a	n/a
3/84	29 ha lentic channel site. Does not have access to floodwaters due to complying levee. Located outside of previous floodway network.	Adverse farm operation impacts arising from restoration of floodwater access outweigh environmental benefits. No changes to existing arrangements.	n/a	n/a
3/120	20 ha lentic channel site. Site has restricted access to floodwaters (via valve operated pipe structure through levee bank).	Pipe structure to be modified to improve capacity and fish passage attributes. Realign floodway boundary to encompass significant red gum forest area on south side of this site.	Medium	DNR / landholder
3/129	6 ha lagoon site. Has access to floodwaters. Located partly outside of previous floodway network.	Realign floodway boundary to encompass this site. No physical works required.	High	DNR
3/130	1 ha scroll swale site. Has access to floodwaters. Located partly outside of previous floodway network.	Realign floodway boundary to encompass this site. No physical works required.	High	DNR
3/141	7 ha lentic channel site. Has access to floodwaters. Located outside of previous floodway network.	Realign floodway boundary to encompass this site. No physical works required.	High	DNR
3/343	10 ha lentic channel site. Has restricted access to floodwaters.	No changes to existing arrangements.	n/a	n/a

Note:

1. Wetland site locations are shown on Figure 5.1.

5.4 Summary of FMP Environmental Impacts

A summary of the environmental impacts arising from the Tuppal and Bullatale Creeks FMP is provided in Table 5.2. The major environmental impact in relation to the Tuppal and Bullatale Creeks FMP is its influence on ensuring floodwater access to flood dependent ecosystem areas is maintained within the Tuppal and Bullatale Creeks floodway network. Target 25 of the State Water Management Outcomes Plan aims to provide floodwater access to 60% of the natural 1 in 5 year flooded area.

The Tuppal and Bullatale Creeks floodway network has been sized to convey a 1975 event design flow (equivalent to a 1 in 20 to 1 in 40 year event). In many instances, the floodway width adopted is considerably broader than that which is needed based purely on hydraulic needs (e.g. sections of Tuppal Creek floodway are up to 3 km wide).

Natural flooding conditions are difficult to define within the Tuppal and Bullatale Creeks floodplain given the presence of adjoining Murray River levees on both the NSW and Victorian sides of the river dating back to the late 1800's. Based on knowledge of flooding behaviour gained from the Tuppal and Bullatale Creeks Flood Study and FMS, it is considered almost certain that the proposed floodway network exceeds the 60% target.

The Tuppal and Bullatale Creeks FMP will not have a significant impact on other environmental features including soil conditions, groundwater characteristics, water quality and Aboriginal / European heritage sites.

Table 5.2 Summary of FMP Environmental Impacts

Feature	Tuppal and Bullatale Creeks FMP Impact
Wetlands	Wetlands rely on access to floodwaters to remain healthy. Adopted FMP environmental outcomes include the restoration of future floodwater access to two wetland / flood dependent ecosystem sites encompassing 25 ha. This will have a beneficial impact on the health of these sites. The FMP will also maintain flood flow access to wetlands currently connected to the flooding regime by including them within the floodway network.
Vegetation / fauna	Vegetation and fauna communities within flood dependent ecosystem areas will benefit from the restoration and future preservation of floodwater access to these areas. Approximately 85% of existing floodplain vegetation stands present within the study area are located within the floodway network.
Fish	The floodway network ensures continuity of connectivity between the Murray River and the Tuppal and Bullatale Creeks floodplain (including all significant anabranches) in flood events. This is desirable from a fish passage viewpoint. Issues associated with environmental flows and in-stream low level works influencing fish passage / health are currently being assessed as part of a separate DNR commissioned project.
Soils	The floodway network will have a positive affect on soils by ensuring that velocities and the associated scour risk is not unduly increased and by assisting in maintaining soil structure through the retention of regular wetting and drying regimes within floodway areas.
Groundwater	The FMP will not have a measurable impact on groundwater characteristics. Recharge characteristics will not change given flooding behaviour within the study area (frequency / duration / extent) will remain largely unchanged.
Water Quality	The FMP will not have a measurable impact on water quality in Tuppal and Bullatale Creeks. The current Tuppal Creek environmental flows project may provide a means by which the relatively poor water quality in Tuppal Creek can be improved.
Heritage	The FMP will not impact on any of the 20 recorded aboriginal heritage sites located within the vicinity of the study area. Other unrecorded sites are likely to be present given no systematic archaeological survey of the area has been carried out. Future flood control works applications should be checked against the NPWS Aboriginal Sites Register for any recorded sites in the vicinity of proposed works.

6. Other Floodplain Management Issues

6.1 Floodway Management

The primary function of floodways is the conveyance of floodwaters. For this reason works (e.g. levee banks, raised supply channel banks) within floodway areas with the potential to obstruct floodwaters are generally not permitted.

Flooding behaviour (flow velocities, flood levels) is directly affected by the flow resistance present across the floodplain. An increase in the density of vegetation present will increase the flow resistance, leading to reduced flow velocities and higher flood levels. Regrowth levels, if allowed to continue unchecked, will reduce the hydraulic capacity of floodways, compromising its primary function. For this reason, ongoing thinning of vegetation focusing on regrowth is needed. Vegetation management / maintenance needs to be carried out in a careful manner, aiming to achieve a balance between hydraulic and ecological functions.

The following guidelines are provided for managing floodway areas:

- Any maintenance activities undertaken within floodways must comply with the relevant resource management legislation and relevant natural resource management plans.
- Preserve all remnant vegetation including dead trees and remove competitive weeds.
- Where regrowth levels become excessive, carry out thinning / clearing in accordance with the applicable regional vegetation management plan and best management practices.
- Use locally occurring native species where efforts are made to increase permanent vegetation cover (e.g. in erosion sensitive areas).
- Exclude or limit the access of stock to flood dependent ecosystems (e.g. wetlands, waterways) to minimise the potential for soil compaction, vegetation damage, habitat degradation and water quality deterioration.
- Exclude or limit the use of chemicals in the vicinity of flood dependent ecosystems for the same reasons.
- Undertake best practice agricultural management techniques within floodway areas (e.g. avoid over grazing, avoid grazing / cropping of erosion sensitive areas including gullies and depressions, retain surplus irrigation runoff for reuse).

6.2 Levee Design / Construction and Maintenance Issues

The Tuppal and Bullatale Creeks FMP does not specify design, construction or maintenance minimum standards or requirements for levees or other forms of flood control works aside from the need to comply with approved alignments and on occasions height restriction conditions. Landholders cannot be forced to adhere to any such standards in the case of privately funded levees for the purpose of protecting private property.

The erection of levees for the purpose of protecting private property will continue to be on a voluntary basis. This includes proposed levee schemes spanning multiple properties.

DNR will provide guidance to landholders in relation to levee design, construction and maintenance issues upon request by landholders where resources allow. This may include:

- Provision of suitable written design / construction / maintenance guidelines.
- Advice in relation to flood heights where information is readily available.
- On-site assistance in the set-out of alignments using a GPS device.
- On-site inspections of levee conditions and advice regarding maintenance needs.

In relation to ongoing maintenance of levees, landholders should carry out inspections annually and shortly after major significant events. Inspections should check for any visual damage, including crest erosion, batter erosion / slumping, tree growth (remove regrowth from vicinity of levees) and animal burrows (if discovered dig out and fill with compacted soil).

6.3 Monitoring

Monitoring of future flooding behaviour to assess the floodway system's performance is the responsibility of both landholders and DNR. Observations and measurements recorded will assist in identifying future improvements to the floodway network.

Monitoring and collection of data should focus on the following:

- Recording of peak flood height marks in significant floods (landholders and DNR).
- Stream gaugings for the Tuppal Creek at Lower River Road and Aratula Road, Bullatale Creek at inflow points, Tocumwal-Mathoura Road and Cornalla Road (DNR).
- Collection of any other relevant data with links to the Tuppal and Bullatale Creeks FMP (e.g. flood photography, areas experiencing erosion, environmental observations).

7. Implementation

7.1 Roles and Responsibilities

Implementation of the Tuppal and Bullatale Creeks FMP will be regulated under Part 8 of the Water Act 1912. DNR is responsible for administering floodplain management within rural NSW west of the Great Dividing Range and will therefore be responsible for administering the Tuppal and Bullatale Creeks FMP.

The successful implementation of the Tuppal and Bullatale Creeks FMP largely depends on community ownership of the plan. Retention of the designated floodway areas as areas reserved primarily for the discharge and storage of floodwaters needs to be acknowledged and supported by landholders as being in the interests of all, and socially and lawfully responsible.

Implementation of recommended plan measures (refer Tables 4.1 and 5.1) aims to have high priority measures implemented within 12 months of the plan's adoption. Medium priority measures should be implemented within 3 years.

Roles and responsibilities are outlined as follows:

CMFMC

- Oversee the implementation of the Tuppal and Bullatale Creeks FMP

DNR

- Facilitate arrangements for implementation of the required Tuppal and Bullatale Creeks FMP measures
- Provide technical assistance and support to landholders where appropriate
- Assess future flood control works applications
- Ongoing monitoring of flooding behaviour / Tuppal and Bullatale Creeks FMP performance indicators

Landholders

- Undertake required changes to flood control works
- Comply with any conditions placed on future flood control works permits
- Ongoing monitoring of flooding behaviour / floodway performance

Local Government

- Maintain adequate capacity at roadway waterway structures

7.2 Performance

Detailed performance indicators for assessing the success of implementing floodplain management plans are to be developed as part of state floodplain management policy. These indicators are likely to be targeted towards measuring the following objectives:

- Minimising the obstruction to floodwater conveyance and loss of storage within the adopted floodway network.

- Restoring / retaining floodwater access to flood dependent ecosystem areas.
- Improving the level of protection against future flood damage.

7.3 Application Procedures for Flood Control Works

General

Development consent from the local council under *Murray REP2* and approval from DNR under *Part 8 of the Water Act, 1912* is required for flood control works (i.e. works that could affect the distribution of floodwaters on the floodplain).

As a first step in obtaining approval for an existing flood control work, landholders should enquire at the local council office as to whether or not development consent is required under *Murray REP2*. A number of established banks, levees and works that have not been altered since construction may have existing use rights and may not require development consent. If unlicensed, however, these banks will still require approval from DNR under *Part 8 of the Water Act, 1912*.

How to apply for approval

For works without existing use rights - council development consent required:

- A Development Application is made at the local council office for consent under *Murray REP2*.
- An application is then lodged with the local DNR office's Licensing Section for approval under *Part 8 of the Water Act* (please refer to Section 7.4).

For works with existing use rights – council development consent not required:

- An application is lodged with the local DNR office's Licensing Section for approval under *Part 8 of the Water Act* (please refer to Section 7.4).

What happens when development consent is required

A Development Application is lodged with the local council which is the consent authority for flood control works under *Murray REP2*. Council is required to refer the Development Application to DNR before consent is granted. DNR advises council of its general terms of approval. The general terms of approval should be comprehensive enough to cover all of the constraints (terms and conditions) that may be applied to the relevant Part 8 licence. If DNR decides it cannot issue general terms of approval then Council must refuse development consent.

The Development Application for a flood control work is advertised in the local newspaper and any submissions are assessed by the local council or by its Floodplain Management Committee. Council also consults with MDBC regarding development applications for flood control works. Council's assessment procedure is under *Part 4 of the Environmental Planning and Assessment (EPA) Act, 1979*, and requires a broad environmental assessment of the works described in the development application. Appeals against the council's development consent or refusal are heard in the Land and Environment Court.

Following the granting of consent, an application is lodged with DNR for the issue of a licence under *Part 8 of the Water Act* (please refer to Section 7.4).

What happens when development consent is not required

An application is made directly to DNR for approval under *Part 8 of the Water Act* (please refer to Section 7.4). If the application complies with the FMP and meets DNR environmental requirements under *Part 5 of the EPA Act*, DNR will issue a licence. However, if the application does not comply with the FMP it must be advertised in a local newspaper and in the Government Gazette. If objections result following advertising, DNR will arrange a compulsory mediation session with the purpose of resolving the objections.

DNR determines an application by granting an approval or by refusing the approval. Appeals against DNR's determination are heard in the Land and Environment Court.

7.4 Part 8 Approval Process for Flood Control Works

General

All activities associated with flood control works are administered under the relevant sections of Part 8 of the *Water Act 1912*. The Water Administration Ministerial Corporation (hereafter WAMC) is the body who prepares, adopts and administers FMPs, as well as receives and determines Part 8 applications. DNR acts on behalf of WAMC for all matters relating to Part 8 of the Water Act. DNR needs to know whether or not development consent is required when processing an application. When development consent is required, the issue of a Part 8 licence is subject to the consent being granted by the local council under *Murray REP2* (please refer to Section 7.3). The Council is required to consult with DNR, MDBC and Council's local Floodplain Management Committee. If DNR decides to refuse approval then Council must refuse development consent.

In short, please note the following:

1. All flood control works require an approval under Part 8 of the Act;
2. All Part 8 applications for new and existing (unapproved) works within the Tuppal and Bullatale Creeks floodplain will be determined in accordance with the Tuppal and Bullatale Creeks FMP and Part 8 of the Act; and
3. Any existing unauthorised works for which a Part 8 application is not lodged, may be served a notice under Section 180D of the Act for removal or DNR may consider prosecution action.

Refer to Section 7.6 for further details regarding unauthorised works and Part 180D of the *Water Act 1912*.

Works That Require Approval

Works referred to as flood control works are defined under *Part 8 of the Water Act 1912* as 'controlled works'. Controlled works require approval under the Act and are defined as:

- An earthwork, embankment or levee that is situated, or proposed to be constructed, on land that:
 - is, or forms part of, the bank of a river or lake, or is within a floodplain, or

- Any work that is situated, or proposed to be constructed, on land that:
 - is, or forms part of, the bank of a river or lake, or is within a floodplain and that is declared by order of the WAMC published in the Gazette to be a controlled work, or,
- An earthwork, embankment or levee, wherever situated or proposed to be constructed, that:
 - affects or is reasonably likely to affect the flow of water to or from a river or lake, and
 - is used or is to be used for, or has the effect or likely effect of, preventing land from being flooded by water, or
- Any work, wherever situated or proposed to be constructed, that:
 - affects or is reasonably likely to affect the flow of water to or from a river or lake, and
 - is used or is to be used for, or has the effect or likely effect of, preventing land from being flooded by water, and
 - is declared by order of the WAMC published in the Gazette to be a controlled work.

Applying for Approval

The following is an outline of the steps required by an applicant in applying for approval for a flood control work:

Step 1 - Obtain an application form and discuss your proposal with neighbouring landholders.

Step 2 - Contact a DNR Floodplain Licensing Officer to arrange a site inspection, discuss the application and get advice on the information required for the approval process.

Step 3 - Gather supporting information as your application will require you to supply technical information.

Step 4 - Fill in the application form. Complete additional information requirements on the form including condition of the existing surrounding environment.

Step 5 - Lodge the application with the supporting information and application fee at your local DNR office.

Determination Process

All applications under *Part 8 of the Water Act 1912* must proceed through a set process prior to DNR determining the application under Section 171 of the Act. This process includes (but not limited to):

- **Section 166C of the Water Act 1912** - DNR must have regard to the matters for general consideration outlined in Section 166C including (but not limited to):
 - The contents of any relevant FMP or any other relevant Government policy;

- The need to maintain the natural flood regimes in wetlands and related ecosystems and the preservation of any habitat animals (including fish) or plants that benefit from periodic flooding;
 - The effect or likely effect on water flows in downstream river sections;
 - Any geographical features, or other matters of Aboriginal interest that may be affected by a controlled work;
 - The effect or likely effect of a controlled work on the passage, flow and distribution of flood waters;
 - The effect or likely effect of a controlled work on existing dominant floodways or exits from floodways, rates of flow, flood water levels and the duration of inundation; and
 - The protection of the environment.
- **Part 5 of the *Environmental Planning and Assessment Act 1979*** - all proposals must undergo assessment under Part 5 except where development consent under Murray REP2 is required (please refer to Section 7.3). The factors to be considered include but are not limited to:
 - Any environmental impact on a community;
 - Any environmental impact on the ecosystem of a locality;
 - Any reduction of aesthetic, recreational, scientific or other environmental quality or value of a locality;
 - Any impact on the habitat of protected fauna;
 - Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air;
 - Any reduction in the range of beneficial uses of the environment; and
 - Any cumulative environmental effect with other existing or likely future activities.
 - **Floodplain Management Plan** - DNR must consider the Tuppal and Bullatale Creeks FMP and information contained within the Tuppal and Bullatale Creeks FMP including principles, assessment criteria, and any recommendations.
 - **Additional Information** - DNR must consider any investigation information that has been provided by the applicant.

Possible Determinations

DNR will inform the applicant at the earliest opportunity of the determination of an application for a flood control work. Where development consent under Murray REP2 is required, DNR will advise council of its general terms of approval (please refer to Section 7.3). The general terms of approval should be comprehensive enough to cover all of the constraints (terms and conditions) that may be applied to the relevant Part 8 licence. Under the *Water Act 1912*, there are three (3) possible determinations - approval of the application, approval of the application subject to conditions, or refusal of the application.

There are provisions within the *Water Act 1912* for a corporation or individual to object to an application approval if their interest(s) are affected by the approval. There are also provisions for an applicant and / or objector to appeal against the determination to the Land and Environment Court. Refer to the *Water Act 1912* for further details regarding these matters.

7.5 Complying and Non Complying Works

Under Section 168B(2) of the *Water Act 1912*, a flood control work is to be assessed as a complying work if DNR is satisfied that the work complies with the FMP for the area in which the work is situated or proposed to be constructed. Within the Tuppal-Bullatale Creeks floodplain a work complies with the FMP if:

- The work is or is proposed to be located outside the FMP Floodway Network as shown on Figures 4.1 to 4.4 and where described in the required modifications in Table 4.1 and Table 5.1.
- The work where applicable is to be modified in accordance with the required modifications in Table 4.1 and Table 5.1.

When lodging a Development Application with the local council and a Part 8 application with DNR, the applicant will be required to provide the necessary technical details to demonstrate that the application is a complying work. Where an existing unapproved or proposed flood control work is determined to be complying and the required environmental assessment is satisfactory, it is envisaged that the approval process will be more expedient.

Under Section 168B(3) of the *Water Act 1912*, a flood control work is to be assessed as a non-complying work if DNR is not satisfied that the work complies with the FMP for the area in which the work is situated or proposed to be constructed. Within the Tuppal and Bullatale Creeks floodplain a work is non-complying if:

- The work is or is proposed to be located within the FMP Floodway Network as shown on Figures 4.1 to 4.4 and where described in the required modifications in Table 4.1 and Table 5.1.
- The work where applicable is to be modified not in accordance with the required modifications in Table 4.1 and Table 5.1.

Non-complying works may be approved after a detailed investigation of the hydraulic, environmental, social and economic impacts of the proposal. The cumulative impact of the proposal on flooding characteristics will need to be comprehensively addressed. It is important to understand that it is the applicant's responsibility to organise a suitably qualified consultant to undertake the investigation and pay for the investigation. DNR will provide direction and guidance for the consultant. Where the requested supporting information is not furnished, DNR can refuse to deal with the application.

Applications for non-complying works must be advertised and third party objections sought prior to the determination of the application. If an objection is received that cannot be resolved, compulsory mediation will be required. DNR may request additional supporting information from the party who lodged the objection, with failure to do so possibly resulting in the objection being rejected.

7.6 Unauthorised Works

Unauthorised controlled works include the following:

- Works without approval;
- Works which have been constructed in contravention of an approval; or
- Works which have not been constructed in accordance with approval conditions.

Where unauthorised works are identified, DNR may direct that one or more of the following types of work be carried out by issuing a notice under Section 180D of the *Water Act, 1912*:

- (a) Work to remove, modify, repair or restore the controlled work or to render the work ineffectual.
- (b) Work to repair any damage caused by the controlled work (including any damage caused to any specified land, river, lake, structure or vegetation, or to the environment).
- (c) Works to ensure that any specified land, structure, river, lake or vegetation, or the environment, will not be damaged or adversely affected, or further damaged or further adversely affected, by the controlled work.
- Without limiting (a) to (c) above, work to correct or restore any alteration caused by the controlled work to the flow of water into or from, or the quantity of water contained in, any specified river or lake.

In the event of the occupier not complying with the served notice, DNR can carry out the work and recover the costs incurred in doing such work. DNR is not required to give any prior notice of its decision to exercise these powers. The occupier can appeal such action to the Land and Environment Court.

Roads and Railways

Roads and railways (and associated bridges, road works and railway works) vested in Local or State Government transport agencies are prescribed works under Part 8 of the *Water Act 1912*. While these works do not require an approval under these pieces of legislation, agencies are required to assess the impacts of these works under the *Environmental Planning and Assessment Act 1979*.

Appendix A

Glossary and Abbreviations

Glossary

Term	Definition
Average recurrence interval (ARI)	The long term average number of years between the occurrence of a flood as big or larger than the selected event (eg. floods with a discharge as great or greater than the 100 year ARI event will occur on average once every 100 years).
Attenuation	Term used to describe when a flood peak is reduced due to the duration of a flood being drawn out by the temporary storage of floodwaters.
Calibration	The process by which parameter values within a computer model (e.g. hydraulic model) are progressively altered until the modelled output best matches the observed flooding behaviour.
Catchment	The area of land draining to a particular site.
Discharge (or flow)	The rate of flow measured in terms of volume per unit time (e.g. megalitres per day – ML/day).
Floodplain	Area of land subject to inundation by floods up to the probable maximum flood event.
Floodplain management plan	The document describing how a particular floodplain is to be used and managed.
Flood risk	Potential for damage to property or persons due to flooding.
Flood storage area	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood.
Floodway areas	Those areas of a floodplain where a significant discharge of floodwater occurs during floods. Floodways are areas, which even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood level.
Hydraulics	Term given to the study of water flow in waterways.
Flow hydrograph	A graph which shows how the discharge at any particular location changes with time during a flood.
Hydrologic / hydraulic computer models	The mathematical representation of the physical processes involved in runoff generation and streamflow.
Hydrology	Term given to the study of the rainfall and runoff process.

Term	Definition
Gauged flow	Flow rate at a particular location determined based on field measurements.
Observed flood data	Flood data which has been measured and / or recorded during or after a flood (eg. flood height mark, velocity of floodwaters).
Peak discharge (or peak flow)	The maximum flow recorded during a flood event.
Stage	Equivalent to water level. Usually measured with reference to a specified datum.
Stage hydrograph	Graph which shows how the flood level at a particular location changes with time during a flood.
Validation	The process of testing a calibrated computer model against a new flood event to test its ability to simulate flooding behaviour.

Abbreviations

Abbreviation	Source name
AHD	Australian Height Datum
ARI	Average Recurrence Interval
CMFMC	Central Murray Floodplain Management Committee
DEM	Digital Elevation Model
DNR	Department of Natural Resources
FMS	Floodplain Management Study
FMP	Floodplain Management Plan
LIDAR	Light Detection and Ranging Technology
MDBC	Murray - Darling Basin Commission
NPWS	National Parks and Wildlife Service
REP	Regional Environmental Plan
WAMC	Water Administration Ministerial Corporation