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## 11.4 Voluntary Purchase

As mentioned in Section 10 in certain high hazard areas of the floodplain, it may be impractical or uneconomic to mitigate flood hazard to existing properties at risk, or flood modification measures may significantly increase hazard to a property unable to be protected. In such circumstances it may be appropriate to cease occupation of such properties in order to free both residents and potential rescuers from the danger and cost of future floods.

A depth of flooding of 2.5m has been adopted as a cut off point for voluntary purchase. This is approximately the additional height that may be provided by adding a non-habitable ground floor to an existing residence. Residential properties with depths less than 2.5m may be suitable for house raising, as discussed below. Within Nathalia for a 100-year ARI event the highest over floor flooding in the residential area is 1.5 meters. As a consequence voluntary house purchase is not considered to be a viable option for Nathalia.

Whilst voluntary house purchasing is not considered viable for Nathalia it does remove forever a high hazard situation, benefiting both the resident and the emergency services, but also allows the land to be put to flood compatible use.

## 11.5 House Raising and Flood Proofing

House raising and flood proofing is considered a possible floodplain management measure for Nathalia. Based on the criteria that if the flood level during a 100-year ARI event got to within 100mm of the floor level or 100mm above then flood proofing maybe appropriate anywhere where the level was above 100mm then the floor level would need to be raised. Based on this criteria there are 93 residential properties which could be flood proofed and 489 residential properties which would need to be raised

Based on an average cost of house raising of \$40,000 the comprehensive implementation of this measure in Nathalia would cost up to \$19,560,000. An additional \$6.0M should be allowed for raising those that are brick walled.

Based on the estimated cost of flood proofing of \$10,000 however, this is a very site specific measure and the price range could be  $\pm 50\%$ . The comprehensive implementation of the proposed flood proofing measure in Nathalia would cost up to \$930,000. An additional \$465,000 should be allowed for complex flood proofing measures.

As with a Voluntary Purchase Program, it should be borne in mind that any adoption by Council of such an approach does not require the immediate expenditure of this amount. If a House Raising Program is adopted as a floodplain management measure, the Program can be implemented over as many years as is required.

As discussed in Section 8 the total AAD calculated for the existing Nathalia Township is estimated to be \$508,000 (in round terms). The AAD damages was reassessed with the mitigation option in place. With the residential houses in town protected against a 100-year ARI event the AAD damages is reduced to \$358,000 (in round terms) a reduction of \$150,000. The assumption is that there is no change to the damages for any event greater than the 100-year ARI event.

The Benefit/Cost Ratio was calculated as 0.1

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As mentioned in Section 10 in all cases, the decision on whether house raising or flood proofing will be implemented must be assessed on the merits of each case. Such an assessment will include detailed internal and external examination, a structural examination and a check of whether any lower storey rooms are habitable. Any illegal development, such as habitable lower storey rooms contrary to development approval, will need to be addressed before implementation of the scheme.

## 11.6 Planning Scheme Amendments (Land-Use Planning)

Amendments to the current planning scheme are designed to ensure that future land use and development are compatible with flooding risks as identified by this study. Section 10 outlines the approach adopted by this study in providing improved planning information to the Moira Shire and the GBCMA.

Improved land use planning does not immediately reduce flood damages for existing development, but does provide an effective means of reducing flood damages in the future.

The improved information, in particular the updated maps, will aid in more effective assessment of applications for development in the future.

## 11.7 Response Modification Measures

### 11.7.1 General

As discussed in Section 10 response modification measures encompass various means of modifying the response of the community to the flood threat. Such measures include flood warning, plans for the defence and evacuation of an area, for the relief of evacuees and for the recovery of the area once the flood subsides. Planning for these measures is incorporated in the Moira Shire Flood Plan (2000), which is part of the Emergency Management Plan.

Unless the probable maximum flood is adopted as the design flood, all flood and property modification measures will ultimately be overwhelmed at some time by a flood larger than that designed for. The development and implementation of effective response plans are a significant means of reducing flood related damages.

The recommendations for the warning process are:

- Undertake a calibration of the Casey Weir gauge during a large flow event.
- Replace existing flood level boards at Walsh's Bridge and Nathalia with a single flood level gauge. Also places the flood boards downstream of Walsh's Bridge.
- Add a telemetry (ERTS) stream gauge and link to the Bureau of Meteorology at the following sites:
  - Broken Creek at Nathalia (optional)
  - Broken Creek at Walsh's Bridge
  - Broken Creek and Katamatite (streamflow and rain gauges already operating)
  - Boosey Creek at Tungamah (streamflow and rain gauges already operating)
- Telephone alerting arrangements to communicate impending floods to the affected community (Expedite System as used for Benalla and Shepparton-Mooroopna.
- Develop and prepare flood education information and community flood response guidelines.

The capital cost for the above would require approximately \$60,000 and approximately \$5,000 per annum for maintenance costs. In the past funding for flood warning capital has been provided

equally by the Australia and State governments with the on-going maintenance provided from the local beneficiaries, via local municipalities or CMAs. Note Nathalia gauge would require additional capital of \$17,000 and \$2,500 for annual maintenance.

The estimated cost to undertake the additional works recommended above is shown in Table 11.6 below.

**Table 11.6: Estimated Costs - Flood Warning & Prediction System**

Item	Number required	Unit Cost	Total Cost
Stream Level Gauge with ERRTS (at Walsh's Bridge)	1	\$17,000	\$17,000
Flood Level Board (at Nathalia and Walsh's Bridge)	2	\$2,000	\$4,000
ERRTS (at Tungamah and Katamatite)	2	10,000	20,000
Expedite (voiceReach) telephone alert	1	5,000	5,000
Awareness program and brochures	1	15,000	15,000
		<b>Total</b>	<b>\$61,000</b>

There will be ongoing maintenance costs for the system. This would be approximately \$620 per stream gauge per annum. VoiceReach telephone alerting system operational cost is approximately \$500 per annum.

### 11.7.2 Economic Benefit of Flood Prediction and Warning

#### **Economic Impact**

The impact of the implementation of the recommended Flood Warning and Prediction system was assessed through revision of the Average Annual Damage estimates for commercial and residential properties.

For commercial properties, the various types of items were assessed for whether they would be moveable given adequate warning time to undertake this task. For those that were assumed moveable, percentage reductions between 10% and 50% were made to the value of damage sustained during the flood event. For residential properties, warning time is accounted for through a factor which is included in the equations to account for a reduction in damages due to the available time. In the initial damage assessment, this factor was set at 0.7. To account for the warning system being in place, this factor was reduced to 0.4.

From the analysis, the implementation of the recommended Flood Warning and Prediction system will result in a reduction in the Average Annual Damage for residential and commercial properties in the Nathalia from \$508,000 (in round term) to \$359,000 (in round terms).

#### **Benefit/Cost Ratio**

It can be determined that the benefits of implementing the Flood Warning and Prediction would be some \$149,000 annually. These benefits would be increased by a significant reduction in the social impacts on the community. While it is difficult to place an exact monetary value on this benefit, it could be expected that it would amount to some \$25,000 annually. Thus, the benefit of the recommended response measure is \$174,000.

From Table 11.6, the costs of implementing the total scheme are \$61,000, plus there will be ongoing maintenance costs of approximately \$5,000 p.a. From this the Benefit/Cost Ratio was calculated as 87.2.

## 11.8 Summary of Economic Impact

As detailed in Section 8, a detailed flood damages analysis was made for the residential, commercial and industrial areas of Nathalia that may be flood prone. The analysis established that the Average Annual Damage (AAD) in Nathalia is \$508,000.

The recommended floodplain management measures, raising of levees, opening up floodways, house raising and flood warning were applied to the property database used to calculate the existing AAD. This was done by eliminating all damages for properties after the works were undertaken. For the levee raising options a conservative approach was taken. It was assumed that the measures only protected the town to the point they were designed for.

As shown in Table 11.7 below, the implementation of certain measures will result in a significant reduction in the Average Annual Damage for properties in Nathalia.

In addition, a component of the AAD will remain which represents the continuing flood problem due to floods greater than the 100-year ARI event. This is managed through the response modification measures outlined in Section 10.

**Table 11.7: Potential Average Annual Damages for Residential Properties for Recommended Floodplain Management Options**

Management Option Considered	Average Annual Damage	Cost of Construction	Benefit/Cost Ratio
No option implemented	\$508,000	-	-
Raise Levee for 100-year ARI plus 300 freeboard (Option 1)	\$103,000	\$1,500,000	3.7
Raise Levee for 100-year ARI plus 600mm freeboard (Option 2)	\$103,000	\$4,800,000	1.2
Open up northern floodway by removing the levees on both the left and right banks between the old railway bridge and Drain 13 (Option 3)	\$141,000	\$280,000	18.0
Open up northern floodway by placing a 50m siphon on the farm channel to the north of the show grounds, lower the east-west road by 0.3m over 50m between Allotments 4B and 4K and reconstruction of the irrigation layout in Allotment 4B. Open up the western floodway by including a 50m siphon for Channel 38/12 adjacent to Chinamans weir (Option 4)	\$375,000	\$230,000	8.0
Option 3 and 4 combined (Option 5)	\$103,000	\$510,000	10.9
Construct an overflow channel to the south east of town directing flow from the Broken Creek into the Broken River system (Option 6)	\$78,000	\$5,800,000	1.0

**Table 11.7: Potential Average Annual Damages for Residential Properties for Recommended Floodplain Management Options (cont.)**

<b>Management Option Considered</b>	<b>Average Annual Damage</b>	<b>Cost of Construction</b>	<b>Benefit/Cost Ratio</b>
Open up the southern floodway by placing a 100m siphon on channel 38/12 (Option 7)	\$415,000	\$180,000	7.1
Option 3, 4 and 7 combined (Option 8)	\$103,000	\$690,000	8.1
Remove the railway embankment between north of town located within the northern floodway (Option 9)	\$413,000	\$200,000	6.5
House Raising	\$358,000	\$26,955,000	0.1
Flood Warning	\$334,000	\$66,000	87.2

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## 11.9 Flood Mitigation Outside of Nathalia Township

Federal and State Governments have recognised existing urban communities which live with flooding risk through funding initiatives. These funding initiatives include structural measures such as the construction of levees. These funds have been directed to help communities where an existing problem to an urban population and its associated infrastructure exists, provided that the proposed works have no adverse impact on surrounding areas and are cost effective, socially acceptable and environmentally sound.

In hindsight, towns with existing flood risk would most likely be located away from active floodplain areas through the use of sound planning principles.

Funding initiatives to protect open rural type land is generally not supported in principle by governments. These areas are expected to continue to allow for flood conveyance and flood storage.

The rural surrounds of Nathalia has many constructed private levees which have been put in place over many years. These levees are generally recognised 'as of right' under the Moira Planning Scheme. The level of management for these existing rural private levees is to recognise their location and current height and not to introduce further levees.

A detailed survey of these private levees has been undertaken and a plan prepared showing both location and height to metres AHD. This plan is to form part of the floodplain management plan which provides a benchmark of what is deemed 'acceptable'.

Although the protection from flooding of rural open type lands is not generally supported, these areas will have greater protection through the implementation of an improved flood warning system providing up to two days warning of a flood event.

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## 11.10 Environmental Impact Assessment

### 11.10.1 Visual Assessment

The only proposed flood management measures likely to have a significant visual impact upon the community is the raising of levees, with the traditional 600mm freeboard requirement. This would hinder views of the creek.

The recreational option of provided a structural treatment in term of a shared 1.2m wide foot/bike path would generally only require raising the levee by some 200mm, and would have little visual impact. Given the structure integrity, freeboard requirements have been reduced to 300mm.

### 11.10.2 Ecological Assessment

It is considered that the proposed management measures will not have an impact on the ecology of the floodplain. The only option which will have a direct impact on the flow regime of the river during flood will be the opening up of existing floodways. Currently the northern and western floodways are activated during flood and the only change would be an increase in the amount of water passing through the floodway. The southern floodway is currently blocked by channels if these were opened then flow would be increased into these areas. As these areas are natural floodways and the majority of land is pasture the environmental risk is considered to be low.

The only other measure that will have an indirect impact will be the land use re-zoning and development controls. These measures will have the effect of providing better management of the floodplain.

### 11.10.3 Ecologically Sustainable Development

Ecologically sustainable development (ESD) seeks to achieve the integration of environmental and economic considerations into the decision-making process. Ecologically sustainable development has been defined by the Commonwealth Government (1990) as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'. The concept of ESD has developed from the concern that insufficient weight has been placed on environmental considerations when making decisions about resource use.

The principles of ESD defined in the Protection of the Environment Administration Act 1991 and the Environmental Planning and Assessment Regulation 1994, are described below.

- The precautionary principle: This principle states that if there are any threats of serious or irreversible environmental damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
- Inter-generational equity: This principle states that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.
- Conservation of biological diversity and ecological integrity: This principle is not described in the Regulation, although it means that the diversity of genes, species, populations and the communities, as well as the ecosystems and habitats to which they belong, must be maintained or improved to ensure their survival.
- Improved valuation and pricing of environmental resources: This principle is not described in the Regulation, although it is described in Harding (1990) as:

"Traditionally pricing and resources have not reflected their scarcity, replacement costs in the long term, or future cost of irreversible and cumulative damage to natural systems. This principle requires that the true costs to the environment be factored into the cost of

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production or use of the resource. Those who pollute or degrade the environment should be held accountable for the restoration of the environment to its previous natural condition.”

The proposed flood management measures are consistent with the objectives of ecologically sustainable development.

## 11.11 FINAL RECOMMENDATIONS

The final recommendations for floodplain management measures are summarised in Table 11.8 below.

**Table 11.8: Summary of Recommended Floodplain Management Measures**

Management Option	Objective	Recommended for inclusion in the FMP
<b>Flood Modification Measures</b>		
Raise Levee for 100-year ARI with 300mm freeboard (Option 1)	Protect town	Yes
Raise Levee for 100-year ARI with 600mm Freeboard (Option 2)	Protect town	No
Open up northern floodway by removing the levees on both the left and right banks between the old railway bridge and Drain 13 (Option 3)	Protect town	No (see option 5)
Open up northern floodway by placing a 50m siphon on the farm channel to the north of the show grounds, lower the east-west road by 0.3m over 50m between Allotments 4B and 4K and reconstruction of the irrigation layout in Allotment 4B. Open up the western floodway by including a 50m siphon for Channel 38/12 adjacent to Chinamans weir (Option 4)	Protect town	No (see option 5)
Option 3 and 4 combined (Option 5)	Protect town	No
Construct an overflow channel to the south east of town directing flow from the Broken Creek into the Deep Creek system (Option 6)	Protect town	No
Open up the southern floodway by placing a 100m siphon on channel 38/12 (Option 7)	Protect town	No
Option 3, 4 and 7 combined (Option 8)	Protect town	No
Remove the railway embankment between north of town located within the northern floodway (Option 9)	Protect town	No

**Table 11.8: Summary of Recommended Floodplain Management Measures (cont.)**

Management Option	Objective	Recommended for inclusion in the FMP
<b>Property Modification Measures</b>		
New flood maps	Show level of flooding and therefore development controls applying to property	Yes
Land Use Zoning	Ensures consistent, equitable, and compatible land management within flood prone areas.	Yes
Voluntary Purchase	Removes development and people from high hazard areas	No
House Raising	Raises development above flood planning levels in flood affected areas	No
Flood Proofing	Minimises the potential impacts of flooding	No
<b>Response Modification Measures</b>		
Flood Warning	Enable and persuade the community to take the appropriate actions to increase safety and reduce the damages associated with flooding	Yes
Community Awareness & Preparedness	Ensure that the community is fully aware that floods are likely to interfere with normal activities in the floodplain	Yes
Emergency Plans	<p>Provide a sound basis for planning, preparation, response and recovery activities by VICSES and other emergency service providers during flood event</p> <p>The flood inundation maps devised as part of this report should be incorporated</p> <p>The access during flood should be addressed with the Murray Valley Highway inundated during significant events and the town is isolated</p>	Yes

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### 11.11.1 Discussion of Structural Mitigation Options

During a 100-year ARI type flood, the township of Nathalia is vulnerable to flooding for long periods of time, likely to be more than ten days. The level of over the floor flooding is extensive with more 80% of the buildings affected including dwelling, retail, office, commercial and industrial buildings.

Ideally, opening up floodways is desirable as it lowers the flood height. Hydraulic analysis has however shown small reduction in flood height outside the town levees, leaving the town still vulnerable to flooding during a repeat of a 100-year ARI type flood.

All options, except the levee treatment to the 100-year ARI standard, would require floor levels to be set 300mm above flood level within town, which would mean finished floor heights would be some 900 to 1,200mm above ground. Also, subdivision would be prohibited with floodway areas as defined under the Victoria Planning Provisions.

Initially levees with 600mm freeboard above the 100-year ARI flood height were considered. To raise the levees with this amount of freeboard would raise concerns from the community. The previous refusal by sections of the residents to accept the visual intrusion caused by the levees, even at the existing height, resulted in the absence of any levee in sections of Weir Street, indicates that increasing the existing levee height to provide 600mm freeboard over significant lengths is likely to be strongly opposed.

There are sections of the levee system which are not obstructing the creek view from any residences, including the majority of levee 3 and short sections of levees 1 and 2. These sections could be raised as an earthen bank, with the remaining levee provided by a different solution. The Goulburn Broken Catchment Management Authority has advised, given the nature of flood flows, the freeboard could be reduced to 300mm if the existing levee is structurally capped or similar.

The recreational structural treatment of providing a 1.2m wide shared foot/bike path along the majority of the levee would provide sufficient 300mm freeboard above the 100-year ARI flood height. This in turn would offer protection to the planning and building standard, but must be complimented with awareness, flood warning, and alerting programs.

This option has support for both the Moira Shire Council and the Goulburn Broken Catchment Management Authority.

At an estimated cost of \$1.5 million (including 40% contingencies) this option could be implemented over a two year time frame with funding available on an equal basis from Australian, State and Local Governments.