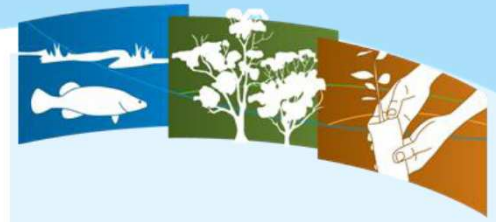




# ROCHESTER FLOOD MANAGEMENT PLAN



## BACKGROUND

The North Central Catchment Management Authority (CMA) received funding from local, state and commonwealth governments to prepare the Rochester Flood Management Plan (the Plan). The purpose of the Plan is to reduce the impact of future flood events on the township of Rochester. The Plan has determined the potential impact of a range of flood events on the town of Rochester. It has produced information to improve flood warnings and emergency response activities and has also assessed potential mitigation options.

The North Central CMA has led the development of the Plan in partnership with the Shire of Campaspe.

A community-based Steering Committee has overseen the development of the Plan with support from a Technical Working Group consisting of representatives from the North Central CMA, Shire of Campaspe, VicSES, Goulburn-Murray Water, VicRoads, Department of Environment and Primary Industries, Bureau of Meteorology and VicTrack.

## COMMUNITY FEEDBACK SOUGHT

The Plan is nearing completion. The third public meeting was held on Wednesday 1 May 2013 to present the draft Plan to the community.

The meeting provided further details on the draft Rochester Flood Management Plan, including flood mitigation options. A summary of the information presented at the public meeting is provided in this brochure. Included with this brochure is a feedback form and a reply paid envelope so that completed forms can be sent back to the North Central CMA.

Please take the time to read the contents of this brochure and provide your feedback about the draft Plan.

It is vital that Rochester residents indicate their level of support for the proposed mitigation options.

## OVERVIEW

- The draft Rochester Flood Management Plan is complete
- A key outcome of this plan is the recommendation to develop accurate and timely flood warnings for the community of Rochester
- Options to reduce the future risk of flooding have been explored for Rochester and are summarised in this brochure
- Community feedback is sought about the Draft Plan. Please complete the enclosed feedback form and return via the reply paid envelope to the North Central CMA by Friday 17 May, 2013



*Campaspe Weir looking south,  
15th January 2011.*

# THE CAMPASPE RIVER CATCHMENT

The catchment of the Campaspe River above Rochester is approximately 3,345km<sup>2</sup>. It extends from the Great Dividing Range near Woodend to the northern plains where it meets the Murray River at Echuca.

Lake Eppalock is situated within the catchment. It is a large storage (over 300 GL in volume) which is used to store water for downstream irrigation, domestic supply and environmental water along the Campaspe River.

Upstream of Lake Eppalock the Coliban River is a major tributary of the Campaspe River. Below Lake Eppalock Mount Pleasant Creek meets the river just upstream of Elmore. In total 40% of the catchment area of the Campaspe River is situated downstream of Lake Eppalock.

The river channel at Rochester has a limited capacity, leaving the town susceptible to flooding. When the channel capacity is exceeded this results in widespread flooding adjacent to the river and across the floodplain.

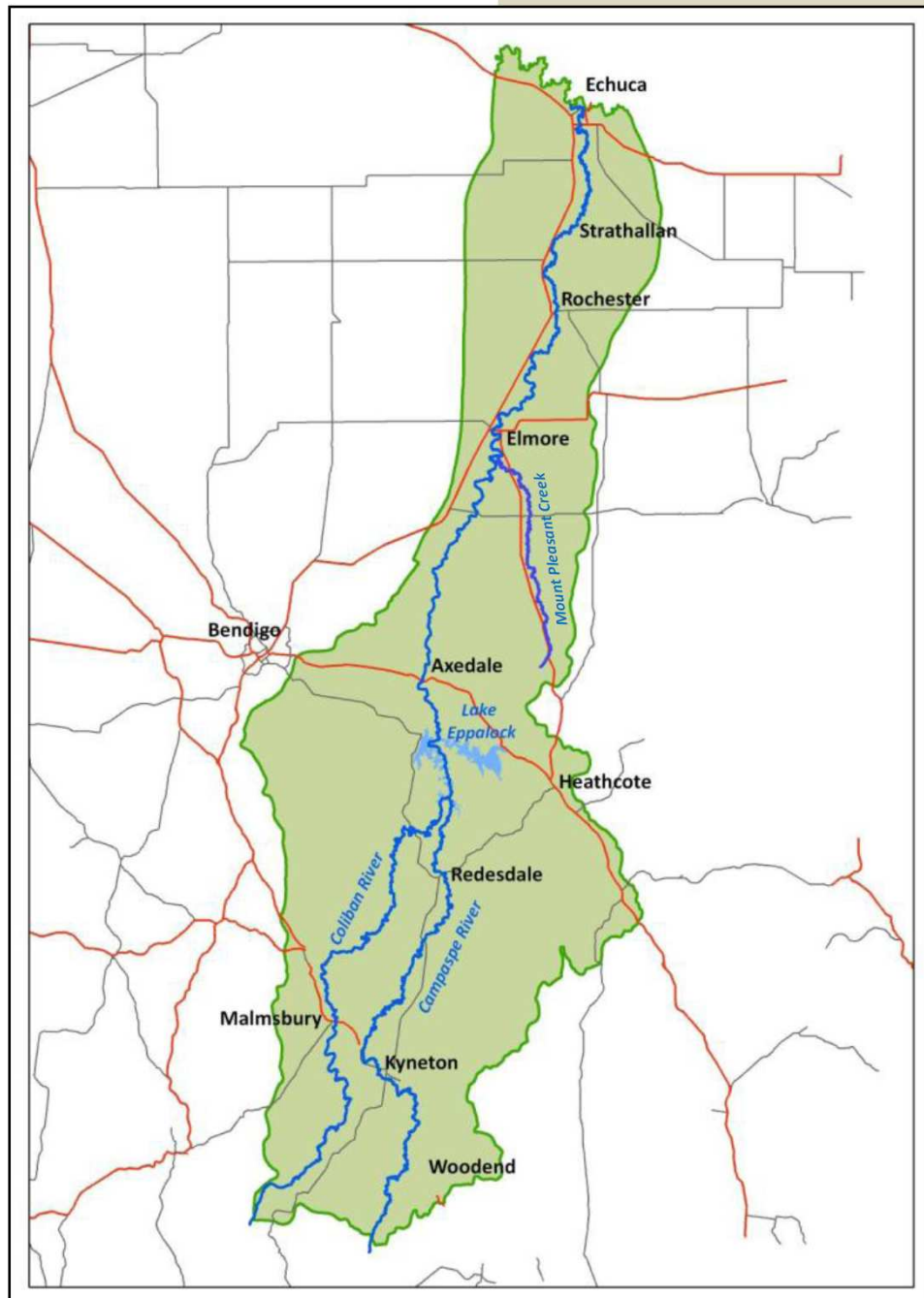
Rochester has a history of regular flooding. The January 2011 flood event was an extreme flood event, with significant rainfall in the upper catchment. A flood event of this magnitude has a 1% probability of occurring in any given year. The January 2011 flood event is thought to be the largest flood event to date in Rochester.

During the January 2011 flood event Mount Pleasant Creek contributed approximately 13% of the total flow into Rochester. This indicates that the majority of the flow arriving at Rochester during January was generated from runoff upstream of Lake Eppalock.

In contrast, during the November 2010 flood, approximately 36% of the total flow through Rochester was attributed to Mount Pleasant Creek. This flood event was much smaller than January 2011. It was an event that had a 10% probability of occurring in any given year.

## Summary

- The Campaspe River Catchment upstream of Rochester is approximately 3,345km<sup>2</sup>, or 334,500 hectares, in size
- The January 2011 flood event was the largest ever recorded in Rochester
- The largest storage on the River is Lake Eppalock. Significant tributaries upstream of Lake Eppalock include the Coliban River
- Downstream of Lake Eppalock, Mount Pleasant Creek contributes significant flows to the Campaspe River.



*The Campaspe River catchment.*

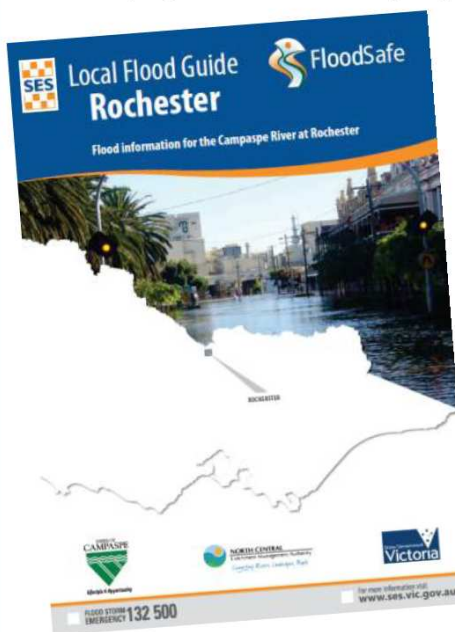
# IMPROVED FLOOD WARNINGS

The Steering Committee acknowledges that timely and accurate flood warnings are essential for the Rochester community. A key outcome of this Plan is the recommendation to develop accurate and timely flood warnings that can be linked to the Rochester town gauge and the Barnadown gauge.

The Plan will determine the potential impact of a range of flood events on the town of Rochester and it will provide information to improve flood warnings.

Initiatives that are being undertaken to improve flood warnings include:

- Better use of local knowledge, especially upstream landowners.
- Improvements to the Rochester town gauge and upstream gauges to improve reliability during a flood event.
- Floor level survey information of over 1000 residential and commercial buildings.
- Developing a Local Flood Emergency Plan for Rochester.



## Rochester Local Flood Guide

The Victoria State Emergency Service (VicSES) will lead the development of a FloodSafe program for Rochester. The development of the Rochester Local Flood Guide is part of this approach. This program will utilise the information that has been developed through this plan to assist residents to better prepare for future flood events.

As the FloodSafe program continues to be rolled out further information will become available to enable residents to understand the potential impacts to their properties in future flood events. The Rochester Local Flood Guide is the first stage of the FloodSafe program, copies of the guide can be obtained from VicSES and are available online at: <http://ses.vic.gov.au/prepare/floodsafe>.

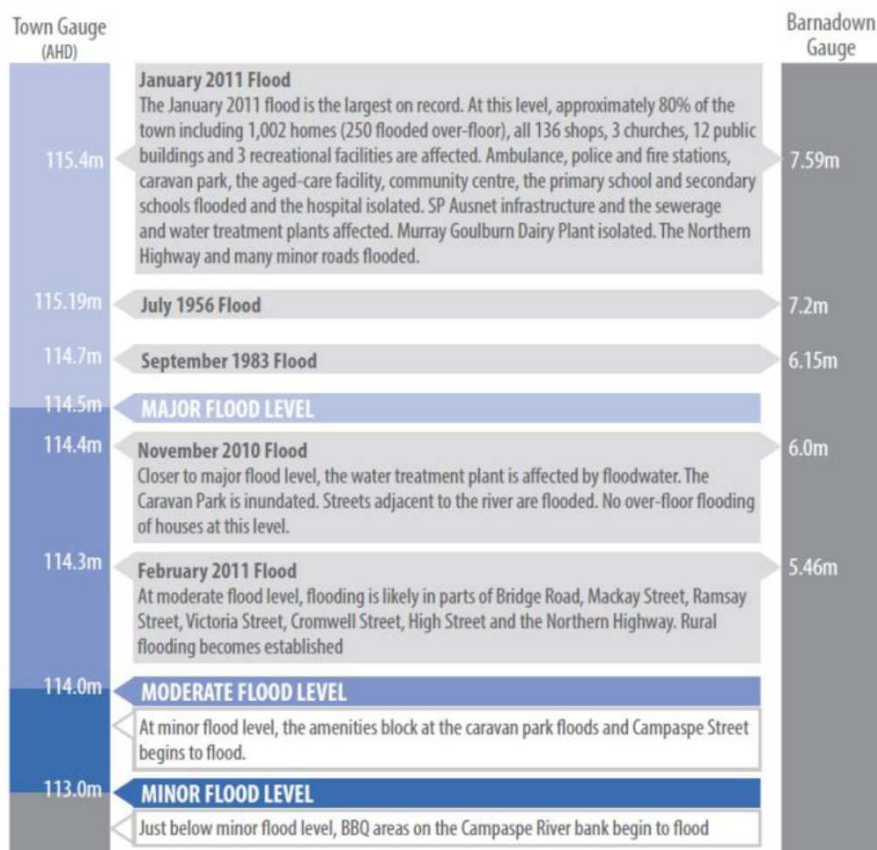
## Summary

- The main outcome of the Plan is the recommendation to develop accurate and timely flood warnings for the Rochester community
- The Plan will produce information that will be used to improve flood warnings and emergency response activities
- The Plan has determined the potential impact of a range of flood events on the town

The North Central CMA in partnership with Campaspe Shire and VicSES will be seeking additional funding as a priority to implement the flood warning recommendations from the Plan.

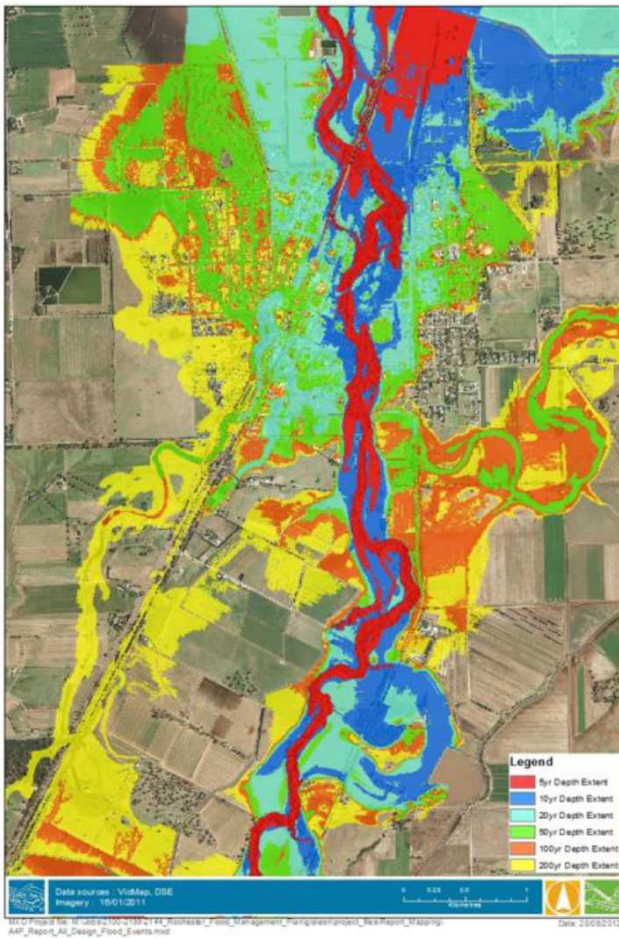
## Flood Warning Recommendations

- Change the flood forecast location to town gauge and upgrade this site to a telemetered gauge.
- Rework flood forecast model to predict to the town gauge.
- Review flood class levels to Campaspe Weir gauge.
- Install flood markers indicating heights of previous floods around the town.
- Relocate the rain gauge from the Campaspe Siphon to the town gauge.
- Initiate a community engagement program.
- Prepare and distribute property specific flood depth charts.

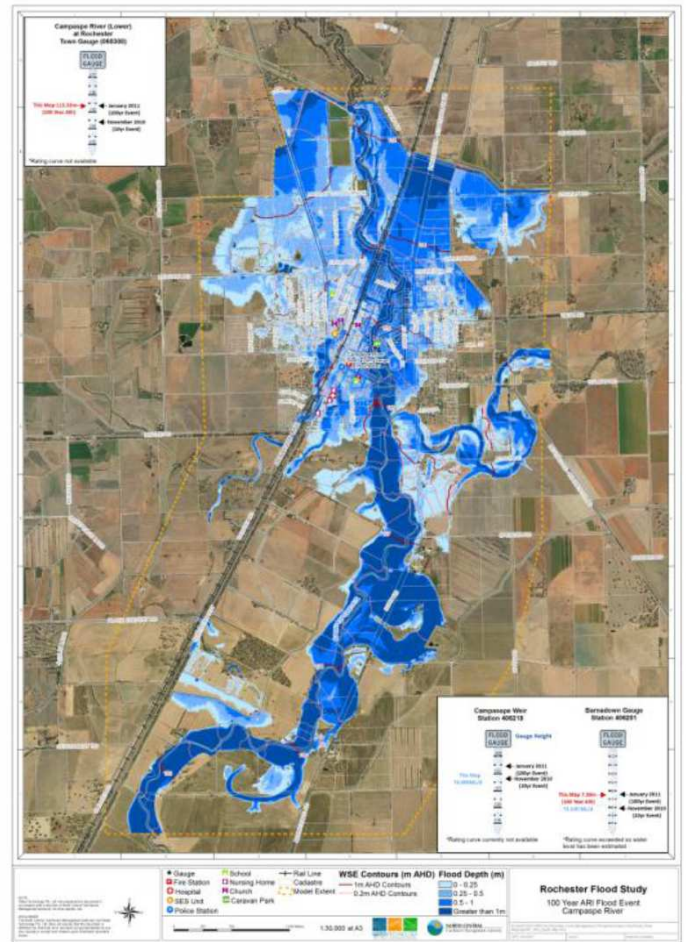


The relationship between the Barnadown gauge and the town gauge with reference to historical flood events in Rochester.

# MODELLED FLOOD EVENTS



Extent of potential flood inundation in all modelled flood events. Without mitigation options.



An example of the new flood mapping which includes reference to gauges. Mapping has been completed for a full range of flood scenarios up to and including the 0.5% or 1 in 200 year flood.

Event	Peak Flow (ML/d)	Flooding Characteristics
20% AEP (5 year ARI)	21,427	Flood is well confined along the Campaspe River. Wetlands, lagoons and low depressions adjacent to the river are inundated by backwater from the river.
10% AEP (10 year ARI)	30,240	Just below Major Flood Level at the Rochester Gauge. This event is similar in extent and depth to the November 2010 flood event.
5% AEP (20 year ARI)	42,509	Widespread flooding occurs east of the railway line, most properties inundated between the river and High St. The hospital grounds and a number of care facilities around the hospital may witness shallow inundation on the property. To the west of the railway line, between the railway line and the Northern Highway a significant proportion of properties are inundated north of George St.
2% AEP (50 year ARI)	59,098	Almost the entire area east of the river and north of the Kyabram-Rochester Rd is inundated. East of the railway line there is only a small pocket of houses bounded by Lindsay St, High St and Aitken Rd that are not inundated. Floodwaters completely surround the hospital. Floodwaters are expected to rise between the Northern Hwy and the railway line and also break out west of the Northern Hwy, inundating the golf course and a number of properties between Diggora Rd and McKenzie St.
1% AEP (100 year ARI)	74,304	A flood event similar to that of January 2011. This flood event will be the benchmark design standard for setting any conditions for new development. Flooding to the east and west of the railway line is very similar to that of the 2% AEP event, with increased depths and slightly wider extents expected.
0.5% AEP (200 year ARI)	96,422	The flooding to the east of the railway line through town and on to the Waranga Western Channel is very similar to that of the 1% AEP (100 year ARI) and 2% (50 year ARI) events with increased depth. The flooding to the west of the Northern Highway is significantly increased in extent, with only small pockets of houses not inundated.

\*Annual Exceedance Probability (AEP) likelihood of occurrence of a flood of given size or larger occurring in any one year. AEP is expressed as a percentage (%) risk.  
 \*Average Recurrence Interval (ARI) likelihood of occurrence, expressed in terms of long-term average number of years, between flood events as large or larger than the design flood event

# MITIGATION OPTIONS

A wide range of on-ground works to reduce the risk of future flooding for Rochester were explored as part of the Plan's development. The works were suggested by the community, Technical Working Group and the Steering Committee. Below is a summary of the suggested works that were investigated as part of the Plan:

- Levee from Pascoe Street to the bridge.
- Increased railway bridge capacity.
- Additional culverts under the highway.
- Development restrictions on floodplain.
- Remove or lower existing channels and levees.
- Removal of the Campaspe Siphon.
- Clearing debris in the river.
- Lower roundabout at the west end of the road bridge.
- Improve local stormwater drainage, add flap valves.
- Changed management of Lake Eppalock.
- Divert flow around town using bypass channel.

## Summary

- Potential mitigation options were recommended by the community, Steering Committee and the Technical Working Group.
- Each option was assessed during a prefeasibility stage.
- The potential reduction in flood damage, cost and feasibility and environmental aspects of each options were assessed.

All on-ground works were assessed during a prefeasibility stage before the Flood Mitigation Options presented in this brochure were developed further. Each suggested mitigation option was assessed against a number of criteria including the potential reduction in flood damage, cost of construction, feasibility of construction and environmental impact.

The prefeasibility assessment identified a number of works as being not feasible on the basis of low associated damage reduction, high costs and other constructability or environmental issues or unsuitable for detailed modelling due to the nature of the options.

## Clearing of Debris and Vegetation along the Campaspe River

Clearing of debris along the Campaspe River channel was suggested to improve the flow of water through the township. This option was modelled by reducing the amount of vegetation and debris substantially along the Campaspe River channel. In order to achieve a significant impact, as outlined in the table to the right **the river would need to resemble a concrete lined channel.**

In a large flood the impact of vegetation along the river is negligible as the majority of the floodplain is inundated, with most of the flow travelling outside of the channel.

Location	Change in Flood Level	
	10 Year ARI	100 Year ARI
Road Bridge	-230mm	-30mm
Rail Bridge	-280mm	-30mm
Upstream of Town (level with Spencer Road)	-320mm	-100mm

*Results of vegetation management modeling.*

## Increased Capacity of Road and Bridge Crossings

Increasing the flow capacity of the road and railway bridges was suggested to stop water backing up behind these structures and allow water to flow through Rochester more easily.

This option was modelled by increasing the flow capacity of both the railway and road bridges by 25%.

Results from modelling indicate the impact is negligible.

Location	Change in Flood Level	
	10 Year ARI	100 Year ARI
Road Bridge	Negligible (less than 10mm)	-10mm
Rail Bridge	Negligible (less than 10mm)	-10mm

*Results of increasing capacity of road and rail crossings.*

## Excavation of the Campaspe River Channel

Excavation of the channel to reduce a 5% AEP (20 year) flood extent to a 10% AEP (10 year) extent would require an extra 142 m<sup>3</sup>/s of channel capacity. This would require excavation to an additional 5m depth and an additional 16m of channel width would be needed along a 1km reach of river and would have an approximate cost of \$5.2 million.

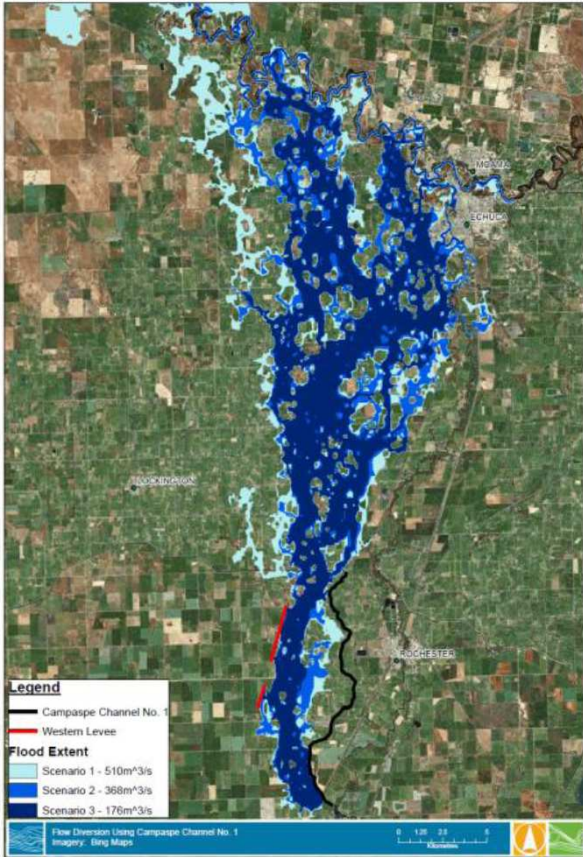
This proves to be a very expensive option and is unlikely to be feasible due to the costs and the environmental and social impacts.

## Mitigation Option: WESTERN DIVERSION

The Western Diversion option was initially investigated as a large-scale mitigation option aimed at diverting significant flows to the west of Rochester using the raised banks of Campaspe Channel No 1 as a levee. For this option to be successful, flows would need to be diverted from the Campaspe River at the channel offtake at Campaspe Weir. Depending on the volume of water diverted flood levels within the township of Rochester have the potential to be significantly reduced. Campaspe Channel No 1 runs in a north-south direction to the west of Rochester.

Campaspe Channel No. 1 is not sufficiently large to transmit a significant volume of flow itself. Its capacity is in the order of 2,500 ML/day to 3,500 ML/day. So instead of using the channel to convey the floodwater a floodway would need to be constructed to the west of the channel with

the raised banks of the channel used as a form of levee. This would also require raising the height of the right-hand bank of the channel in some areas.



### Model Results

The model results for three flow scenarios have been mapped and are detailed in the map to the left. In each scenario, flows are initially confined to a floodway between the Campaspe Channel No.1 and the Western Levee. Downstream of the Western Levee and Campaspe Channel No 1 the area of inundation widens significantly.

A large number of private landholders would be impacted as a result of the diversion of floodwater. The majority of floodwater would flow overland in a northerly direction before entering the Murray River and a portion of the flows return to the lower Campaspe upstream of Echuca.

### Feasibility and Costing

The total cost to achieve this option is anticipated to be in the order or at least \$80 –\$100 million. It is unlikely that this option would receive any further funding.

### Summary

- The Western Diversion option involves the diversion of flood flows away from Rochester, impacting on many private properties to the west of Rochester.
- Additional works/measures will need to be considered including compensation and ring levees.
- Estimated cost of construction: \$80- \$100 million. This is a high cost which is unlikely to be funded.
- This option is not supported by the Steering Committee due to the high cost and impacts to a large number of landholders.

There are many elements that must be factored into this option, including:

- Detailed design and construction
- Off- take regulator
- Road crossing upgrades
- Floodway earthworks between the river and east of the railway line
- Topping up of the Campaspe Channel banks
- Construction of western levee
- Land acquisition/compensation costs to all affected landholders (over 237km<sup>2</sup>)
- Ring levees to protect impacted dwellings

## CHANNEL DECOMMISSIONING WORKS

Through the irrigation modernisation program Goulburn Murray Water has been working with landholders in the region. This includes the decommissioning of some irrigation channels. Through this project it has been identified that a section of channel just south of the town will be required to be retained or replaced with a formal levee in order to continue to provide a level of protection for the town.

Flood modelling has indicated that the planned decommissioning of this section of channel of approximately 1.2km in length has the potential to allow for the passage of floodwaters into the west side of town which may increase flood levels by up to 200mm.

Additional funding will be sought to undertake detailed design and the construction of a formal levee at this break out point to mitigate against this and protect those properties on the west side of town. Ongoing management arrangements will also be resolved through this process. These works are essential and will be considered as part of all options moving forward.

# RECOMMENDED MITIGATION OPTION

This mitigation option involves the construction of a number of structural measures within Rochester to protect the town from more frequent flood events. These options were suggested by the community and include strategic levees, new drains and earthen excavation to reconnect the floodplain. The package of works proposed as part of this option is detailed in the map below and includes:

## Earthen Excavation at Two Sites

**Site One:** Allows for the reconnection of the floodplain to the north of the town and through the railway culvert located 200 m north of the railway bridge. Approximately 10,800 m<sup>3</sup> of earth would need to be excavated.

**Site Two:** Allows for the reconnection of a floodway which flows eastwards from Rochester. Under existing conditions this floodway is well utilised in a 1% AEP (100 year) flood event, but not in a 5% AEP (20 year) flood event and lower. Approximately 5,800 m<sup>3</sup> of earth would need to be excavated.

## Construction of Strategic Levees

**Site One:** The levee aims to protect from a large breakout which flows north-west through this area in the 5% AEP (20 year) flood event and greater. The levee would be approximately 1,100 m long and have an average height of 1.1m.

**Site Two:** This levee will protect properties from the reconnection of the eastern floodway. The levee would be approximately 280 m long and have an average height of 0.7 m.

## Construction of an Open Drain

The construction of an open drain will assist with draining floodwaters and local runoff. Approximately 3,900 m<sup>3</sup> of soil would need to be excavated to construct the drain.

## Summary

- Flood modelling has demonstrated that this option results in a significant reduction in flood risk for many parts of Rochester in the full range of flood events.
- Many of the options in this package of works were suggested by the community and include strategic levees, new drains and earthen excavation to better engage the floodplain.
- The total cost of the proposed works is expected to be in the order of approximately \$1.8 million.

## Results

Flood Modelling has shown that Rochester can not be fully protected from large flood events such as the January 2011 flood, however this package provides a significant benefit to the township of Rochester for both the 1% AEP (100 year) and 5% AEP (20 year) flood events as demonstrated in the map to the left.

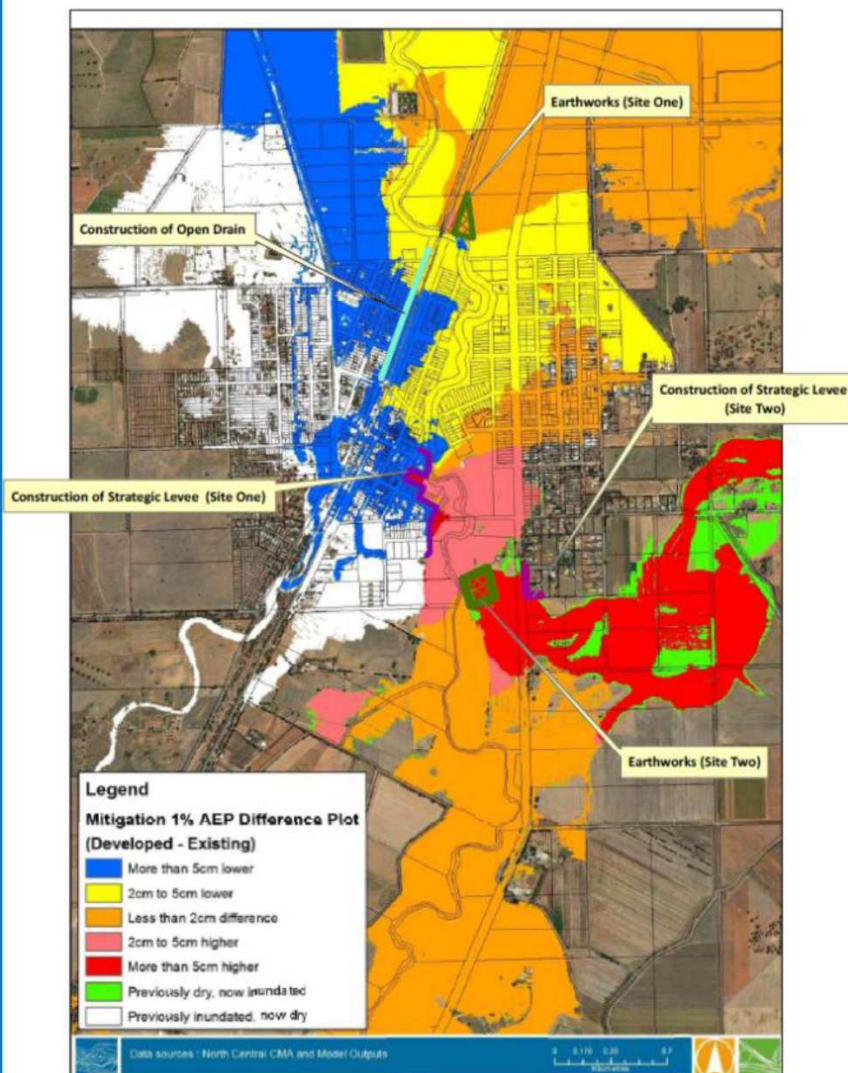
Reductions of up to 400 mm in flood depth in areas to the west of the rail line can be achieved in a large flood event. Resulting in approximately 60 properties around Northcote, Hopetoun and Queen Streets being protected from floodwater. Inundation and access around the hospital will also be improved as a result of these works.

No properties within the urban area of Rochester are adversely affected by the proposed works. However, compensatory works in the form of ring levees or drainage improvements may be required for rural residences towards Nanneella that may be negatively impacted as a result of the eastern floodway. Detailed design is required to better understand these impacts.

## Indicative Costs

The estimated cost of these works is in the order of \$1.8 million. This option is only a concept at this time and may take a number of years to construct. If supported, in the first year additional funding will be sought for detailed design of the proposed package of works.

There is a high cost benefit ratio with these works due to the significant reduction in flood impacts and the relative cost associated with the works. This option is well positioned to receive further funding for detailed design and implementation, provided the community also supports the proposed package of works.



Indicative location of proposed works and difference in flood levels in the 1% AEP (100 year) Flood Event.

# ROCHESTER FLOOD MANAGEMENT PLAN

## THE INFLUENCE OF LAKE EPPALOCK ON FLOODING IN ROCHESTER

All flood modelling undertaken as part of the Rochester Flood Management Plan assumes Lake Eppalock is at 100% capacity at the start of the flood event.

Even if Lake Eppalock is at 100% capacity it still plays an important role during a flood event, with attenuation of flood waters still occurring. As outlined in the table below, figures from January 2011 indicate that despite the dam being at capacity at the start of this event, without the dam, flooding would have been much worse for Rochester. The peak flow of water would have exceeded that of a 0.5% AEP flood event or 1 in 200 year flood event.

Lake Eppalock is not designed or intended to be operated as a flood mitigation structure. It is designed and operated to harvest, store and release bulk water for downstream entitlement holders. The water held in storage is owned by irrigators, urban water corporations and environmental water holders.

When possible, Goulburn- Murray Water storages are operated to provide a limited mitigation benefit by delaying the onset of a flood and reducing its peak. The degree of mitigation is affected by the size of the flood and the volume in the storage prior to the event.

Scenario	Peak Flow (ML/day) at Rochester
Jan 2011- 100% full	75,313
Jan 2011- No dam	113,400

*The influence of Lake Eppalock in January 2011.*

### Summary

- Despite being 100% full Lake Eppalock still played a critical role in reducing the impact of the flood on Rochester in January 2011.
- Changes to the management of Lake Eppalock are outside the scope of the Plan.

## SUMMARY – RECOMMENDED PACKAGE OF WORKS

The Steering Committee is now seeking feedback from the community for the recommended package of works. The package of works is made up of the following:

- **Flood Warning Upgrades**
- **Recommended Mitigation Option**
- **Channel Decommissioning Compensatory Works**

We require your written feedback and ask that you please complete the attached feedback form and return this to the North Central CMA via the Reply Paid envelope no later than **Friday 17 May 2013**.

**Additional funding will be sought in the first year to implement the recommended Flood Warning Upgrades. If the recommended mitigation option is supported, in the first year additional funding will be sought for detailed design of the proposed works. Once detailed design is complete further funding will be sought to undertake construction.**

### Summary

- The Steering Committee is now seeking your feedback on the recommended package of works.
- If the recommended mitigation option is supported additional funding will be sought to undertake detailed design.
- Please provide your comments to the North Central CMA by Friday 17 May 2013.

*North Central CMA and the Shire of Campaspe thank the Rochester community for their ongoing support and involvement in the development of the draft Rochester Flood Management Plan.*

For further information about the Rochester Flood Management Plan please contact the North Central CMA on (03) 5448 7124.