

Clare and Gilbert Valleys Council

Stage 2 SMPs for 7 Townships

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# RHYNIE STORMWATER MANAGEMENT PLAN

APPROVED FINAL

July 2020



CLARE & GILBERT  
VALLEYS COUNCIL



Government of South Australia  
Stormwater Management Authority

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The report contains recommendations for stormwater management. Council will seek funding and resources for these recommendations from a range of sources. The availability and timing of funding and resources will determine the order and staging of the works.

## Table of Contents

|     |   |    |
|-----|---|----|
| 1   | Introduction.....   | 1  |
| 1.1 | Background.....   | 1  |
| 1.2 | History and Nature of the Problem in the Region .....                         | 3  |
| 1.3 | Consultation and Development of the Plan.....                                 | 3  |
| 1.4 | Legislative Context.....  | 3  |
| 2   | Description of the Study Area .....   | 5  |
| 2.1 | Study Area Boundary .....   | 5  |
| 2.2 | Climate and Soils.....  | 6  |
| 2.3 | Ecology.....  | 6  |
| 2.4 | Hydrology of the Catchment.....   | 7  |
| 2.5 | Township Population and Development Pressure.....                             | 7  |
| 2.6 | Existing Stormwater Assets.....   | 8  |
| 3   | Identification of Problems and Opportunities.....                             | 10 |
| 3.1 | Social, Economic and Environmental Issues .....                               | 10 |
| 3.2 | Riverine and Local Flooding .....   | 12 |
| 3.3 | Properties and People at Risk of Flooding .....                               | 13 |
| 3.4 | Impacts of Future Development on Flooding .....                               | 13 |
| 3.5 | Exploring Opportunities.....  | 14 |
| 4   | Stormwater Management Objectives .....  | 15 |
| 4.1 | Approach.....   | 15 |
| 4.2 | Stormwater Management Objectives.....   | 17 |
| 5   | Stormwater Management Plan Strategies .....                                   | 23 |
| 5.1 | Approach.....   | 23 |
| 5.2 | Non-Structural Flood Management Measures .....                                | 23 |
| 5.3 | Management of Flood and Local Runoff .....                                    | 26 |
| 5.4 | Effectiveness of Flood Mitigation Works .....                                 | 28 |
| 5.5 | Regular Maintenance of Drainage Infrastructure and Watercourses.....          | 29 |
| 5.6 | Water Quality Assessment.....   | 33 |
| 5.7 | Stormwater Harvesting and Reuse .....   | 36 |
| 5.8 | Managed Aquifer Recharge (MAR) .....  | 37 |
| 6   | Recommendations .....   | 38 |
| 6.1 | Structural and Non-structural Measures .....                                  | 38 |
| 6.2 | Environmental, Social and Economic Opportunities/Benefits.....                | 41 |
| 7   | Implementation Issues and Funding Opportunities.....                          | 42 |
| 7.1 | Priorities and Timeframes for Implementation .....                            | 42 |
| 7.2 | Responsibilities for Implementation and Potential Funding Contributions ..... | 44 |
| 7.3 | Responsibility for Maintenance .....  | 45 |
| 8   | Review of the Stormwater Management Plan .....                                | 47 |
| 9   | References.....   | 48 |

## List of Tables

|  |    |
|--|----|
| Table 2-1: Projected Population .....  | 8  |
| Table 3-1: Surface Watercourses Environmental Values.....  | 12 |
| Table 3-2: Population and Properties at Risk in a 100 Year ARI event .....                                   | 13 |
| Table 5-1: Breakdown of Dwellings Protected in Different ARI events .....                                    | 28 |
| Table 5-2: Comparison Against Pollutant Load Reduction Targets for each system .....                         | 33 |
| Table 5-3: Comparison of Water Quality Against Environment Protection (Water Quality) Policy Criterion ..... | 34 |
| Table 5-4: Effectiveness of Water Quality treatment.....   | 34 |
| Table 5-5: Summary of Average Annual Pollutant Reduction .....   | 34 |
| Table 5-6: Average Catchment Stormwater Runoff Yields .....  | 36 |
| Table 5-7: Stormwater Runoff Yields for Reuse.....   | 37 |
| Table 6-1: Recommendations.....  | 39 |
| Table 7-1: Summary of Priorities .....   | 43 |
| Table 7-2: Responsibility for Implementation and Potential Funding / Partnership Opportunities.....          | 45 |

## List of Figures

|   |    |
|---|----|
| Figure 1-1: Location .....  | 2  |
| Figure 2-1: Study Area .....  | 5  |
| Figure 2-2: Monthly Rainfall and Evaporation.....                                   | 6  |
| Figure 2-3: Existing Stormwater Assets .....  | 9  |
| Figure 4-1: Issues and Opportunities Raised by the Community .....                  | 16 |
| Figure 5-1: Recommended Measures and Effectiveness on Flood Inundation .....        | 30 |
| Figure 5-2: Flood Inundation Difference .....                                       | 31 |
| Figure 5-3: Trafficability of Roads.....  | 32 |
| Figure 5-4: Opportunities for Stormwater Quality Treatment, Harvest and Reuse ..... | 35 |

## Appendices

Appendix A : Flood Inundation Maps

Appendix B : Community Feedback

Appendix C : Assessment of Priorities

Appendix D : Implementation Plan

# 1 Introduction

## 1.1 Background

The Clare and Gilbert Valleys Council (Council) engaged Australian Water Environments (AWE) to prepare a Stormwater Management Plan (SMP) for Rhynie. The SMP builds upon the outcomes of the recently completed floodplain mapping for the town prepared by AWE (2013).

The purpose of SMPs is outlined by the Stormwater Management Authority (SMA), as follows - to manage stormwater on a total catchment basis with the relevant Natural Resources Management Board, local government authorities and state government agencies. The aim is to work together to develop, implement and fund a coordinated and multi-objective approach to stormwater management in the area. This allows for consistent management that addresses existing problems and identifies opportunities for providing a range of benefits through multi-objective planning, including stormwater reuse where feasible.

This SMP investigates ways to alleviate existing stormwater and flooding problems and provides flood protection for public and private assets. It aims to assess flood mitigation options, investigate opportunities for stormwater reuse, including Managed Aquifer Recharge (MAR), without compromising flow management or flood mitigation infrastructure. The SMP also explores opportunities for environmental enhancement in the design of stormwater infrastructure. Environmental enhancement may be in the form of improved water quality and reduced roadside erosion, and increased biodiversity. The SMP will assess stormwater management options and rank their priority in accordance with the format recognised in the SMA SMP Guidelines with verification against Council wide assessment criteria.

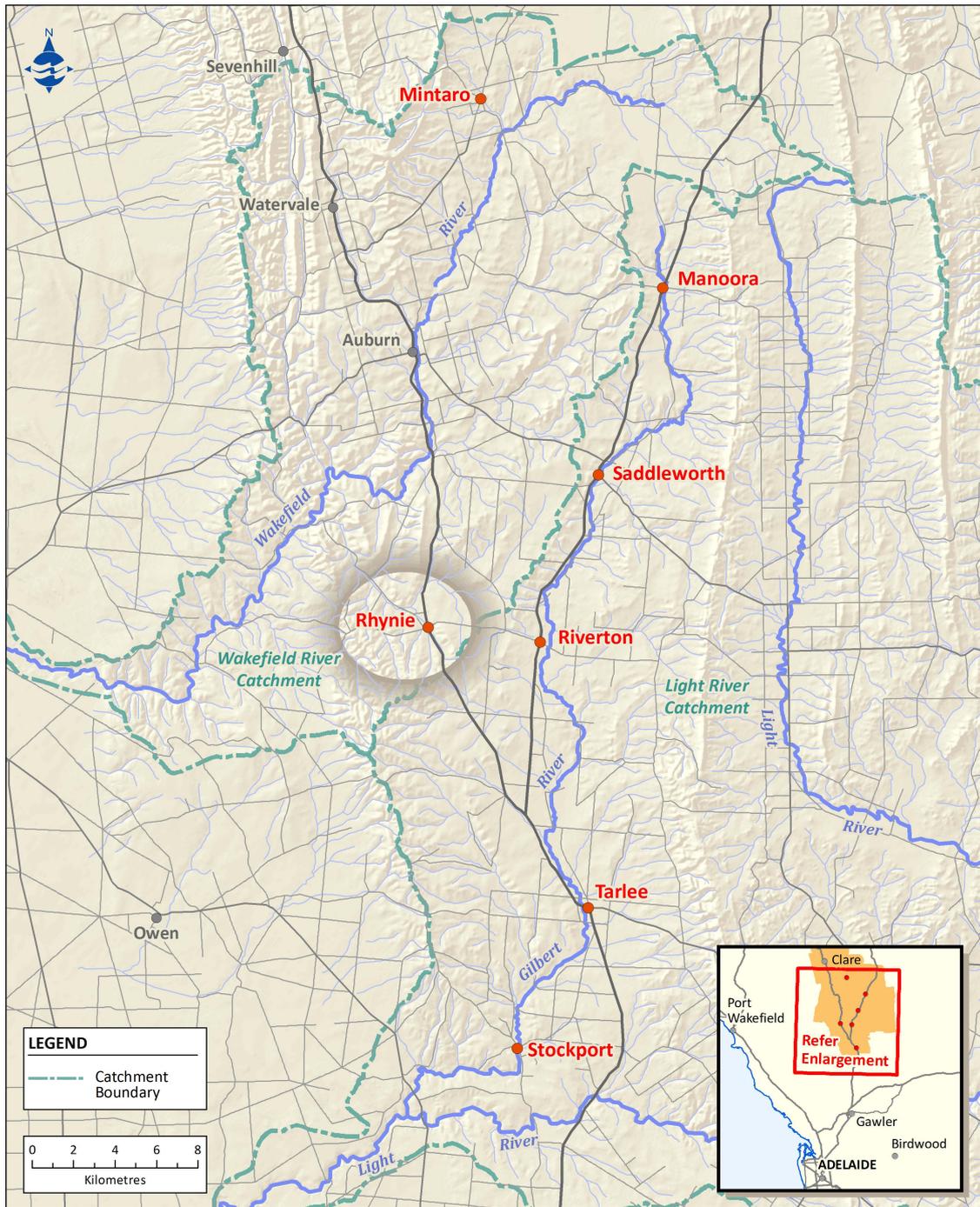
This SMP has been developed in conjunction with developing SMPs for six additional townships for the Council, including: Tarlee, Saddleworth, Riverton, Stockport, Mintaro, and Manoora. These towns are located approximately 80 km – 130 km north of Adelaide, as shown in Figure 1-1.

Of the 7 towns, Rhynie and Mintaro are located within the Wakefield River catchment, while Manoora, Saddleworth, Riverton, Tarlee and Stockport are located along the Gilbert River which is a major tributary of the Light River catchment. Over time, the catchments have been cleared for farming and viticulture purposes, and dry land agriculture is the current dominant land use.

***This report has been prepared on the basis of the best information, research and knowledge currently available to the Council. The report contains a range of recommended actions for consideration. The availability and timing of funding and resources will determine the order and staging of these actions.***

***Assistance in the form of funding and/or resources will be sought from the following:***

- ***Australian Government - grants and subsidies***
- ***State Government of South Australia - grants and subsidies***
- ***Private sector – developer contributions***
- ***Council – administration, implementation and funding***
- ***Community – volunteer support***



14009 D100 v5 Location Plan 140618  
Last Updated: 18/06/2014

FIGURE 1-1: LOCATION

## 1.2 History and Nature of the Problem in the Region

The region has experienced flooding since its settlement, and this has become more apparent over recent years. Flooding in many of the townships has been caused by over bank flows from the rivers (e.g. Gilbert River and Wakefield River tributaries) and from runoff from adjacent hills and slopes. Inadequate stormwater systems/infrastructure within the towns is also contributing to flooding problems. Flooding events have been known to cause inundation and property damage, disruption to road and rail infrastructure. In some townships flooding occurs at least once a year, often twice a year. Council is also concerned over the quality of water in these river systems and the impacts the towns may be having on water quality.

## 1.3 Consultation and Development of the Plan

Council was successful in applying for funding from the Stormwater Management Authority's (SMA) Stormwater Management Fund to assist in preparing the floodplain mapping and this SMP.

The SMP was developed under the direction of a Steering Committee comprising representatives from Council, SMA/Department of Planning, Transport and Infrastructure, Northern and Yorke Natural Resources Management Board (NRMB) and the Bureau of Meteorology (BoM).

The community has also provided input in developing the SMP by confirming the nature and extent of flood and stormwater issues and were given the opportunity to provide comment on the proposed management strategies through a series of community meetings.

## 1.4 Legislative Context

The Local Government (Stormwater Management Agreement) Amendment Act 2016 came into operation in April 2016. This established the Stormwater Management Authority and new financing and governance arrangements for stormwater management and flood mitigation throughout South Australia.

The SMA implements the Stormwater Management Agreement and operates as the planning, prioritising and funding body in accordance with the Agreement. The SMA is charged with:

- Working with Councils to facilitate and coordinate catchment stormwater management planning;
- Allocation of State funding to projects in coordination with Council and other sources of financing; and
- Facilitating cooperative action by all relevant public authorities in the planning, construction and maintenance of stormwater management works.

The framework established by the Stormwater Management Act requires councils to prepare stormwater management plans on a catchment basis, and to implement infrastructure works in accordance with the catchment plans.

The process and content by which stormwater management plans are developed have been formalised by the State Government via the SMA in a guideline entitled *Stormwater Management Planning Guidelines*.

South Australia's legislative framework provides a number of other legislative tools and policy tools to address water management ranging from state-wide legislation to regional and local policy.

One of the key mechanisms for achieving the desired outcomes of integrated water management is to ensure that the objectives of the stormwater management plan meet and contribute to other State and National natural resource management policies and strategies. These strategies in turn assist in the implementation of the desired water management outcomes for townships.

This SMP has been developed in accordance to the requirements of the Stormwater Management Planning Guidelines.

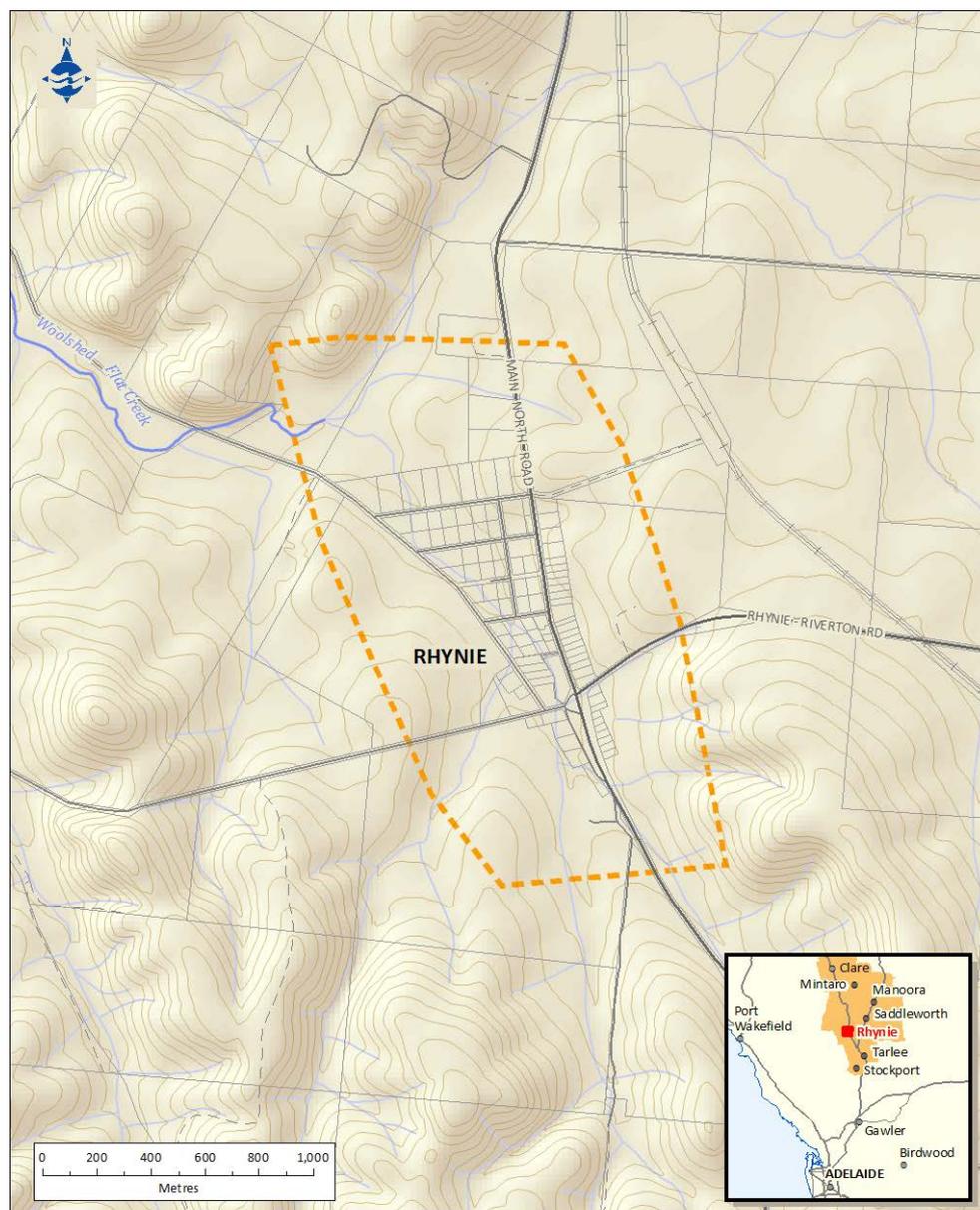
The Northern and Yorke NRM Board declared the Clare Valley Prescribed Water Resource Area in 1999 under the Water Resources Act 1997 to address concerns about the ability of surface water run-off to sustain irrigation needs while also contributing to the flow of watercourses in an amount necessary to protect the health of the watercourses and dependent ecosystems. The Prescribed Area comprises numerous small catchments and towns, such as the township of Rhynie and its tributaries. The SMP is required to have consideration of the requirements of the Prescribed Area.

## 2 Description of the Study Area

### 2.1 Study Area Boundary

Rhynie is located approximately 95 km north from Adelaide in the Mid North region of South Australia. The town is situated on the Main North Road, halfway between Tarlee and Auburn and adjacent to tributaries leading into the Wakefield River. The small town is home to a historic hotel, and it has links to the Rattler Trail which is an extension to the Riesling Trail enjoyed for cycling and walking.

The area for the stormwater management plan is shown as shaded in Figure 2-1:



14009 D101 v1 Study Area 140219  
Last Updated: 21/02/2014

**FIGURE 2-1: STUDY AREA**

## 2.2 Climate and Soils

The soils in the region are predominantly red topsoil overlaying a limestone and tend to be free-draining and have an ability to hold water, particularly in the dryer months.

The climate associated with the study area is a temperate climate with dry summers (low rainfall), and rainfall generally occurs in the winter months.

The long term average rainfall information is based on information provided by BOM for the general region and is approximately 540 mm/yr. The average precipitation and evaporation for each month in the general region is shown in Figure 2-2.

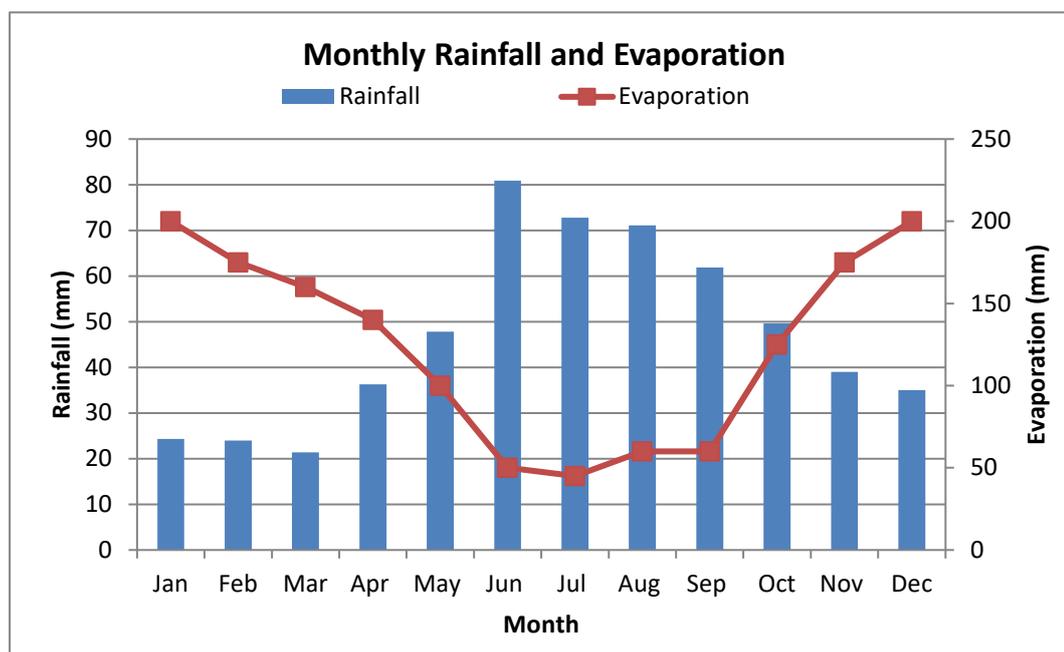


FIGURE 2-2: MONTHLY RAINFALL AND EVAPORATION

## 2.3 Ecology

Rhynie is located within the Wakefield River catchment. The Wakefield River catchment is one of three main ephemeral rivers in the Mid North, with the Broughton River catchment to the north and the Light River catchment to the south. The Wakefield River begins just above Mintaro and flows southwards through Auburn, then turns westerly and is fed by tributaries (such as from Rhynie) and flows through Balaklava, then Pt Wakefield and finally into the Gulf St Vincent.

The Wakefield River system has been dramatically modified since European settlement due to changing land use practices, clearance of native riparian and floodplain vegetation, stock grazing, and the introduction of exotic plants and animals. The original flow regime of the river system has been modified by vegetation clearance, agricultural development, farm dams and groundwater extraction. The condition of the river varies considerably between reaches and the ecological health of the Wakefield River system is highly degraded. However, there are a number of areas of

significant ecological value, such as The Rocks Recreation Reserve, and sections of the upper Wakefield River and the Skillogalee Creek.

The aquatic vegetation community is not diverse and, in many areas, is absent. Riparian vegetation, such as river red gums and native grasses, is healthy in some reaches but severely denuded in others. Submerged aquatic vegetation is found only in the few 'pristine' deep pools (e.g. at The Rocks) and includes *charophytes* and *Potamogeton pectinatus*. The predominant aquatic vegetation present in the system includes the emergent reed *Phragmites australis* and *Typha* spp. The ecology of the Wakefield River is highly dependent on groundwater-fed baseflows and permanent pools.

## 2.4 Hydrology of the Catchment

Rhynie is located in a valley of a tributary of the Wakefield River, and the town has a catchment area of 14 km<sup>2</sup>.

Rural land use dominates the catchment area, as such all sub-catchments are considered fully pervious. There are no major storages along either the Wakefield or Gilbert River. It was assumed that channel types were natural.

Major tributaries of Wakefield River are the Eyre, Skillogalee, Pine, Rices, Hermitage and Woolshed Flat Creeks. Rhynie is located along Woolshed Flat Creek.

The channel through the township is not well defined and much of the township is built on the floodplain of the watercourse. There are several major flow paths within the township of Rhynie. Flow is predominantly south to north, and a channel bisects the town. There are also some minor catchments from the hills to the east and west of the town.

Topographical features of relevance within this SMP area include:

- Several road culverts; and
- A ford near the northern end of the town.

## 2.5 Township Population and Development Pressure

Council's Strategic Directions Report 2012/13 included information on population projections and stormwater management derived from its Water Security Plan (2011). According to that information the population growth in the Council region is expected to grow to 9,795 people by the year 2031 – an average around 0.6 per cent per annum over the 25 years 2006 to 2031 or 15.5 percent in total. This is somewhat higher than projected growth at the state level over this period (11.0 percent).

The projected population growth for Rhynie along with the other 6 townships in the project is shown in the table below:

**TABLE 2-1: PROJECTED POPULATION**

| <b>Town</b> | <b>2006 population</b> | <b>2031 population</b> | <b>Projected annual growth</b> |
|-------------|------------------------|------------------------|--------------------------------|
| Rhynie      | 362                    | 370                    | 0.08%                          |
| Manoora     | 277                    | 280                    | 0.04%                          |
| Tarlee      | 288                    | 318                    | 0.38%                          |
| Riverton    | 723                    | 1000                   | 1.1%                           |
| Saddleworth | 425                    | 450                    | 0.22%                          |
| Mintaro     | 223                    | 246                    | 0.37%                          |
| Stockport   | 234                    | 259                    | 0.02%                          |

According to Council's Strategic Directions Report 2012/13, population growth in the region should primarily be channelled into Clare, Riverton and Saddleworth by utilising the benefit of existing community infrastructure and appropriately zoned land. The remaining towns were to retain their small scale village character, but still to allow for modest growth.

## 2.6 Existing Stormwater Assets

Rhynie has limited stormwater infrastructure. Stormwater is discharged to the creek running through the township primarily in informal channels through properties. There are several crossings of this creek - Salters Spring Road has a culvert crossing of the creek that is under capacity and ford crossings at Harriet Street and Milne Street. Flow from catchments to the east and west of the township are conveyed in culverts under Main North Road and Rhynie-Balaklava Road respectively. The channels from these culverts are informal running through private allotments.

During the community consultation process, flooding issues at Slape Road were identified. This area is outside the scope of the SMP and therefore any works to address this are not included in this document. However, it is recommended that Council considers placing a ford crossing and drop structure at Slape Road in order to facilitate flows and prevent road damage during high flows. The catchment area associated with these works is greater than 40ha.

Existing stormwater assets at Rhynie are shown on the following page in Figure 2-3.

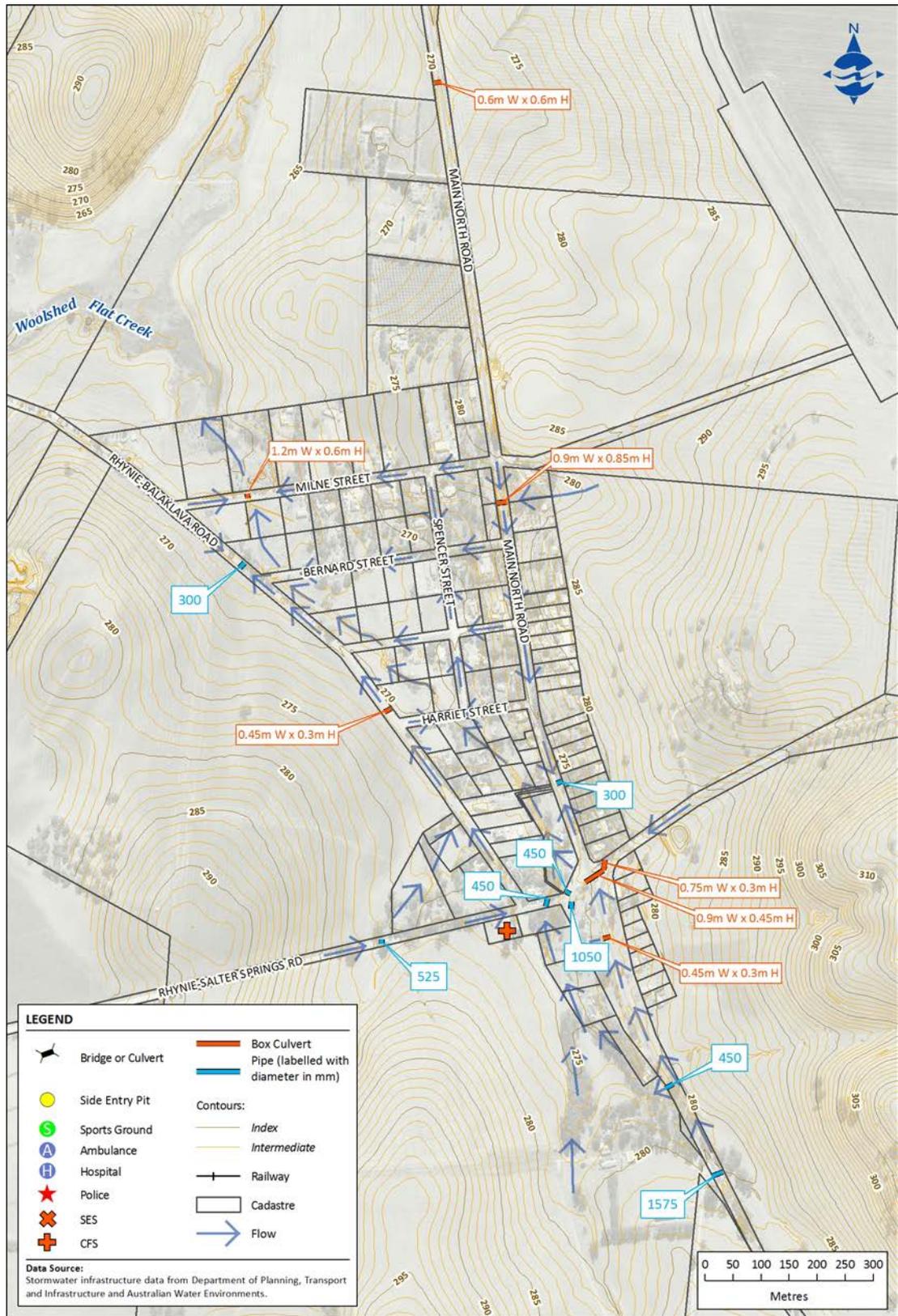


FIGURE 2-3: EXISTING STORMWATER ASSETS

## 3 Identification of Problems and Opportunities

### 3.1 Social, Economic and Environmental Issues

#### 3.1.1 Economic

In December 2010, floods occurred in Rhynie and other nearby towns such as Stockport and Tarlee. The floods affected houses, sheds, fences, traffic disruption and accessibility, as well as causing significant damage to Council infrastructure, such as bridges and roads, which all involve significant economic costs (Council infrastructure: \$2.5 million in bridge damage and \$3 million to roads).

#### 3.1.2 Social

The social impacts of flooding and poor stormwater management are often difficult to quantify in monetary terms. These impacts are related to the physical and mental health of individuals, environmental impacts and disruption to essential community services and operations. They can include aspects such as the following:

- Loss of life, personal injury and associated losses and expenses;
- Destruction of memorabilia (e.g. family photos);
- Loss of heritage and cultural features;
- Loss of amenity, recreational value and aesthetics;
- Increased medical costs and reduced life expectancy associated with increases in levels of sickness in a community following a disaster;
- Emotional stress and mental illness associated with experiencing damage to family homes and businesses, including:
  - Replacement of damaged property, particularly if there is no flood insurance or it is insufficient;
  - Living in temporary accommodation;
  - Children attending a different school;
  - Death of pets; and
  - Loss of business goodwill.

#### 3.1.3 Environmental Values

Erosion and sedimentation caused by stormwater and flooding in Rhynie can result in a decline in water quality and ecological health of downstream environments. The downstream (receiving) environment includes the Wakefield River, which includes a few areas of ecological importance (such as The Rocks). The River then makes its way to the estuarine coastal environment of Pt Wakefield, comprising samphire and mangrove vegetation, and finally flowing to Gulf St Vincent. Therefore, measures to control erosion and sedimentation arising from stormwater and flooding in Rhynie can help protect water quality and ecological health of these downstream environments.

There is not much water quality data available, however this SMP includes water quality principles to protect downstream environments. The water quality targets for both new and existing developments in the region are designed to reduce the impact on the receiving environments whilst preserving environmental values.

Although there is no available water quality data at present, visual assessment suggests the watercourses in the area of the SMP are in a moderate condition, despite the region as a whole being dramatically modified since European settlement.

Environmental values are those that the community place on the environmental services. The strategy underpinning the determination of the environmental values for the SMP is the National Water Quality Management Strategy (NWQMS). The NWQMS aims to enable Council and community groups to protect the health of water bodies and waterways. Environmental values for this SMP can be guided by the objectives of this Strategy which include the following (but not limited to):

- To ensure the water quality monitoring of waterways and regulation for the discharging of pollutants into waterways adheres to the agreed water quality objectives;
- Provide a strategic direction for the management of all watercourses as well as protecting ecosystems and not compromising the economic well-being of the community; and
- Prioritise funding for environmental management which will ultimately lead to improved water quality.

As part of developing this SMP, environmental values were ascribed for the region, as shown in Table 3-1. These values reflect the community's value of the watercourses. Management actions need to safeguard these values.

TABLE 3-1: SURFACE WATERCOURSES ENVIRONMENTAL VALUES

| Environmental Values               | Supporting Details   |  |
|------------------------------------|--|--|
| <b>Aquatic Ecosystems</b>          |   | Supporting highly disturbed systems ( <b>HD</b> ) (see below)                                      |
|                                    | Highly disturbed systems ( <b>HD</b> ). These are degraded systems likely to have lower levels of naturalness. These systems may still retain some ecological or conservation values that require protecting. Targets for these systems are likely to be less stringent and may be aimed at remediation and recovery or retaining a functional but highly modified ecosystem that supports other environmental values also assigned to it (e.g. primary industries). |  |
| <b>Primary Industries</b>          |   | <b>Irrigating</b> crops such as vines, crops, etc  |
|                                    |   | Water for <b>farm use</b> such as in fruit packing or milking sheds, etc                           |
|                                    |   | <b>Stock watering</b>  |
|                                    |    | <b>Human consumption</b> of wild or stocked fish or crustaceans                                    |
| <b>Recreation &amp; Aesthetics</b> |   | <b>Visual appreciation</b> with no contact with water such as picnicking, bushwalking, sightseeing |
| <b>Cultural &amp; Spiritual</b>    |   | <b>Cultural and spiritual</b> values including the cultural values of traditional owners           |

## 3.2 Riverine and Local Flooding

### 3.2.1 Floodplain Mapping

AWE (2013) undertook floodplain mapping for the town, including riverine and direct rainfall. This is summarised below and also shown in 100 year ARI event inundation maps in Appendix A.

### 3.2.2 Riverine Flooding

#### **20 Year ARI Event**

During the 20 year ARI event there is ponding upstream of Milne Street and surrounding Harriet Street. The channel directly north of the Rhynie-Salter Spring Road breaks out with parallel flow paths either side of the main channel for approximately 200m.

#### **100 to 500 Year ARI Event**

The depth and area inundated increase with the higher ARI events (but no new areas of breakouts).

### 3.2.3 Local Flooding Assessment<sup>1</sup>

Local flooding in Rhynie where inundation of more than 50mm in depth (as modelled) is mostly confined within the same area as for the riverine flooding (described above).

## 3.3 Properties and People at Risk of Flooding

Flood maps (based on riverine flooding for the 100 year ARI event) and aerial photography were used to identify properties at risk of flooding. The number of people at risk of flooding in a 100 year ARI event was determined by analysing the number of properties at risk of flooding and the average number of people per property.

The population and number of properties in Rhynie at risk of flooding in a 100 year ARI event are shown in the following table.

**TABLE 3-2: POPULATION AND PROPERTIES AT RISK IN A 100 YEAR ARI EVENT**

| Population at risk of flooding | No. of properties at risk of flooding in each flood hazard zone (Riverine flooding) |     |      |       |
|--------------------------------|---|-----|------|-------|
|                                | Low   | Med | High | Total |
| 149                            | 10  | 6   | 5    | 21    |

There are no additional properties at risk of inundation from direct rainfall (local storm) only. Also, those properties which are put at risk from local rainfall are as a result of limited channel capacity rather than sheet flow issues.

## 3.4 Impacts of Future Development on Flooding

It is important to understand if future development is planned and what impacts this may have on flooding. Any new development or redevelopment will need to take into account of the flood extent and depth maps within this SMP to reduce the risk of being flooded, as well as to reduce any impact it may have on flood paths and flood behaviour.

As outlined previously in chapter 2.5 of this SMP, Rhynie is not anticipated to expand in the immediate to medium term. It is to retain its small scale village character, but still to allow for modest growth.

The township is zoned as 'Township' and is surrounded by land zoned 'Primary Production'. There is no 'Deferred Urban' zone and therefore future development is likely to be limited to infill development.

<sup>1</sup> Runoff causing local flooding issues was assumed to be caused by rainfall falling directly on the townships and the immediate surrounding slopes. This whole area was typically contained within the Digital Elevation Model (DEM) contained within the TuFlow model for each town. In some cases, inflows from small catchment areas that lay outside the DEM could also cause local flooding issues, and in these cases the external catchment inputs were modelled in RORB and hydrographs included as boundary conditions to the TuFlow Model.

### 3.5 Exploring Opportunities

This SMP explores opportunities for better managing the risk of flood, including structural and non-structural flood mitigation measures. Non-structural measures include aspects such as flood warning and preparedness and better integration between stormwater management and Council's Development Plans.

Harvesting of stormwater as an alternative source of water is a desirable option for many towns, for purposes such as greening of public open space, irrigating sports ovals and other recreational areas. The SMP describes options for water harvesting including aquifer storage, however it is noted that any reuse would need to have regard to the requirements of the Prescribed Water Area and the health of downstream water dependent ecosystems.

The design of stormwater infrastructure has consideration of potential environmental enhancement and benefits to receiving environments, such as the Wakefield River and Gulf St Vincent, e.g. through establishing a wetland for pollutant removal purposes.

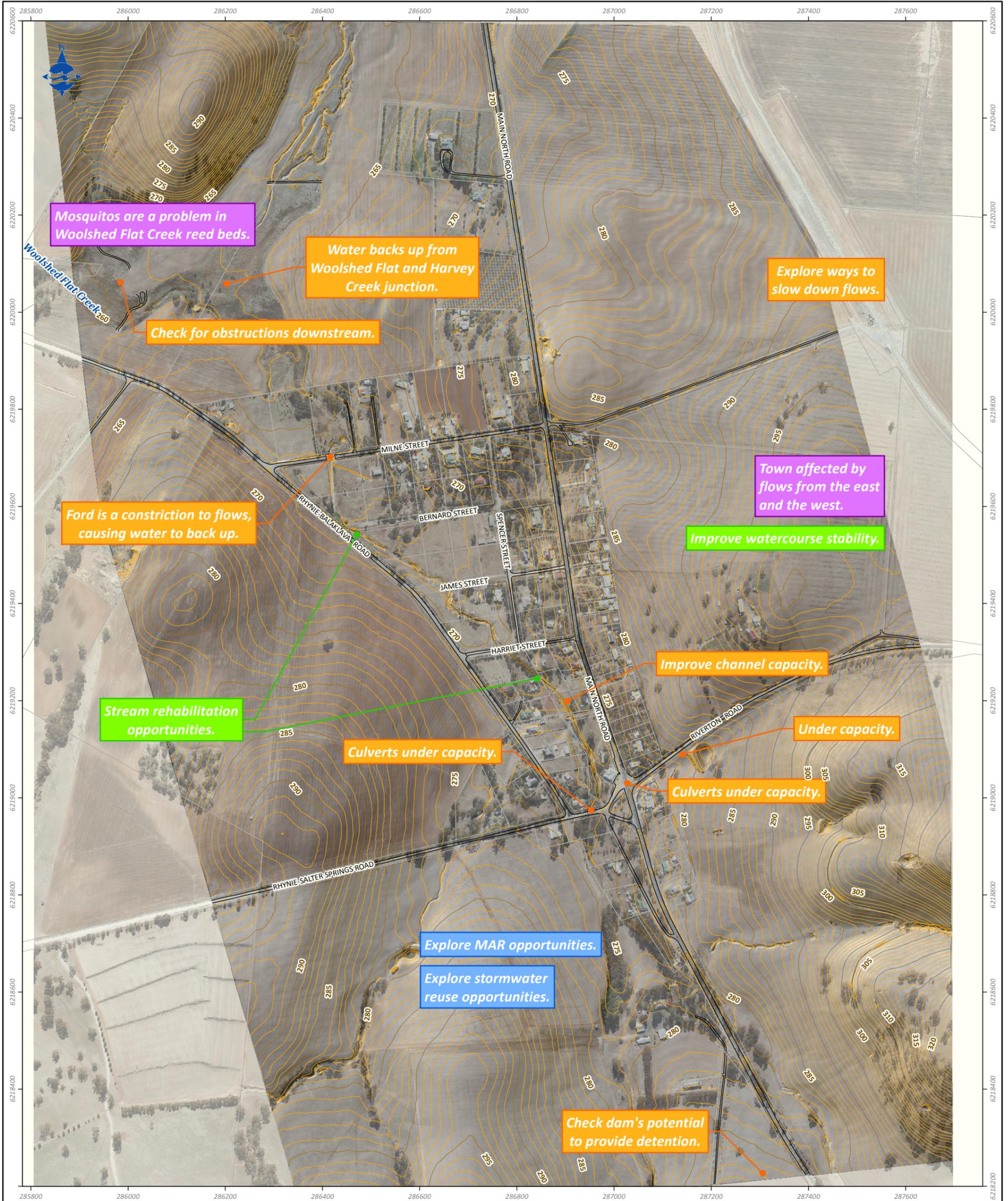
## 4 Stormwater Management Objectives

### 4.1 Approach

The development of stormwater management objectives has had consideration of the earlier floodplain mapping and technical assessments, consultation activities and the requirements of the SMA Guidelines.

The project has been overseen by a steering committee including representatives from Council, DPTI/SMA, the Northern and Yorke NRMB, and more recently from BOM. Regular meetings have been held throughout the project to discuss progress, issues arising, and to confirm the approach to technical investigations and community consultation.

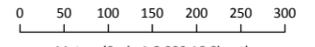
Consultation with the Rhynie community was undertaken in August 2013 to identify issues and opportunities for stormwater and flood management. This information helped to determine the objectives of the SMP. A summary of the issues raised by the community is shown on the following page in Figure 4-1 and in Appendix B.



**LEGEND**

- Contours:
    - Index
    - Intermediate
  - Railway
  - Road Edge
  - Cadastre
- 
- Flood control/management
  - General comment
  - Water reuse
  - Water quality/biodiversity/erosion control

**Data Source:**  
 Aerial Imagery, Road Edge and Contours from Aerometrex; Road Names and Cadastre from Clare & Gilbert Valleys Council; Railway Alignment from DTEI.



Stormwater Management Plan  
 For Seven Townships In The  
 Clare And Gilbert Valleys Council  
 Rhyrie

**Issues and Opportunities Raised by the Community**

## 4.2 Stormwater Management Objectives

With consideration of the above technical information, consultation feedback and SMA Guidelines, the following stormwater management objectives have been developed for Rhynie:

- Reduce the impact of nuisance local flooding, such as pooling of stormwater in the vicinity of Milne Street and Harriet Street;
- Provide an acceptable level of protection of assets from local and regional flooding (from Woolshed Flat Creek);
- Manage stormwater to benefit the community and explore opportunities for the beneficial use of stormwater runoff;
- Develop an appropriate, and sustainable, stormwater management system which has consideration of operational and maintenance requirements and costs;
- Continue to improve maintenance processes to optimise the water quality and water quantity management services performed by the stormwater network;
- Minimise adverse impacts on downstream environments resulting from stormwater management and water harvesting activities;
- Use the planning system to achieve desirable outcomes for new developments, open spaces, recreation and local amenity;
- Manage rural catchment contributions such that the management, control and harvesting of both rural and urban runoff is efficient and effective; and
- Seek opportunities to protect water quality and ecological health of the downstream environments.

A brief description of these objectives follows.

### 4.2.1 Local Flooding

The following criteria were adopted:

#### ***Formal Infrastructure to Remain Effective***

Formal infrastructure, such as culverts, ford, dam and diversion structure (lock) should be functional and able to cope with their design flows.

#### ***Informal Infrastructure to Remain Effective***

The informal infrastructure (such as the roadways and road verges) should remain effective with only standard maintenance activities.

#### ***Stormwater Flows should be Contained in the Road Reserve and Defined Flow Paths***

Stormwater flows should not inundate and cause damage to areas outside of the road easement where possible. Where flow is through private allotments the flow paths should be identified to ensure future development does not negatively impact these flow paths. If significant flows leave the road reserve or defined flow paths there is potential for damage to private property.

**All Built Roads are Required to be Trafficable**

Council's built roads are required to be trafficable against the following ARI events:

- 5 year ARI event for local arterial and collector roads; and
- 2 year ARI event for the remaining roads.

The road was assumed to be trafficable when small conventional vehicles can safely traverse the sections of deepest flowing water. The deepest water is expected to occur in the roadside swales. A small vehicle is expected to be able to safely traverse flows that are less than or equal to 0.3 m deep.

The velocity of the flowing water is also important in determining whether the flow can be safely traversed. The combination of depth and velocity (i.e. DxV) reflects the hazard of the flows. To provide safe access for small conventional vehicles the hazard must be low (SCARM, 2000). Low hazard has previously been defined for floodplain mapping projects in South Australia as flows with a depth less than 0.3m and a velocity less than 0.3 m/s i.e. a maximum DxV of 0.09 m<sup>2</sup>/s. This value of the DxV relationship is also supported by the data in SCARM (2000) which specifies low hazard flows to have a DxV value of less than or equal to 0.09 m<sup>2</sup>/s.

**New Developments to not Increase Peak Flow Rates**

The SMP is to seek ways to support Council's Development Plan which specifies that water discharged from a development site should:

- a) be of a physical, chemical and biological condition equivalent to or better than its pre-developed state; and
- b) not exceed the rate of discharge from the site as it existed in pre-development conditions.

## 4.2.2 Regional Flooding

Rhynie experiences flooding from Woolshed Flat Creek during the 20 year, 100 year and the 500 year ARI events, and flows tend to inundate local streets. Objectives include providing protection to properties within the identified township boundary from the 100 year ARI event. The SMP can assist with achieving this by providing guidance on:

- Formulating drainage paths to limit flooding of properties in the township;
- Ensuring drainage infrastructure is appropriate for conveying flows, eg culvert capacities;
- Appropriate finished floor levels to prevent over bank flooding from tributaries entering buildings in the town;
- Reducing any restriction to flows caused by inefficient drainage system;
- Options for mitigating flooding;
- Identify areas of flood affected property to understand risk of flooding; and
- Identify major flow paths and extent of potential flooding to help guide better planning and development.

The SMP is to seek ways to support Council's Development Plan relating to flood hazards. It specifies the following principles of development control:

- *Principle 4 - Development should not occur on land where the risk of flooding is likely to be harmful to safety or damage property.*
- *Principle 5 - Development should not be undertaken in areas liable to inundation by tidal, drainage or flood waters unless the development can achieve all of the following:*
  - a) *it is developed with a public stormwater system capable of catering for a 100 year average return interval flood event; and*
  - b) *buildings are designed and constructed to prevent the entry of floodwaters in a 100 year average return interval flood event.*

In terms of flooding and mitigating peak flows, Council's Development Plan also includes information on stormwater and includes the following principles of development control:

- *Principle 31 - Development should include stormwater management systems to protect it from damage during a minimum of a 100 year average return interval flood.*
- *Principle 33 - Development should have adequate provision to control any stormwater over-flow run-off from the site and should be sited and designed to improve the quality of stormwater and minimise pollutant transfer to receiving waters.*
- *Principle 34 - Development should include stormwater management systems to mitigate peak flows and manage the rate and duration of stormwater discharges from the site to ensure downstream systems are not overloaded.*
- *Principle 38 - Where not detained or disposed on site, stormwater should be drained to a public stormwater disposal system.*

The SMP is to seek ways to support the above principles of development control.

### 4.2.3 Water Quality and Ecological Protection

Stormwater runoff should not impair the health of receiving environments, such as the Wakefield River and the saltmarsh coastal environment of Gulf St Vincent. The SMP can assist this by estimating the quality of runoff and developing mitigation strategies aimed at protecting water quality.

Desirable end-state values for watercourses and riparian ecosystems have been identified earlier in this SMP in section 3.1.3. This also included objectives aimed at protecting the health of waterbodies and waterways. This issue is expanded below.

The SMP aims to reduce the pollutant load of stormwater and will be guided by the State Government's targets for stormwater quality (pollutant reduction), as outlined below:

- 80% reduction in Total Suspended Solids
- 60% reduction in Total Phosphorus
- 45% reduction in Total Nitrogen
- 90% reduction in litter/gross pollutants

(Water Sensitive Urban Design, 2013)

In addition, the SMP will help support the following Council objectives:

Council's Development Plan provides objectives to protect natural resources, such as:

*Objective 2 - Protection of the quality and quantity of South Australia's surface waters, including inland and underground waters.*

The Development Plan also includes principles of development controls that aim to manage the quality of stormwater runoff, such as:

*Water Sensitive Design*

*Principle 11 - Development should have adequate provision to control any stormwater overflow runoff from the site and should be sited and designed to improve the quality of stormwater and minimise pollutant transfer to receiving waters.*

*Water Catchment Areas and Water Quality*

*Principle 24 - The quality of water leaving the site of a development should be of a physical, chemical and biological condition equivalent to or better than pre-development conditions, and the rate of water discharged from the site should not exceed the rate of discharge from the site in pre-development conditions.*

*Stormwater*

*Principle 35 - Development should include stormwater management systems to minimise the discharge of sediment, suspended solids, organic matter, nutrients, bacteria, litter and other contaminants to the stormwater system.*

*Principle 36 - Stormwater management systems should preserve natural drainage systems, including the associated environmental flows.*

The SMP aims to support the Northern and Yorke NRM's resource condition targets for a range of NRM issues - the most relevant issues and their targets are outlined below:

- Integrity of native vegetation communities:
  - By 2030, maintain the condition of the region's 1,200,000 ha of remnant native vegetation, and improve the condition of 15% from 2008 levels.
- Integrity of inland aquatic ecosystems (rivers and other wetlands):
  - By 2030, inland and estuarine water-dependent ecosystems are maintained or improved in condition from 2008 levels.
  - By 2030, core refuge areas are protected by a 20% reduction in the extent of priority degrading watercourse management issues.
- Integrity of estuarine, coastal and marine habitats:
  - By 2030, there is no reduction in the extent and a steady improvement in the condition of coastal, estuarine and marine ecosystems, compared to 2008.
  - By 2030, the extent and diversity of coastal landscapes is maintained, and their condition improved, compared with 2008.

- Nutrients in aquatic environments, Turbidity/suspended particulate matter in aquatic environments, Surface water salinity in freshwater aquatic environments:
  - By 2030, water quality is maintained, within climatic limitations and natural conditions, below levels set for aquatic ecosystems in the Environment Protection (Water Quality) Policy.
- Significant native species and ecological communities:
  - By 2030, there has been no loss of species or ecological communities and their viability and conservation status has improved from 2008 levels.

The Northern and Yorke NRM's Regional Plan (Volume D) also contains information and requirements relating to managing works around watercourses, known as Water Affecting Activities (WAA's). A permit is required to undertake any of the WAAs listed in Section 5 of the NRM Plan either in the non-prescribed areas, or in relation to prescribed water resources where no water allocation plan exists. The purpose of this permit is to ensure activities support the NRM's aims of protecting water resources. However, Council may decide to develop Best Operating Practices that have been approved by the Board which will replace the need for a WAA permit, such as for the construction of a culvert or managing vegetation along a watercourse.

#### 4.2.4 Stormwater Reuse

The reuse of stormwater for watering the parks was identified by the community as a potential opportunity to be explored through this SMP.

The SMP also assessed options for MAR and stormwater harvesting with the aim of not causing harm to downstream water dependent ecosystems. The SMP describes the likely effectiveness of the reuse scheme so that Council can plan for its future development should funds become available.

##### ***Supporting Documents***

Opportunities for stormwater harvesting and reuse at Rhynie will help to support the Government strategies described below.

The South Australian Government's Stormwater Strategy (2011) has targets for the Greater Adelaide region however it also provides the basis for stormwater management in regional areas of the State. It supports the State Government's water security plan "*Water for Good*" (2009) target of harvesting 15 GL a year in regional areas by the year 2050.

Regional Development Australia Yorke and Mid North in partnership with the Clare & Gilbert Valleys Council, the Northern and Yorke NRM Board, the Clare Wine Grape Growers Association, SA Water and the Department for Water prepared the Water Security Plan (2011) with the aim of waterproofing the region. This is to be done by diversifying the availability of water resources via assessing the future water requirements of the region; identifying future potential water sources, including those created through stormwater capture and wastewater treatment and reuse; and identifying the appropriate strategies to secure water fit for purpose over the next 20 years to 2030.

Council should continue to ensure development is sited and designed to capture and re-use stormwater, where practical, as outlined in its Development Plan.

## 4.2.5 Desirable Planning Outcomes

### ***New Development***

As outlined earlier in this SMP, there is no 'Deferred Urban' zone and therefore future development is likely to be limited to infill development.

Any future development needs to have consideration of the land's flood risk. Flood maps produced in this SMP provide information on flood extents and heights. This information is useful in Council setting minimum finished floor levels to adequately provide protection from floods. This information may also be useful in updating Council's Low Lying Land Policy for Rhynie which identifies numerous allotments that have been known to be affected by flooding and provides guidance on development and planning matters.

Future development also needs to have consideration of how it may affect flood paths. To ensure adequate drainage is achieved, it may be necessary to provide detention onsite for a single allotment, or a detention basin placed within a larger subdivision, so not to exacerbate the town's drainage system.

### ***Open Space, Recreation and Amenity***

Areas of open space, recreation and amenity are important to the community and options to safeguard and enhance these values are explored in this SMP, such as investigating watercourse rehabilitation works, water quality improvements, and stormwater reuse options. Options will need to be in accordance with the requirements of the Clare Valley Prescribed Water Area in which Rhynie is situated within.

## 5 Stormwater Management Plan Strategies

### 5.1 Approach

The development of stormwater management strategies has been based on the stormwater management plan objectives, modelling and technical investigations, and feedback received from the Steering Committee, Elected Members and the local community. A summary of the community feedback on draft strategies is provided in Appendix B.

The recommended strategies in this report are assigned a unique label and number, such as:

Flood management: F1, F2, etc.

Water Quality: WQ1, WQ2, etc.

Reuse: R1, R2, etc.

Preparedness and planning: P1, P2, etc.

Combined strategies (not predominantly one of the above): C1, C2, etc.

Strategies for managing flooding and stormwater runoff, and opportunities for improving water quality, the local amenity and potential reuse are outlined as follows.

In addition to the proposed measures outlined below, the road network's function of conveying high flows will continue.

It is noted that the availability and timing of funding and resources will determine the order and staging of the recommended works.

### 5.2 Non-Structural Flood Management Measures

Recommended non-structural measures include a flood preparedness program and planning/ development controls.

In addition to structural measures aimed at controlling flooding, there is a range of non-structural measures that can assist in achieving this outcome and minimise the impacts of flooding in the future. Non-structural measures are typically highly cost effective and can be implemented over much shorter timeframes. Both structural and non-structural approaches should be incorporated within an overarching management plan for Rhynie.

Examples of non-structural measures are described below.

#### 5.2.1 Flood Preparedness

Flood preparedness is a cost effective non-structural means of reducing damages as a result of a flood. Flood preparedness is basically about helping people to be aware of the flood risk and how best to respond to it. Flood preparedness programs in this context are considered in four phases: flood awareness, flood warning, response and recovery. They form the key elements of a total flood warning system (Commonwealth of Australia, 2009).

##### ***Flood Awareness***

A flood awareness program for people in Rhynie is an important aspect of reducing the risk of flood damage. A community awareness program, similar to the Clare township's 'Floodsafe' program which assists the community in being better prepared and able to respond to flood risks and events

is recommended. This program is based on the SA State Emergency Service's (SES) highly successful community education and awareness raising 'Floodsafe' program. A program such as this may include awareness activities such as informing the community through discussions with individual households, the Council's newsletters, public presentations, articles in local media, information included on Council's website, and information about a flood emergency kit.

A coordinated education program is one means of ensuring this information is effectively disseminated. The development of such programs is essential for ensuring that landholders can take full advantage of flood warnings.

### ***Flood Warning***

Research has demonstrated that flood warning can substantially reduce the damage costs associated with flooding. Generally, the greater the warning time, and the more prepared the community are then the greater the savings may be. A well informed community can reduce the costs associated with a flood by around 20% with only 2 hours warning whilst with 12 hours warning costs can be reduced by around 60% (BTE, 2001).

At Rhynie, there is a short duration of time from the onset of rainfall in the catchment to the time of peak flooding in the town. Nevertheless, warnings based on intensity of rainfall as measured in nearby towns (eg existing rainfall gauges in the Hutt River catchment and potentially in the future the Gilbert River catchment) can help alert the people in Rhynie of a potential impending flooding issue. This provides time for the community to prepare for the flood event. An effective flood warning system may require more flow information, additional river and rain gauging stations in the catchment to significantly improve the ability to warn the people of Rhynie of impending high flows or intense rainfall.

### ***Flood Response***

The flood response phase (and to a lesser extent the recovery phase) is highly influenced by the experience or knowledge of people of the likely behaviour and nature of a flood event. There are a range of actions people can do with their property before and during a flood that can substantially reduce the damage costs. Many of these measures are very simple and easily implemented. To be effective landholders potentially affected by flooding need to be aware of their options and response strategies.

The response of emergency services during a flood is obviously also a key factor in reducing flood damages and threats to public safety. Integrated disaster response plans are an important means for helping to ensure emergency services can effectively respond. Whilst not wishing to suggest that current response services are deficient (because they are not), the regular review of these plans and the conduct of "dry run" flood response exercises can be effective ways of ensuring emergency response staff and volunteers are aware of the issues, hazards, and opportunities that might be presented to them during a real flood event. Such initiatives should be effectively supported.

### ***Flood Recovery***

The recovery phase post flood is critical to reducing social disruption and long lasting health issues associated with trauma (and in extreme cases disease) as well as ensuring communities can get back to "normal" as soon as possible and thereby contain the overall damage costs.

A flood preparedness program is included in the list of recommendations as option P1 in Table 6-1. This includes a total flood warning system and a community awareness/education program (to be implemented every 5 years).

## 5.2.2 Development/Planning Controls

The Development Plan is a statutory document that controls and manages all forms of development within the Clare and Gilbert Valleys area. It sets out a range of development zones, maps and rules (Objectives and Principles) to help ensure that development occurs in a well-managed way and takes account of relevant environmental, infrastructure, urban design, heritage and community requirements (Strategic Directions Report 2012/13).

Planning controls within Council's Development Plan provide a framework to plan and build in a manner that incorporates stormwater management. Council already has information in its Development Plan to help guide development in terms of stormwater runoff volumes, water quality and reuse aspirations.

To further improve the effectiveness of the Development Plan in terms of water quality, Council may consider including specific water quality targets identified in the State Government's targets and the NRM Board's resource condition targets as described earlier in this SMP.

It is recommended that Council includes flood maps in its Development Plan to demonstrate land at risk of flooding and to guide appropriate development.

In relation to stormwater reuse, the Development Plan may be improved by including the reuse targets outlined in the State Government's Stormwater Strategy and "Water for Good" plan and also support the region's "Water Security Plan" (2011).

It is also recommended that Council enforces its current flood hazard requirements in its Development Plan, such as not allowing development on land where the risk of flooding is likely to be harmful to safety or damage property. In addition, to avoid buildings being constructed too low and thus potentially at risk of flooding, it is recommended that finished floor levels of new developments are 300mm above 100 year ARI event level, or if the development lies outside a floodplain area, then 300 mm above surrounding land levels.

There are a variety of planning and legislative controls available to minimise the various risks to the receiving environments, with the fundamental requirement that stakeholders have a duty of care to not adversely impact on the environment. For example, the Development Plan has a section on Water Sensitive Design which, amongst other provisions, requires:

*Water discharged from a development site should:*

*(a) Be of a physical, chemical and biological condition equivalent to or better than its pre-developed state*

*(b) Not exceed the rate of discharge from the site as it existed in pre-development conditions.*

The improvements to water quality, developing a wetland area, actions to reduce the risk of erosion and flooding, and the future potential reuse to 'green' the town will help to achieve better planning outcomes associated with open space, recreation and amenity.

Development / planning controls are included in the list of recommendations as option P2 in Table 6-1.

## 5.3 Management of Flood and Local Runoff

Management strategies have been developed that focus on improving the performance of the existing infrastructure to manage flows coming through the town from Woolshed Flat Creek (north-west of the town), the main road and the town's street network. The suggested measures are based on a level of protection for the 100 year ARI event.

In addition to the proposed measures outlined below, the road network's function of conveying high flows will continue.

The recommended measures are described below and shown in Figure 5-1. This figure also shows the effectiveness of these recommendations on flood inundation. In some cases, works will be required on private land and as such Council may require an easement or acquire land so that it can gain access for maintenance of infrastructure (refer also Section 7.3).

The difference in flood inundation pre and post measures is shown in Figure 5-2.

Further information on the properties protected in different ARI events is provided in section 5.4 of this report.

### 5.3.1 Regrade and Lower the Ford on Milne Street

The existing ford on Milne Street is recommended to be lowered and the road regraded to increase the overflow capacity of the ford. The catchment area associated with these works is greater than 40ha.

These works are included in the list of recommendations as option F1 in Table 6-1.

### 5.3.2 Increase Channel Capacity

It is recommended that the capacity of the main channel through the town is increased. Recommended dimensions are, bottom width 6m, top width 15m, and 1.5m deep. The catchment area associated with this measure is greater than 40ha. This would involve works on private land.

This measure is included in the list of recommendations as option F2 in Table 6-1.

The community has raised an interest in using the excavated material, and so it is recommended that Council explore future use of fill with the community.

### 5.3.3 Provide a Levee and Flow Path Around Existing Dwelling on Rhynie-Balaklava Road

It is recommended that a levee and flow path be placed around the existing dwelling on Rhynie-Balaklava Road to protect it from flooding. The catchment area associated with this measure is greater than 40ha. This would involve works on private land.

These works are included in the list of recommendations as option F3 in Table 6-1.

### 5.3.4 Regrade Salter Springs Road and Provide a Levee

It is recommended that Salter Springs Road be regraded to move low point in line with main channel and provide a levee for the property at the junction with Bowden Bridge Road. A new levee is recommended along the Rhynie-Salter Springs Road (0.6m high, including freeboard). The existing

culverts also need to be upgraded (to 2x 2m W by 0.45m H). This would involve work on private and public land.

The catchment area associated with these works is greater than 40ha.

These works are included in the list of recommendations as option F4 in Table 6-1.

### 5.3.5 Infrastructure on Main North Road Near Riverton Road

Duplicating the culverts under Main North Road at the intersection of Riverton Road is required along with reshaping the roadside swale in the immediate vicinity of the culverts. The catchment area associated with these works is greater than 40ha. Main North Road is DPTI road and the DPTI requirement for culverts under a road of this type (sealed, unkerbed) would be to achieve a 20 year ARI standard, (which is achieved) however, DPTI approvals are required for any culvert works, and they may also require Council to install road safety barrier protection if deemed required. DPTI have indicated during the consultation process of this plan preparation that it is unlikely to contribute to funding of such works.

These works are included in the list of recommendations as option F5 in Table 6-1.

### 5.3.6 Formalise Overflow Path Along Bernard Street

A roadside swale is recommended along Bernard Street to manage and direct flows into the main channel. These flow from the eastern slopes will otherwise encroach on private property and affect trafficability. This would involve works in private land. The catchment area associated with these works is less than 40ha.

This measure is included in the list of recommendations as option F6 in Table 6-1.

### 5.3.7 Levee and Contour Drain to East of Main North Road

To prevent nuisance sheet flow through properties it is recommended that a contour drain is provided to the east of properties located on the Main North Road. This would involve works in private land. The catchment area associated with these works is less than 40ha. The contour drain needs to be 2 m wide by 0.5 m deep.

These works are included in the list of recommendations as option F7 in Table 6-1.

### 5.3.8 Duplicate Culverts Under Main North Road

It is recommended that culverts under Main North Road are duplicated to reduce flooding of the road. Main North Road is DPTI road and the DPTI requirement for culverts under a road of this type (sealed, unkerbed) would be to achieve a 20 year ARI standard, (which is achieved for two of the three sets of culverts and would need to be verified for the third, most southern set). Furthermore, DPTI approvals are required for any culvert works, and they may also require Council to install road safety barrier protection if deemed required. DPTI have indicated during the consultation process of this plan preparation that it is unlikely to contribute to funding of such works.

The catchment areas associated with two of the recommended culverts are greater than 40ha, and one culvert is under 40ha.

This measure is included in the list of recommendations as option F8 in Table 6-1.

### 5.3.9 Other Options

During the Council and community consultation meetings there were a number of people indicating that farm dams upstream of the towns should be assessed for their potential to reduce peak flow rates.

Aerial photography was used to identify potential dams and to estimate their approximate size. In most cases it was found that existing dams were either too small or not located in an area of the catchment that would allow them to be effective with respect to flood mitigation.

Opportunities were also considered for the construction of new flood control dams upstream of the townships. This assessment process revealed that the volumes of storage required were large and the rounded topography made it impractical to size a dam that would be effective for major floods.

Landholders also identified that land management practices have improved and are continuing to improve further with respect to minimum tillage / direct drilling / contour bank techniques that are all effective in retaining more water on farm. These techniques along with farm dams all contribute to reducing peak flows but the effectiveness of these systems diminishes with the larger, less frequent floods. The volumes of water associated with the 20 year ARI event are simply too great for these measures to be effective. Their effectiveness is usually limited to floods up to the 5 or occasionally 10 year ARI event.

## 5.4 Effectiveness of Flood Mitigation Works

### 5.4.1 Difference in Flood Inundation Pre and Post Mitigation Measures

The flows of a 100 year ARI event were modelled with the recommended management measures in place. The difference in flood inundation pre and post mitigation measures is shown in Figure 5-2. This figure shows areas that were once inundated are either now shallower or dry. As a result of changing the flood paths some areas that were once dry are now seen to be wet or flooded in the 100 year ARI event. The measures have been designed to ensure that these new areas do not create a nuisance or damage to third parties.

In Rhynie there are 21 properties at risk of flooding in the 100 year ARI event, which includes 7 dwellings and 4 other buildings. The recommended measures are expected to reduce the risk of flooding to these properties and provide protection to the dwellings. One of these dwellings would continue to experience flooding of its surrounds but the depth of flooding would be reduced and is expected to be less than 100 mm and hence over floor flooding is not expected.

A breakdown of the number of dwellings protected in a range of ARI events (with the recommendations in place), is provided below.

**TABLE 5-1: BREAKDOWN OF DWELLINGS PROTECTED IN DIFFERENT ARI EVENTS**

| <b><i>ARI event</i></b>                      | 20 year ARI | 50 year ARI | 100 year ARI |
|--|-------------|-------------|--------------|
| <b><i>Number of properties protected</i></b> | 4           | 4           | 7            |

### 5.4.2 Trafficability of Road Network

Objectives of this SMP include Council's built roads are to be trafficable under the following scenarios:

- 5 year ARI event for local arterial and collector roads; and
- 2 year ARI event for the remaining roads.

The 5 year ARI event (based on local flooding/direct rainfall) was modelled to assess the trafficability of roads following the implementation of recommended works. This showed that the recommended measures will improve the trafficability of the road network. The designated standards (refer figure 5-3) will be achieved with the exception of the road ford crossings at Milne Street, Harriet Street and Salter Springs Road. All these fords would be overtopped in the 2 year ARI event. Salter Springs Road ford would remain trafficable for conventional vehicles in a 5 year ARI event. Emergency vehicles could also continue to use the Milne Street ford during a 5 year ARI event. Harriet Street ford would not be trafficable.

The trafficability of the roads is shown in Figure 5-3.

### 5.4.3 Impact of Mitigation Measures on Downstream Stream Stability

It is important to understand the impact of the proposed mitigation measures on downstream environments, such as higher flow velocities that may cause erosion issues.

In a 100 year ARI event, the proposed works are expected to reduce the velocity of flows leaving the town by 28% compared to the existing situation. This will help protect downstream environments by reducing the risk of stream instability and erosion.

## 5.5 Regular Maintenance of Drainage Infrastructure and Watercourses

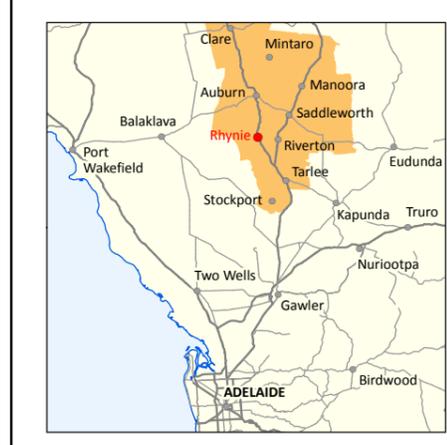
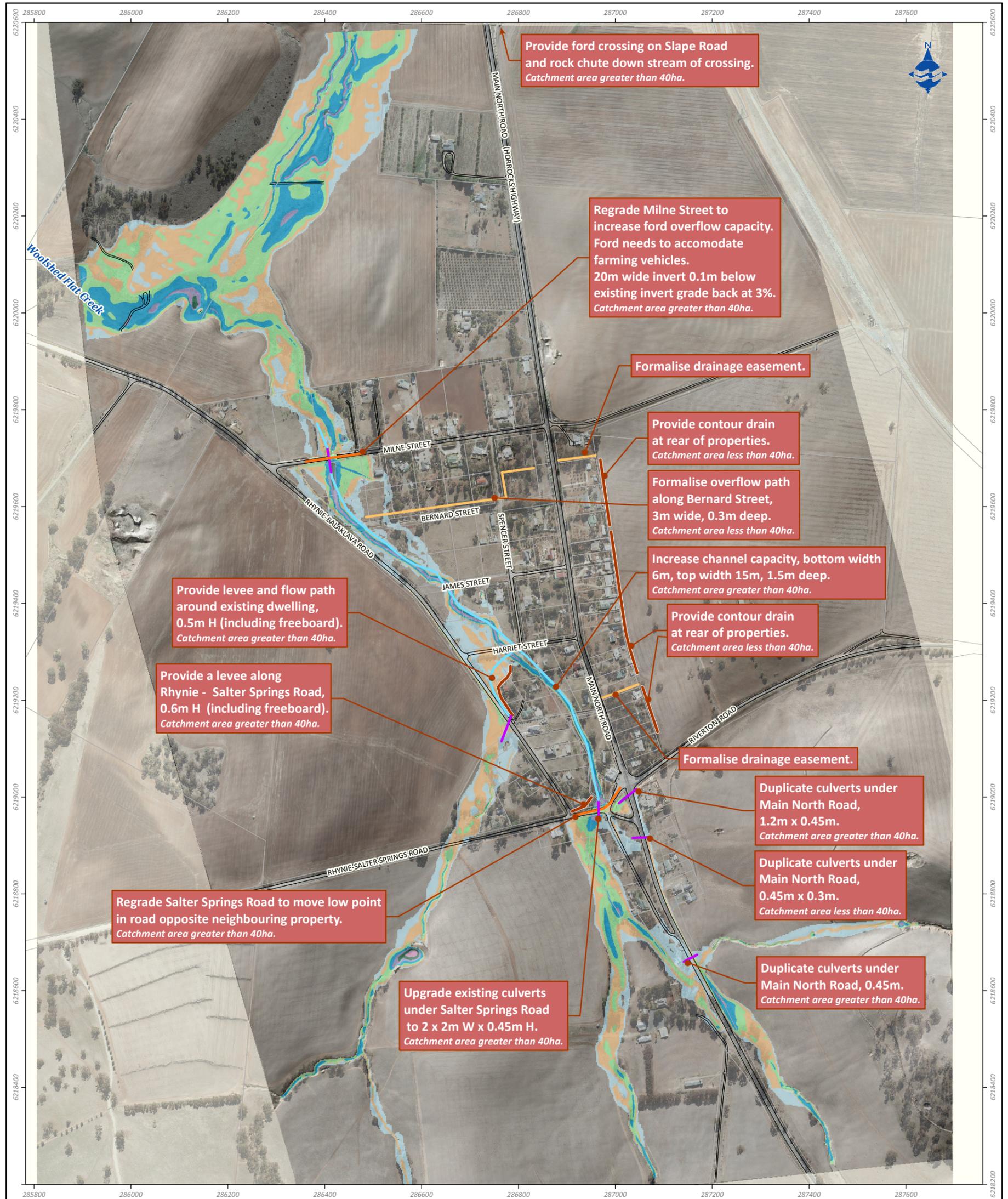
The effectiveness of stormwater drainage infrastructure and watercourses is influenced by whether or not they are maintained and free of blockages. It is recommended that Council maintain the drainage paths and infrastructure in a manner to ensure they perform as designed, i.e. to enable efficient flow of water.

Council will continue to improve maintenance processes to optimise the water quality and water quantity management services performed by the stormwater network.

In relation to fences across watercourses, it is also recommended that Council, in conjunction with the NRM Board, assesses the suitability of stream fencing that may be in place, and identifies the need for any upgrade/modification to existing fences as appropriate. It is anticipated that this work would be done in partnership with landholders and the NRM Board.

This measure is included in the list of recommendations as option F9 in Table 6-1.

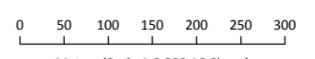
Further information and recommendations on the maintenance of watercourses and stormwater infrastructure located in private and public land is provided in section 7.3 of this report.



**LEGEND**

|                                      |                         |
|--------------------------------------|-------------------------|
| <b>Proposed Remediation Options:</b> | Cadastre                |
| Upgraded Culvert                     | <b>Flood Depth (m):</b> |
| Roadside Swale                       | 0 - 0.10                |
| Regraded Road                        | 0.11 - 0.25             |
| Channel Modification                 | 0.26 - 0.50             |
| Levee                                | 0.51 - 1.00             |
| Railway                              | 1.01 - 1.50             |
| Road Edge                            | 1.51 - 2.50             |
|                                      | 2.51 - 5.00             |
|                                      | Greater than 5.00       |

**Data Source:**  
Road Edge, Contours and Aerial Imagery from Aerometrex; Roadnames and Cadastre from Clare & Gilbert Valleys Council; Railway alignment from DTEI; Flood Data modelled by Australian Water Environments.



0 50 100 150 200 250 300  
Metres (Scale 1:8,000 A3 Sheet)

Government of South Australia  
Stormwater Management Authority

CLARE & GILBERT VALLEYS COUNCIL

Australian Water Environments

Stormwater Management Plan  
For Seven Townships In The  
Clare And Gilbert Valleys Council

Rhyynie

**Recommended Measures and Effectiveness on Flood Inundation**



**LEGEND**

**Proposed Remediation Options:**

- Upgraded Culvert
- Roadside Swale
- Regraded Road
- Channel Modification
- Levee
- Railway
- Road Edge
- Cadastre

**Wet Previously Wet:**

- Significant increase in flood depth (over 0.5m)
- Moderate increase in flood depth (up to 0.5m)
- No significant change in flood depth
- Moderate decrease in flood depth (up to 0.5m)
- Significant decrease in flood depth (over 0.5m)

**Wet Previously Dry** ■

**Dry Previously Wet** ■

Note: Flood difference was determined by subtracting mitigation data from the current scenario therefore negative values represent a greater depth in mitigation data.

Data Source: Road Edge, Contours and Aerial Imagery from Aerometrex; Roadnames and Cadastre from Clare & Gilbert Valleys Council; Railway alignment from DTE; Flood Data modelled by Australian Water Environments.

0 50 100 150 200 250 300  
Metres (Scale 1:8,000 A3 Sheet)

Government of South Australia  
Stormwater Management Authority

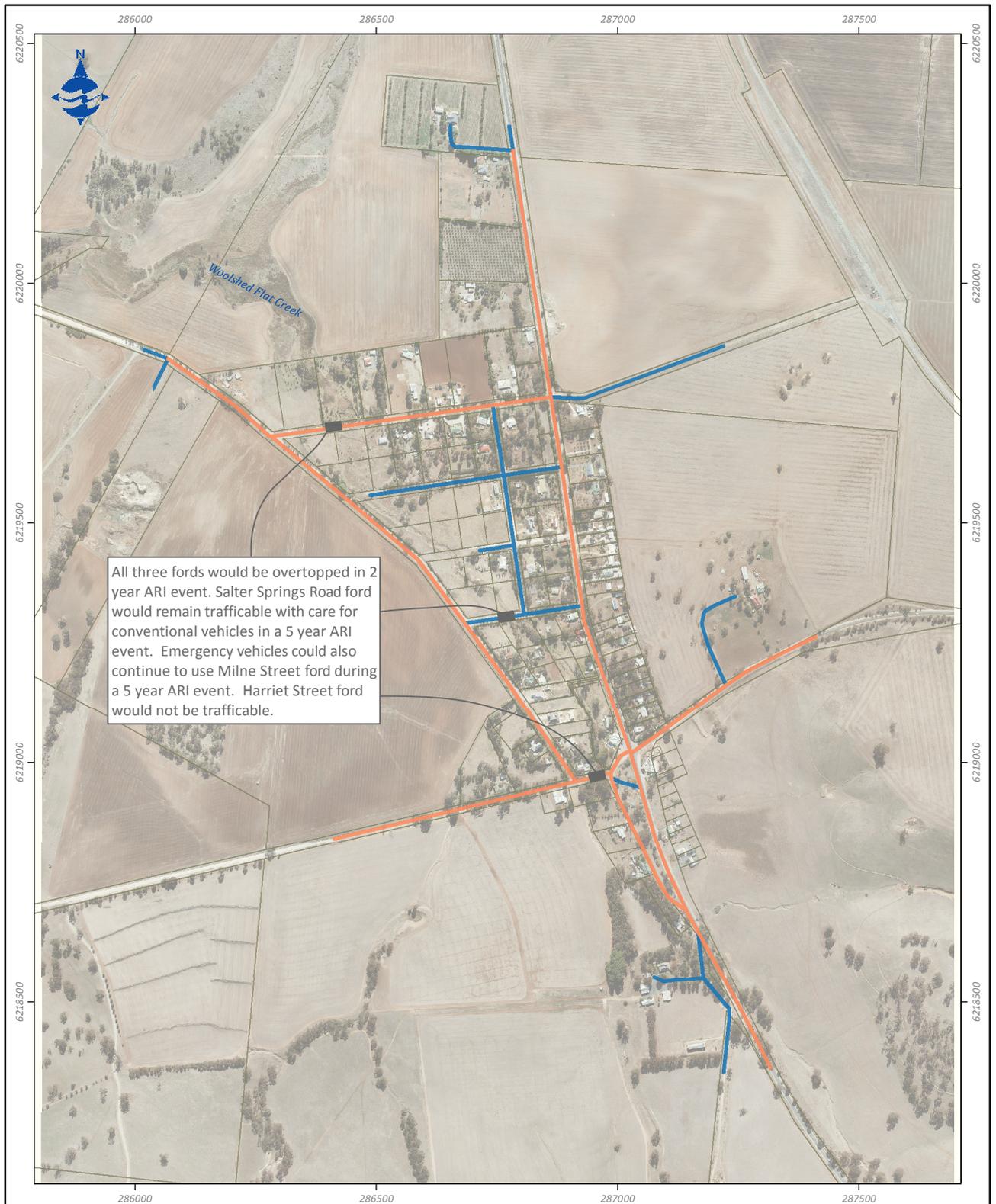
CLARE & GILBERT VALLEYS COUNCIL

Australian Water Environments

Stormwater Management Plan  
For Seven Townships In The  
Clare And Gilbert Valleys Council

**Rhyne**

**100 Year ARI Event Inundation Difference**



All three fords would be overtopped in 2 year ARI event. Salter Springs Road ford would remain trafficable with care for conventional vehicles in a 5 year ARI event. Emergency vehicles could also continue to use Milne Street ford during a 5 year ARI event. Harriet Street ford would not be trafficable.



**LEGEND**

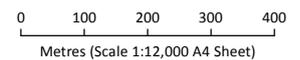
**Road Trafficability Standard**

- Post Mitigation Works:
- 5 year ARI event
  - 2 year ARI event

- Railway
- Cadastre

**Data Source:**

Railway alignment from Department of Planning, Transport and Infrastructure; Cadastre and Roads from Clare & Gilbert Valleys Council; Aerial Imagery from Aerometrex.



Stormwater Management Plan  
For Seven Townships In The  
Clare And Gilbert Valleys Council

Rhyne

**Trafficability of Roads**

## 5.6 Water Quality Assessment

Recommendations for improving water quality include establishing a wetland in low lying land on the corner of Main North Road and Rhynie-Riverton Road.

An opportunity for a potential wetland has been identified and assessed for the purpose of improving water quality in Rhynie.

Analysis of the catchment area and land uses was undertaken to determine the likely pollutants at Rhynie. These attributes were modelled using the computer software program MUSIC (Model for Urban Stormwater Improvement Conceptualisation). This program enables the user to quantify stormwater volumes and quality as well as to develop conceptual designs for treatment systems.

There is naturally low lying land on the corner of Main North Road and Rhynie-Riverton Road that may be suitable as a wetland. The wetland would work as a treatment system to improve overall water quality and storage capacity for stormwater runoff from the Rhynie catchment.

The primary roles of the wetland are as follows:

- Provide treatment for stormwater runoff from Rhynie;
- Improve amenity of the Rhynie landscape;
- Provide storage capacity;
- Potential reuse opportunity, and
- Reduces runoff rates which will help to minimise adverse impacts to watercourses and receiving waters.

The recommended surface area of the wetland system to facilitate treatment processes is 5000 m<sup>2</sup> with a 1.5 m and 0.5 m maximum and operating depth respectively. The operating depth of 1.5 m would improve the sediment removal function of the wetland.

The performance of the basin would meet (exceed) the pollutant reduction percentage targets of the South Australian Government (Water Sensitive Urban Design, 2013), as shown below in Table 5-2.

**TABLE 5-2: COMPARISON AGAINST POLLUTANT LOAD REDUCTION TARGETS FOR EACH SYSTEM**

|                                | Surface Area<br>(m <sup>2</sup> ) | % Reduction |    |    |
|--------------------------------|-----------------------------------|-------------|----|----|
|                                |                                   | TSS         | TP | TN |
| <b>State Government target</b> |                                   | 80          | 60 | 45 |
| <b>Wetland</b>                 | 5,000                             | 85          | 78 | 59 |

A flow weighted mean concentration (mg/L) was calculated for the outflow from the proposed treatment system to understand the quality of water as a result of treatment. The results of this analysis were compared against water quality criterion for TSS, TP and TN identified in the Environment Protection (Water Quality) Policy 2003 for fresh water. These results are summarised in Table 5-3.

**TABLE 5-3: COMPARISON OF WATER QUALITY AGAINST ENVIRONMENT PROTECTION (WATER QUALITY) POLICY CRITERION**

| Treatment System | Pollutant | Fresh Water Criterion (mg/L) | Flow Weighted Mean Concentration (mg/L) |
|------------------|-----------|------------------------------|---|
| Wetland          | TSS       | 20                           | 57                                      |
|                  | TP        | 0.5                          | 0.1                                     |
|                  | TN        | 5                            | 2                                       |

The comparison in Table 5-3 indicates that through the treatment of stormwater runoff the nutrient concentration would meet the freshwater guidelines for water quality. Whilst the wetland meets the water quality criterion for TP and TN, expected TSS loads from the catchment into the wetland system would be significant given the total catchment area is 70 ha and incorporates a portion of the township environment.

The effect on water quality improvement as a result of the wetland is demonstrated by comparing it to the existing water quality at Rhynie, as shown below in Table 5-4.

**TABLE 5-4: EFFECTIVENESS OF WATER QUALITY TREATMENT**

|                                 | Average Pollutant Loads (kg/yr) |                       |                     |
|---------------------------------|---------------------------------|-----------------------|---------------------|
|                                 | Total Suspended Solid (TSS)     | Total Phosphorus (TP) | Total Nitrogen (TN) |
| Water quality with no treatment | 9,110                           | 23                    | 180                 |
| Water quality with treatment    | 1,366                           | 5                     | 74                  |

The wetland will improve the overall total pollutant loads, as demonstrated in the table below:

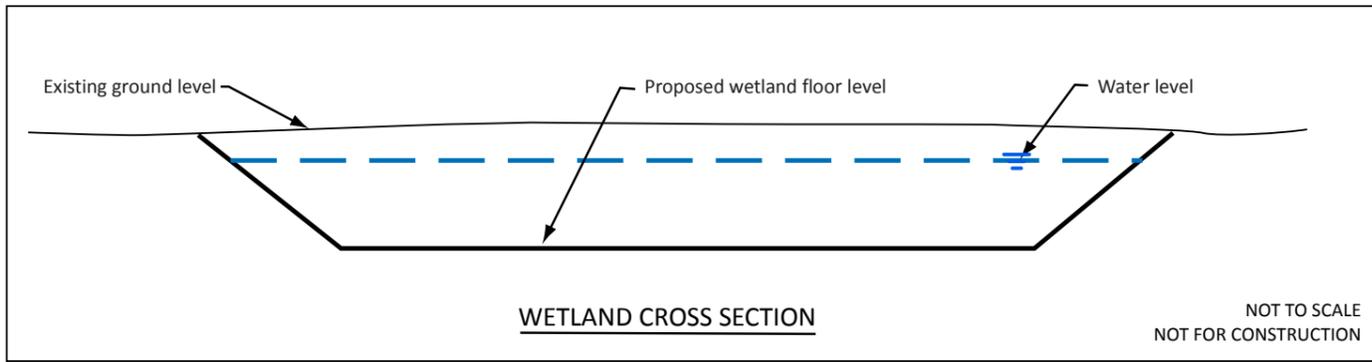
**TABLE 5-5: SUMMARY OF AVERAGE ANNUAL POLLUTANT REDUCTION**

| TSS (kg/yr) | TP (kg/yr) | TN (kg/yr) |
|-------------|------------|------------|
| 6,760       | 17         | 108        |

The results of the MUSIC modelling suggest that State Government targets for water quality are being met. The overall expected improvement in water quality supports Council's Development Plan principles relating to managing and improving the quality of stormwater runoff. It also helps support the NRMB's resource condition targets relating to maintaining and improving water quality in aquatic environments.

The area within which the wetland system would need to be constructed is presented in Figure 5-4. If a wetland were to be developed here it would require a considerable change to this area of community open space, which may not provide the best use of this area for the community.

The catchment area associated with this wetland is greater than 40 ha. This measure is included in the recommendations in Table 6-1 as option WQ1.

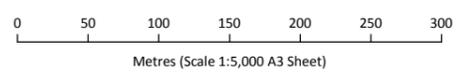


Potential wetland system.  
(see Wetland Cross Section)

**LEGEND**

- Services
- CFS
  - Road Edge
  - Cadastre
  - Potential Wetland

Data Source:  
Road Edge and Contours from Aerometrex; Roadnames, Cadastre from Clare & Gilbert Valleys Council; Railway alignment from DTEI;



Stormwater Management Plan  
For Seven Townships In The  
Clare And Gilbert Valleys Council  
Rhynie

**Stormwater Treatment, Harvest and Reuse**

## 5.7 Stormwater Harvesting and Reuse

### 5.7.1 Overview

The proposed wetland described in the previous chapter for water quality treatment purposes also provides an opportunity for storage for future reuse. However further detailed investigations into the actual demand for stormwater reuse for irrigating gardens and parklands would be recommended should the community decide to pursue this option in the future.

An MAR scheme for harvesting and reuse was investigated, however it was deemed not feasible for Rhynie due to number of factors such as lack of operational bores and sufficient land available for this purpose.

Opportunities for harvesting and reusing stormwater were explored in response to the community's aspiration to reuse stormwater for irrigation of parklands and gardens, as well as it being a requirement of the SMA as part of preparing stormwater management plans. The wetland described in the previous chapter for treatment purposes also provides an opportunity for storage for future reuse.

The investigations are summarised below.

### 5.7.2 Wetland

A high level water balance assessment was undertaken to assess the potential for stormwater reuse in the future for the irrigation of parklands and gardens. The stormwater volumes generated as part of the MUSIC Modelling for the catchment of Rhynie were used to understand the potential stormwater yields and harvestable stormwater volumes.

The option of creating a wetland for stormwater storage and reuse would alleviate some of the storage and conveyance issues associated with runoff from the urban environment and provide a potential to reuse the stormwater for irrigation of parklands and gardens.

The first component of the high level water balance assessment was to determine average annual yield of stormwater generated from the catchments being directed to the proposed wetland. This is summarised below in Table 5-6.

**TABLE 5-6: AVERAGE CATCHMENT STORMWATER RUNOFF YIELDS**

| <b>System</b> | <b>Surface Area (m<sup>2</sup>)</b> | <b>Average Catchment Stormwater Yields (kL/yr)</b> |
|---------------|-------------------------------------|--|
| Wetland       | 5,000                               | 61,000   |

The next step of the water balance assessment involved determining the indicative harvestable volume of stormwater of the wetland. As part of acquiring a permit to construct a water storage such as a wetland/storage basin, the total amount of actual water which can be harvested must not exceed the 25% of the median annual flow calculated for the total catchment (Northern and Yorke NRM Plan 2004).

Table 5-7 provides a summary of the median annual and harvestable volume respectively based on the requirements for obtaining a permit.

TABLE 5-7: STORMWATER RUNOFF YIELDS FOR REUSE

| System  | Median Annual Volume (kL) | Harvestable Volume (kL) |
|---------|---------------------------|-------------------------|
| Wetland | 56,000                    | 14,000                  |

The investigation determined that the wetland is a possible stormwater reuse option, but further investigations would need to be undertaken to prove its cost effectiveness. It is recommended as part of subsequent stages that more detailed water balance investigations are undertaken which consider the following:

- Actual reuse demands for the irrigation of parklands and gardens;
- Potential storage (MAR);
- Existing irrigation regimes;
- Evaporation and rainfall;
- Detailed design wetland configuration; and
- Associated regulations and requirements, such as the NRM Board's Water Affecting Activity permit.

## 5.8 Managed Aquifer Recharge (MAR)

MAR is the process of adding stormwater and/or treated wastewater to aquifers in a controlled environment. The purpose of MAR is to allow for the extraction and storage of reuse water for irrigation and providing alternative water resources particularly in extended dry periods.

The aquifers within the Rhynie area are typically fractured rock aquifers. The fractures act as channels which convey the groundwater within and around a matrix of rock. The rock matrix acts as the storage reservoir of the groundwater. Therefore, the yield is dependent on the orientation and the amount of fractures that contain groundwater. The hydrogeologic units within this area are known as Skillogalee Dolomite and known to have very low porosity.

Based on a review of bores on the *Water Connect* website this revealed that salinity is typically 1300mg/L and bores have been used domestic and irrigation purposes. Bore yield was typically 0.05L/s and considered too low for the purposes of extraction and injection.

The volume of local stormwater which could be injected into the aquifer is based on the harvestable volumes. The results indicate a total of 14 ML/yr would be available for injection however this would require more detailed water balance to accurately determine the annual injection and extraction rate.

Typically, MAR schemes need to be between 100 to 200 ML/a to be cost effective. Whilst there can be many other factors that support the development of a MAR scheme the limited stormwater supply was considered to be a major limitation on feasibility. Furthermore, stormwater needs to be treated to a high level before it is used in a MAR scheme, usually requiring an area of land for storage which is not available in Rhynie at this present time.

## 6 Recommendations

### 6.1 Structural and Non-structural Measures

Recommendations include structural measures aimed at improving stormwater and flood management, opportunities for stormwater harvesting and reuse, as well as several non-structural measures.

Recommendations with their associated costs and benefits are shown in Table 6-1.

This table also identifies if the catchment area of the proposed works is greater than 40 ha.

TABLE 6-1: RECOMMENDATIONS

| Recommended works   | Preliminary construction cost estimate | Benefits                      |   |
|---|--|-------------------------------|---|
|   |  | Number of buildings protected | Other   |
| F1: Regrade Milne Street to increase ford overflow capacity ( <i>catchment area is greater than 40ha</i> )  | \$40,000                               | 2                             | Improved road trafficability                            |
| F2: Increase channel capacity, bottom width 6m top width 15m, 1.5m deep ( <i>catchment area is greater than 40ha</i> )                                      | \$80,000                               | 3                             | Improved road trafficability                            |
| F3: Provide a levee and flow path around existing dwelling on Rhynie-Balaklava Road ( <i>catchment area is greater than 40ha</i> )                          | \$20,000                               | 2                             | Improved road trafficability                            |
| F4: Regrade Salter Springs Road to move low point in road opposite neighbouring property and upgrade culvert ( <i>catchment area is greater than 40ha</i> ) | \$110,000                              | 2                             | Improved road trafficability                            |
| F5: Create roadside swale and duplicate culverts under Main North Road at intersection of Riverton Road ( <i>catchment area is greater than 40ha</i> )      | \$50,000                               | 1                             | Improved road trafficability                            |
| F6: Formalise swale/overflow path along Bernard Street ( <i>catchment area is less than 40ha</i> )  | \$30,000                               | 1                             | Improved road trafficability                            |
| F7: Provide a contour drain to east of properties on the Main North Road ( <i>catchment area is less than 40ha</i> )  | \$30,000                               | -                             | Prevents nuisance sheet flow through properties         |
| F8: Duplicate culverts under Main North Road ( <i>catchment area for 2 of the culverts is greater than 40ha, and one culvert is less than 40ha</i> )        | \$120,000                              | -                             | Reduced flooding of road. Improved road trafficability. |

| Recommended works  | Preliminary construction cost estimate | Benefits                       |  |
|--|--|--------------------------------|--|
|  |  | Number of properties protected | Other  |
| WQ1: Wetland<br><i>(catchment area is greater than 40ha)</i>   | \$150,000                              | -                              | Reduced pollutant loads.<br>Improved local amenity through 'greening' the streetscape and enhanced sense of place. Potential to enhance biodiversity values.   |
| F9: Regular maintenance of stormwater drainage infrastructure and watercourses   | \$5,000<br>(ongoing cost)              | -                              | An effective drainage system   |
| P1: Flood preparedness program<br>Establish a total flood warning system.<br>Community education program - e.g. Floodsafe<br>(Community/education officer role and associated materials)   | \$30,000<br><br>\$10,000               | -                              | Provides a warning for flood events which provides time for preparation and therefore reduces the risk and impact of flooding.<br>Reduce risk and impacts of flooding.<br>Gain community support for stormwater management.<br>Build capacity of the community to prepare for floods.<br>Improve community's sense of worth and feeling of security.   |
| P2: Development / planning controls:<br>Enforcement and inclusion of flood maps in Council's Development Plan<br>Ensure siting of developments 300mm above surrounding land level.<br>Water quality targets and the NRM Board's resource condition targets to be included in Council's Development Plan<br>Stormwater reuse targets to be included in Council's Development Plan | -                                      | -                              | Reduced risk and cost of flooding to properties and people.<br><br>Protection of health of watercourses and receiving waters as a result of detaining flows and reducing runoff rates by the wetland.<br>Improvements to water quality, enhancements to biodiversity, actions to reduce the risk of erosion and flooding, and the future potential reuse to 'green' the town will help to achieve better planning outcomes associated with open space, recreation and amenity. |

## 6.2 Environmental, Social and Economic Opportunities/Benefits

Environmental enhancement opportunities resulting from the recommended actions in this SMP are predominantly based on the improvements to water quality and better management of stormwater flows. There will also be benefits to watercourses and receiving waters as a result of detaining flows and reducing runoff rates by the wetland. Channel improvements will benefit riparian environments to support native vegetation and wildlife, which would also improve the amenity of the town. These actions will help to protect the receiving environment of the Wakefield River as well as the estuarine and marine environment associated with Gulf St Vincent.

The improved infrastructure aimed at flood control recommended in this SMP will provide social benefits, including improved road trafficability, public safety, protection of property and continuity of community services. The increased standard of drainage and regular infrastructure maintenance will help to prevent nuisance flooding. This will alleviate community frustration and help maintain business trade in the town.

Inclusion of water reuse and treatment objectives in Council's Development Plan will help to ensure the protection of these downstream environments. Developing a wetland will provide an opportunity to detain flows, reduce pollutant loads and alleviate peak flows further downstream. The wetland area has the potential to improve aesthetics, community pride and biodiversity.

Non-structural measures, such as flood preparedness programs, flood warning systems and education will improve the community's capacity to prepare for and manage stormwater issues, as well as create a stronger sense of security within the community. Planning controls (e.g. Council's Development Plan) provide a framework to plan and build in a manner that incorporates stormwater management.

These improvements to water quality, enhancements to biodiversity, actions to reduce the risk of erosion and flooding, and the future potential reuse to 'green' the town will help to achieve better planning outcomes associated with open space, recreation and amenity.

There are also economic benefits as there won't be the same damage costs as there would be without the stormwater infrastructure. The measures help to prevent flooding which will result in less disruption to business trade and transport routes, and also avoid economic losses arising from stormwater issues. The improvements to stormwater management may have a positive impact on business confidence and attract future economic investment in the area.

## 7 Implementation Issues and Funding Opportunities

### 7.1 Priorities and Timeframes for Implementation

The SMA Guidelines recommend that the highest priorities are for works and measures that reduce flood hazard and protect life and property. In accordance to the multi-objective approach to stormwater management, greater weighting should be placed on strategies that also provide opportunities for stormwater reuse, and improvement to water quality, open space/local amenity, biodiversity and recreation.

A subjective assessment of the recommended strategies has been undertaken to determine their ranking and priorities. This assessment is shown Appendix C.

A detailed 10 year program for implementing the recommended strategies has been developed for Council, refer to the Implementation Plan in Appendix D. It provides information on the priorities, timeframes, costs, benefits and potential funding partners.

Notwithstanding this preferred list of actions and timing, the availability and timing of funding and resources will determine the order and staging of the works.

A summary of the priorities is provided on the following page in Table 7-1.

TABLE 7-1: SUMMARY OF PRIORITIES

| Priority | Timeframe                           | Recommendations |   | Capital Cost (\$)    | Recurrent Cost (\$ pa) |
|----------|-------------------------------------|-----------------|---|----------------------|------------------------|
|          | 0 - 1 yr<br>1 - 5 yrs<br>5 - 10 yrs |                 |   |                      |                        |
| 1        | 0 - 1                               | F9              | Regular maintenance of stormwater drainage infrastructure and watercourses  | \$5,000              | -                      |
| 1        | 0 - 1                               | P2              | Development / planning controls: <ul style="list-style-type: none"> <li>Enforcement and inclusion of flood maps in Council's Development Plan</li> <li>Ensure siting of developments 300mm above surrounding land level.</li> <li>Water quality targets and the NRM Board's resource condition targets to be included in Council's Development Plan</li> <li>Stormwater reuse targets to be included in Council's Development Plan</li> </ul> | -                    | -                      |
| 1        | 0 - 1                               | P1              | Flood preparedness program - <ul style="list-style-type: none"> <li>Establish a total flood warning system</li> <li>Community education program</li> </ul>  | \$30,000<br>\$10,000 | \$5,000<br>\$1,000     |
| 1        | 1 - 5                               | F2              | Increase channel capacity   | \$80,000             | \$1,000                |
| 1        | 1 - 5                               | F1              | Regrade Milne Street to increase ford overflow capacity   | \$40,000             | \$1,000                |
| 1        | 1 - 5                               | F3              | Provide a levee and flow path around existing dwelling on Rhynie-Balaklava Rd   | \$20,000             | \$1,000                |
| 2        | 1 - 5                               | F6              | Formalise swale/overflow path along Bernard Street  | \$30,000             | \$1,000                |
| 2        | 1 - 5                               | F5              | Create roadside swale and duplicate culverts under Main North Road at intersection of Riverton Road   | \$50,000             | \$1,000                |
| 2        | 1 - 5                               | F4              | Regrade Salter Springs Road to move low point in road opposite neighbouring property  | \$110,000            | \$1,000                |
| 3        | 5 - 10                              | F7              | Provide contour drain to the east of properties on Main North Road  | \$30,000             | \$2,000                |
| 3        | 5 - 10                              | F8              | Duplicate culverts under Main North Road  | \$120,000            | \$1,000                |
| 4        | 5 - 10                              | WQ1             | Wetland   | \$150,000            | \$10,000               |

## 7.2 Responsibilities for Implementation and Potential Funding Contributions

Council will incorporate stormwater management strategies in its Infrastructure and Asset Management Plan; however, it will need to seek funding contributions from other sources, as described below. The availability and timing of funding and resources will determine the order and staging of the works.

A stormwater management plan that has been approved by the SMA and gazetted is in a good position to attract funding contribution from the SMA to implement the recommendations. The SMA has the discretion to contribute more or less than 50% of the cost of certain works and may elect to contribute to the cost of works in a catchment of less than 40 ha, provided that those works form part of an approved Stormwater Management Plan. To assist in identifying funding opportunities with the SMA, the catchment sizes for the structural measures are provided in Table 6-1.

Council may also be able to secure some funding from the NRM Board, particularly in relation to water quality improvement works. The Commonwealth government also offers grants at various times for the purpose of flood disaster planning and relief.

The Yorke and Mid North Regional Development Board may also be another source of funding for implementing some of the recommended actions in this SMP. For example, the Regional Development Fund (RDF) is an annual grant fund administered by South Australia (Regions SA). This funding is to drive economic growth and productivity by investing in regional infrastructure, creating jobs and new opportunities for regional South Australia.

Responsibilities for implementation of recommendations and potential funding opportunities are presented in Table 7.2, with further details in the Implementation Plan (refer Appendix D).

TABLE 7-2: RESPONSIBILITY FOR IMPLEMENTATION AND POTENTIAL FUNDING / PARTNERSHIP OPPORTUNITIES

| Recommendations |   | Responsibilities for Implementation and Potential Funding  |
|-----------------|---|--|
| F9              | Regular maintenance of stormwater drainage infrastructure and watercourses                          | Council, and in partnership with landholders and the NRM Board as appropriate  |
| P2              | Development / planning controls   | Council  |
| P1              | Flood preparedness program  | Council, with potential partnership and/or funding from BoM and SMA (flood warning system); and SES (community education program)          |
| F2              | Increase channel capacity   | Council to lead design, consultation and construction processes, with potential funding from SMA   |
| F1              | Regrade Milne Street to increase ford overflow capacity   | Council to lead design, consultation and construction processes, with potential funding from SMA   |
| F3              | Provide a levee and flow path around existing dwelling on Rhynie-Balaklava Rd                       | Council to lead design, consultation and construction processes, with potential funding from SMA   |
| F6              | Formalise swale/overflow path along Bernard Street  | Council to lead design, consultation and construction processes  |
| F5              | Create roadside swale and duplicate culverts under Main North Road at intersection of Riverton Road | Council to lead design, consultation and construction processes, with potential funding from SMA. Further consultation with DPTI required. |
| F4              | Regrade Salter Springs Road to move low point in road opposite neighbouring property                | Council to lead design, consultation and construction processes, with potential funding from SMA   |
| F7              | Provide contour drain to the east of properties on Main North Road                                  | Council to lead design, consultation and construction processes  |
| F8              | Duplicate culverts under Main North Road  | Council to lead design, consultation and construction processes. Further consultation with DPTI required.                                  |
| WQ1             | Wetland   | Council to lead design, consultation and construction processes, with potential funding from NRM Board                                     |

### 7.3 Responsibility for Maintenance

The maintenance of watercourses and stormwater infrastructure that is located in **road reserves and council owned land** is normally the responsibility of the council concerned. For **other land** however, there is no legislation specifically identifying this as council's responsibility. Instead, it is the landowners responsibility under the *Natural Resources Management Act* to maintain their land and watercourses in good condition in line with natural resource management practices. Any stormwater infrastructure constructed on **other land** is not the responsibility of the council to maintain unless the council has an interest in the land through an easement etc.

Maintenance of watercourses in good condition may include actions such as removal of weeds and removing any obstacles to flow (e.g. fallen branches, poorly constructed / inappropriate fencing). The NRM Board could also assist landowners by providing information on appropriate natural resource management practices including information on best practice for the maintenance of watercourses.

Information on watercourse management can be found on the following page of the Northern and Yorke NRMB's website:

[http://www.naturalresources.sa.gov.au/northernandyorke/water/managing-water-resources/watercourses/Managing\\_watercourses](http://www.naturalresources.sa.gov.au/northernandyorke/water/managing-water-resources/watercourses/Managing_watercourses)

Councils may also acquire, through an approved and gazetted stormwater management plan, the legislative responsibility to maintain watercourses in other land, including the power to enter such land (with reasonable notice) and to carry out works and infrastructure in accordance with the approved stormwater management plan. The legislative provision for this is contained in the Local Government (Stormwater Management Agreement) Amendment Act 2016.

It is important that the council puts in place the appropriate administrative arrangements to facilitate ongoing maintenance of any permanent infrastructure established on other land as part of this stormwater management plan. Unless otherwise agreed with the landowner, council must take on responsibility for permanent stormwater infrastructure that is to be placed on other land by taking an interest in the land. Examples of such an interest include an easement, a Land Management Agreement (under the Development Act) with the landowner (which would go on the title of the land), or land acquisition.

Examples of recommended stormwater infrastructure works in private land that may benefit from a formal arrangement with the landowner, such as creating an easement, land acquisition or a Land Management Agreement, are provided below:

- New levees
- New contour drains located at rear of properties
- Formulising drainage easements
- Increasing channel capacity

## 8 Review of the Stormwater Management Plan

It is anticipated that this Stormwater Management Plan will be a 'living document' that is periodically reviewed to take account of current knowledge, changing conditions within the catchment and changing community attitudes to the management of stormwater and other water resources making up the urban water cycle.

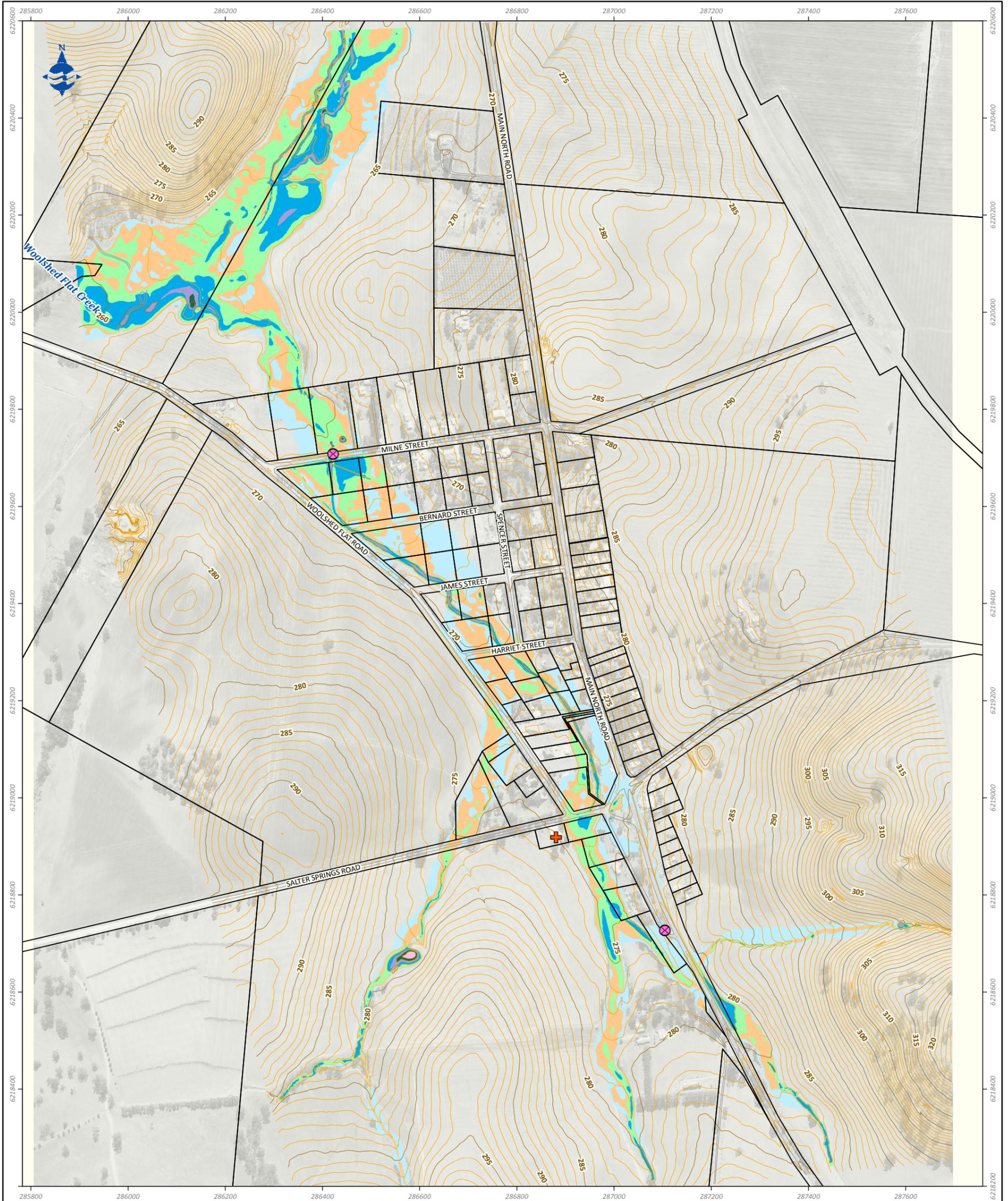
To ensure that this occurs, it is expected that Council initiates a review of this Plan at least every 5 years and that the proposed works and strategies to be adopted for the subsequent 10 year period will be identified.

The SMA recognises that the Plan may need to be amended to account for modifying or elevating the priority of the recommended actions as a result of unforeseen circumstances, provided that the proposed changes are consistent with the overall strategy and properly integrate with any existing or proposed infrastructure, including any Stormwater Management Plan for an adjoining catchment.

## 9 References

- Australian Water Environments (2013) Floodplain Mapping for Seven Townships, prepared for the Clare and Gilbert Valleys Council
- Bureau of Transport Economics (2001) Economic Costs of Natural Disasters in Australia
- Clare and Gilbert Valleys Council - Strategic Directions Report 2012/13
- Clare and Gilbert Valleys Council (2011) Water Security Plan
- Commonwealth of Australia (2009) Flood Preparedness, Manual 20 Australian Emergency Manual Series
- Department for Environment and Heritage (2000). A River Management Plan for the Wakefield Catchment. Government of South Australia
- Department for Water (2011) Stormwater Strategy - The Future of Stormwater Management, Government of South Australia
- Department of Environment, Water and Natural Resources (2013) Water Sensitive Urban Design – Creating more liveable and water sensitive cities in South Australia, Government of South Australia
- Northern and Yorke Natural Resources Management Board (2009) Northern and Yorke Regional NRM Plan – Volume B: Strategic Plan 2009 – 2018, Government of South Australia
- Northern and Yorke Natural Resources Management Board (2009) Northern and Yorke Regional NRM Plan – Volume D: Regulatory and Policy Framework, Government of South Australia
- SCARM (2000) Floodplain Management in Australia: Best Practice Principles and Guidelines. SCARM Report 73, CSIRO Publishing, Australia
- Water for Good (2009) Government of South Australia

## Appendix A : Flood Inundation Maps

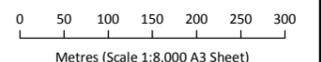


**LEGEND**

- |  |                   |  |                     |  |                   |
|--|-------------------|--|---------------------|--|-------------------|
|  | Bridge or Culvert |  | Water Main Crossing |  | Road Edge         |
|  | Sports Ground     |  | Diameter (mm):      |  | Flood Depth (m):  |
|  | Ambulance         |  | 63; 80; 100; 150    |  | 0 - 0.10          |
|  | Hospital          |  | 200; 250; 375       |  | 0.11 - 0.25       |
|  | Police            |  | 600; 750            |  | 0.26 - 0.50       |
|  | SES               |  | Contours:           |  | 0.51 - 1.00       |
|  | CFS               |  | Index               |  | 1.01 - 1.50       |
|  | Cadastre          |  | Intermediate        |  | 1.51 - 2.50       |
|  |                   |  | Railway             |  | 2.51 - 5.00       |
|  |                   |  |                     |  | Greater than 5.00 |

**Data Source:**

Flood Data, Sports Ground and Railway Extent from AWE; Road Edge, Aerial Imagery and Contours from Aerometrex; Water Mains from SAWater; Bridges from DPTI; Roadnames, Bridges and Cadastre from Clare & Gilbert Valleys Council; CFS from South Australian Country Fire Service; SES from South Australian State Emergency Service; Police Stations from South Australia Police; Hospital from Australian Institute of Health and Welfare; Ambulance from SA Ambulance Service; Watercourses from Geoscience Australia.

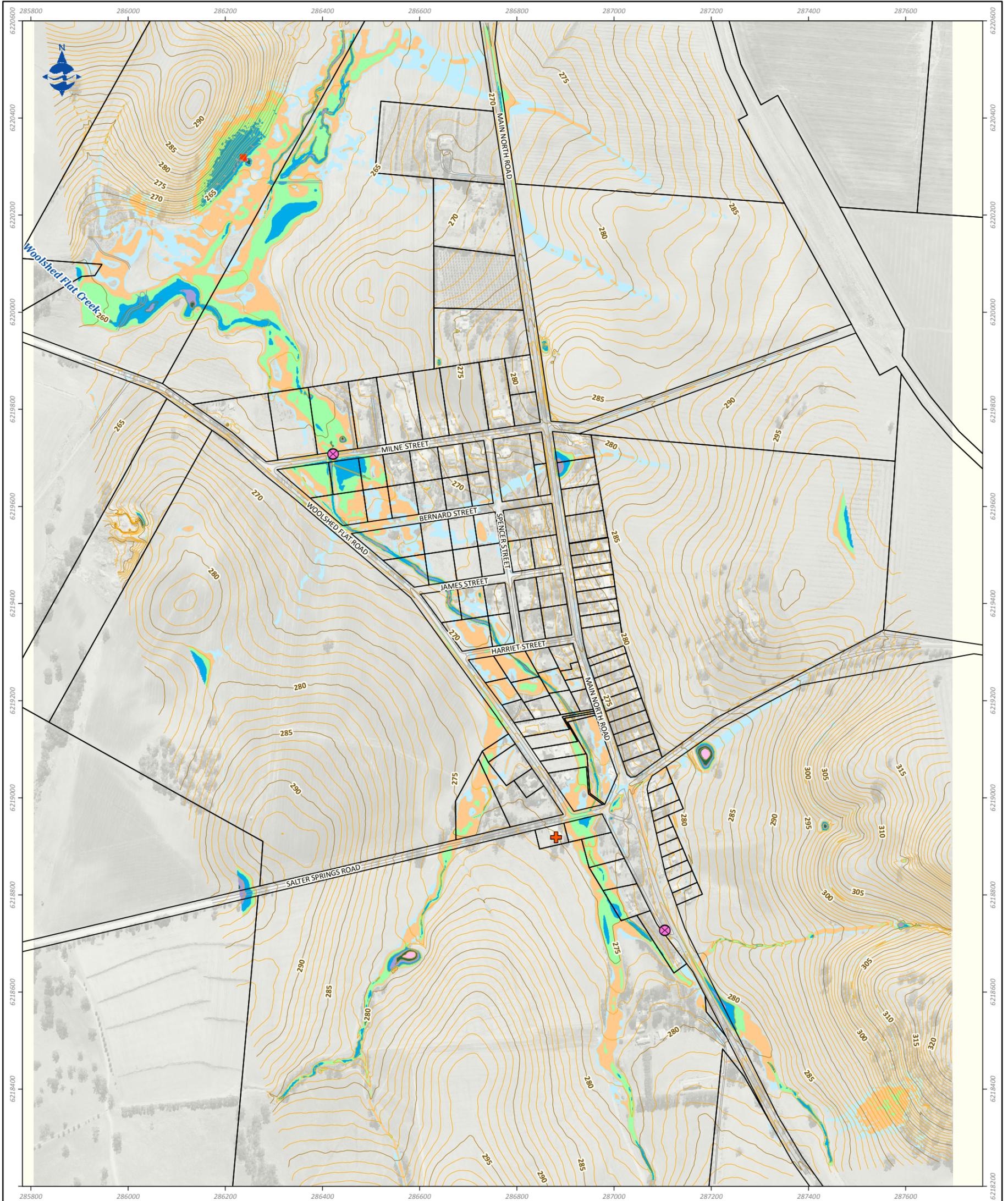


Metres (Scale 1:8,000 A3 Sheet)



Floodplain Mapping for Seven Townships  
Clare and Gilbert Valleys Council

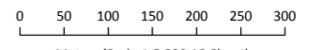
Rhynie (Riverine)  
**100 Year ARI Event Inundation**



**LEGEND**

|  |                   |  |                        |  |                   |
|--|-------------------|--|------------------------|--|-------------------|
|  | Bridge or Culvert |  | Water Main Crossing    |  | Road Edge         |
|  | Sports Ground     |  | 63; 80; 100; 150       |  | 0.05 - 0.10       |
|  | Ambulance         |  | 200; 250; 375          |  | 0.11 - 0.25       |
|  | Hospital          |  | 600; 750               |  | 0.26 - 0.50       |
|  | Police            |  | Contours: Index        |  | 0.51 - 1.00       |
|  | SES               |  | Contours: Intermediate |  | 1.01 - 1.50       |
|  | CFS               |  | Contours: 2.51 - 5.00  |  | 1.51 - 2.50       |
|  | Cadastre          |  | Railway                |  | 2.51 - 5.00       |
|  |                   |  |                        |  | Greater than 5.00 |

**Data Source:**  
 Flood Data, Sports Ground and Railway Extent from AWE; Road Edge, Aerial Imagery and Contours from Aerometrix; Water Mains from SAWater; Bridges from DPTI; Roadnames, Bridges and Cadastre from Clare & Gilbert Valleys Council; CFS from South Australian Country Fire Service; SES from South Australian State Emergency Service; Police Stations from South Australia Police; Hospital from Australian Institute of Health and Welfare; Ambulance from SA Ambulance Service; Watercourses from Geoscience Australia.



Metres (Scale 1:8,000 A3 Sheet)

Government of South Australia  
Stormwater Management Authority

CLARE & GILBERT VALLEYS COUNCIL

Australian Water Environments

Floodplain Mapping for Seven Townships  
Clare and Gilbert Valleys Council

Rhynie (Direct Rainfall)  
100 Year ARI Event Inundation

## Appendix B : Community Feedback



# Rhynie Stormwater Management Plan

## Community Consultation

### Identification of Issues

Consultation with the Rhynie local community was undertaken early in the project (August 2012) to identify their issues and opportunities for stormwater and flood management. The community meeting also provided the opportunity to confirm the accuracy of the modelled flow paths with the community.

A summary of the main issues raised by the community is provided below.

#### ***Stormwater and flooding issues:***

- Watercourse instability;
- Blocked culverts;
- Backing up of water at Ford (Milne Street);
- Town is affected by flows across paddocks from the east and west of the town;
- Town is affected by flows from tributaries that feed into the Wakefield River, such as Woolshed Flat Creek;
- There are high flow rates during larger storm events; and
- There is overgrowth of weeds in the watercourse as well as mosquito problems.

#### ***Aspirations and Opportunities:***

- Explore opportunity to recontour banks to improve the capacity of the watercourse to manage flows, as well as to improve bank stability and as a result improve water quality;
- Explore any ASR potential and potential reuse such as creating a landscape park through the town, and watering of park;
- Need to slow down flows – establish contour banks, buffer strips;
- Revegetate banks;
- Look at using existing dams to capture flows;
- The culverts and ford need to be maintained and reeds in the creeks need to be controlled.

## **Consultation on Draft Strategies**

Feedback on the draft strategies was provided by the Project Steering Committee and the Elected Members. A meeting was held in Rhynie (May 2014) to gain feedback from the local community on the draft strategies. This feedback helped to finalise the recommendations of the SMP.

A summary of the community consultation is provided below.

A meeting was held in Rhynie on 7<sup>th</sup> May 2014 and approximately 17 members of the community attended. Feedback forms were made available to the wider community to provide the opportunity for others to comment.

During the meeting AWE presented the key issues and draft suggested measures, including the impact to controlling flood. The feedback is summarised below.

### ***Discussion:***

- Concern about runoff from eastern paddock – culvert is possibly not in the right place.
- Community to arrange a visit by NRM Board to discuss the management of reeds in the watercourse (congestion).
- There are a number of bores in the town area.

### ***Do you think the measures address stormwater and flooding issues?***

- Yes – a good start.
- Need better maintenance of infrastructure and watercourse management.
- Recheck measures to address local runoff from the east.
- Any changes to the Milne St ford (lowering and regarding) will need to accommodate a range of vehicle types (eg farming vehicles) that use this road.
- Concern about poor drainage/blocked channel adjacent Main North Rd at intersection of Slape Rd.
- Check alignment of the proposed swale along Bernard St to ensure it captures local runoff from the east.

### ***Do you think the measures address water quality, local amenity and reuse options?***

- These are a lower priority compared to flood and stormwater management measures

### ***Are there any issues that Council should be aware of in implementing the suggested measures?***

- The Private properties – how to undertake works in these areas? How to manage fences across the drainage lines and the collection of debris?
- Be aware of the need for the Milne St ford to be trafficable for a range of vehicles.

### ***What are the most important measures?***

The community members present at the meeting were asked to indicate what they thought were the most important suggested measures, as shown in the following table.

**Table - Community Feedback - Most Important Measures**

| Recommended measures  | Which suggested measures do you think are most important?<br><br>(percentage of people's preference) |
|---|--|
| Stormwater and flooding measures:<br><ul style="list-style-type: none"> <li>Regrade Milne Street to increase ford overflow capacity<br/>(Cost \$40,000; protection to 2 properties)</li> </ul>            | 21%  |
| <ul style="list-style-type: none"> <li>Increase channel capacity, bottom width 6m top width 15m, 1.5m deep<br/>(Cost \$40,000; protection to 3 properties)</li> </ul>                                     | 18%  |
| <ul style="list-style-type: none"> <li>Provide levee and flow path around existing dwelling on Rhynie-Balaklava Road<br/>(Cost \$20,000; protection to 2 properties)</li> </ul>                           | 0%   |
| <ul style="list-style-type: none"> <li>Regrade Salter Springs Road to move low point in line with main channel and provide levee for property<br/>(Cost \$110,000; protection to 2 properties)</li> </ul> | 8%   |
| <ul style="list-style-type: none"> <li>Create road side swale and duplicate culverts under Main North Road at intersection of Riverton Road<br/>(Cost \$50,000; protection to 1 property)</li> </ul>      | 8%   |
| <ul style="list-style-type: none"> <li>Formalise overflow path along Bernard Street<br/>(Cost \$30,000; protection to 2 properties)</li> </ul>  | 2%   |
| <ul style="list-style-type: none"> <li>Duplicate culverts under Main North Road<br/>(Cost \$120,000; protect road from flooding)</li> </ul>   | 35%  |
| Water Treatment – Wetland<br>(Cost \$150,000; reduce pollutant loads, improve local amenity and enhance biodiversity)   | 0%   |
| Regular maintenance of stormwater drainage infrastructure<br>(Cost \$5,000)   | 8%   |
| Establishment of a flood warning system<br>(Cost \$30,000)  | 0%   |
| Enforcement and inclusion of flood maps in Council's Development Plan   | 0%   |
| Community education program - e.g. Floodsafe<br>(Cost \$10,000)   | 0%   |

Feedback forms were also available for people to provide comment on the draft strategies. A total of 3 forms were received by Council. Key issues raised included:

- Suggested measures seem to address the key issues.
- Council to be aware of essential services when undertaking works in this area - 0.900mm below the base of the creek at the rear of No 12 Woolshed Flat Road, and at west easement and east easement.
- Concern about flooding in property of the Rhynie Hotel.
- Suggest the creek be widened and deepened.
- Encourage Council to liaise with landowners to identify any interest in people reusing excavated material. That may become available as a result of the works.

## Appendix C : Assessment of Priorities



## Appendix D : Implementation Plan

## Rhynie – Implementation Plan

| Priority | Timeframe<br>0 - 1 yr<br>1 - 5 yrs<br>5 - 10 yrs | Project/ Activity and Location  | Capital Cost<br>(\$) | Recurrent Cost<br>(\$ pa) | Flood Mitigation Benefit<br><i>Measures:</i><br><i>(P) – Properties Affected</i><br><i>(properties protected by measures in the 1 in 100 ARI event)</i> | Water Harvesting Benefit<br><i>Measures:</i><br><i>(V) – Volumetric</i><br><i>(Q) – Qualitative</i> | Water Quality Benefit  |                               |                          | Other Benefits<br><i>Rating:</i><br><i>(H) - High</i><br><i>(M) - Medium</i><br><i>(L) – Low</i><br><br>Qualitative description of benefit  | Potential funding partners with Council |
|----------|--|---|----------------------|---------------------------|---|---|--|-------------------------------|--------------------------|---|---|
|          |  |   |                      |                           |   |   | <i>Rating:</i><br><i>(H) - High</i><br><i>(M) - Medium</i><br><i>(L) – Low</i> | Benefit to whole of catchment | Benefit to township only |   |   |
| 1        | 0 - 1  | F9: Regular maintenance of stormwater drainage infrastructure and watercourses  | \$5,000              | -                         | Effective drainage and therefore reducing risk of flooding.   | -   | -  | -                             | -                        | Improved sense of security and wellbeing amongst the community.   | -                                       |
| 1        | 1 - 5  | F1: Regrade Milne Street to increase ford overflow capacity   | \$40,000             | \$1,000                   | 2 properties protected  | -   | -  | -                             | -                        | Improved road trafficability  | SMA                                     |
| 1        | 1 - 5  | F2: Increase channel capacity, bottom width 6m top width 15m, 1.5m deep   | \$80,000             | \$1,000                   | 3 properties protected  | -   | -  | -                             | -                        | Improved road trafficability  | SMA                                     |
| 1        | 1 - 5  | F3: Provide a levee and flow path around existing dwelling on Rhynie-Balaklava Road   | \$20,000             | \$1,000                   | 2 properties protected  | -   | -  | -                             | -                        | Improved road trafficability  | SMA                                     |
| 1        | 0 - 1  | <b>P2:</b> Development / planning controls  | -                    | -                         | Reduced risk and cost of flooding to properties and people.   | -   | -  | -                             | -                        | Better planning and development outcomes.<br>Improved sense of security and wellbeing amongst the community.  | -                                       |
| 2        | 1 - 5  | F4: Regrade Salter Springs Road to move low point in road opposite neighbouring property  | \$110,000            | \$1,000                   | 2 properties protected  | -   | -  | -                             | -                        | Improved road trafficability  | SMA                                     |
| 2        | 1 - 5  | F5: Create road side swale and duplicate culverts under Main North Road at intersection of Riverton Road                                  | \$50,000             | \$1,000                   | 1 property protected  | -   | -  | -                             | -                        | Improved road trafficability  | SMA                                     |
| 2        | 1 - 5  | F6: Formalise swale/overflow path along Bernard Street  | \$30,000             | \$1,000                   | 2 properties protected  | -   | -  | -                             | -                        | Improved road trafficability  | -                                       |
| 1        | 0 - 1  | P1: Flood preparedness program - Flood warning system   | \$30,000             | \$5,000                   | -   | -   | -  | -                             | -                        | Provides a warning for flood events which provides time for preparation and therefore reduces the risk and impact of flooding.<br>Community awareness raised and people are empowered to protect their properties and response – thereby significantly reducing flood damages.<br>Improved sense of security and wellbeing amongst the community. | BoM, SMA                                |
| 1        | 0 - 1  | P1: Flood preparedness program - Community education program - e.g. Floodsafe (Community/education officer role and associated materials) | \$10,000             | \$1,000                   | -   | -   | -  | -                             | -                        | Reduce the risk of flooding and impacts of flooding.<br>Gain community support for implementation and ongoing management of the stormwater management measures.<br>Build the capacity of the community to prepare for floods as well as reduce risk of flooding.<br>Improve the community's sense of worth and feeling of security.               | SES                                     |

| Priority | Timeframe<br>0 - 1 yr<br>1 - 5 yrs<br>5 - 10 yrs | Project/ Activity and Location   | Capital Cost<br>(\$) | Recurrent Cost<br>(\$ pa) | Flood Mitigation Benefit<br><i>Measures:</i><br><i>(P) – Properties Affected</i><br><i>(properties protected by measures in the 1 in 100 ARI event)</i> | Water Harvesting Benefit<br><i>Measures:</i><br><i>(V) – Volumetric</i><br><i>(Q) – Qualitative</i> | Water Quality Benefit  |                               |  | Other Benefits<br><i>Rating:</i><br><i>(H) - High</i><br><i>(M) - Medium</i><br><i>(L) – Low</i><br>Qualitative description of benefit | Potential funding partners with Council |
|----------|--|--|----------------------|---------------------------|---|---|--|-------------------------------|--|--|---|
|          |  |  |                      |                           |   |   | <i>Rating:</i><br><i>(H) - High</i><br><i>(M) - Medium</i><br><i>(L) – Low</i> | Benefit to whole of catchment | Benefit to township only   |  |   |
| 3        | 5 - 10   | F7: Provide contour drain to east of properties on the Main North Road | \$30,000             | \$2,000                   | Prevents nuisance sheet flow through properties   | -   | -  | -                             | -  | Prevents nuisance sheet flow through properties  | -                                       |
| 3        | 5 - 10   | F8: Duplicate culverts under Main North Road                           | \$120,000            | \$1,000                   | Reduced risk of road flooding.  | -   | -  | -                             | -  | Reduced risk of road flooding. Improved road trafficability.   | -                                       |
| 4        | 5 - 10   | WQ1: Wetland   | \$150,000            | \$10,000                  | -   | Harvestable volume: 14,000 kL   | Low  | Low                           | Reduced pollutant loads:<br>Reduce TSS by 6,760 kg/yr, TP by 17 kg/yr and TN by 108 kg/yr.<br>Achieves State Government targets (Water Sensitive Urban Design, 2013) for whole of town reduction in pollutant loads.<br>Achieves Environment Protection (Water Quality) Policy 2003.<br>Supports Council's Development Plan principles for managing and improving quality of stormwater runoff.<br>Also helps support s NRMB's resource condition targets for maintaining and improving water quality in aquatic environments. | Improved local amenity through 'greening' the streetscape and enhanced sense of place.<br>Potential to enhance biodiversity values.    | NY NRMB                                 |