



CITY OF  
BALLARAT

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# STORMWATER MANAGEMENT PLAN Vol 1

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**prepared by:**

***The Water Group***

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# EXECUTIVE SUMMARY

## A Scope of the Plan

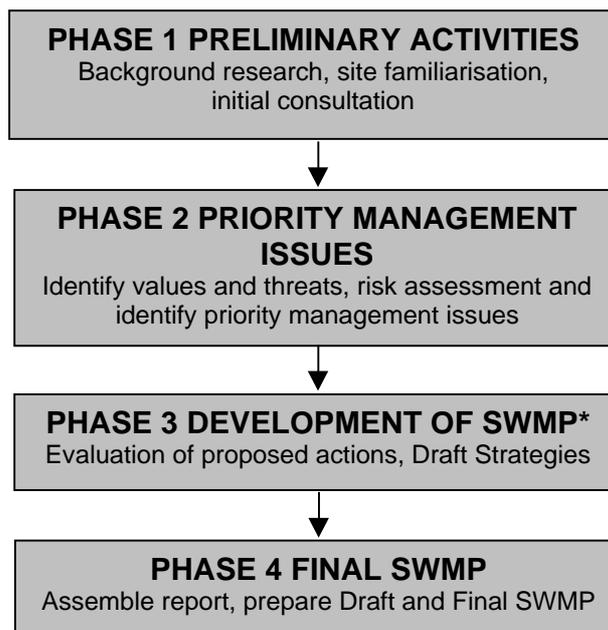
The Ballarat Stormwater Management Plan has been prepared as part of the state-wide program to develop Municipal Stormwater Management Plans throughout Victoria to meet the standards of the State Environment Protection Policy (SEPP) "Waters of Victoria". The Plan identifies and documents strategies for improving urban stormwater quality so that the State standards contained in the *Urban Stormwater Best Practice Environmental Management Guidelines 1999* can be met. This Plan therefore focuses on the management of stormwater **quality** and on stormwater quantity issues where they impact on the health of receiving water environments. The Plan focuses on land that is drained by the reticulated stormwater system but does not address specific drainage or flooding issues which are managed by Flood Management Plans. This Stormwater Management Plan should be seen as one of the tools used as part of an integrated catchment management approach to achieving improved environmental practices.

The Plan documents values to be protected and restored in the City of Ballarat's waterways, and outlines clear, prioritised strategies to improve the quality of stormwater from existing urban areas, and to proactively implement best practice management for newly developing areas.

During the Plan's development, there has been close consultation with the City of Ballarat and partnership agencies to generate commitment and awareness of the stormwater issues. This involvement in the Plan's development has established the basis for ongoing co-operation and implementation by the Council and various agencies. The Plan is largely non-technical and consists of actions that impact on the planning scheme, education and environmental services, operations and maintenance programs and design and infrastructure works.

## A1 Methodology

The project was undertaken in consultation with the relevant agencies and stakeholders who currently have a role in effective stormwater management in the City of Ballarat. The following broad project methodology was followed:



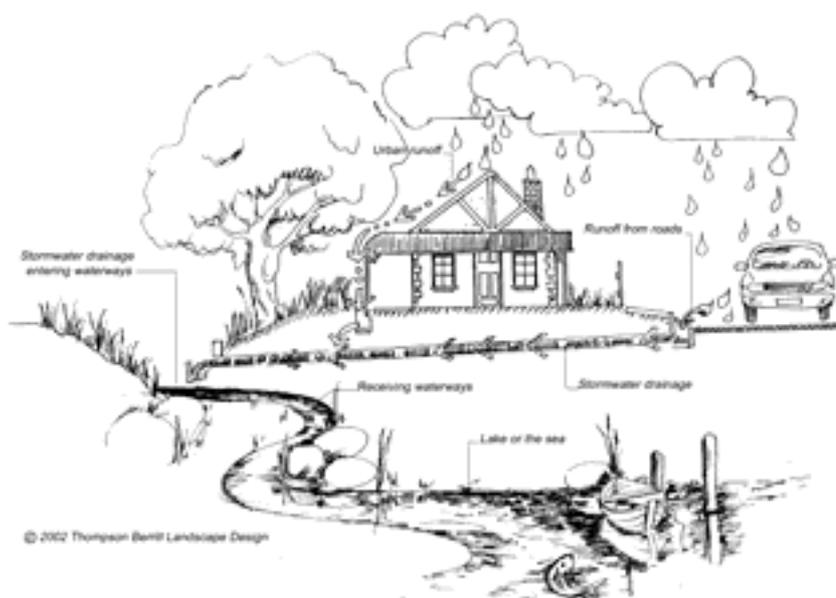
\*SWMP - Stormwater Management Plan

## B What is Stormwater and why does it matter?

Stormwater is the runoff from our streets and outdoor hard surfaces (including roofs in the majority of urban areas) which is collected in the stormwater drainage system. Stormwater does not include sullage (grey water) or sewage. The standard underground stormwater drainage systems were developed with urbanisation to effectively transport rainwater away from urban environments as quickly as possible to facilitate settlement free from flooding.

Historically, there was no consideration given to the quality of stormwater, or to the downstream impacts. There is now an awareness that as the stormwater flows over sealed and unsealed surfaces it accumulates pollutants and sediments that are then transported to the waterways causing a decline in the ecological health and diversity of waterway environments. In addition, the increased impervious areas results in an increase in both the volume and rate of runoff, causing erosion and degradation of downstream waterways.

This Plan is focused on measures to decrease the amount of pollutants and sediments entering the receiving waterway environments and protection of downstream waterways from channel erosion and habitat loss.



**FIGURE 1 WHAT IS STORMWATER?**

## C Key Issues identified on a municipality-wide basis

The project identified a number of key issues that need to be addressed as a priority. These are called Priority Management Issues in the Plan.

- There is a need to protect the water-based recreational and environmental values from water quality decline in the lakes in and around Ballarat. The water-based recreational activities include swimming, waterskiing, rowing, fishing and boating
- Identify and protect heritage values associated with the receiving waterway environments in any future stormwater infrastructure design and vegetation management programs

- Unsealed roads and unsealed road verges in urban areas require management to minimise sediment loads, whilst protecting their existing cultural and heritage values
- Industrial areas need to be managed to minimise point source pollution discharge
- Management of flood risks in the city may constrain water quality treatment opportunities. Creative approaches, utilising structural and non-structural components, will therefore be required. In many cases, a 'win-win' situation will be possible
- Current planning documents, including Outline Development Plans (ODP) and other structure plans, do not contain best practice management of urban stormwater, including construction and design matters, and these issues need to be incorporated into the review of the municipal planning scheme
- There is a need to incorporate best practice urban stormwater management into future Outline Development Plans or other structure plans as required
- There is a lack of integration of flood and stormwater management information in the planning scheme and appropriate Council planning documents. This is an impediment to the adoption of water sensitive urban design within the City of Ballarat
- There is a lack of co-ordination and adequate funding to allow infrastructure planning and asset management areas of Council to achieve optimum performance of the existing retarding basins for flow attenuation and water quality treatment
- There is a need to reduce the threat of sewer overflows to receiving waters

## **D Priority Actions from Strategies to address key issues**

To address the priority issues identified, Actions have been developed and assigned a code to identify its type, for ease of implementation by Council. The Action types include Land Use Planning, Regulation and Enforcement, Education and Awareness, Municipal Operations, Stormwater Treatment Measures and Flow Control Measures. Each Action developed addresses one or more of the Priority Management Issues identified in the Plan. The Priority Management Issues usually require a combination of Actions to effectively manage them (for example, a litter problem may be best addressed by the combined use of a Stormwater Treatment Measure (eg. Gross Pollutant Trap) and Education and Awareness). The grouping of several Actions together to effectively manage a given Priority Management Issue is called a Strategy. Below is a list of some of the Priority Actions from the Strategies.

### **D1 Overall**

- Create a permanent position within Council for a Stormwater Co-ordinator to promote improved stormwater management within Council and co-ordinate the implementation of the Plan

### **D2 Land Use Planning Actions**

- Amend the Ballarat Planning Scheme to include requirements for Best Practice Stormwater Management in Ballarat
- Incorporate a local planning policy for stormwater management in the Ballarat Planning Scheme and indicate how development will be treated in the planning process
- Review or prepare structure plans for major development areas and incorporate in the Ballarat Planning Scheme as local planning policy
- Review Council engineering subdivision and site development standards for private development

### **D3 Municipal Operations Actions**

- Review Council's road and drainage construction and maintenance work practices in accordance with Best Practice Environmental Management Guidelines (BPEMG) for Urban Stormwater Management
- Review Council's building design standards for capital works projects
- Establish a Stormwater Management Forum with external agencies for information exchange and co-ordinating the SWMP implementation
- Develop a design for unsealed road verges that improves water quality from road runoff
- Review Council's Park and Environment maintenance contract and revise in accordance with BPEMG for Urban Stormwater Management
- Liaise with Central Highlands Water to prioritise sewer maintenance and upgrade works, to protect important receiving waters

### **D4 Education and Awareness Actions**

- Education campaign targeted at the traders in CBA of Ballarat in conjunction with the Ballarat Chamber of Commerce to improve understanding of Best Practice Environmental Management (BPEM) of Urban Stormwater. Once developed, this campaign will be targeted in other commercial centres through the City of Ballarat
- Undertake a training program for Council staff to improve their knowledge of BPEM of Urban Stormwater
- Undertake an education program for developers and builders to explain the purpose of introducing BPEMG for stormwater

### **D5 Regulation and Enforcement Actions**

- Implement a municipal local law to address construction site management

### **D6 Structural Treatment Measures Actions**

- Construct the Yarrowee/Redan Wetlands
- Install Gross Pollutant Traps (GPT) at selected locations identified in this Plan
- Retrofit selected existing retarding basins with low flow treatment wetlands
- Install side entry pit traps in selected commercial centres (eg CBA)
- Construct porous embankments at existing drain outfalls to Lake Wendouree

### **D7 Flow Control Measures Actions**

- Construct new Retarding Basins where required with incorporated low flow treatment wetlands (eg. Paul's Basin Wetland).

# ACKNOWLEDGEMENTS

TWG wish to thank the Steering Committee and Project Working Group for all their time and input to the development of this plan.

Specifically TWG would like to thank Uldis Neilands as the Council's Project Manager for the SWMP for all his work in arranging for the meetings, venues, coordinating feedback from the committees and overall support and input to the project.

## Steering Committee

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## Project Working Group

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**Community Groups**

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Jenny Sedgewick	Leigh Catchment Group
Mike Caldwell	Lake Burrumbeet Advising Committee

# DEFINITIONS & ABBREVIATIONS

## Definitions:

Term	Description
Actions	The individual recommendations to address a given PMI.
Aquatic environment	Describes the environment within a waterway, and therefore refers to values or threats to organisms which live in water.
Implementation Framework	The implementation framework establishes management arrangements for ensuring strategies are implemented in a coordinated and effective way, with regular monitoring to review progress.
Management Framework Strategies	Actions to manage issues or gaps identified in Council's approach to planning, design and operations. Management Framework Strategies are intended to be proactive, seeking to prevent future stormwater degradation.
Priority Management Issue (PMI)	Highest priority issues identified from the Risk Assessment Process to be addressed by this SWMP.
Reactive Strategies	Actions to manage existing on-ground issues. Reactive strategies primarily focus around structural treatment and flow control measures.
Receiving water	A water body or waterway (e.g. river, stream, lake or wetland) which receives urban stormwater flows.
Riparian environment	Describes the environment next to a waterway, including the banks and adjacent floodplain. The riparian zone is very important to the overall health of a waterway, as it contributes shade, nutrients and organic matter.
Stormwater quality	A combination of the rate of stormwater flow and the pollutant load carried in urban stormwater.
Strategies	The combination of Actions to create Strategy to manage each PMI.

## Abbreviations:

CBA	Central Business Area of Ballarat (The Business area only, not the urban area).
CCMA	Corangamite Catchment Management Authority
CHW	Central Highlands Water
CMA	Catchment Management Authority
COB	City of Ballarat
EPA	Environment Protection Authority
GHCMA	Glenelg Hopkins Catchment Management Authority
LINCS	Linear Networks of Communal Spaces
NRE	Department of Natural Resources & Environment
PMI	Priority Management Issue
SRW	Southern Rural Water
SWMP	Stormwater Management Plan
TWG	The Water Group
MFS	Management Framework Strategies

# 1.0 INTRODUCTION

## 1.1 The brief

### Key Tasks

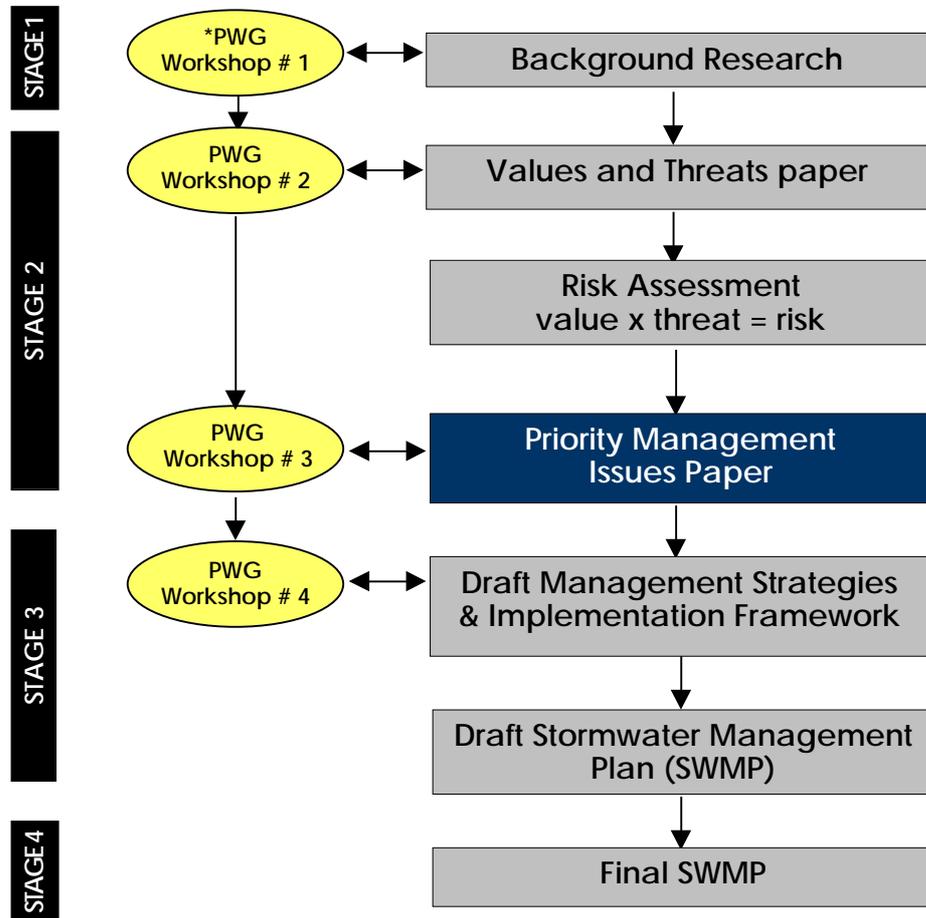
- Lead a process with Council and necessary stakeholder group meetings to establish a detailed work program outlining various suitable outcome based projects for the municipality based on the updated version of Chapter 3 of the Best Practice Environmental Management Guidelines for Urban Stormwater 1999 (CSIRO);
- Providing ongoing facilitation, technical support and all resources necessary to complete the project;
- Identify and implement processes for successful involvement of other stakeholders;
- Identify opportunities to integrate the stormwater management plan objectives and strategies into other planning and management activities of Council;
- Prepare stormwater management plans for each of the Councils, based on recommended model; and
- Prepare a brief report on the project.

### Key Outputs

- A detailed, prioritised output based program of works for each municipality that will satisfy future funding requirements;
- Suggested changes to planning schemes, MSS, policies and permit conditions;
- Target groups for education programs or enforcement;
- Specific locations for target programs (eg a particular industrial or commercial area or receiving environment);
- The need for coordination with others;
- Training and education requirements to ensure effective implementation of actions;
- Responsibility for leading implementation ie. Council departments, CMA, EPA or others;
- The type, location and indicative cost of structural treatment measures;
- Indicative costs of implementing strategies and actions; and
- Suggested performance measures.

## 1.2 Methodology

The project methodology has been undertaken for this project in accordance with that described in the revised Chapter 3 from the Best Practice Environmental Guidelines for Urban Stormwater. This revised Chapter describes the proposed methodology in detail. Below is a brief flow chart of the project methodology, and for further detail, refer to the revised Chapter 3.



**FIGURE 2 SCHEMATIC METHODOLOGY**

\* PWG = Project Working Group

- Stages nominated above correspond with stages in Chapter 3 of the Best Practice Environmental Management Guidelines (BPENG) for Urban Stormwater.

## 1.3 Report Structure

### **Summary Report - Volume 1**

Executive Summary  
 Background information  
 Methodology  
 Summary of the values, threats and risk assessment process  
 Priority Management Issues  
 Strategies  
 Implementation Framework

### **Appendices - Volume 2**

Detailed Values and Threats Paper  
 Risk Assessment Tables  
 Draft Strategies Evaluation Tables  
 Action tables by type - eg by Land Use Planning, etc.

## 1.4 Agency Responsibilities

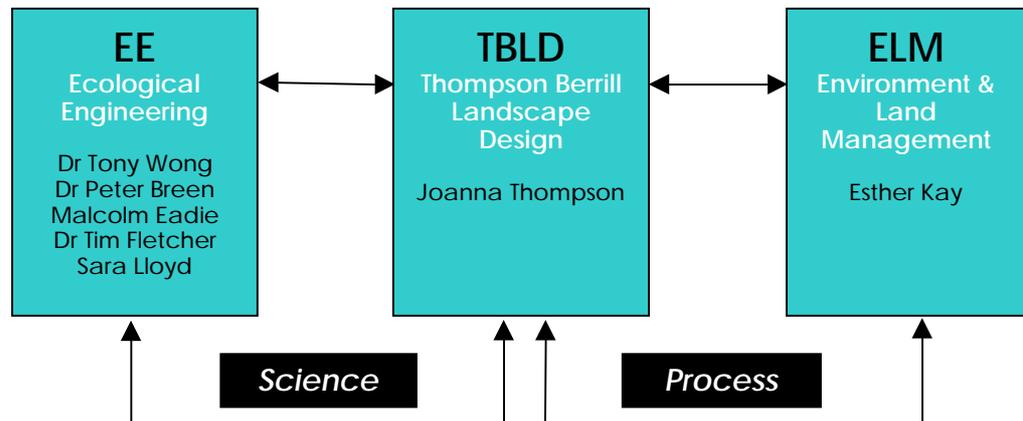
Agency	Responsibilities relevant to the SWMP
Dept of Natural Resources and Environment (NRE)	<ul style="list-style-type: none"> <li>▪ Management of Crown Water frontages and other Crown land reserves.</li> <li>▪ Management of flora and fauna.</li> <li>▪ Bulk Water entitlements. (Environmental flows).</li> </ul>
Catchment Management Authorities : Corangamite CMA, Glenelg-Hopkins CMA & North Central CMA	<ul style="list-style-type: none"> <li>▪ Development and implementation of Regional Catchment Strategy and Waterway Health Strategy.</li> <li>▪ Strategic direction for land and water resource management.</li> <li>▪ Waterway, floodplain and rural drainage management.</li> <li>▪ Community education and involvement in waterway health.</li> <li>▪ Development of water quality and nutrient management plans.</li> <li>▪ Regional oversight of National Heritage Trust process (NHT).</li> <li>▪ Provision of funding support for projects, which aim to protect and enhance waterway health and water quality.</li> <li>▪ Licensing of works on waterways.</li> </ul>
Southern Rural Water (SRW) (supplies rural irrigation and potable domestic water)	<ul style="list-style-type: none"> <li>▪ Water allocation for private and industrial users.</li> <li>▪ Stream flow management plan.</li> </ul>
Central Highlands Water (CHW) (provides reticulated water and sewer)	<ul style="list-style-type: none"> <li>▪ Waterwatch</li> <li>▪ Reticulated water supply</li> <li>▪ Wastewater management</li> </ul>

Agency	Responsibilities relevant to the SWMP
City of Ballarat	<ul style="list-style-type: none"> <li>▪ Administer and review planning schemes</li> <li>▪ local drainage authority</li> <li>▪ Management of Council-owned or Crown land (where acting as Committee of Management) adjacent to waterway.</li> <li>▪ Manage municipal infrastructure (e.g. roads, drainage systems) which may impact on receiving waters.</li> </ul>
Environment Protection Authority (EPA)	<ul style="list-style-type: none"> <li>▪ License sewerage and other discharges to the environment</li> <li>▪ Monitor water quality</li> <li>▪ Produce and enforce State Environment Protection policies for the protection of surface water and groundwater.</li> <li>▪ Administer Victorian Stormwater Action Program and provide funding support for development and implementation of Stormwater Management Plans</li> </ul>
Highlands Regional Waste Management Group	<ul style="list-style-type: none"> <li>▪ Taskforce made up of local Municipalities, charged with the responsibility of developing strategies and programs for reducing litter pollution, and waste generation.</li> <li>▪ Play a role in reducing the generation of gross pollutants, and their subsequent transport into receiving waters.</li> </ul>
Vic Roads	<ul style="list-style-type: none"> <li>▪ Main road crossing of waterways and floodplains</li> <li>▪ Management of urban stormwater run off from major roads</li> <li>▪ Emergency response plan for containment of spills associated with major roads.</li> </ul>
Ballarat Chamber of Commerce	<ul style="list-style-type: none"> <li>▪ Peak body representing commerce and industry within the City of Ballarat.</li> <li>▪ Can play a key role in educating members about the importance and benefits of responsible stormwater management.</li> </ul>
Lake Burrumbeet Committee of Management	<ul style="list-style-type: none"> <li>▪ Group delegated with responsibility for overseeing the management of Lake Burrumbeet and environs.</li> <li>▪ Have a keen interest in ensuring the Lake is protected from urban stormwater pollution, and habitat degradation.</li> </ul>
Landcare Groups (e.g. LINCS)	<ul style="list-style-type: none"> <li>▪ Community-based action groups working to address land and water resource management issues</li> <li>▪ Community education</li> </ul>

## 1.5 Project Team

The Water Group (TWG) is a consortium of firms who have come together through a mutual desire to improve the environmental performance of the urban water cycle including the urban stormwater system.

Central to our project team structure is an understanding of the importance of integration, input and participation across the different disciplines of science and process, as illustrated in the diagram below.



Within the structure of The Water Group, stormwater management plans are developed with the following skills and expertise:

EE provides scientific and engineering expertise, facilitating the development of practical solutions to stormwater management problems. EE has extensive experience in the assessment of waterway health, and the development of strategies to address impacts of urbanisation. These include the design of stormwater treatment measures (e.g. wetlands or biofiltration systems), and the integration Water Sensitive Urban Design objectives.

TBLD provide identification of the receiving water values that require protection from urban stormwater impacts, Project Management, Workshop design and facilitation, development of strategies to improve community education and municipal operations within council, production of all papers and final report.

ELM provides integration of land use and development with best practice stormwater management as well as incorporation of desired environmental outcomes in the planning system.

# 2.0 SWMP CONTEXT

## 2.1 State-wide Context



FIGURE 3 STATE-WIDE CONTEXT FOR STORMWATER MANAGEMENT PLANS

### 2.1.1 State Environment Protection Policies (SEPP)

#### SEPP (Waters of Victoria)

The policy identifies the 'beneficial uses' of the waterways and establishes environmental quality objectives that ensure protection of these uses.

#### Beneficial uses include:

- natural aquatic ecosystem and associated wildlife
- water based recreation
- agricultural water supply
- potable water supply
- production of molluscs for human consumption
- commercial and recreational use of edible fish and crustacean
- industrial water use

SEPP (Waters of Victoria) requires that run-off from urban and rural areas must not compromise the identified beneficial uses of receiving waters (listed above)

## 2.1.2 Stormwater Committee

The Stormwater Committee was formed in partnership between Environment Protection Authority (EPA), Melbourne Water Corporation (MWC) and Municipal Association of Victoria (MAV) aimed at improved stormwater quality. This Stormwater Committee commissioned the preparation of the *Urban Stormwater Best Practice Environmental Management Guidelines*<sup>1</sup>.

## 2.1.3 Best Practice Environmental Management Guidelines for Urban Stormwater

The *Urban Stormwater Best Practice Environmental Management Guidelines* were developed by the Stormwater Committee with contributions from a wide range of industry leaders including several members of The Water Group. The guidelines were published in 1999 by the CSIRO. These contain the recommendations for all Council's to prepare ***Stormwater Management Plans to guide local government to achieve best practice in environmental management of stormwater***

## 2.1.4 Victorian Stormwater Action Program (VSAP)

To facilitate the implementation of these plans the Victorian Government Launched the **Victorian Stormwater Action Program (VSAP) with committed funding to resource outcomes from Stormwater Management Plans. This program had \$22.4 million committed to it over 3 years, commencing in 2000.** The EPA is co-ordinating this program, with an Advisory Committee, which provides advice on the development and implementation of the VSAP. This committee contains representatives from the EPA, local government, Melbourne Water, Catchment Management Authorities, Department of Infrastructure, Department of Natural Resources and Environment, peak conservation and environment bodies, and community groups.

As part of the VSAP programs there are a number of state-wide guidelines being developed. These include:

- Carwash retrofitting to recycle water
- Rooftop greening using stormwater
- Council contract specifications
- Building and development project management of stormwater issues
- Monitoring, evaluation and protocols for structural and non-structural treatments
- Local Government Planning and Training for stormwater issues
- Domestic wastewater link project
- Independent Stormwater Management Plan review

## 2.2 Municipal Urban Stormwater Management Plans

### 2.2.1 The intent of the SWMP

A better understanding of how urban stormwater affects receiving waters is creating a widespread recognition that stormwater flows are a resource, rather than just a “drainage problem”, and that they can play an important environmental role in the urban landscape.

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<sup>1</sup> *Urban Stormwater Best Practice Environmental Management Guidelines*, 1999, CSIRO Publishing, Melbourne. Compiled by Melbourne Water, Victoria's Environment Protection Authority and Department of Natural Resources and Environment, Municipal Association of Victoria and CSIRO.

This recognition has resulted in a trend towards managing urban stormwater for a *range of objectives*, including drainage, environmental values, landscape amenity, and water re-use.

It is important to recognize that the impacts of urban stormwater extend beyond water quality degradation. Increased impervious area and drainage connectivity within urban catchments results in major disturbance to the natural flow regimes, with a subsequent increase in flow volumes, and in peak discharge. The consequences of this include channel erosion, sediment transport, habitat smothering, and ultimately, a loss of biodiversity.

Municipal stormwater management plans seek to create a cultural change in the way stormwater is thought about and managed on both public and private land. The plans then identify and document ways of improving urban stormwater quality so that State standards contained in the *Urban Stormwater Best Practice Environmental Management Guidelines* 1999 can be met. The strategies contained in the plan ensure that further degradation of receiving waters is reduced or prevented and, where complementary restoration programs are undertaken, the decline can be reversed and ecological health re-established.

Therefore, at a practical level, stormwater management plans provide a program to improve the quality of stormwater from existing urban areas and to proactively implement best practice management for newly developing areas. The focus is on land, which drains through a reticulated stormwater system. In country municipalities the boundary between urban stormwater, semi-formal drainage and rural runoff is not always easy to define. Stormwater management should be seen as one of the tools used as part of an integrated catchment management approach.

A SWMP provides a strategic basis for council and its partnership agencies to improve their environmental management of urban stormwater in the short and long term.

Specifically they are intended to:

- generate **commitment** to and awareness of best practice environmental management of stormwater (this is in some ways, the most important outcome of the plan)
- identify **priority issues** using a risk-based approach
- develop **management strategies** to address the priority issues and risks
- establish a basis for **ongoing co-operation** and co-ordination between different sections of the council and between different agencies
- Ensure the **effective integration of any actions** by all partners.

Plans are largely non-technical and will consist of actions and recommendations that feed directly into council's business and strategic planning.

Actions impact on:

- planning schemes
- education and environmental services
- operations and maintenance programs

## 2.2.2 Standard approach for the development of the plans

Municipalities throughout Victoria are progressively preparing and implementing urban stormwater management plans. Development of plans includes coordination with State and regional authorities operating in the municipal area. The program was originally sponsored by Melbourne Water, which provided part funding for plans in the Melbourne metropolitan area. Melbourne Water is completing the program in the metropolitan area. The EPA has now taken lead responsibility for preparing stormwater management plans in other areas of Victoria and for providing funding incentives for implementation activities, where plans have been completed.

Preparation of stormwater management plans is guided by the *Urban Stormwater Best Practice Environmental Management Guidelines* 1999. Plans must identify strategies to put best practice non-structural and structural measures into place through a formal Implementation Framework. Non-structural measures deliver cultural change in approaching stormwater management. Structural measures are the physical works needed to achieve State stormwater objectives. Ideally, both should be implemented in a co-ordinated and integrated manner. Chapter 3 contains comprehensive guidelines for development of stormwater management plans, and refers to non-structural measures as “management framework strategies” and structural measures as “reactive strategies”.

The Chapter 3 guidelines are intended to act as a “minimum standard” for development of the stormwater management plans, with innovation and tailoring to the specific requirements of each Municipality encouraged. This approach has been adopted in development of the Ballarat Stormwater Management Plan.

## **2.3 The case for the Best Practice Environmental Management of Urban Stormwater**

### **2.3.1 Impacts of urbanisation on receiving waters**

Urban stormwater systems collect runoff from outdoor areas. Traditionally this runoff has been directed into pipes or drainage channels and transported as quickly as possible without treatment to the nearest outlet such as a stream or lake, without regard for the environmental consequences. Waterways and water bodies that receive urban stormwater are termed “receiving waters”. Stormwater systems can be differentiated from a sewerage system, which collect wastewater and transport it to a treatment plant before it is released.

Two stormwater factors affect receiving waters. These are the rate of storm flows moving through the system and the pollutant load. Both of these factors are measurements of the overall *stormwater quality*.

Urbanisation and traditional urban stormwater systems increase the rate of storm flows. Flow volumes and velocity increase as a result of increased impervious area. The impervious areas (e.g. roads, footpaths, roofs) prevent infiltration of rainfall into the ground, resulting in a much higher proportion of rainfall ending up as “runoff”. Urban stormwater systems capture this runoff primarily to avoid local inundation and/or flooding. These piped systems are very effective conveyors of flows, resulting in a ‘concentration’ of flows into a short space of time. A concentrated volume of runoff carries sufficient energy to dislodge banks and sensitive vegetation, and disrupt local habitats. As incremental development occurs, even frequent ‘small’ storms will cause these effects (due to increased flow rates). Increased frequency of these “disturbance events” means that aquatic ecosystems do not have time to regenerate and recover. Bank erosion, habitat smothering, flooding and decline in species dependent on instream habitat are the visible, long term result.

Where regular flooding occurs, waterways can be modified to carry larger stormwater flows. Engineering solutions include construction of levees, streambank reinforcement and, where a large number of buildings are threatened, channelisation. These works further reduce natural functions, separating the waterway from its floodplain, and can have multiple downstream effects. These types of engineering solutions have been employed in the past in the City of Ballarat, as they have worldwide. It is only recently that the long-term environmental degradation resulting from these approaches have been recognized.

Storm flows also carry pollutants picked up from the atmosphere and the ground. Urban pollutants can be toxic, or interfere with aquatic and riparian life. These range from highly

visible litter and gravels to invisible toxic elements (e.g. heavy metals) suspended in water or attached to fine sediments. Different pollutants are linked to specific land uses. For example, nutrients from fertilisers are associated with urban residential areas, while heavy metals are found in locations such as roads and car parks with heavy vehicle use. The adverse effects on receiving waters depend on the type and concentration of the pollutant and the sensitivity of affected species. The increased efficiency of drainage resulting from piped and channelised stormwater conveyance systems, not surprisingly also results in an increase in the 'efficiency' of delivery of these pollutants from urban catchments to their receiving waters.

Common types of stormwater pollutants are listed in the *Urban Stormwater Best Practice Environmental Management Guidelines 1999*<sup>2</sup> (p. 5). A copy of the table is included on the following page. Best practice management of urban stormwater should identify the pollutants impacting on receiving waters, so that responses can be designed to address these impacts. For example, there is little point in installing a gross pollutant trap to remove soluble nitrogen, whilst a stormwater treatment wetland should not be expected to remove litter.

Pollutant	Urban source
Sediments	Land surface erosion Pavement and vehicle wear Atmospheric deposition Spillage/illegal discharge Organic matter (e.g. leaf litter, grass) Car washing Weathering of buildings/structures
Nutrients	Organic matter Fertiliser Sewer overflows/septic tank leaks Animal/bird faeces Detergents (car washing) Atmospheric deposition Spillage/illegal discharge
Oxygen demanding substances	Organic matter decay Atmospheric deposition Sewer overflows/septic tank leaks Animal/bird faeces Spillage/illegal discharges
pH (acidity)	Atmospheric deposition Spillage/illegal discharge Organic matter decay Erosion of roofing material
Micro-organisms	Animal/bird faeces Sewer overflows/septic tank leaks Organic matter decay
Toxic organics	Pesticides Herbicides Spillage/illegal discharge Sewer overflows/septic tank leaks
Heavy metals	Atmospheric deposition Vehicle wear Sewer overflows/septic tank leaks Weathering of buildings/structures Spillage/illegal discharges
Gross pollutants (litter and debris)	Pedestrians and vehicles Waste collection systems Leaf-fall from trees Lawn clippings Spills and accidents
Oils and surfactants	Asphalt pavements Spillage/illegal discharges Leaks from vehicles Car washing Organic matter
Increased water temperature	Run-off from impervious surfaces Removal of riparian vegetation

**FIGURE 4 COMMON POLLUTANTS AND LIKELY SOURCES FOUND IN URBAN STORMWATER**  
(SOURCE: URBAN STORMWATER BEST PRACTICE ENVIRONMENTAL MANAGEMENT GUIDELINES 1999, CSIRO)

<sup>2</sup> *Urban Stormwater Best Practice Environmental Management Guidelines*, 1999, CSIRO Publishing, Melbourne. Compiled by Melbourne Water, Victoria's Environment Protection Authority and Department of Natural Resources and Environment, Municipal Association of Victoria and CSIRO.

## 2.3.2 Current best practice Stormwater Management Standards

Victorian objectives for stormwater quality are included in the *Urban Stormwater Best Practice Environmental Management Guidelines* 1999 (p. 15). Achieving the objectives is an inherent goal of a municipal stormwater management plan. Meeting the objectives is designed to mitigate the adverse effects of urbanisation in the catchment.

Pollutant	Receiving water objective:	Current best practice performance objective:
<b>Post construction phase:</b>		
Suspended solids (SS)	comply with SEPP (eg. not exceed the 90 <sup>th</sup> percentile of 80 mg/L) (1)	80% retention of the typical urban annual load
Total phosphorus (TP)	comply with SEPP (eg. base flow concentration not to exceed 0.08 mg/L) (2)	45% retention of the typical urban annual load
Total nitrogen (TN)	comply with SEPP (eg. base flow concentration not to exceed 0.9 mg/L) (2)	45% retention of the typical urban annual load
Litter	comply with SEPP (eg. no litter in waterways) (1)	70% reduction of typical urban annual load (3)
Flows	maintain flows at pre-urbanisation levels	Maintain discharges for the 1.5 ARI* at pre-development levels
<b>Construction phase:</b>		
Suspended solids	comply with SEPP	Effective treatment of daily run-off events (eg. <4 months ARI). Effective treatment equates to a 50 <sup>th</sup> ile SS concentration of 50 mg/L.
Litter	comply with SEPP (eg. no litter in waterways) (1)	Prevent litter from entering the stormwater system
Other pollutants	comply with SEPP	Limit the application, generation and migration of toxic substances to the maximum extent practical
1 An example using <i>SEPP (Waters of Victoria 1988)</i> , general surface waters segment. 2 SEPP schedule F7–Yarra Catchment–urban waterways for the Yarra River main stream. 3 Litter is defined as anthropogenic material larger than five millimeters.		

**FIGURE 5 OBJECTIVES FOR ENVIRONMENTAL MANAGEMENT OF STORMWATER**  
 (SOURCE: URBAN STORMWATER BEST PRACTICE ENVIRONMENTAL MANAGEMENT GUIDELINES 1999)

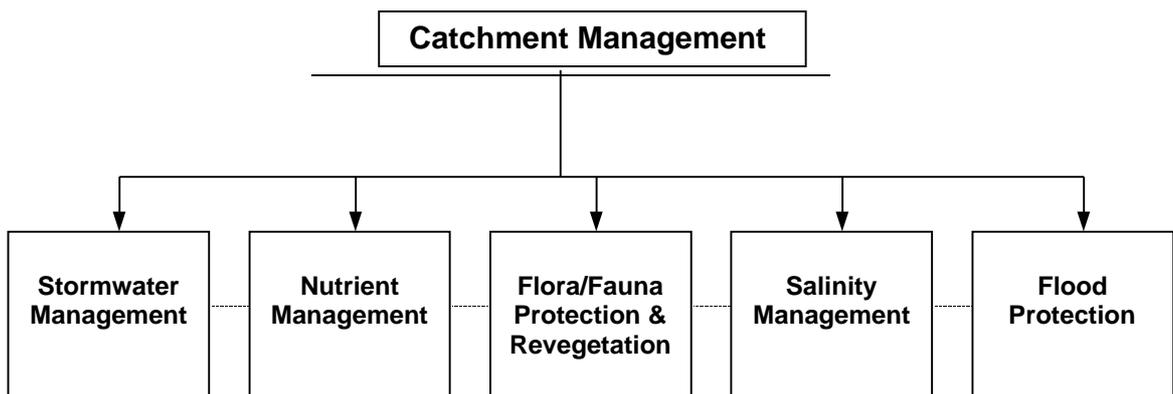
## 2.4 Stormwater Management and Catchment Planning

Catchment planning is an integrated method of protecting and enhancing the ecological health of soils, water, flora, fauna, and air. In Victoria, the CALP Board and Catchment Management Authorities are responsible for catchment planning at the river catchment level, ie. the area of land that drains to a river system. The Catchment Management Authorities (CMA) with jurisdiction in the urbanised catchments of the City of Ballarat are the Corangamite and Glenelg-Hopkins CMAs. Their jurisdictions extend outside the municipal boundaries. Refer to Map No. 1 on page 41.

Catchment planning is concerned with a wide range of issues, from agricultural productivity to managing habitat for native plants and animals. One of its primary concerns is water quality in the catchment, including water quality of principal waterways. Management of a catchment involves working with municipalities on common areas of interest, as municipal decisions can have a major impact on the success of the ecological health of the catchment.

### 2.4.1 Relationship of the SWMP to Catchment Planning

Stormwater management has an important place in catchment management and fits with other management approaches as illustrated below:



*FIGURE 6 RELATIONSHIP OF THE SWMP TO CATCHMENT PLANNING*

Solving stormwater management problems can assist with meeting broader catchment management objectives. For example, improving the quality of runoff from residential areas can reduce nutrient loads carried to receiving waters, resulting in increased ecosystem health within aquatic and riparian habitats. Similarly, attenuation of flows to prevent erosion and habitat degradation and reduce the incidence of flooding. Best practice stormwater management should therefore seek to integrate multiple objectives, wherever possible.

Throughout the project a number of issues were raised regarding rural land use, flood management and local sewerage treatment plants. Whilst these issues impact on receiving waterway values, and may be exacerbated by urban stormwater runoff, they are not given priority in this plan for action. They are however recognised in the risk assessment process and discussion of PMIs. They should ideally be dealt with as part of broader catchment strategies, by agencies responsible for their management. The Implementation Framework therefore seeks to provide a mechanism for overall coordination of urban stormwater management within the broader catchment management program.

# 3.0 KEY OBJECTIVES FOR THE BALLARAT SWMP

## 3.1 Introduction

The Project Working Group developed objectives for the Ballarat SWMP at its first meeting, and these were used to guide the development of the SWMP for the remainder of the process

## 3.2 Guiding Principles

- **Integration** of multiple objectives
- **Coordination** with government and community initiatives
- **Community and industry** ownership of management plan
- **Strategies** to promote best practice and consistency

## 3.3 Summary of Broad Objectives

- Stormwater quality improvement
- Protection of environmental values of aquatic and riparian ecosystems
- Integration into urban planning, design, landscape and municipal operations
- Support for stormwater reuse, where appropriate
- Management of stormwater drainage and flood mitigation

## 3.4 Objectives and impediments of each Broad Objective

### 3.4.1 Stormwater Quality Improvement

#### **Management Objectives**

- Coordinated and targeted management of point sources – link to site objectives
- Reduction of pollutant export from diffuse sources - link to CMA and State Objectives
- Increase community awareness and participation
- 

#### **Impediments**

- Community/industry participation and ownership of problem and remedial measures
- Technologies, guidelines and life-cycle costs
- Need for more definitive water quality targets

### **3.4.2 Protection of environmental values of aquatic and riparian ecosystems**

#### **Management Objectives**

- Defining local and downstream objectives in terms of water quality improvement and habitat protection or rehabilitation, at both local and regional level
- Incorporation of riparian zone management (integrate with LINCS objectives)
- Increasing community participation and ownership

#### **Impediments**

- Diffuse causes related to catchment management
- Prioritisation of activities/expenditures

### **3.4.3 Integration into urban planning, design and operations**

#### **Management Objectives**

- Leadership and facilitation of water sensitive urban design (WSUD) across council and other relevant agencies at all levels
- Integrate with existing activities, such as LINCS Masterplan
- Linking Council Planning Scheme to stormwater management objectives identified
- Protect heritage values, eg. bluestone channels, lakes etc. *move to end*

#### **Impediments**

- Limited industry adoption of WSUD due to uncertainties associated with cost and construction methods
- Built-up catchment constrains available treatment measures

### **3.4.4 Stormwater Reuse**

#### **Management Objectives**

- Provide water quality levels suited to stormwater reuse at a regional level
- Facilitate stormwater reuse at a household level

#### **Impediments**

- Stormwater reuse infrastructure
- Cultural and price signals
- Competition with downstream objectives

### **3.4.5 Stormwater Drainage and Flood mitigation**

#### **Management Objectives**

- Flood protection to 100 year ARI standard, where appropriate
- Mitigation of nuisance flooding to 5 or 10 year ARI standard
- Implementing Planning Scheme flood overlay linked to CMA initiatives, to ensure appropriate management of land use within floodplains

#### **Impediments**

- Built-up area currently subject to flooding
- Gross pollutants and flood debris
- Future growth will further exacerbate flood vulnerability

## 4.0 EXISTING CONDITIONS

### 4.1 Overview of catchment characteristics

The City of Ballarat has essentially two major catchments affected by urban stormwater. These are the Burrumbeet Creek catchment to the north of the Central Business Area of Ballarat which flows to Lake Burrumbeet, and the Yarrowee River Catchment, which flows to the Leigh/Barwon River System discharging to Bass Strait. The Burrumbeet Creek Catchment is a tributary to the Hopkins River catchment, within the Glenelg Hopkins Catchment Management Authority (CMA) boundary. The Yarrowee River catchment is contained within the Corangamite CMA boundary. The remaining receiving waterway environments within the City of Ballarat are not significantly affected by urban stormwater, and have therefore not been described or considered in this study. Ballarat has the unusual position of being at the headwaters of several major river systems and therefore has a significant role to play in maximising the opportunities to improve in-stream health and water quality of downstream waterways. For the purposes of the study, sub-catchments have been developed to more easily locate and address specific issues. The sub-catchments are:

- Burrumbeet Creek
- Upper Yarrowee River
- Middle Yarrowee River
- Lower Yarrowee River
- Canadian Creek
- Buninyong Township
- Winter Creek

The topography of the City varies significantly with predominantly flat topography west of the CBA, undulating to the south and steeply undulating to the east.

The key growth areas identified for the city are spread over the two main catchments. Currently most of the growth is occurring in the Yarrowee River Catchment with some smaller pockets in the Burrumbeet Creek Catchment. In the longer term there are areas of future growth planned in Miners Rest which is located in the Burrumbeet Creek sub-catchment and extensive areas in Delacombe and Alfredton in the Winter Creek sub-catchment of the Yarrowee River

Please refer to Map No. 1, Catchment Management Authority Boundaries on page 42

### 4.2 Overall values and threats

#### 4.2.1 Values

Identifying important values in the receiving waterway environments is a key task of the SWMP. Protecting these values from the impacts of urban stormwater is the underlying aim of improved stormwater management in Ballarat. Detailed site investigations to identify and assess values have therefore been undertaken. The location and significance or 'health' of the values inform the development of targeted objectives and actions that focus on protecting and enhancing them.

Some of the key overall values identified for Ballarat include:

- Access to water-based recreational activities and organised sports including swimming, water skiing and fishing, in the lakes throughout the municipality, including Lake Burrumbeet, Lake Learmonth in the Burrumbeet Creek sub-catchment and Lake Wendouree in the Mid Yarrowee River sub-catchment.
- Access to land based recreation activities in open space adjoining waterways, including Yarrowee River and Canadian Creek.
- Environmental values with areas of instream and riparian indigenous vegetation including Winter Swamp and Flax Mill Swamp in the Burrumbeet Creek sub-catchment, and the upper reaches of Buninyong Creek in the Buninyong Township sub-catchment.
- Historical values associated with waterway environments including bluestone and brick lined channels and remnant infrastructure from the alluvial gold mining. This occurs in the Mid Yarrowee and Lower Yarrowee River sub-catchments and the Canadian Creek sub-catchment.
- Economic and tourism values including the commercial eel fishing industry based at Lake Burrumbeet and commercial boat operators and restaurants along the shores of Lake Wendouree.
- Tourism values associated with Lake Wendouree.
- Flood conveyance capacity of existing drainage infrastructure, which occurs in all sub-catchments.
- Existing and proposed stormwater quality treatment wetlands in industrial and residential catchments, with examples in the Mid Yarrowee and Lower Yarrowee River sub-catchments.
- The forthcoming review of the Ballarat Planning Scheme which allows the opportunity to incorporate changes to improve best practice stormwater management in the city.
- Existing community involvement and interest in stormwater management via other programs including Waterwatch and LINCS.
- Existing awareness within Council of stormwater management, and existing schemes to improve best practice management of stormwater.
- Landscape amenity/character values associated with lake and waterway environments.

## 4.2.2 Threats

The key overall urban stormwater threats that currently or potentially impact on the values of receiving waterways are linked to the land use characteristics found in urbanised Ballarat and smaller townships. These threats include:

- Future urban residential growth (both infill and greenfield) without provision of adequate stormwater management systems (targeting both flow attenuation and water quality protection/improvement) to prevent further degradation of receiving waterway environments. Major future development areas that are identified as sub-catchment priorities include:
  - Miners Rest and West Wendouree (Burrumbeet Creek)
  - Brown Hill (Upper Yarrowee)
  - Ballarat East, Mt Clear and Mt Helen (Canadian Creek)
  - Buninyong (Buninyong Creek)
  - Sebastopol/West Sebastopol, Alfredton and Delacombe (Winter Creek)
- Lack of sediment control and on-site construction management on a subdivision, individual lot redevelopment scale, commercial and industrial development and public infrastructure.
- Ongoing infill redevelopment within the existing urban areas resulting in increased impervious surfaces and associated impacts from this, and sediment runoff during site construction.

- Litter, sediment and pollutant loads from existing urbanised areas, causing water quality degradation, and flow-induced degradation of downstream habitat.
- Flow-induced degradation of downstream habitats.
- Pollutant loads in runoff from sealed roads along with impacts from their construction.
- Industrial land use including the large and small industrial estates.
- Limited use of existing retarding basins for water quality treatment.
- Constrained floodplains limiting opportunities for improved management of urban stormwater within the waterway corridor.
- The existing MSS does not provide a strong rationale for best practice stormwater management.
- The current planning scheme, background strategic planning documents and planning approvals for urban development have limited reference to an integrated approach to best practice stormwater management.
- Existing infrastructure design standards and operational practices, including management of public open space, are not always compatible with best practice stormwater management.
- Limited community understanding of stormwater issues and management, including lack of existing education programs and strategies to improve this broad understanding.
- Individual commercial and industrial premises with outdated and/or poorly maintained treatment measures and connections to urban stormwater.

## 4.3 Sub-catchment breakdown of values and threats

The city has been divided into Sub-Catchments which are described below and shown on Map No. 2. Sub-Catchment Boundaries on page 43

### 4.3.1 Burrumbeet Creek sub-catchment

#### 4.3.1.1 Summary of sub-catchment characteristics:

The Burrumbeet Creek catchment extends north of the Central Business Area (CBA) of Ballarat, and falls within a predominantly rural catchment. The topography is relatively flat with the only steeply undulating topography in the upper catchment around the Invermay area. The upper reaches include the majority of the industrial estates in Wendouree, with large industrial land holders and the urban township of Miners Rest, which is highlighted for future urban expansion. The smaller rural townships in the catchment include Learmonth and Cardigan Village, which are not anticipated to expand significantly. Miners Rest is identified as an urban growth centre, and has an existing Outline Development Plan which is currently being reviewed and updated. Miners Rest has, however, been relatively slow to develop.

In 1983 a State Environment Protection Policy (*SEPP*) for the surface and ground water of Lake Burrumbeet and its catchment was developed. The policy identified the need to limit the impact of nutrients from the Ballarat North Sewerage Treatment Plant and to ensure that proposed urban expansion does not lead to further degradation in water quality, stability and flooding characteristics of the creek. Given that development has been slow, there are opportunities for this strategy to assist in identifying ways to minimise impacts of the planned urban expansion.

#### 4.3.1.2 Summary of Values

The Burrumbeet Creek catchment drains to Lake Burrumbeet, which is a key recreational resource for the district, offering water-based activities include boating, waterskiing, swimming and fishing. There are remnant River Red Gums around the eastern and southern shores of the lake, which are significant in the Ballarat area, given that there is

only a small amount of remnant vegetation remaining due to agricultural and mining land use. North of Lake Burrumbeet is the smaller Lake Learmonth, which is valued for its water and land-based recreational uses, along with the associated historical values of the township located on its shores. The Burrumbeet Creek in the lower reaches near Lake Burrumbeet has some scattered remnant indigenous riparian vegetation, however, the upstream reaches are largely cleared and exotic vegetation dominates. Through Miners Rest Township there are open space reserves that directly adjoin the creek and have existing and future proposed land based recreation values. Upstream of Miners Rest in the upper catchment are two swamps that have significant habitat values and are used by migratory birds. There is also a reed bed in the Burrumbeet Creek, downstream of the Sewerage Treatment Plant that provides a water quality treatment function.

#### **4.3.1.3 Summary of Threats**

Existing urban stormwater inputs from Miners Rest township and the industrial and commercial land use in Wendouree are contributing to water quality degradation. High sediment loads from unsealed roads in the upper catchment of Invermay, and some parts of Wendouree, are threatening downstream waterways, and degrading instream habitat. Existing planning documents for Miners Rest Township allow further urban development in the declared floodplain of Burrumbeet Creek, and this will limit the floodplain capacity and water quality treatment opportunities for the catchment. There are existing flooding issues in the township, which will be increased by further development, both in Miners Rest itself, and upstream in Wendouree.

### **4.3.2 Upper Yarrowee River sub-catchment**

(Upstream of Western Highway)

#### **4.3.2.1 Summary of sub-catchment characteristics**

The Upper Yarrowee River Catchment extends from the upper reaches of the Yarrowee River, to the east of the City downstream to the Western Highway. This includes the water supply catchments of Gong Gong, Kirks and White Swan Reservoirs. Other dominant land uses in the sub-catchment include rural residential and agricultural land use. Further urban development is proposed for the area in the future. The topography is steeply undulating and the Yarrowee River is deeply incised throughout its length.

#### **4.3.2.2 Summary of Values**

The upper reaches of the Yarrowee have some indigenous vegetation in the riparian zone, including stands of Blackwood, Messmate and Peppermint Forests, and relatively intact instream vegetation. There are, however, significant stands of exotic vegetation such as Willows, and some Poplars. Gong Gong, Kirks and White Swan Reservoirs provide water storage and supply, along with visitor facilities for picnics and walking trails, and a water education centre and display developed by Central Highlands Water at Kirks Reservoir. The Yarrowee Linear Trail originates at Gong Gong Reservoir and this linear trail is to be promoted in the future for regional visitation and awareness of the River's environmental values.

#### **4.3.2.3 Summary of Threats**

Future urban development has been identified in locations throughout this catchment, which has the potential to cause increased flow regimes due to an increase in impervious areas, soil disturbance during construction and loss of vegetation cover. Current flows are already contributing to erosion and habitat loss. The existing planning documents for future urban development in the Brown Hill area lack adequate guidelines for best practice stormwater management. The impacts of future development along with specific industrial discharge points are key threats to the values in this upper catchment. Some inappropriate road management is leading to high sediment loads being delivered to the stormwater system and subsequently to receiving waters. Some identified point sources of pollutants (e.g. CHW timber mill) need immediate attention.

### **4.3.3 Middle Yarrowee River sub-catchment**

(Western Highway to confluence with Canadian Creek)

#### **4.3.3.1 Summary of sub-catchment characteristics**

The middle Yarrowee River catchment includes part of the CBA of Ballarat, Brown Hill, Ballarat North and Central Ballarat. The dominant land use is existing urban, which includes residential and commercial use with a small area of industrial use. Existing rural areas on the fringe are being slowly redeveloped into urban residential land.

#### **4.3.3.2 Summary of Values**

Yarrowee River through this middle reach is extensively modified, with predominantly exotic vegetation in the riparian zone, and heritage values associated with exotic plantings and the constructed bluestone channel. Tributaries have similar characteristics, particularly in Gnarr Creek where the channel is a combination of brick, concrete and bluestone. Existing residential development brings with it higher recreational use and need for open space along the river and tributaries. There are some significant open space reserves in this sub-catchment including Lake Wendouree, Eastern Oval and Whiteflat Reserve. Lake Wendouree has the highest recreational use and value in the City for both water and land based recreation. The historical values and role Lake Wendouree has played in the development of Ballarat, and its regional significance are important influences on the high ratings assigned to the values at the lake. The community has been involved in revegetation projects along the Yarrowee including at Nerrina Wetlands, and the areas near Yuille's Park.

#### **4.3.3.3 Summary of Threats**

Threats within this sub-catchment result primarily from existing urban residential and commercial activity, along with some urban development on a building level. This includes high impervious area, causing increased flow, and exacerbating existing flooding and erosion issues, poor water quality through urban runoff, high sediment loads associated with gravel verges to roads, high litter loads, and high nutrient loads causing blue-green algae growth in Lake Wendouree. High levels of (exotic) leaf litter contribute to water quality problems, by reducing oxygen levels in the receiving waters. There is a small amount of residential development still to occur within the catchment, and the threats associated with this include poor on-site construction management. The other major threats are associated with ongoing urban consolidation at the individual lot level within the developed catchment, and the lack of acknowledgment and visibility of the Yarrowee River in the Central Business Area of Ballarat. Flooding issues within this sub-catchment may constrain water quality treatment opportunities, but may also provide an opportunity for achieving multiple objectives.

### **4.3.4 Lower Yarrowee River sub-catchment**

(Downstream of the confluence with Canadian Creek)

#### **4.3.4.1 Summary of sub-catchment characteristics**

This downstream section of Yarrowee has a range of land uses including a developed urban catchment in the upper reach, an area of industrial land use in the Sebastapol area and changing to rural living and rural land use in the lower reaches. The Yarrowee River valley is deeply incised with relatively flat topography to the west, and undulating to the east.

#### **4.3.4.2 Summary of Values**

The upper reaches of this section of the Yarrowee River are bluestone lined, including Redan Creek, which enters the Yarrowee in this catchment. The historical values of the bluestone and brick lined drains and channels are very high through this area, along with the bluestone drains in the streets. The Yarrowee changes to an earth lined channel in the downstream section, which increases the potential in-stream values of the river. There have been some significant amounts of revegetation undertaken by the Council in association with the community, particularly in the reach upstream of Prest Street. The linear trail and associated open space along the Yarrowee River results in high recreational values on local use and a regional level. The values will improve in the near future with the development of the Yarrowee/Redan Confluence wetlands and associated

trails, revegetation and interpretation facilities. Downstream of this area is the Yuilles Station Park and Wetlands which have established trails, bird hides and picnic facilities. Downstream of the City of Ballarat boundary, the River has some significant geological and riparian flora and fauna habitat values. The improvements to stormwater management in the entire Yarrowee River catchment will contribute to the protection of these important downstream values.

#### **4.3.4.3 Summary of Threats**

The threats are primarily associated with existing urban residential, commercial and industrial activity and development. Some of the urban runoff threats will be partly mitigated in the near future with the construction of the Yarrowee/Redan confluence wetlands. Other key threats include high leaf litter loads from exotic vegetation, in-stream erosion and potential for mining to occur in the future within the floodplain. The high level of erosion in this area has isolated the river from its floodplain, constraining available water quality treatment options.

### **4.3.5 Canadian Creek Sub-Catchment**

#### **4.3.5.1 Summary of sub-catchment characteristics**

Located to the south of the central business area of Ballarat, this catchment includes steeply undulating topography with a range of land uses including state forest and associated timber harvesting, planned future residential growth areas, existing residential development and other institutional development including universities. Historically the townships of Mt Clear and Mt Helen have been distinct, but future planned growth in this area will effectively link these townships. These townships are currently experiencing urban development.

#### **4.3.5.2 Summary of Values**

The upstream reaches of Canadian Creek have some intact stands of indigenous vegetation in the riparian corridor including relatively rare Yarra Gums and some native in-stream vegetation. The lower reaches of the Canadian Creek are dominated by exotic vegetation, and close to the confluence with Yarrowee, the creek is a timber and bluestone lined channel. Open space is provided along the creek through the developed areas, and as additional residential development occurs, the provision of open space adjacent to the creek will increase, along with the recreational values. There is an existing linear trail that continues into Ballarat and is well used by the local community. There are a number of tributaries that contribute to the open space network and links, along with habitat values. The upper reaches of these tributaries have a range of values including existing native vegetation and recreational values. Currently development in the floodplain is limited, and there are opportunities to address future flooding issues through adequate drainage reserves in future development applications.

#### **4.3.5.3 Summary of Threats**

The threats are associated with the diversity of land use in the catchment and include high sediment runoff from unsealed roads, existing urban development and impacts from proposed development areas within the steep catchment, with inadequate attention to flow management or stormwater quality. The lack of a pro-active planning framework is a major threat to the values in this catchment. Some point sources have been identified and should be acted on. High flooding threats within this sub-catchment provide some constraints, but also represent an opportunity to combine water quality and flow management objectives.

### **4.3.6 Buninyong Township Sub-Catchment**

#### **4.3.6.1 Summary of sub-catchment characteristics**

Located to the south of the central business area of Ballarat, the Buninyong township drains to two main catchments, Buninyong Creek and Hasties Creek. This established

township has been experiencing strong residential growth that is projected to continue. The dominant land use includes residential development, with adjoining rural residential and rural land use. Future residential development is proposed. The town is located on undulating topography, with the relatively wide, main floodplain of Hasties Creek to the south and Buninyong Creek to the west.

#### **4.3.6.2 Summary of Values**

The township of Buninyong has some unique features including the springs that supply water to the major creeks in the township. The presence of the springs has influenced the town's historical development, with the Buninyong Botanical Gardens and the Gong located on waterways fed by springs. These open space areas are popular passive recreational areas today, particularly the Gong where people used to enjoy swimming, prior to it becoming eutrophic and experience algae blooms. There are some other significant areas of open space including Union Jack Reserve, which has indigenous vegetation values and has been identified as an opportunity to develop interpretative signage and information about the natural values of the site. Generally the open space use and recreational values are for local use, with people visiting the springs for water supply from further afield. As Buninyong develops over time, the open space use and values are anticipated to improve.

#### **4.3.6.3 Summary of Threats**

The springs, which are a feature of the township, currently pose a threat to human health, with high *E.coli* levels, the cause of which is likely to be from septic seepage. The major ongoing threats identified in the township include poor water quality in the Gong and poor water quality of springs. The existing Outline Development Plan (ODP) for Buninyong Township does not adequately address stormwater management.

### **4.3.7 Winter Creek Sub-Catchment**

#### **4.3.7.1 Summary of sub-catchment characteristics**

Located to the south west of the Central Business Area of Ballarat township, this is a large catchment that contains a range of land uses. The topography is relatively flat which has influenced land use activities. There is the large industrial area in Delacombe, existing urban development in Alfredton, Delacombe and Sebastapol and large areas of strong future residential growth. Outside of the urban areas the land use changes to rural and rural residential in the adjoining Shire.

#### **4.3.7.2 Summary of Values**

Winter Creek traditionally has been cleared for grazing, with only small stands of remnant vegetation remaining in the floodplain. The existing environmental and recreation values are relatively low but are anticipated to increase with future urban growth, accompanied by open space planning and rehabilitation of the waterway corridor.

#### **4.3.7.3 Summary of Threats**

The existing residential and industrial land use, along with future residential development currently provides the greatest threat to the receiving waterway values, including illegal filling and dumping in the floodplain and poor ongoing maintenance practices. The existing Outline Development Plans for future growth do not address appropriate stormwater management, causing high levels of future residential development to pose a major threat. Flooding will limit capacity to construct stormwater treatments and future development could exacerbate this situation. Carefully designed treatment measures will be required, to integrate the flow and water quality management objectives.

# 5.0 PRIORITY MANAGEMENT ISSUES

## 5.1 Risk Assessment

### Value x Threat = Risk

The key priorities have been determined by undertaking the Risk Assessment for the Values and Threats identified in the first phase of the project. All the values and threats identified are assigned a priority rating value of Very High, High, Moderate or Low. To undertake the Risk Assessment these priority ratings have been assigned a numerical value, as follows:

Very High = 4  
High = 3  
Moderate = 2  
Low = 1

Prioritisation of issues has then been undertaken to ensure that strategies are focused on addressing the most important issues first. To be included as the Priority Management Issues, the issue needs to have been assigned a Very High priority rating to either the Value or the Threat or to both. Meeting this condition means that the given issue received a numerical score of 12 or higher. This does not mean that the development of Management Strategies will ignore issues with ratings lower than 12. Strategies will still be developed for these, but the *prioritisation* of strategies will be undertaken according to the priority scores derived during the Risk Assessment. Where possible, strategies are developed in an integrated way, to address more than one priority management issue.

#### **Examples to illustrate the Risk Assessment**

*A natural lake being used regularly during the summer for swimming and associated water contact sports, would have a Very High (4) rating given to the recreational value. Urban runoff causing a significant decline in the water quality, which in turn may cause harm to human health, or decrease the water contact sporting use, would have a Very High (4) threat rating. By multiplying the Value (4) x Threat (4) = Risk of 16. This would constitute a high priority management issue (ie. Risk score > 12) and would be included in as a Priority Management Issue.*

*An alternative example is that the threat of Litter in the site may be minor, but would still constitute a threat to recreational values, and be given a priority rating of Moderate (2). By multiplying the Value (4) x Threat (2) = Risk of 8. In this instance, this would not be included as a priority management issue (i.e. Risk score < 12).*

This risk assessment process allows for an objective assessment of the relative priority of various stormwater issues. It is undertaken in spreadsheets on a sub-catchment basis for all the values and threats included in the paper. A spreadsheet is prepared for each nominated site in each sub-catchment, which were identified by the Project Team, in consultation with the Steering Committee and Project Working Group, and identified in the Values and Threats Paper. The derived tables show the risk score for every issue, along with a description of it, and these formed the "Values and Threats Paper", prepared in Stage 2 of the process (refer to Section 1.2).

## **5.2 Overall Priority Management Issues**

### **5.2.1 Summary of Key Priority Management Issues on a municipality wide basis**

- There is a need to protect the water-based recreational and environmental values from water quality decline in the lakes in and around Ballarat. The water-based recreational activities include swimming, waterskiing, rowing, fishing and boating.
- Identify and protect heritage values associated with the receiving waterway environments in any future stormwater infrastructure design and vegetation management programs.
- Unsealed roads, and unsealed road verges in urban areas require management to minimise sediment loads, whilst protecting their existing cultural and heritage values.
- Industrial areas need to be managed to minimise point source pollution discharge.
- Management of flood risks in the city may constrain water quality treatment opportunities. Creative approaches, utilising structural and non-structural components, will therefore be required. In many cases, a 'win-win' situation will be possible.
- Current planning documents, including Outline Development Plans (ODP) and other structure plans, do not contain best practice management of urban stormwater, including construction and design matters, and these issues need to be incorporated into the review of the municipal planning scheme.
- There is a need to incorporate best practice urban stormwater management into future Outline Development Plans or other structure plans as required.
- There is a lack of integration of flood and stormwater management information in the planning scheme and appropriate Council planning documents. This is an impediment to the adoption of water sensitive urban design within the City of Ballarat.
- There is a lack of co-ordination and adequate funding to allow infrastructure planning and asset management areas of Council to achieve optimum performance of the existing retarding basins for flow attenuation and water quality treatment.
- There is a need to reduce the threat of sewer overflows to receiving waters.

### **5.2.2 Summary of Overall Related Issues not addressed by this plan**

- Septic seepage in the catchments contributing to a decline in water quality.
- Poor rural land management contributing to the decline of in-stream values in the receiving waterway environments.
- Management of timber harvesting operations

## 5.3 Sub-catchment Priority Management Issues

### 5.3.1 Burrumbeet Creek sub-catchment

#### 5.3.1.1 Summary of Key Priority Management Issues in Burrumbeet Creek sub-catchment

##### 5.3.1.1a Lake Burrumbeet

- The impacts of existing and future urban residential, industrial and commercial runoff on the in-stream habitat, recreational and commercial use of Lake Burrumbeet.

##### 5.3.1.1b Lower Burrumbeet Creek

- Changed flow regimes are causing streambank erosion and a decline in in-stream habitat values in Burrumbeet Creek, which are rated as high due to presence of native fish in the stream. This will potentially be exacerbated by future residential and industrial development.
- Changed flow regimes are causing a reduction in the floodplain storage and conveyance capacity of the creek, thereby exacerbating local flooding issues in the lower reaches.

##### 5.3.1.1c Lake Learmonth

- Existing urban and commercial runoff is causing a decline in water quality of the lake, which threatens the recreational values of the lake, along with its historical value.

##### 5.3.1.1d Burrumbeet Creek through Miners Rest Township

- The existing residential development in the floodplain constrains future opportunities for water quality treatment, and threatens waterway values.
- The existing planning scheme and council's planning documents permit further urban development in the floodplain, which if allowed to continue will further constrain the flood conveyance capacity of the creek and opportunities for integrated stormwater management.
- A reed bed in the floodplain of Burrumbeet Creek upstream of the township provides some water quality treatment function.

##### 5.3.1.1e Miners Rest Wetland

- No high priority issues identified.

##### 5.3.1.1f Mitchell Park (Wendouree Industrial area)

- The existing North Common Wetland established downstream of the Wendouree industrial area lacks a formal plan for management and maintenance, which may be resulting in reduced water quality treatment function.

##### 5.3.1.1g Pauls Drain

- Construction of a wetland/retarding basin is proposed for the upper catchment, at a site identified as being of habitat value for Latham's Snipe. These very important works will need to be designed so as to protect and enhance this habitat, and local environmental values, whilst providing water quality treatment and flow attenuation.
- Significant input of poor water quality from industrial, urban and commercial land uses including litter.
- Inadequate capacity in the local drainage infrastructure causes nuisance flooding, which may constrain the ability to undertake water quality treatment works in parts of the catchment.

##### 5.3.1.1h Flax Mill Swamp

- Existing and future industrial land use impacts (eg. industrial land use) including high sediment and litter loads on the habitat values in the swamp.

- Fragmented land management and lack of co-ordination between different land managers resulting in reduced protection of the environmental values.

#### **5.3.1.1i Winter Swamp**

- Impacts of existing and future industrial runoff on the habitat values of the swamp.

#### **5.3.1.2 Summary of related issues outside the scope of urban stormwater management**

Ballarat North Sewerage Treatment Plant has been identified as contributing flow and high nutrient levels in the Burrumbeet Creek catchment. The SEPP for Burrumbeet Creek Catchment has identified and addressed this issue, and an upgrade of the plant is planned by Central Highlands Water.

- Rural land use is contributing to high nutrient loads in Lake Burrumbeet, which are to be considered in the context of urban stormwater inputs also contributing to nutrient loads in Lake Burrumbeet. The SEPP for Burrumbeet Creek Catchment has identified this issue, which is addressed in the Glenelg Hopkins Nutrient Management Plan.
- Continued supply of water to Lake Learmonth via the Moretons Cutting Diversion is important to sustaining the recreational uses identified as a value in this paper. The management of this issue is outside the role of this plan and is undertaken by NRE in their role of managing Bulk Entitlements under provisions of the Water Act 1989.
- Land management practices need to be improved for use and development on rural land.

### **5.3.2 Upper Yarrowee River sub-catchment**

#### **5.3.2.1 Summary of Key Priority Management Issues in the Upper Yarrowee River sub-catchment**

##### **5.3.2.1a Yarrowee River Upper Reach**

- Existing urban residential stormwater runoff is causing a decline in instream habitat values. The values include historical records of platypus and fish in this upper reach of the Yarrowee River
- Increase in flows is causing instream erosion and the associated infrastructure works to prevent erosion are causing a decline in the enjoyment of the natural waterway setting for passive recreational use, along with in-stream habitat values.
- Lack of co-ordination between responsible authorities and significant landholders to address existing water quality discharge issues that have been previously identified by the council.
- The existing Western Highway Bypass Retarding Basin has an important role in attenuation of high flow events for the urban areas of Ballarat, which needs to be protected.
- The important role of the floodplain needs to be acknowledged and protected in Council's planning scheme and other strategic planning documents.

##### **5.3.2.1b Gong Gong Reservoir Park**

- Impact of existing stormwater quality discharge from the timber mill on the in-stream values of upper reaches of the Yarrowee River, within the Gong Gong Reservoir Reserve and downstream.
- There are land-based passive recreational facilities in the reserve including picnic areas and the beginning of the Yarrowee Linear Trail, which is promoted for regional use. A significant decline in in-stream values caused by poor stormwater quality will decrease these values.

##### **5.3.2.1c Kirks Reservoir Park**

- Central Highlands Water have established a water education display and interpretation centre at this reserve and a significant decline in water quality and in-stream values will have an impact on this centre.

- Future stormwater management works need to protect the heritage values associated with bluestone channels and the outlet structure.

#### **5.3.2.1d Brown Hill ODP Area**

- Existing Outline Development Plan for this area does not adequately address impacts of urban stormwater runoff on the waterway values and opportunities for integrating stormwater management with land development.
- Impacts of development and associated stormwater runoff on the recreational, riparian habitat and visual landscape qualities of the Yarrowee River.

#### **5.3.2.2 Summary of related issues outside the scope of urban stormwater management**

- A lack of vegetation protection overlays is causing vegetation loss, contributing to erosion of dispersive soils.
- Illegal dumping is occurring in the floodplain, and enforcement and waste management must be strengthened to address this. This should be addressed by the Central Highlands Regional Waste Management Strategy and the Ballarat Waste Management Strategy.
- Land management practices need to be improved for use and development on rural land.
- Septic tanks require investigation in this area.

### **5.3.3 Middle Yarrowee River sub-catchment**

#### **5.3.3.1 Summary of Key Priority Issues in the Middle Yarrowee River sub-catchment**

##### **5.3.3.1a Yarrowee River Middle Reach**

- Future works in the floodplain need to protect the heritage values associated with the bluestone channels and other infrastructure from the gold mining period.
- Properties in the Yarrowee River floodplain through this sub-catchment are already subject to flooding, and any future development or redevelopment within the catchment must not increase the threat of flooding.
- Negative impact of litter from the CBA on the recreational values of the river corridor.
- Weed management in the Yarrowee River

##### **5.3.3.1b Nerrina Wetlands**

- Weed management within extensive wetland system and revegetation areas.

##### **5.3.3.1c Lake Wendouree**

- Water and land based recreational use along with historical values and community awareness associated with the lake the highest in Ballarat. As a consequence the impacts of high litter loads and poor water quality from urban, commercial and industrial inputs to the lake are key issues.
- Impacts of litter on the tourism and commercial use of the lake including restaurants beside the lake, and visitors to festivals and events.

##### **5.3.3.1d North Gardens Wetland**

- The risk that a potential lack of appropriate maintenance and/or educative material could cause to community interest, value and understanding of the water quality treatment wetland, and similar projects in the future.

##### **5.3.3.1e Gnarr Creek**

- Impacts of future urban development in the catchment on floodplain storage given the limited capacity that currently exists.
- Recent urban development has already reduced the limited floodplain storage capacity and future water quality treatment options.

- Lack of funding to modify existing retarding basins to improve water quality treatment.
- Unsealed road verges contributing high sediment load in the catchment.

#### **5.3.3.2 Summary of related issues outside the scope of urban stormwater management**

- Nerrina Wetlands may have inadequate water supply for its size, which may contribute to invasion of weed species.
- Rubbish dumping and illegal activities undertaken on the floodplain need to be addressed.
- Riparian weeds are reducing environmental, recreational and property values.
- Flooding in the mid Yarrowee catchment, and inadequate flood capacity of existing drainage infrastructure.

### **5.3.4 Lower Yarrowee River sub-catchment**

#### **5.3.4.1 Summary of Key Priority Management Issues in the Lower Yarrowee River sub-catchment**

##### **5.3.4.1a Yarrowee River Lower Reach**

- Existing urban land use including residential, industrial and commercial runoff on instream values (including erosion) and recreational values, such as those associated with the linear trail.
- Significant litter load decreases the visual landscape values of the waterway. There are expansive views over the valley in this reach, which are degraded by litter.
- The planning scheme and other strategic planning documents need to recognise the value of floodplains and riparian zones, and provide guidance on appropriate land uses within these areas.
- Potential mining leachate on any future opportunities for stormwater quality treatment wetlands in the floodplain. Leachate should be addressed before development commences.

##### **5.3.4.1b Redan Creek**

- Future infrastructure works associated with stormwater management impacting on the heritage values of the bluestone channel and road drainage system.
- Impact of litter in channel on visual landscape values.
- Lack of water quality treatment in the Morshead Park Retarding Basin.
- Unsealed road verges contribute high sediment loads to the stream reducing in-stream values.

##### **5.3.4.1c Redan Confluence with Yarrowee River**

- Future wetland and infrastructure design needs to protect the heritage values associated with gold mining in this area.
- This wetland has the potential to be a good demonstration project to improve community awareness of best practice stormwater management in the city. A lack of resources to successfully promote this with well developed education and visitor facilities and ongoing maintenance may limit this.
- High sediment load from unsealed road verges causing a decline to instream values.

##### **5.3.4.1d Yuilles Station Park and Wetlands**

- The deposition of litter in the floodplain. This decreases the recreational and visual landscape values of the open space corridor.
- Increased flows causing channel incision and further isolation of the creek from the floodplain. This reduces water quality treatment options, and degrades instream habitat and vegetation.

#### **5.3.4.2 Summary of related issues outside the scope of urban stormwater management**

Threats outside of the scope of this plan include:

- The location of the Ballarat South Sewerage Treatment Plant in the floodplain.
- Inappropriate management of timber harvesting operations may contribute to sediment delivery into nearby waterways. Council, in partnership with the CMAs, should ensure compliance with the Code of Forest Practice, and, where appropriate, compliance with appropriate provisions of the Planning Scheme.
- Riparian weeds are reducing values in the creek.
- Illegal dumping and fill needs to be addressed
- Potential industrial/commercial development at Cambrian Hill (Golden Plains Shire), which impacts on the Yarrowee River immediately downstream of the City of Ballarat boundary.

## **5.3.5 Canadian Creek sub-catchment**

### **5.3.5.1 Summary of Key Priority Management Issues to be addressed in the Canadian Creek sub-catchment**

#### **5.3.5.1a Canadian Creek**

- Impact of future urban development on instream and riparian habitat values, including water quality and in-stream erosion. This will also impact on recreational values of the riparian corridor.
- Future infrastructure works associated with stormwater management need to protect the heritage values of the bluestone and timber lined channel section of the creek.
- Future development needs to be appropriately designed to avoid decreasing existing floodplain storage capacity of the creek. This includes the appropriate use of planning provisions to protect the capacity of the creek and its floodplain.
- Litter degrading environmental and recreational values of the waterway.
- Existing review of extent of development areas and planning documents need to consider best practice stormwater management, including flood storage capacity of floodplain.

#### **5.3.5.1b Tributaries to Canadian Creek**

- Future infrastructure works associated with stormwater management may impact on the heritage values of the bluestone channels.

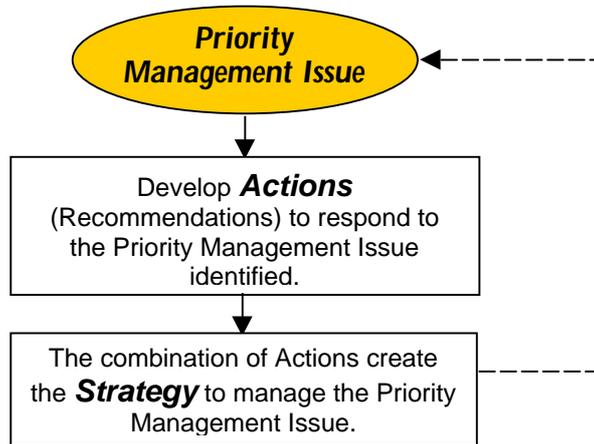
#### **5.3.5.2 Summary of related issues outside the scope of urban stormwater management**

- Inappropriate management of timber harvesting operations may contribute to sediment delivery into nearby waterways. Council, in partnership and the CMAs, should ensure compliance with the Code of Forest Practice, and, where appropriate, compliance with appropriate provisions of the Planning Scheme.

# 6.0 STRATEGIES

## 6.1 Development of Strategies

The draft strategies are the combination of a range of actions to address each of the Priority Management Issues identified. This relationship is explained in the diagram below:



**FIGURE 7 RELATIONSHIP BETWEEN PRIORITY MANAGEMENT ISSUES, ACTIONS AND STRATEGIES**

Each action contained in the Strategies has undergone an evaluation process in accordance with Chapter 3 *Urban Stormwater Best Practice Environmental Management Guidelines* 1999 (please refer to this document for the background explanation of the screening and evaluation process). The evaluation process has been undertaken for Actions in the following types:

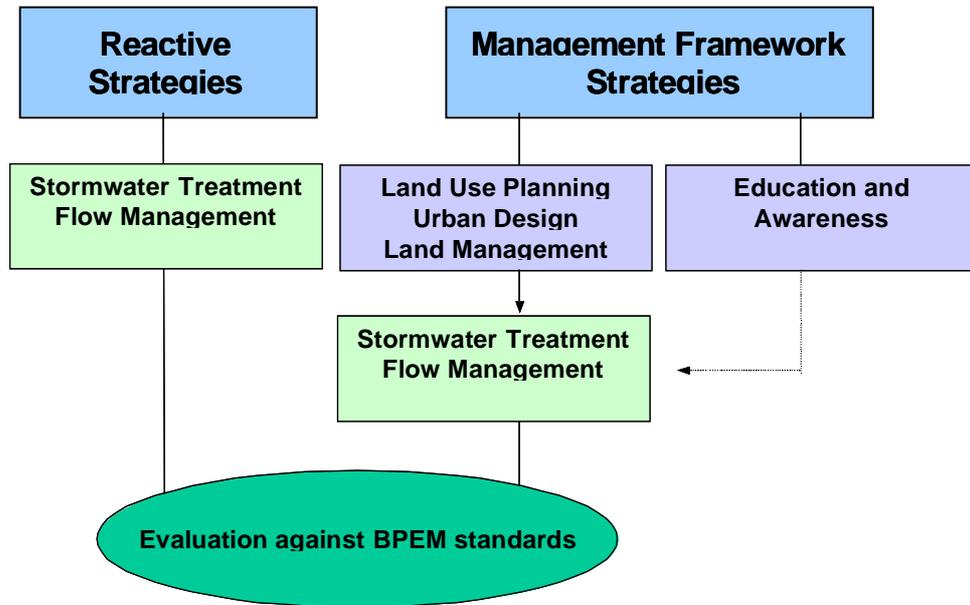
Land Use Planning	}	Management Framework Actions
Regulation and Enforcement		
Education and Awareness		
Municipal Operations		
Stormwater Treatment Measures	}	Reactive Management Actions
Flow Control Measures		

Each of the actions that make up the Strategies have been assigned a code to identify its type:

- LU Land Use Planning
- RE Regulation and Enforcement
- EA Education and Awareness
- MO Municipal Operations
- ST Stormwater Treatment Measures
- FC Flow Control Measures

Each Action has been developed to respond to one or more of the Priority Management Issues (PMI), and in some cases one Action may address a range of PMI's. Gaps identified in the management framework review have also been addressed in the development of draft strategies.

There is a strong relationship between Management Framework Strategies and Reactive Strategies; they have been developed in an integrated manner. Many of the Management Framework Strategies will result in improved stormwater quality through construction of stormwater treatment and flow control measures. The relationship between Reactive and Management Framework Strategies is shown below:



**FIGURE 8 RELATIONSHIP BETWEEN REACTIVE AND MANAGEMENT FRAMEWORK STRATEGIES**

The SWMP makes recommendations for improved stormwater management across a number of sections of Council. These sections include:

- Strategic Planning
- Statutory Planning
- Parks and Environment
- Local Laws
- Building
- Civil Design
- City Works
- Waste management
- Community Services (education)

The following table (refer to Figure 9) illustrates how different types of Actions should be implemented by Council within their existing business plan and operational processes. The left column of the table is labelled Stormwater Management Action. This is the generic list of best practice stormwater management actions that correspond with each stage of project and program planning, approvals, construction and management. The actions are grouped in the same categories as above, eg. LU is Land Use Planning, ST is Stormwater Treatment Measures. Detailed Actions are listed in the SWMP for each of these categories.

The other two columns of the table divide Council functions into Strategic and Statutory Planning, and Infrastructure and Operations. Strategic and Statutory Planning manages private development; sometimes this includes construction of public infrastructure as part

of a larger project. Infrastructure and Operations manage Council's infrastructure program. The columns show how normal Council functions can adopt and implement the Stormwater Management Actions. This example illustrates the relationship between the Stormwater Management Actions and Council functions:

The first box of Stormwater Management Actions (1<sup>st</sup> column) includes (a) planning for future land use and development in the municipality while recognising stormwater issues and (b) designing and managing public land with attention to good urban design. These two types of actions are implemented in Council's planning (2<sup>nd</sup> column) and infrastructure/operations (3<sup>rd</sup> column) functions.

Within Planning, the Ballarat Planning Scheme should be amended to take into account where and how best practice stormwater management can be implemented in the future. For example, as structure and development plans are prepared, the proximity of development to waterways must be considered. The location and type of local stormwater management measures should be nominated, with thought given to other standards for subdivision (eg. road layout, urban design, open space) and suitable sites (eg. building envelopes). This will assist Council to achieve Water Sensitive Urban Design in new urban areas. Better performance should be achieved within infill sites by indicating in the planning scheme that the principles of Water Sensitive Urban Design will be applied to these developments.

Within Infrastructure/Operations, stormwater management recommendations in this report will help Council prioritise the locations for retrofitting stormwater treatment and flow management into the existing system. From an infrastructure perspective, it will also assist infrastructure planning and standards for new urban areas (eg. location and type of open space, location and type of stormwater management treatment, road construction). The infrastructure planning standards should be integrated with Council planning scheme standards for new urban areas and infill sites. Detailed engineering and performance standards should also be communicated to developers.

STORMWATER MANAGEMENT ACTION		CORRESPONDING COUNCIL ACTIVITY	
		STRATEGIC & STATUTORY PLANNING	INFRASTRUCTURE & OPERATIONS
PLANNING	<b>LU, ST and FC</b> Strategic land use and development decisions informed by opportunities and constraints of stormwater management	<b>Strategic Land Use Planning</b> MSS and Local Planning Policy Monitoring and continuous improvement	<b>Strategic Infrastructure Planning</b> Municipal physical and community infrastructure Monitoring and continuous improvement
	<b>LU, ST and FC</b> Design and management of the public realm Relationships between public and private land	<b>Local and Site Planning</b> Structure and development plans including location of infrastructure and open space, subdivision layouts, building envelopes	<b>Local Infrastructure Planning</b> Infrastructure and open space planning including for growth areas
APPROVALS	<b>LU</b> Land use and development approvals  <b>ST and FC</b> Selection of best practice source treatment or structural control, or a combination of measures	<b>Council/Statutory Approvals</b> Amendments, development plans, subdivision plans, planning permits Coordination of approvals internally (with reference to Council design and operational specifications) and with external authorities Permit conditions or other approval requirements with use of Section 173 agreements	<b>Infrastructure Design</b> Design of local stormwater system, open space, landscaping, roads Council engineering standards  <b>Operational Specifications</b> Council maintenance standards with performance requirements for staff, contractors, developers, body corporate

STORMWATER MANAGEMENT ACTION		CORRESPONDING COUNCIL ACTIVITY	
		STRATEGIC & STATUTORY PLANNING	INFRASTRUCTURE & OPERATIONS
CONSTRUCTION	<b>LU and RE</b> Management of land development and construction activities  <b>MO</b> Construction of Council assets  <b>EA</b> Education for parties involved with construction of infrastructure and buildings	<b>Site Development and Building</b> Permit conditions or other approval requirement for environmental management/site management plans Council oversight and enforcement	<b>Council Contracts</b> Performance requirements for construction contracts  <b>Local Law</b> Local Law for construction site management with bonds and fines Council oversight and enforcement  <b>Community Education</b> Campaigns for construction companies, builders, contractors, new home owners
	<b>RE</b> Ongoing use of land and associated activities  <b>MO</b> Monitoring and maintenance of regional or local elements of the stormwater system (usually public)  <b>ST and FC</b> Upgrade of regional or local elements of the stormwater system  <b>EA</b> Education for businesses and residents in the community	<b>Land Use Activity</b> Enforcement of permit conditions, environmental management plans and other performance requirements Coordinated enforcement of EPA and similar requirements	<b>Infrastructure Design and Operational Specifications</b> Upgrade of infrastructure for developed areas  <b>Council Contracts</b> Performance requirements for Council operations (maintenance contracts or in-house staff) as per Council operational specifications  <b>Community Education</b> Education for residents, business and industry supplemented by targeted campaigns for problem areas

**FIGURE 9 RELATIONSHIP OF STORMWATER MANAGEMENT PLAN ACTIONS WITH COUNCIL ACTIVITIES**

### 6.1.1 The screening process

#### Step 1:

For each Priority Management Issue, were potentially appropriate action types were identified for addressing the issue. An example of this process is shown in an extract of the screening table (Figure 10), below (appropriate action types are shown by a 'Y'):

BALLARAT STORMWATER MANAGEMENT PLAN				Management Action Type					
Catchment	Location	PMI Code	Priority Management Issue	Land Use Planning	Regulation & Enforcement	Education & Awareness	Municipal Operations	Stormwater Treatment Measures	Flow Control Measures
<b>Burrumbeet Creek</b>	Lake Burrumbeet	3.5.1	The impacts of existing and future urban residential, industrial and commercial runoff on the in-stream habitat, recreational and commercial use of Lake Burrumbeet.	y	y	y		y	

**FIGURE 10 EXTRACT OF SCREENING TABLE**

#### Step 2:

Develop Actions within each of the Action Types (which are broadly aligned with Council's functional divisions) to address the PMIs. These are presented in two ways:

- by Action Type to allow council officers who are working in specific areas of council to find all the relevant actions easily for their functional area;
- by sub-catchment, to allow geographical priorities to be assessed

The following Figure 11 illustrates the Action by Type Table:

EDUCATION AND AWARENESS						
Subcatchment	Location	PMI Code	Priority Management Issue	Action Code	Action	
Burrumbeet Creek	Lake Burrumbeet	3.5.1	The impacts of existing and future urban residential, industrial and commercial runoff on the in-stream habitat, recreational and commercial use of Lake Burrumbeet.	EA1	Target education campaigns in each of the industrial estates through development of a pamphlet targeted at appropriate and inappropriate management of stormwater, and distribute to the landholders.	
				EA3	Develop side entry pit stencil designs that increase community awareness that stormwater drains to receiving waterway environments. The stencil designs to be run in conjunction with local schools as a competition. The stencils to highlight a local receiving waterway environment - eg Lake Burrumbeet, Yarowee River, Lake Wendouree.	
				EA4	Sub-regional, district and neighbourhood commercial centres to receive targeted campaigns, tailored from the information developed in EA2. This would include running workshops and/or personal contact with individual commercial property owners to explain the relevance of improved stormwater management, and provide assistance with effective implementation.	

FIGURE 11 EXTRACT OF ACTION BY TYPE TABLE

### Step 3:

Evaluate each Action according to a range of technical criteria, including estimate of cost, and assign priorities to each relative to other Actions within the functional area type. The evaluation includes, where appropriate, site evaluation of each proposed action. Refer Figure 12 below:

No.	Type	Description	Relevant PMI's	Design Life	Capital Cost	Ongoing cost	Equip. ann. cost	Treated (Ha)	Hydrologic Effectiveness	Removal Efficiency	Catchment Rating	Effectiveness Score	Cost Efficiency Score	Cost Efficiency Rank	Priority	Multiple benefits
LU1		Amend the Ballarat Planning Scheme MSS to include information about stormwater management in Ballarat, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. The amendment should set out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describe Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identify the issues and priority actions from the stormwater management plan, include objectives and strategies for dealing with stormwater in future development and identify implementation measures such as overlays and local planning policy.	2.5b, 2.5c, 2.5d, 2.5g, 3.5.1, 3.5.2a, 3.5.2b, 3.5.4a, 3.5.4b, 3.5.4c, 3.5.8a, 3.5.9, 4.5.4a, 4.5.4b, 5.5.1b, 5.5.3a, 5.5.5a, 6.5.1c, 6.5.1d, 6.5.4b, 7.5.1a, 7.5.1c, 7.5.1e, 8.5.1, 9.5.1a, 9.5.2a, 9.5.2b	3	\$2,000	\$0	\$ 667	16800	1	0.3	0.5	2520.00	0.26455026	3.00	VH	Increased awareness of the role of stormwater management and related environmental improvements amongst the general community.

FIGURE 12 EXTRACT OF EVALUATION TABLE

### Step 4:

Compile Strategies for each PMI from the confirmed Evaluation Tables. This assembles all of the Actions identified to achieve the PMI. An extract is shown in Figure 13 below.

UPPER YAROWEE RIVER									
Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 25</b>									
Yarowee River Upper Reach	4.5.1a	Existing urban residential stormwater runoff causing a decline in in-stream habitat values. The values include historical records of platypus and fish in this upper reach of the Yarowee River.	RE2	With the EPA, address compliance with EPA regulations. Give priority to industrial sites and easements. Review Council's parks and gardens maintenance and works contract to include improve maintenance practices including the following: protection and effective management of in-stream vegetation, appropriate litter collection in parks (especially prior to grass cutting), grass cutting disposal, herbicide use, vegetation selection to eliminate use of weed species. Reference to Best Practice Environmental Management of Urban Stormwater is to be made.	VH	as per 3.5.1	as per 3.5.1	EPA, COB	M
			MO1	Review Council's road construction and maintenance works practices and revise design and maintenance standards in accordance with Best Practice Environmental Management for Urban Stormwater.	H	as per 3.5.4c	as per 3.5.4c	COB	M
			MO5	Review Council's building design standards to encourage use of appropriate materials to minimise increase to quantity of urban stormwater runoff, and improve water quality, and encourage water reuse options.	M	\$3,500	\$0	COB	L
			MO6	Construct a retarding basin on the Nerrina tributary, upstream of the confluence with the Yarowee River. It is recommended that a multi-stage outlet structure be included in the design to provide for optimised attenuation for frequent flows (up to the 2yr ARI - for in-stream habitat protection and stream erosion management) and extreme flood flows (100yr ARI - for flood damages management).	M	\$3,500	\$0	COB	L
			FC4	Construct a retarding basin on the Nerrina tributary, upstream of the confluence with the Yarowee River. It is recommended that a multi-stage outlet structure be included in the design to provide for optimised attenuation for frequent flows (up to the 2yr ARI - for in-stream habitat protection and stream erosion management) and extreme flood flows (100yr ARI - for flood damages management).	H	\$200,000	\$5,000	COB	L

FIGURE 13 EXTRACT OF STRATEGIES TABLE

Each Action has been evaluated to identify its efficiency and effectiveness to address the PMIs. This process is described in detail Chapter 3 of the Best Practice Environmental

Management Guidelines for Urban Stormwater. The intent of this evaluation is to identify the most efficient and effective Actions for the City and other agencies to implement, and provides the rationale behind the prioritisation of each action.

## 6.1.2 The Evaluation Process

The evaluation process has been undertaken for all Actions included in the Draft Strategies. The evaluation process has been undertaken by Action type. For example, all the Education and Awareness Actions have been evaluated together, and rated relative to each other.

The process results in the calculate of a cost-efficiency score, which is a measure of the cost of the action, divided by its performance effectiveness. The performance effectiveness is determined by:

- the catchment area being treated,
- the pollutant load of the catchment
- the proportion of annual runoff treated by the action
- the pollutant removal efficiency (of the flow treated) of the action

The cost-efficiency equation is shown below (the denominator represents the performance effectiveness of the action):

### Equivalent annual cost

---

(Catchment Area Treated x Catchment Load Rating x Hydrologic Effectiveness. x Removal Efficiency)

This results in a ranked (*first by cost efficiency score, and then by performance effectiveness*) list of management actions with indicative costs. The indicative costs include an allowance for maintenance. The list also indicates the priority (from Very High through to Very Low) of each action, and identifies the responsible management agency/ies for its implementation.

## 6.1.3 Strategies

As stated in the Introduction, a 'Strategy' is the combination of Actions required to effectively manage a Priority Management Issue identified during the project. Within each of the Strategies all Actions will have their own individual priority. The priorities have been assigned to each Action by evaluating them together with other Actions of the same type (as described in the Screening Process). For example, all the Education and Awareness Actions were evaluated together, and implementation priorities allocated to them relative to how they would be implemented with each other. An example which explains this is as follows:

*A priority Action is a targeted education and awareness program to be run with the commercial property owners and traders in the CBA of Ballarat. The recommendation includes development of a leaflet to highlight some of the key impacts caused by current practices in the commercial precinct. Once this leaflet has been developed for the CBA it will be used in education campaigns in the smaller commercial precincts in the City. In prioritising the education and awareness Actions, it is important that the CBA campaign is given a higher priority than the other subsequent smaller ones, to ensure the material and process to developed for the CBA is available for use in the subsequent campaigns.*

Once all of the Actions have had a priority score allocated to them, each one is evaluated for its potential to address each of the Priority Management Issues. Each Action retains its allocated priority score. Therefore, the Strategies are made up of a number of Actions each with their own priority Score, so that some Actions will have a higher priority than others. Refer to Figure 14 on following page.

This assigning of appropriate priorities to the individual Actions has been undertaken in all the Action types including Land Use Planning, Regulation and Enforcement, Municipal Operations, Structural Treatment Measures and Flow Control Measures. When the relevant Actions are assigned to the Priority Management Issue resulting in the formulation of a Draft Strategy, the Actions keep the priorities assigned to them in the evaluation process. Therefore, individual Actions within each Strategy may have different priority scores. Incidentally, this process has resulted in an even distribution of priorities throughout the physical area of the City.

The Strategies contained in the plan have only been developed for the Priority Management Issues, which ensures that the Strategies are all targeting the high priority actions within the city. Prioritisation in this manner is an important part of the Plan's outcomes, as there remains more issues overall than could be resourced by Council and its partnership agencies within a foreseeable timeframe. By default the Strategies will be improving management of a range of lower priority issues identified during the project process.

There are a total of 10 Strategies to address Overall or Municipality-wide Priority Management Issues, along with a total of 67 Strategies to address the site specific PMI's identified in each of the seven sub-catchments.

The Strategies have been presented in accordance with the format of the Priority Management Issues Paper - with Municipality Wide/Overall PMI's first, followed by the PMI's by each sub-catchment in the following order:

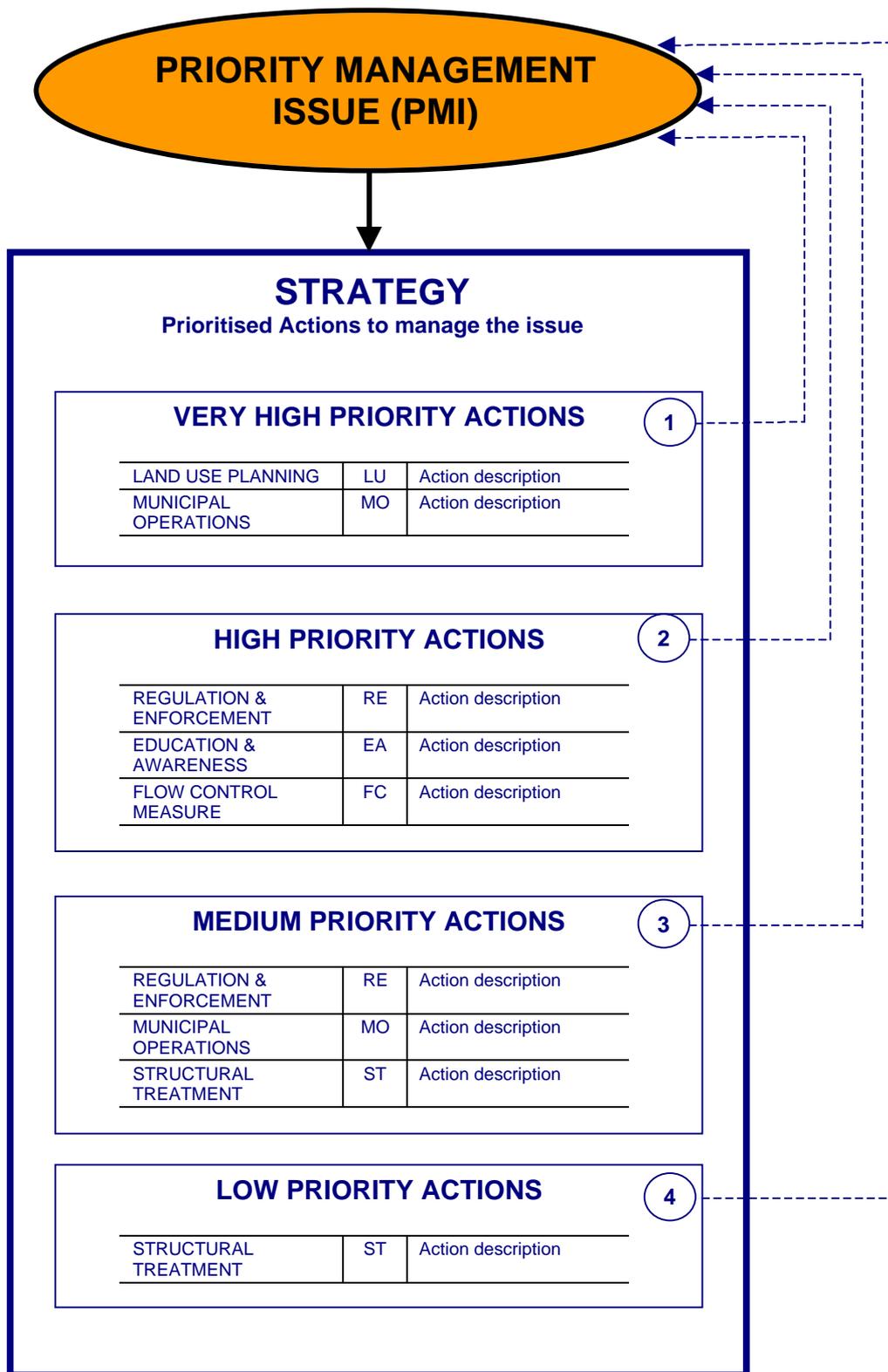
- 10 Strategies for the Overall, Municipality-wide issues
- 14 Strategies for Burrumbeet Creek sub-catchment
- 11 Strategies for the Upper Yarrowee sub-catchment
- 13 Strategies for the Middle Yarrowee sub-catchment
- 13 Strategies for the Lower Yarrowee sub-catchment
- 6 Strategies for the Canadian Creek sub-catchment
- 3 Strategies for the Buninyong Township sub-catchment
- 7 Strategies for the Winter Creek sub-catchment

## **6.2 Overall Strategies on a City-wide basis**

For strategies please refer to Attachment A following Chapter 7 page A/1

## **6.3 Sub-catchment Strategies**

For strategies please refer to Attachment B following Chapter 7 page B/1



**FIGURE 14 IMPLEMENTATION PROCESS FOR STRATEGIES TO ADDRESS PRIORITY MANAGEMENT ISSUES**

# 7.0 IMPLEMENTATION FRAMEWORK

## 7.1 Overview of approach

The successful implementation of the Stormwater Management Plan relies on all officers and agencies involved to not only implement the actions identified, but to be involved in regular information exchange and review about Best Practice Environmental Management (BPEM) of Urban Stormwater.

During the development of the SWMP members of the Steering Committee and Project Working Group have been involved in the detailed process of identifying the priority issues. This has established a core group of officers and community representatives who understand the background to the SWMP and will help drive the implementation of the SWMP in the future. Establishing a mechanism to regularly meet and review the implementation of the SWMP is key to its success. This is referred to as the Stormwater Management Forum.

There needs to be clear understanding of the need to continue to update and review the latest information available on BPEM of urban stormwater. The recommendations contained in the SWMP are the starting point for the actions required, but there is a need to undertake more detailed research or investigation during the implementation of each Action.

In addition to recommending the establishment of a Stormwater Management Forum as a regular liaison group for the SWMP, it is recommended that the Stormwater Co-ordinator position be established as a permanent position within Council. The role of the stormwater Co-ordinator would be to oversee and guide the ongoing implementation of the plan, organise the Forums and be the 'champion' of improved urban stormwater quality management in the City of Ballarat. If long-term commitment to best-practice management of stormwater is to be maintained, then this 'champion for cultural change' will be critical. No amount of expenditure on capital works can replace the need for this commitment.

The Management Framework Actions listed in the Very High Priority category should be implemented first. These actions identify key changes to Council's core planning, design and maintenance contracts and documents, which through amendment, will have a broad influence of current and future improvements to urban stormwater management. This supports immediate improvement in development, capital works and maintenance outcomes so that future problems are not created and current problems are not exacerbated.

The land use planning recommendations have been identified for the highest priority attention, to ensure that as many of these actions as possible are included in the current Planning Scheme review that is about to take place. Actions from other areas in Council have also been given priority to jointly achieve preventative management and pro-active management should continue to have high priority as the SWMP is implemented. The emphasis on land use planning does not signal greater problems in this area of the Council compared to others. Rather it is due to the opportunity to influence the design of new development through the Planning Scheme and thereby reduce future costs of retrofitting the stormwater system.

This is, of course, not to negate the high priority actions for other on-ground work, but is to place due emphasis on the need to make the changes to the overall planning principles and guidelines to ensure there is consistency of approach to all aspects of stormwater management. *Capital works should be undertaken based on a strong foundation of planning, regulatory and education attention to urban stormwater management.*

The Implementation Framework and its strategies for each catchment and sub-catchment in the City of Ballarat contain non-structural and structural actions. Implementation should generally follow assigned priorities, however it is important not to miss opportunities when they arise because a particular action has not been identified as the next one to be undertaken. Opportunities will arise in a number of circumstances such as:

- Funding becomes available for programs that align with a particular action or group of actions
- A person with specialised skills is employed by the Council, a CMA or other organisation, or is active in the community
- Another program being implemented can absorb or support an identified action, including community-based programs
- Major developments come on line earlier than anticipated
- A community priority supports implementing an action
- An action is a predecessor to another action that can be undertaken more quickly than originally thought.

## **7.2 Implementation Process**

### **7.2.1 Stormwater Co-ordinator**

Create a permanent position within Council for a Stormwater Co-ordinator to promote improved stormwater management within the Council, and co-ordinate the implementation of the plan.

One of the key roles of the Co-ordinator would be to organise the quarterly meetings of the Stormwater Management Forum. This would include arranging for relevant speakers, research and information to be made available at the Forums, and follow through on the outcomes of these Forums including co-ordination of individual actions, funding grant applications, and providing support to other officers in the implementation of the plan.

### **7.2.2 Stormwater Management Forum**

To ensure the ongoing effective implementation of this SWMP, a key action is for the City of Ballarat and other Key Agencies is to establish a Stormwater Management Forum. This will provide a formal mechanism to review the implementation of the SWMP and to actively encourage information exchange and research into BPEM of Urban Stormwater.

The first meeting of this group is to be held in March/April 2002 as the quarterly continuation of the forums held for the development of the SWMP.

This Forum is to include representatives from the functional areas of the Council responsible for the actions identified in the SWMP, along with the other key agencies.

**Key Agencies to include:**

- Corangamite Catchment Management Authority
- Glenelg-Hopkins Catchment Management Authority
- North Central Catchment Management Authority (as co-ordinators of GIS mapping data Rural and Urban flooding issues)
- Central Highlands Water
- Environment Protection Authority
- Department of Natural Resources and Environment

- Southern Rural Water
- Goulburn Murray Water
- Highlands Regional Waste Management Group

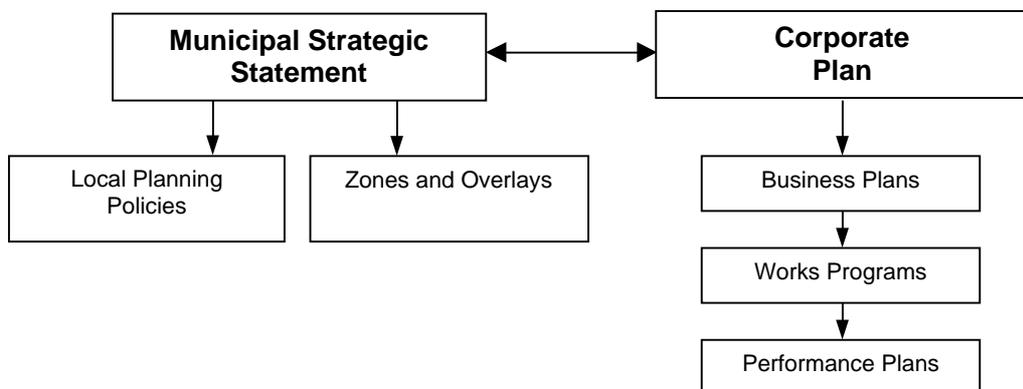
**Relevant Sections of Council to include:**

- Strategic Planning
- Statutory Planning
- Open Space Planning and Design
- Environmental Planning
- Catchment and Infrastructure Planning
- Civil Design
- Building
- Local Laws
- Community Services (Education programs)
- Waste Management
- Parks and Environment
- City Works

The Forum is recommended to meet on a quarterly basis to review the latest developments, research and information available on urban stormwater management, and to integrate and review the implementation of the SWMP. This should include co-ordination across agencies to ensure there is integration and synergies between individual actions and programs. The Forum should also be used to identify relevant budget allocations, funding opportunities and expenditure on stormwater management related programs (Refer 2.4). The Stormwater Co-ordinator should be will be responsible for organising the Forums.

### 7.2.3 Changes to the MSS and Corporate Plan

One of the key priority recommendations in the plan is action LU1 that includes making amendments to the Municipal Strategic Statement (MSS) to incorporate BPEM for urban stormwater in the document. The MSS is the Council's major strategic document for land use and development. The Corporate Plan (CP) is the other major strategic document of the Council and guides the Council organisation. The CP guides upper level management in all aspects of their decision making, including the development of Business Plans, Works Programs and individual Performance Plans. These documents work together and need to recognise and include improved stormwater management principles to allow officers within Council to implement the actions within the SWMP. Making appropriate changes to the MSS and CP are therefore of the highest priority.



**FIGURE 15 EXPLANATORY DIAGRAM OF THE MSS AND CORPORATE PLAN**

## **7.2.4 Changes to Business Plans and Works Programs**

Once the CP is amended and there is upper level support for improved stormwater management within Council, each Section will incorporate the relevant Actions from the Stormwater Management Plan into their Business Plans, Works Programs and Performance Plans.

The Action Evaluation tables prepared as part of this SWMP will assist with the development of these Programs and Plans

## **7.2.5 Funding Grant Applications**

Many of the actions contained in the Plan will be eligible for funding consideration under the current Victorian Stormwater Action Program (VSAP) . A priority for the Forum is to determine which high priority actions should be the basis for funding applications. The background tables and information in this SWMP should be used to assist the preparation of these funding applications.

As well as funding available from VSAP, there is a need to develop a strong collaborative approach for funding between Council and its partners in stormwater management, in particular the Corangamite and Glenelg-Hopkins Catchment Management Authorities.

The Stormwater Co-ordinator will be responsible for identifying appropriate funding sources and preparation of Funding Grant Applications for the City in accordance with the priorities discussed in the Stormwater Management Forum.

It will be important to ensure that any capital works undertaken as part of the implementation of this Plan are accompanied by an appropriate management plan, which guides their ongoing operations and maintenance. It is not adequate to construct a stormwater treatment wetland, for example, without developing a plan (and budget commitment) for its ongoing maintenance.

## **7.3 Summary of Key Priority Actions for initial implementation**

The Actions developed for Land Use Planning, Municipal Operations, Education and Awareness and Regulation and Enforcement have the potential to significantly improve the short and long-term provision of improved stormwater management in the City. This is particularly pertinent given that the City of Ballarat is about to commence a review of the existing Planning Scheme, which provide an ideal opportunity to incorporate the recommendations from the Plan into the review process.

### **7.3.1 Land use Planning Actions**

- LU1 Amending the Ballarat Planning Scheme to include information about stormwater management in Ballarat.
- LU2 Incorporate a local planning policy for stormwater management in the Ballarat Planning Scheme and indicate how development will be treated in the planning process.

- LU3 Review or prepare structure plans for major development areas and incorporate in the Ballarat Planning Scheme as local planning policy
- LU12 Review Council engineering subdivision and site development standards for private development.

### **7.3.2 Municipal Operations Actions**

- MO5 Review Council's road and drainage construction and maintenance work practices and revise in accordance with BPEMG for Urban Stormwater Management.
- MO6 Review Council's building design standards for capital works projects.
- MO7 Establish a Stormwater Management Forum with external agencies for information exchange and co-ordinating the SWMP implementation.
- MO9 Develop a design for unsealed road verges that improves water quality.
- MO1 Review Council's Parks and Environment maintenance contract and revise in accordance with BPEMG for Urban Stormwater Management.
- MO3 Liaise with CHW to prioritise sewer maintenance and upgrade works.

### **7.3.3 Education and Awareness Actions**

- EA2 Education campaign targeted at the traders in CBA of Ballarat in conjunction with the Ballarat Chamber of Commerce, to improve understanding of BPEG of Urban Stormwater.
- EA11 Undertake a training program for Council staff to improve their knowledge of BPEG of Urban Stormwater
- EA12 Undertake an education program for developers and builders to explain the purpose of introducing BPEM for stormwater.

### **7.3.4 Regulation and Enforcement Actions**

- RE1 Implement a municipal local law to address construction site management.

### **7.3.5 Structural Treatment Measures**

- ST7 Construct the Yarrowee/Redan Wetlands
- ST21 Install Gross Pollutant Traps (GPT) at selected locations identified in this Plan
- ST3 Retrofit selected existing retarding basins with low flow treatment wetlands
- ST22 Install side entry pit traps in selected commercial centres (eg CBA)
- ST13 Construct porous embankments at existing drain outfalls to Lake Wendouree

### **7.3.6 Flow Control Measures**

- FC3 Construct new Retarding Basins where required with incorporated low flow treatment wetlands (eg. Paul's Basin Wetland)

# ATTACHMENT A

## Overall Strategies

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 1</b>									
Overall	2.5a	Protect the water-based recreational values from water quality decline in the lakes in and around Ballarat. The water-based recreational activities include swimming, waterskiing, rowing, fishing and boating.	RE1	Implement a municipal local law to address construction site management.	VH	as per 3.5.1		COB	M
			RE2	With the EPA, address compliance with EPA regulations. Give priority to industrial sites and estates.	VH	as per 3.5.1		COB, EPA	M, L
			EA1	Target education campaigns in each of the industrial estates through development of a pamphlet targeted at appropriate and inappropriate management of stormwater, and distribute to the landholders.	VH	\$10,000	\$1,000	COB, EPA	M
			EA2	Traders in CBA of Ballarat to be targeted in an education campaign to improve stormwater management practices. Eg, leaflet designed to discourage traders sweeping and washing shop floor out on footpath, sweeping rubbish from shopfront into gutters, pouring unwanted substances down side entry pits etc. City of Ballarat to work with the Ballarat Chamber of Commerce, who have participated in this process to arrange for launch of the campaign, and follow up reminders of the best practice.	VH	\$10,000	\$1,000	COB, BCC	M
			EA3	Develop side entry pit stencil designs that increase community awareness that stormwater drains to receiving waterway environments. The stencil designs to be run in conjunction with local schools as a competition. The stencils to highlight a local receiving waterway environment - eg Lake Burrumbeet, Yarrowee River, Lake Wendouree.	VH	\$2,000	\$0	COB	L
			EA4	Sub-regional, district and neighbourhood commercial centres to receive targeted campaigns, tailored from the information developed in EA2. This would include running workshops and/or personal contact with individual commercial property owners to explain the relevance of improved stormwater management, and provide assistance with effective implementation.	H	\$500	\$0	COB	L
			EA14	Prepare a brochure that targets education for mobile small business operators - eg dog wash and car maintenance businesses to increase awareness of best practice environmental management practices for urban stormwater.	H	\$3,000	\$0	COB	M
			MO10	Establish a Stormwater Management Forum within Council, include CMAs and EPA. Use the Forum as an information exchange and integrating/coordinating mechanism for planning/infrastructure decision making and SWMP implementation. Integrate flood management and rural catchment issues.	VH	\$1,000	\$200	BCC, EPA, CMA	M
			MO13	Develop management plans for reserves with significant water bodies which may be used for recreational purposes. This is to allow for integration of a number of recreational, heritage, environmental and water quality improvement outcomes.	M			COB	L
			STM1	Construct the Paul's Drain Retarding Basin and wetland system as recommended in the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report'.	H	\$350,000	\$3,500	COB, GHGMA, COMM. FUNDS	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			STM2	The North Garden Wetlands are constructed and treat stormwater runoff from the local catchment prior to discharging into Lake Wendouree. A GPT is located upstream of the wetland system on Monastrv drain. Action already implemented.		completed	completed	COB	L
			STM8	Construct a stormwater treatment wetland at the eastern end of the Gong to treat local rural and residential catchment runoff. The design of the wetland should ensure treatment for flows up to the 3 month ARI event.	M	\$40,000	\$2,000	COB	L
			STM11	Provide sediment traps at the inlet to Flax Mill Swamp. Construct porous embankments at drain outfalls to Lake	M	\$2,500	\$250	COB	L
			STM13	Wendouree, from commercial and industrial precincts, to attenuate flows and promote the removal of coarse sediment. The embankments should be constructed parallel to the perimeter of the lake, remaining open at the downstream end. The treatment areas should be densely vegetated to promote the removal of fine particulates and associated pollutants to improve the overall quality of water entering the lake.	VH	\$50,000	\$6,400	COB	L
			STM15	Increase engagement of Burrumbeet Creek floodplain, upstream of Miners Rest township, by re-forming floodplain into an ephemeral vegetated zone, to provide increased treatment of small event-flows in Burrumbeet Creek.	M	\$95,000	\$475	COB, GHCMA.	L
			STM16	Undertake works in Burrumbeet Creek floodplain immediately downstream of Miners Rest Motors, to increase engagement of floodplain, and promote treatment of small storm event-flows. Dense vegetation bands aligned perpendicular to direction of flow should be created within re-formed floodplain. Floodplain should be engaged via sidecast weir.	M	\$275,000	\$2,750	COB, GHCMA	L
			STM19	Install GPTs (recommended circular screen type) on all major drains conveying flows from commercial precincts into Lake Learmonth. As a minimum design feature the traps should be sized to treat the 3 month ARI event.	VH	\$30,000	\$3,000	COB	L
			STM21	Install a GPT (recommended circular screen type) at the inlets to Flax Mill Swamp. As a minimum design feature the traps should be sized to treat the 3 month ARI event.	VH	\$22,500	\$2,250	COB	L
			STM23	Install release nets on drains to Lake Wendouree, from commercial precincts. The release nets could be concealed under viewing platforms.	H	\$48,000	\$19,200	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 2</b>									
Overall	2.5b	Review current planning documents, including Outline Development Plans (ODP) and other structure plans to include best practice management of urban stormwater including construction and design matters, and incorporate into the review of the municipal planning scheme.	LU1	Amend the Ballarat Planning Scheme MSS to include information recently developed through the municipal stormwater management plan, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. An amendment could do this by setting out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describing Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identifying the issues and priority actions from the stormwater management plan, including objectives and strategies for dealing with stormwater in future development and identifying implementation measures such as overlays and local planning policy.	VH	as per 3.5.1	\$0	COB	M
			LU2	Incorporate and implement a local planning policy for stormwater management in the Ballarat Planning Scheme to indicate how development will be treated in the planning process. Include assessment of land subdivision to infill development and the treatment of unsealed roads and verges. Specific issues identified in the municipal stormwater management plan include site layout and design to incorporate structural measures to reduce peak storm flows and pollutant loads, management of waste storage areas to reduce blown litter, ongoing management arrangements for structural measures and construction site management (unless incorporated in local law). Integrate with ResCode.	VH	as per 3.5.1	\$0	COB	M
			LU3	Develop model to review or prepare structure plans for major development areas based on the findings of the municipal stormwater management plan; incorporate plans in the Ballarat Planning Scheme. Provide development setbacks from waterways to protect floodplains and natural drainage/environmental functions. Avoid back fences to increase surveillance of open space corridors along waterways, improve appreciation and enjoyment of waterways by new residents. Identify structural measures for flood protection, reduced peak storm flows and treatment of pollutant loads by location (avoid floodplains), approximate size and type, development staging, funding and management. Identify open space for residents independent of land required for drainage functions/scheme. Integrate retarding basins and wetlands with open space. Integrate with urban design guidelines.	VH	as per 3.5.1	\$0	COB	M
			LU4	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Burrumbeet catchment: Miners Rest and West Wendouree (see LU3 for detail).	VH	as per 3.5.1	\$0	COB	L
			LU5	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Upper Yarrowee catchment: Brown Hill (see LU3 for detail).	VH	as per 4.5.4a	\$0	COB	L
			LU6	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Canadian Creek catchment: Ballarat East, Mt Clear and Mt Helen (see LU3 for detail).	VH	as per 7.5.1a	\$0	COB	L
			LU7	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Buninyong catchment: Buninyong Township (see LU3 for detail).	VH	as per 8.5.1	\$0	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			LU8	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Winter Creek catchment: Sebastapol/West Sebastapol, Alfredton and Delacombe (see LU3 for detail).	VH	as per 9.5.2b	\$0	COB	L
			LU12	Based on the information and principles recently developed in the municipal stormwater management plan, review Council engineering subdivision and site development standards for private development. These should respond to the model for local structure plans and encourage use of appropriate stormwater management systems and materials to minimise any increase in the quantity of stormwater runoff, improve water quality and encourage water reuse options.	VH	as per 3.5.1	\$0	COB	M
			MO10	as per 2.5a					
<b>STRATEGY 3</b>									
Overall	2.5c	Develop new Outline Development Plans or other structure plans as required incorporating best practice urban stormwater management.	LU1	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU3	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU4	as per 3.5.1	VH	as per 3.5.1		COB	L
			LU5	as per 4.5.4a	VH	as per 4.5.4a		COB	L
			LU6	as per 7.5.1a	VH	as per 7.5.1a		COB	L
			LU7	as per 8.5.1	VH	as per 78.5.1		COB	L
			LU8	as per 9.5.2b	VH	as per 9.5.2b		COB	L
			MO10	as per 2.5a					
<b>STRATEGY 4</b>									
Overall	2.5d	There is a lack of integration of flood and stormwater management information in the planning scheme and appropriate council planning documents. This is an impediment to the adoption of water sensitive urban design within the City of Ballarat.	LU1	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU3	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU4	as per 3.5.1	VH	as per 3.5.1		COB	L
			LU5	as per 4.5.4a	VH	as per 4.5.4a		COB	L
			LU6	as per 7.5.1a	VH	as per 7.5.1a		COB	L
			LU7	as per 8.5.1	VH	as per 78.5.1		COB	L
			LU8	as per 9.5.2b	VH	as per 9.5.2b		COB	L
			MO10	as per 2.5a					
<b>STRATEGY 5</b>									
Overall	2.5e	There is a need for improved co-ordination and adequate funding to allow infrastructure planning and asset management areas of council to achieve optimum performance of the existing retarding basins for flow attenuation and water quality treatment.	MO10	as per 2.5a					

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 6</b>									
Overall	2.5f	Identify and protect heritage values associated with the receiving waterway environments including future stormwater infrastructure design and vegetation management.	LU10	Amend the Ballarat Planning Scheme to identify and protect components of Ballarat's cultural history and character that could be affected by environmental improvements in the stormwater plan. This may include using the Heritage Overlay (where it does not already apply)	VH	\$3,000	\$0	COB	M
			MO7	Engineering design standards and guidelines to include protection of heritage values of the bluestone, brick and timber-lined drains that are of heritage significance to ensure protection of these values in any works where modification to the channel may be required.	VH	\$2,000	\$200	COB	M
			MO9	Identify street trees that are environmental weeds in waterway environments, and list these in the Council's street tree selection guidelines to ensure no further weed species are planted as street trees. This list will require regular review as new cultivar's become available	VH	\$1,000	\$100	COB	M
			MO10	as per 2.5a					
			MO17	Develop plan of management for reducing leaf litter from existing established deciduous trees that have heritage values entering waterway environments. This may include increased frequency of street sweeping during autumn, and additionally when seeds are ripe on deciduous trees that are identified as weed species in waterway environments	VH	\$2,000	\$5,000	COB	M
<b>STRATEGY 7</b>									
Overall	2.5g	High sediment loads from unsealed roads, and unsealed road verges in urban areas require management, whilst protecting their cultural and heritage values.	LU2	as per 2.5a					
			LU10	Amend the Ballarat Planning Scheme to identify and protect components of Ballarat's cultural history and character that could be affected by environmental improvements in the stormwater plan. This may include using the Heritage Overlay (where it does not already apply)	VH	\$3,000	\$0	COB	M
			MO10	as per 2.5a					
			MO11	Develop a design for unsealed road verges in the Gnarr Ck and Redan Ck catchments (and others where appropriate) that improves water quality treatment via vegetated swales and integrates with the historical urban character of these wide road verges. Once the design has been developed and approved, this work could be progressively implemented as part of Council's roadside maintenance and upgrade program	VH	\$5,000	\$20,000	COB	M
			LU12	as per 2.5b	VH	as per 3.5.1		COB	M
<b>STRATEGY 8</b>									
Overall	2.5h	Industrial areas need to be managed for point source pollution discharge.	RE2	as per 2.5a	VH	as per 3.5.1		COB, EPA	M,L
			EA1	as per 2.5a					

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 9</b>									
Overall	2.5i	Management of flood risks in the city may constrain water quality treatment opportunities. Creative approaches, utilising structural and non-structural components, will therefore be required.	MO10	as per 2.5a					
			MO12	Prior to construction of any of the proposed wetlands in this plan, detailed design and investigation is required to address detailed site design issues, including opportunities for integrating multiple benefits in design development.	VH	\$25,000	\$0	COB, Developer	L
			STM1	as per 2.5a				COB, GHCMA, Comm. funds	L
			STM2	as per 2.5a				COB	L
			STM3	Retrofit the Crompton Street Retarding Basin with a low flow treatment wetland as recommended in the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report'.	VH	\$35,000	\$700	COB, CCMA	L
			STM4	Retrofit the Hillside Drive Retarding Basin with an ephemeral wetland to treat frequently occurring runoff events from the local residential catchment. Refer to the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report' for design concept details.	M	\$25,000	\$500	COB, CCMA	L
			STM6	Retrofit the Morshead Park Retarding Basin with a stormwater treatment wetland to treat local catchment flows prior to discharging into Redan Creek.	VH	\$35,000	\$1,750	COB	L
			STM9	Construct the Lawrie Drive Retarding Basin and wetland to treat local catchment stormwater runoff	M	\$350,000	\$17,500	COB, Developer, Other Funds	L
			STM10	Construct a stormwater treatment wetland in the land bounded by Wiltshire Lane and Latrobe St, to treat industrial runoff prior to discharging to the downstream environment.	M	\$440,000	\$44,000	COB	L
<b>STRATEGY 10</b>									
Overall	2.5j	Threat of sewer overflows to receiving waters.	MO3	Negotiate with CHW to prioritise sewer maintenance and upgrade works based on threats to valuable receiving waters	VH	\$1,000	\$0	CHW, COB	M

# ATTACHMENT B

## Strategies for Burrumbeet Creek Sub-catchment

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 11</b>									
Lake Burrumbeet	3.5.1	The impacts of existing and future urban residential, industrial and commercial runoff on the in-stream habitat, recreational and commercial use of Lake Burrumbeet.	LU1	Amend the Ballarat Planning Scheme MSS to include information recently developed through the municipal stormwater management plan, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. An amendment could do this by setting out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describing Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identifying the issues and priority actions from the stormwater management plan, including objectives and strategies for dealing with stormwater in future development and identifying implementation measures such as overlays and local planning policy.	VH	\$2,000	\$0	COB	M
			LU2	Incorporate and implement a local planning policy for stormwater management in the Ballarat Planning Scheme to indicate how development will be treated in the planning process. Include assessment of land subdivision to infill development and the treatment of unsealed roads and verges. Specific issues identified in the municipal stormwater management plan include site layout and design to incorporate structural measures to reduce peak storm flows and pollutant loads, management of waste storage areas to reduce blown litter, ongoing management arrangements for structural measures and construction site management (unless incorporated in local law). Integrate with ResCode.	VJ	\$5,000	\$0	COB	M
			LU3	Develop model to review or prepare structure plans for major development areas based on the findings of the municipal stormwater management plan; incorporate plans in the Ballarat Planning Scheme. Provide development setbacks from waterways to protect floodplains and natural drainage/environmental functions. Avoid back fences to increase surveillance of open space corridors along waterways, improve appreciation and enjoyment of waterways by new residents. Identify structural measures for flood protection, reduced peak storm flows and treatment of pollutant loads by location (avoid floodplains), approximate size and type, development staging, funding and management. Identify open space for residents independent of land required for drainage functions/scheme. Integrate retarding basins and wetlands with open space. Integrate with urban design guidelines.	VH	\$2,000	\$0	COB	M

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			LU4	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Burrumbeet catchment: Miners Rest and West Wendouree (see LU3 for detail).	VH	\$10,000	\$0	COB	L
			LU12	Based on the information and principles recently developed in the municipal stormwater management plan, review Council engineering subdivision and site development standards for private development. These should respond to the model for local structure plans and encourage use of appropriate stormwater management systems and materials to minimise any increase in the quantity of stormwater runoff, improve water quality and encourage water reuse options.	VH	\$2,000	\$0	COB	M
			RE1	Implement a municipal local law to address construction site management	VH	\$5,000	\$0	COB	M
			RE2	With the EPA, address compliance with EPA regulations. Give priority to industrial sites and estates.	VH	\$0	\$10,000	COB, EPA	M,L
			EA1	Target education campaigns in each of the industrial estates through development of a pamphlet targeted at appropriate and inappropriate management of stormwater, and distribute to the landholders.	VH	\$10,000	\$1,000	COB, EPA	M
			EA3	Develop side entry pit stencil designs that increase community awareness that stormwater drains to receiving waterway environments. The stencil designs to be run in conjunction with local schools as a competition. The stencils to highlight a local receiving waterway environment - eg Lake Burrumbeet, Yarrowee River, Lake Wendouree	VH	\$2,000	\$0	COB	L
			EA4	Sub-regional, district and neighbourhood commercial centres to receive targeted campaigns, tailored from the information developed in EA2. This would include running workshops and/or personal contact with individual commercial property owners to explain the relevance of improved stormwater management, and provide assistance with effective implementation.	H	\$500	\$0	COB	L
			ST1	Construct the Paul's Drain Retarding Basin and wetland system as recommended in the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report'.	H	\$350,000	\$3,500	COB, GHCMA	L
			ST11	Provide sediment traps at the inlet to Flax Mill Swamp.	M	\$95,000	\$475	COB	L
			ST15	Increase engagement of Burrumbeet Creek floodplain, upstream of Miners Rest township, by re-forming floodplain into an ephemeral vegetated zone, to provide increased treatment of small event-flows in Burrumbeet Creek.	M	\$275,000	\$2,750	COB, GHCMA	L
			ST16	Undertake works in Burrumbeet Creek floodplain immediately downstream of Miners Rest Motors, to increase engagement of floodplain, and promote treatment of small storm event-flows. Dense vegetation bands aligned perpendicular to direction of flow should be created within re-formed floodplain. Floodplain should be engaged via sidecast weir.	M	\$440,000	\$44,000	COB, GHCMA	L
			ST20	A GPT ( 2 Rocla units in parallel) has been recently installed on Paul's Drain to reduce the litter load conveyed within the drain. Action already implemented	completed	completed	completed	COB	L
			ST21	Install a GPT (recommended circular screen type) at the inlets to Flax Mill Swamp. As a minimum design feature the traps should be sized to treat the 3 month ARI event.	VH	\$95,000	\$475	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 12</b>									
Lower Burrumbeet Creek	3.5.2a	Changed flow regimes are causing streambank erosion and a decline in in-stream habitat values in Burrumbeet Creek, which are rated as high due to presence of native fish in the stream. This will potentially be exacerbated by future residential and industrial development.	LU1	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU2	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU3	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU4	as per 3.5.1	VH	as per 3.5.1		COB	L
			LU12	as per 3.5.1	VH	as per 3.5.1		COB	M
			FC1	Undertake detailed hydrologic modelling to investigate opportunities to construct a series of sub-catchment storages on the tributaries of Burrumbeet Creek to delay runoff and reduce peak flows downstream. Target should be to return post-developed 1.5yr ARI flow to pre-developed 1.5yr ARI flow for protection of in-stream habitat.	H	\$30,000	\$0	COB	L
			FC3	Construct the Pauls Drain Retarding Basin and wetland system as recommended in the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report'. The retarding basin will provide flow attenuation for the 100yr ARI event to manage flood damage costs along Burrumbeet Creek.	H	\$220,000	\$6,600	COB	L
<b>STRATEGY 13</b>									
Lower Burrumbeet Creek	3.5.2b	Changed flow regimes are causing a reduction in the floodplain storage and conveyance capacity of the creek, thereby exacerbating local flooding issues in the lower reaches.	LU1	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU2	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU3	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU4	as per 3.5.1	VH	as per 3.5.1		COB	L
			LU12	as per 3.5.1	VH	as per 3.5.1		COB	M
			FC1	as per 3.5.2a	H	as per 3.5.2a		COB	L
			FC3	as per 3.5.2a	M	as per 3.5.2a		COB	L
<b>STRATEGY 14</b>									
Lake Learmonth	3.5.3	Changed flow regimes are causing a reduction in the floodplain storage and conveyance capacity of the creek, thereby exacerbating local flooding issues in the lower reaches.	RE2	as per 3.5.1	VH	as per 3.5.1		COB, EPA	M,L
			ST14	Construct porous embankments around drain outfalls discharging to Lake Learmonth. These embankments will attenuate flows and promote the removal of coarse to medium size particulates. The embankments should be constructed parallel to the perimeter of the lake, remaining open at the downstream end. The treatment areas should be densely vegetated to promote the removal of fine particulates and associated pollutants to improve the overall quality of water entering the lake.	H	\$6,000	\$600	COB, GHCMA	L
			ST19	Install GPTs (recommended circular screen type) on all major drains conveying flows from commercial precincts into Lake Learmonth. As a minimum design feature the traps should be sized to treat the 3 month ARI event.	VH	\$30,000	\$3,000	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 15</b>									
Burrumbeet Creek through Miners Rest Township	3.5.4a	The existing residential development in the floodplain constrains future opportunities for water quality treatment and long term waterway values.	LU1	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU2	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU3	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU4	as per 3.5.1	VH	as per 3.5.1		COB	L
			LU12	as per 3.5.1	VH	as per 3.5.1		COB	M
			RE	as per 3.5.1					
<b>STRATEGY 16</b>									
Burrumbeet Creek through Miners Rest Township	3.5.4b	The existing planning scheme and council's planning documents permit further urban development in the floodplain, which if allowed to continue will further constrain the flood conveyance capacity of the creek and opportunities for integrated stormwater management.	LU1	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU2	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU3	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU4	as per 3.5.1	VH	as per 3.5.1		COB	L
			LU12	as per 3.5.1	VH	as per 3.5.1		COB	M
<b>STRATEGY 17</b>									
Burrumbeet Creek through Miners Rest Township	3.5.4c	Reed bed in the floodplain of Burrumbeet Creek upstream of the township provides water quality treatment function.	MO1	Review Council's parks and gardens maintenance and works contract to include improve maintenance practices including the following: protection and effective management of in-stream vegetation, appropriate litter collection in parks (especially prior to grass cutting), grass cutting disposal, herbicide use, vegetation selection to eliminate use of weed species. Reference to Best Practice Environmental Management of Urban Stormwater is to be made	H	\$5,000	\$0	COB	M
			ST15	Increase engagement of Burrumbeet Creek floodplain, upstream of Miners Rest township, by re-forming floodplain into an ephemeral vegetated zone, to provide increased treatment of small event-flows in Burrumbeet Creek.	M	\$95,000	\$475	COB, GHCMA	L
<b>STRATEGY 18</b>									
Mitchell Park (Wendouree Industrial area)	3.5.6	The existing North Common Wetland established downstream of the Wendouree industrial area lacks a formal plan for management and maintenance, which may be resulting in reduced water quality treatment function.	MO4	Develop management plans for all existing wetland sites with environmental significance in the City to ensure effective ongoing protection and management of them.	H	\$5,000	\$0	COB	L
<b>STRATEGY 19</b>									
Pauls Drain	3.5.7a	Construction of a wetland/retarding basin is proposed for the upper catchment, at a site identified as being of habitat value for Latham's Snipe. Works should be designed so as to protect and enhance this habitat and local environmental values.	LU11	Amend the Ballarat Planning Scheme with support from the relevant Referral Authorities to identify and protect wetlands in areas where detailed planning for future urban development including flood mitigation and stormwater management will occur. This will include using the Environmental Significance Overlay (where it does not already exist). Link to structure planning for these areas	VH	\$3,000	\$0	COB	M
			MO4	as per 3.5.6	H	\$5,000	\$0	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 20</b>									
Pauls Drain	3.5.7b	Significant input of poor water quality from industrial, urban and commercial land uses including litter.	RE2	as per 3.5.1	VH	as per 3.5.1		COB, EPA	M,L
			EA1	as per 3.5.1	VH	as per 3.5.1			
			EA4	as per 3.5.1	H	\$500	\$0	COB	L
			ST1	as per 3.5.1	H	as per 3.5.1		COB, GHCMA	L
			ST20	as per 3.5.1	complete				L
<b>STRATEGY 21</b>									
Pauls Drain	3.5.7c	Inadequate capacity in the local drainage infrastructure causes nuisance flooding, which will constrain the ability to undertake water quality treatment works in parts of the catchment.	FC2	Implement the strategy developed by R.J. Keller & Associates (1996) to increase pipe capacity in the Windouree West area and Minors Rest area to convey flows up to the peak 20yr ARI flow. This will be achieved through a combination of pipeline augmentation and replacement as outlined in the R.J. Keller report titled 'Flood Study of Wendouree Area West of the Midland Highway and of the Miners Rest Area'	L	\$100,000	\$5,000	COB	L
<b>STRATEGY 22</b>									
Flax Mill Swamp	3.5.8a	Existing and future industrial land use impacts (eg. industrial land use) including high sediment and	LU1	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU2	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU3	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU4	as per 3.5.1	VH	as per 3.5.1		COB	L
			LU12	as per 3.5.1	VH	as per 3.5.1		COB	M
			RE1	as per 3.5.1	VH	as per 3.5.1		COB	M
			RE2	as per 3.5.1	VH	as per 3.5.1		COB, EPA	M,L
			EA5	Develop interpretative signage for Flax Mill Swamp. This will need to highlight the reserve is there, and provide interpretative information about the habitat values. Develop a leaflet from the signage materials and distribute to adjoining industrial land holders to notify them directly of these values.	M	\$3,500	\$0	COB	L
ST11	as per 3.5.1	M	as per 3.5.1	as per 3.5.1	COB	L			
<b>STRATEGY 23</b>									
Flax Mill Swamp	3.5.8B	Fragmented land management and lack of co-ordination between different land managers resulting in reduced protection of the environmental values.	MO4	as per 3.5.6	H	\$5,000	\$0	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 24</b>									
Winter Swamp	3.5.9	Impacts of existing and future industrial runoff on the habitat values of the swamp.	LU1	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU2	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU3	as per 3.5.1	VH	as per 3.5.1		COB	M
			LU4	as per 3.5.1	VH	as per 3.5.1		COB	L
			LU12	as per 3.5.1	VH	as per 3.5.1		COB	M
			RE1	as per 3.5.1	VH	as per 3.5.1		COB	M
			RE2	as per 3.5.1	VH	as per 3.5.1		COB, EPA	M,L
			EA6	Develop interpretative signage for Winter Swamp to highlight habitat values (run jointly with EA5 to minimise graphic and signage production costs). Develop a leaflet from signage material and distribute to industrial land holders.	M	\$3,500	\$0	COB	L
			MO4	as per 3.5.6	H	\$5,000	\$0	COB	L
			ST12	Provide sediment traps at the inlets to Winter Swamp.	M	\$10,000	\$500	COB	L

# Strategies for Upper Yarrowee River Sub-catchment

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 25</b>									
Yarrowee River Upper Reach	4.5.1a	Existing urban residential stormwater runoff causing a decline in in-stream habitat values. The values include historical records of platypus and fish in this upper reach of the Yarrowee River.	RE2	With the EPA, address compliance with EPA regulations. Give priority to industrial sites and estates.	VH	as per 3.5.1	as per 3.5.1	EPA, COB	M
			MO1	Review Council's parks and gardens maintenance and works contract to include improve maintenance practices including the following: protection and effective management of in-stream vegetation, appropriate litter collection in parks (especially prior to grass cutting), grass cutting disposal, herbicide use, vegetation selection to eliminate use of weed species. Reference to Best Practice Environmental Management of Urban Stormwater is to be made.	H	as per 3.5.4c	as per 3.5.4c	COB	M
			MO5	Review Council's road construction and maintenance works practices and revise design and maintenance standards in accordance with Best Practice Environmental Management for Urban Stormwater.	M	\$3,500	\$0	COB	L
			MO6	Review Council's building design standards to encourage use of appropriate materials to minimise increase to quantity of urban stormwater runoff, and improve water quality, and encourage water reuse options.	M	\$3,500	\$0	COB	L
			FC4	Construct a retarding basin on the Nerrina tributary, upstream of the confluence with the Yarrowee River. It is recommended that a multi-stage outlet structure be included in the design to provide for optimised attenuation for frequent flows (up to the 2yr ARI - for in-stream habitat protection and stream erosion management) and extreme flood flows (100yr ARI - for flood damages management).	H	\$200,000	\$5,000	COB	L
<b>STRATEGY 26</b>									
Yarrowee River Upper Reach	4.5.1b	Increase in flows causing instream erosion and the associated infrastructure works to prevent erosion causing a decline in the enjoyment of the natural waterway setting for passive recreational use,	MO6	as per 4.5.1a	M	as per 4.5.1a	as per 4.5.1a	COB	L
			FC4	as per 4.5.1a	H	as per 4.5.1a	as per 4.5.1a	COB	L
<b>STRATEGY 27</b>									
Yarrowee River Upper Reach	4.5.1c	Lack of co-ordination between responsible authorities and significant landholders to address existing water quality discharge issues that have been previously identified by the Council.	RE2	as per 4.5.1a		as per 3.5.1a	as per 3.5.1a	COB, EPA	M, L
			MO10	Establish a Stormwater Management Forum within Council, include CMAs and EPA. Use the Forum as an information exchange and integrating/coordinating mechanism for planning/infrastructure decision making and SWMP implementation. Integrate flood management and rural catchment issues.	VH	\$1,000	\$200	COB, EPA, CMA	M
<b>STRATEGY 28</b>									
Yarrowee River Upper Reach	4.5.1d	The existing Western Highway Retarding Basin has an important role in attenuation of high flow events for the urban areas of Ballarat, which needs to be protected.	MO10	as per 4.5.1c	VH	as per 4.5.1c	as per 4.5.1c	COB, EPA, CMA	M
<b>STRATEGY 29</b>									
Yarrowee River Upper Reach	4.5.1e	Role of the floodplain needs to be acknowledged and protected in Council's planning scheme and other strategic planning documents.	LU9	Amend the Ballarat Planning Scheme to incorporate floodplain zones and overlays. These should discourage urban development in floodplains and receive input and support from relevant Referral Agencies. Link to structure planning for new areas.	VH	\$5,000	\$0	COB	M

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Respons-ibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 30</b>									
Gong Gong Reservoir Park	4.5.2a	Impact of existing stormwater quality discharge from the timber mill on the in-stream values of upper reaches of the Yarrowee River within the Gong Gong Reservoir Reserve.	RE2	as per 4.5.1a	VH	as per 3.5.1	as per 3.5.1	COB, EPA	M, L
			MO10	as per 4.5.1c	VH	as per 4.5.1c	as per 4.5.1c	COB, EPA, CMA	M
			MO18	Negotiate with Central Highlands Water to construct a water quality treatment measure to treat water from the CHW Timber Mill, prior to discharge into the Gong Gong tributary.	H	\$40,000	\$1,200	CHW	L
<b>STRATEGY 31</b>									
Gong Gong Reservoir Park	4.5.2b	There are land-based passive recreational facilities in the reserve including picnic areas and the beginning of the Yarrowee Linear Trail which are promoted for regional use. A significant decline in in-stream values caused by poor stormwater quality will decrease these values.	RE1	Implement a municipal local law to address construction site management.	VH	as per 3.5.1		COB	M
			MO10	as per 4.5.1c	VH	as per 4.5.1c		COB, EPA, CMA	M
			MO1	Review Council's parks and gardens maintenance and works contract to include improve maintenance practices including the following: protection and effective management of in-stream vegetation, appropriate litter collection in parks (especially prior to grass cutting), grass cutting disposal, herbicide use, vegetation selection to eliminate use of weed species. Reference to Best Practice Environmental Management of Urban Stormwater is to be made.	H	as per 3.5.4c		COB	M
<b>STRATEGY 32</b>									
Kirks Reservoir Park	4.5.3a	Central Highlands Water have established a water education display and interpretation centre at this reserve and a significant decline in water quality and in-stream values will have an impact on this centre.	EA7	Promote use of the existing CHW Education Centre by the Ballarat Community, with a focus on organised clubs, groups and schools.	VH	\$500	\$167	CHQW, COB	M
<b>STRATEGY 33</b>									
	4.5.3b	Future stormwater management works need to protect the heritage values associated with bluestone channels and the outlet structure.	LU10	Amend the Ballarat Planning Scheme to identify and protect components of Ballarat's cultural history and character that could be affected by environmental improvements in the stormwater plan. This may include using the Heritage Overlay (where it does not already apply).	VH	\$3,000	\$0	COB	M
			M07	Engineering design standards and guidelines to include protection of heritage values of the bluestone, brick and timber-lined drains that are of heritage significance to ensure protection of these values in any works where modification to the channel may be required.	VH	\$2,000	\$200	COB, CHW	M
<b>STRATEGY 34</b>									
Brown Hill ODP Area	4.5.4a	Existing Outline Development Plan for this area does not adequately address impacts of urban stormwater runoff on the waterway values and opportunities for integrating stormwater management with land development.	LU1	Amend the Ballarat Planning Scheme MSS to include information recently developed through the municipal stormwater management plan, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. An amendment could do this by setting out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describing Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identifying the issues and priority actions from the stormwater management plan, including objectives and strategies for dealing with stormwater in future development and identifying implementation measures such as overlays and local planning policy.	VH	as per 3.5.1	as per 3.5.1	COB	M

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			LU3	Develop model to review or prepare structure plans for major development areas based on the findings of the municipal stormwater management plan; incorporate plans in the Ballarat Planning Scheme. Provide development setbacks from waterways to protect floodplains and natural drainage/environmental functions. Avoid back fences to increase surveillance of open space corridors along waterways, improve appreciation and enjoyment of waterways by new residents. Identify structural measures for flood protection, reduced peak storm flows and treatment of pollutant loads by location (avoid floodplains), approximate size and type, development staging, funding and management. Identify open space for residents independent of land required for drainage functions/scheme. Integrate retarding basins and wetlands with open space. Integrate with urban design guidelines.	VH	as per 3.5.1	\$0	COB	M
			LU5	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Upper Yarrowee catchment: Brown Hill (see LU3 for detail).	VH	\$5,000	\$0	COB	L
<b>STRATEGY 35</b>									
Brown Hill ODP Area	4.5.4b	Impacts of development and associated stormwater runoff on the recreational, riparian habitat and visual landscape qualities of the Yarrowee River.	LU1	as per 4.5.4a	VH	as per 3.5.1		COB	M
			LU2	Incorporate and implement a local planning policy for stormwater management in the Ballarat Planning Scheme to indicate how development will be treated in the planning process. Include assessment of land subdivision to infill development and the treatment of unsealed roads and verges. Specific issues identified in the municipal stormwater management plan include site layout and design to incorporate structural measures to reduce peak storm flows and pollutant loads, management of waste storage areas to reduce blown litter, ongoing management arrangements for structural measures and construction site management (unless incorporated in local law). Integrate with ResCode.	VH	as per 3.5.1			
			LU3	as per 4.5.4a	VH	as per 3.5.1		COB	M
			LU5	as per 4.3.5a		as per 4.5.4a		COB	L
			LU12	Based on the information and principles recently developed in the municipal stormwater management plan, review Council engineering subdivision and site development standards for private development. These should respond to the model for local structure plans and encourage use of appropriate stormwater management systems and materials to minimise any increase in the quantity of stormwater runoff, improve water quality and encourage water reuse options.	VH	as per 3.5.1		COB	M
			RE1	as per 4.5.2b	VH	as per 3.5.1	as per 3.5.1	COB	M

## Strategies for Middle Yarrowee River Sub-catchment

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 36</b>									
Yarrowee River Middle Reach	5.51a	Future works in the floodplain need to protect the heritage values associated with the bluestone channels and other infrastructure from the gold mining period.	LU10	Amend the Ballarat Planning Scheme to identify and protect components of Ballarat's cultural history and character that could be affected by environmental improvements in the stormwater plan. This may include using the Heritage Overlay (where it does not already apply)	VH	as per 4.5.3b		COB	M
			MO7	Engineering design standards and guidelines to include protection of heritage values of the bluestone, brick and timber-lined drains that are of heritage significance to ensure protection of these values in any works where modification to the channel may be required.	VH	\$2,000	\$200	COB, CHW	M
<b>STRATEGY 37</b>									
Yarrowee River Middle Reach	5.5.1b	Properties in the Yarrowee River floodplain through this sub-catchment are already subject to flooding, and any future development or redevelopment within the catchment is not to increase the threat of flooding.	LU1	Amend the Ballarat Planning Scheme MSS to include information recently developed through the municipal stormwater management plan, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. An amendment could do this by setting out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describing Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identifying the issues and priority actions from the stormwater management plan, including objectives and strategies for dealing with stormwater in future development and identifying implementation measures such as overlays and local planning policy.	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU2	Incorporate and implement a local planning policy for stormwater management in the Ballarat Planning Scheme to indicate how development will be treated in the planning process. Include assessment of land subdivision to infill development and the treatment of unsealed roads and verges. Specific issues identified in the municipal stormwater management plan include site layout and design to incorporate structural measures to reduce peak storm flows and pollutant loads, management of waste storage areas to reduce blown litter, ongoing management arrangements for structural measures and construction site management (unless incorporated in local law). Integrate with ResCode.	VH	as per 3.5.1	\$0	COB	M
			LU9	Amend the Ballarat Planning Scheme to incorporate floodplain zones and overlays. These should discourage urban development in floodplains and receive input and support from relevant Referral Agencies. Link to structure planning for new areas.	VH	as per 4.5.1e		COB	M
			MO8	Review Waste Management Plan to investigate incentives to encourage use of the Council's existing green waste disposal program, in order to reduce incidents of dumping of garden waste along water courses.	H	\$500	\$0	COB	M
			MO9	Identify street trees that are environmental weeds in waterway environments, and list these in the Council's street tree selection guidelines to ensure no further weed species are planted as street trees. This list will require regular review as new cultivar's become available.	VH	\$1,000	\$100	COB	M

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			FC4	Construct a retarding basin on the Nerrina tributary, upstream of the confluence with the Yarrowee River. It is recommended that a multi-stage outlet structure be included in the design to provide for optimised attenuation for frequent flows (up to the 2yr ARI - for instream habitat protection and stream erosion management) and extreme flood flows (100yr ARI - for flood damages management).	H	as per 4.5.1b	as per 4.5.1b	COB	L
<b>STRATEGY 38</b>									
Yarrowee River Middle Reach	5.5.1c	Negative impact of litter from the CDB on the recreational values of the river corridor.	RE3	Consider enforcement of litter regulations where education programs are not effective.	M	\$0	\$10,000	COB	M
			EA2	Traders in CBA of Ballarat to be targeted in an education campaign to improve stormwater management practices. Eg, leaflet designed to discourage traders sweeping and washing shop floor out on footpath, sweeping rubbish from shopfront into gutters, pouring unwanted substances down side entry pits etc. City of Ballarat to work with the Ballarat Chamber of Commerce, who have participated in this process to arrange for launch of the campaign, and follow up reminders of the best practice.	VH	\$10,000	\$1,000	COB BCC	M
			ST22	Install side entry pit traps in the CBD areas that are currently not treated downstream by the Bridge Mall CDS unit. A cleaning frequency of once a month in areas with high litter loads is required.	VH	\$15,000	\$10,500	COB, CCMA	L
			ST24	Install a GPT (recommended circular screen type) on the Grant St outfall to the Yarrowee River. As a minimum design feature the trap should be sized to treat the 3 month ARI event.	H	\$37,500	\$3,750	COB, CCMA	L
<b>STRATEGY 39</b>									
Yarrowee River Middle Reach	5.5.1d	Weed management in the Yarrowee River.	EA8	Support the LINCIS program to promote use of native and non-invasive species in residential gardens that adjoin the waterway corridor. This could include a) exchange of bagged weeds with indigenous tubestock and b) leaflet explaining which common garden plant species are weeds, and why they cause problems in waterway environments.	M	\$2,000	\$0	COB	L
			EA9	Review future street tree species selection to ensure no known woody weed species are planted.	M	\$1,000	\$0	COB	M
			MO8	Review Waste Management Plan to investigate incentives to encourage use of the Council's existing green waste disposal program, in order to reduce incidents of dumping of garden waste along water courses.	H	\$500	\$0	COB	M
			MO9	Review Waste Management Plan to investigate incentives to encourage use of the Council's existing green waste disposal program, in order to reduce incidents of dumping of garden waste along water courses.	VH	\$1,000	\$100	COB	M
<b>STRATEGY 40</b>									
Nerrina Wetlands	5.5.2	Weed management within extensive wetland system and revegetation areas.	EA8	as per 5.5.1d	M	as per 5.5.1d	as per 5.5.1d	COB	L
			EA9	as per 5.5.1d	M	as per 5.5.1d	as per 5.5.1d	COB	M
			MO8	as per 5.5.1d	H	as per 5.5.1d	as per 5.5.1d	COB	M
			MO9	as per 5.5.1d	VH	as per 5.5.1d	as per 5.5.1d	COB	M

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 41</b>									
Lake Wendouree	5.5.3a	Water and land based recreational use along with historical values and community awareness associated with the lake are the highest in Ballarat. As a consequence the impacts of high litter loads and poor water quality from urban, commercial and industrial inputs to the lake are key issues.	LU1	as per 5.5.1b	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU2	as per 5.5.1b	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU12	Based on the information and principles recently developed in the municipal stormwater management plan, review Council engineering subdivision and site development standards for private development. These should respond to the model for local structure plans and encourage use of appropriate stormwater management systems and materials to minimise any increase in the quantity of stormwater runoff, improve water quality and encourage water reuse options.	VH	as per 3.5.1		COB	M
			RE1	Implement a municipal local law to address construction site management.	VH	as per 3.5.1	as per 3.5.1	COB	M
			RE2	With the EPA, address compliance with EPA regulations. Give priority to industrial sites and estates.	VH	as per 3.5.1	as per 3.5.1	COB, EPA	M,L
			RE3	as per 5.5.1c	M	as per 5.5.1c		COB	M
			EA1	Target education campaigns in each of the industrial estates through development of a pamphlet targeted at appropriate and inappropriate management of stormwater, and distribute to the landholders.	VN	as per 3.5.1	as per 3.5.1	COB	M
			EA2	Traders in CBA of Ballarat to be targeted in an education campaign to improve stormwater management practices. Eg, leaflet designed to discourage traders sweeping and washing shop floor out on footpath, sweeping rubbish from shopfront into gutters, pouring unwanted substances down side entry pits etc. City of Ballarat to work with the Ballarat Chamber of Commerce, who have participated in this process to arrange for launch of the campaign, and follow up reminders of the best practice.	VH	\$2,000	\$0	COB	L
			EA4	Sub-regional, district and neighbourhood commercial centres to receive targeted campaigns, tailored from the information developed in EA2. This would include running workshops and/or personal contact with individual commercial property owners to explain the relevance of improved stormwater management, and provide assistance with effective implementation.	H	\$500	\$0	COB	L
			ST2	The North Garden Wetlands are constructed and treat stormwater runoff from the local catchment prior to discharging into Lake Wendouree. A GPT is located upstream of the wetland system on Monastery drain. Action already implemented.	completed	completed	completed	COB	L
			ST13	Construct porous embankments at drain outfalls to Lake Wendouree, from commercial and industrial precincts, to attenuate flows and promote the removal of coarse sediment. The embankments should be constructed parallel to the perimeter of the lake, remaining open at the downstream end. The treatment areas should be densely vegetated to promote the removal of fine particulates and associated pollutants to improve the overall quality of water entering the lake.	VH	\$50,000	\$6,400	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 42</b>									
Lake Wendouree	5.5.3b	Impact of litter on the tourism and commercial use of the lake including restaurants beside the lake, and visitors to festivals and events.	RE3	as per 5.5.1c	M	as per 5.5.1c	as per 5.5.1c	COB	M
			EA3	Develop side entry pit stencil designs that increase community awareness that stormwater drains to receiving waterway environments. The stencil designs to be run in conjunction with local schools as a competition. The stencils to highlight a local receiving waterway environment - eg Lake Burrumbeet, Yarrowee River Lake Wendouree	H	\$2,000	\$0	COB	L
			EA4	as per 5.5.3a	H	as per 3.5.1	as per 3.5.1	COB	L
			ST2	as per 5.5.3a	completed	completed	completed	COB	L
			ST23	Install release nets on drains to Lake Wendouree, from commercial precincts. The release nets could be concealed under viewing platforms.	H	\$48,000	\$19,200	COB	L
<b>STRATEGY 43</b>									
North Gardens Wetland	5.5.4a	The potential lack of ongoing maintenance of the instream vegetation if current management practices are not maintained, thereby reducing the water quality effectiveness and amenity of the wetlands at this highly visible and high profile site.	M02	Develop Management Plans for all existing and proposed water quality treatment wetlands to clearly outline maintenance requirements, and establish clear roles and responsibilities where more than one agency is responsible for the wetland.	H	\$5,000	\$0	COB	L
<b>STRATEGY 44</b>									
North Gardens Wetland	5.5.4b	The risk that a potential lack of ongoing maintenance and/or educative material could cause to community interest, value and understanding of water quality treatment wetlands, and similar projects in the future.	MO2	as per 5.5.4a	H	as per 5.5.4a		COB	L
			MO10	Establish a Stormwater Management Forum within Council, include CMAs and EPA. Use the Forum as an information exchange and integrating/coordinating mechanism for planning/infrastructure decision making and SWMP implementation. Integrate flood management and rural catchment issues.	VH	as per 4.5.1c	as per 4.5.1c	COB, EPA, CMA	M
<b>STRATEGY 45</b>									
Gnarr Creek	5.5.5a	Impacts of future urban development in the catchment on floodplain storage given the limited capacity that currently exists.	LU1	as per 5.5.1b	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU2	as per 5.5.1b	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU9	as per 5.5.1b	VH	as per 5.5.1b	as per 5.5.1b	COB	M
			LU12	as per 5.5.3a	VH	as per 3.5.1		COB	M
			FC4	refer 5.5.1b	H	as per 4.5.1b	as per 4.5.1b	COB	L
			FC5	The Cemetery Retention Basin is poorly designed for flow attenuation. It is recommended the permanent pool level be lowered to provide additional flood storage and the basin outlet modified to maximise attenuation of the peak 100yr ARI flow. Also, the existing sediment pond immediately upstream of the Cemetery retention basin should be modified to also function as a retarding basin (by constructing an embankment around the sediment pond to provide flood storage) with the outlet designed to target attenuation of flows up to the peak 10yr ARI flow.	L	\$100,000	\$3,000	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			FC6	Modify the Ballarat North Primary School playing field to serve as a flood retardation basin for medium to large flood events. This would involve excavating the existing playing field to create a depressed basin to impound flood flows and diverting all flows in excess of the peak 1yr ARI flow from the existing concrete lined channel into the basin. The basin would be finished to maintain its current use as sports field for the Primary School. The design should be developed so that the basin operates in conjunction with the Gregory St Retarding Basin.	M	\$150,000	\$4,500	COB	L
			FC14	Construct retarding basin within Marks Reserve, in accordance with recommendations in 1999 Ballarat Stormwater Management Strategy (Wong et. al)	H	\$155,000	\$1,500	COB	L
<b>STRATEGY 46</b>									
Gnarr Creek	5.5.5b	Recent urban development has already reduced the limited floodplain storage capacity and future water quality treatment options.	LU9	as per 5.5.1b	VH	as per 5.5.1b	as per 5.5.1b	COB	M
			LU12	as per 5.5.3a	VH	as per 3.5.1		COB	M
			ST3	Retrofit the Crompton Street Retarding Basin with a low flow treatment wetland as recommended in the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report'.	VH	\$35,000	\$700	COB, CCMA	L
			ST4	Retrofit the Hillside Drive Retarding Basin with an ephemeral wetland to treat frequently occurring runoff events from the local residential catchment. Refer to the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report' for design concept details.	M	\$25,000	\$500	COB, CCMA	L
			FCM4	as per 4.5.1b	H	as per 4.5.1b	as per 4.5.1b	COB	L
			FCM5	as per 5.5.5a	L	as per 5.5.5a	as per 5.5.5a	COB	Local
			FCM6	as per 5.5.5a	M	as per 5.5.5a	as per 5.5.5a	COB	L
<b>STRATEGY 47</b>									
Gnarr Creek	5.5.5c	Lack of funding to modify existing retarding basins to improve water quality treatment.	MO10	as per 5.5.4b	VH	as per 4.5.1c		COB, EPA, CMA	M
<b>STRATEGY 48</b>									
Gnarr Creek	5.5.5d	Unsealed road verges contributing high sediment load in the catchment.	MO11	Develop a design for unsealed road verges in the Gnarr Ck and Redan Ck catchments (and others where appropriate) that improves water quality treatment via vegetated swales and integrates with the historical urban character of these wide road verges. Once the design has been developed and approved, this work could be progressively implemented as part of Council's roadside maintenance and upgrade program.	VH	\$5,000	\$20,000	COB	M

## Strategies for Lower Yarrowee River Sub-catchment

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 49</b>									
Yarrowee River Lower Reach	6.5.1a	Existing urban land use including residential, industrial and commercial runoff on instream values (including erosion) and recreational values, such as those associated with the linear trail.	RE2	With the EPA, address compliance with EPA regulations. Give priority to industrial sites and estates.	VH	\$5,000	\$0	EPA, COB	M,L
			FC4	Construct a retarding basin on the Nerrina tributary, upstream of the confluence with the Yarrowee River. It is recommended that a multi-stage outlet structure be included in the design to provide for optimised attenuation for frequent flows (up to the 2yr ARI - for instream habitat protection and stream erosion management) and extreme flood flows (100yr ARI - for flood damages management).	H	as per 5.5.5a	as per 5.5.5a	COB	L
			FC5	The Cemetery Retention Basin is poorly designed for flow attenuation. It is recommended the permanent pool level be lowered to provide additional flood storage and the basin outlet modified to maximise attenuation of the peak 100yr ARI flow. Also, the existing sediment pond immediately upstream of the Cemetery retention basin should be modified to also function as a retarding basin (by constructing an embankment around the sediment pond to provide flood storage) with the outlet designed to target attenuation of flows up to the peak 10yr ARI flow.	L	as per 5.5.5a	as per 5.5.5a	COB	L
			FC6	Modify the Ballarat North Primary School playing field to serve as a flood retardation basin for medium to large flood events. This would involve excavating the existing playing field to create a depressed basin to impound flood flows and diverting all flows in excess of the peak 1yr ARI flow from the existing concrete lined channel into the basin. The basin would be finished to maintain its current use as sports field for the Primary School. The design should be developed so that the basin operates in conjunction with the Gregory St Retarding Basin.	M	as per 5.5.5a	as per 5.5.5a	COB	L
			FC7	Construct the Kinnersley Avenue Retarding Basin (and wetland) in accordance with the design recommendations in the 1999 Ecological Engineering report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'. Set the outlet from the retarding basin to maximise the attenuation of the peak 50 year ARI flow. The 50yr ARI flow is targeted so as to reduce the frequency of flooding in the Yarrowee River as discussed in the Technical Report.	VH	\$200,000	\$6,000	COB	L
			FC8	Construct a retarding basin on tributary of Canadian creek at Richards Street (RB C in the 1996 GHD study "Canadian Creek Catchment Flood Study"). This basin should be constructed after the Kinnersley Avenue Retarding Basin and with its outlet set to maximise attenuation of the peak 50yr ARI flow as recommended in the report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'.	M	\$500,000	\$15,000	COB	L
			FC9	Construct a retarding basin on Specimen Creek near Blairs Lane (RB G in the 1996 GHD study "Canadian Creek Catchment Flood Study"). This basin should be constructed after RBC and with its outlet set to maximise attenuation of the peak 50yr ARI flow as recommended in the report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'.	M	\$150,000	\$4,500	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			FC10	Construct a retarding basin on Specimen Creek near Stawell Street (RB D in the 1996 GHD study "Canadian Creek Catchment Flood Study"). This basin should be constructed after the RBG and with its outlet set to maximise attenuation of the peak 50yr ARI flow as recommended in the report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'.	M	\$100,000	\$3,000	COB	L
			FC11	Construct a retarding basin on Canadian Creek about 250m south of Olympic Avenue (RB A in the 1996 GHD study "Canadian Creek Catchment Flood Study"). This basin should be constructed after RB D and with its outlet set to maximise attenuation of the peak 50yr ARI flow as recommended in the report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'.	M	\$400,000	\$12,000	COB	L
			FC13	As part of the works to be undertaken for the Yarrowee-Redan wetland the floodplain of the Yarrowee River should be re-contoured to promote regular floodplain engagement during events flows. Modification to the floodplain should be undertaken as recommended in the recent report to council titled 'Yarrowee-Redan Wetlands Final Design Report'.	M	\$100,000	\$5,000	COB	L
<b>STRATEGY 50</b>									
Yarrowee River Lower Reach	6.5.1b	Significant litter load decreases the visual landscape values of the waterway. There are expansive views over the valley in this reach.	RE3	Consider enforcement of litter regulations where education programs are not effective.	M	as per 5.5.1c	as per 5.5.1c	COB	M
			EA1	Target education campaigns in each of the industrial estates through development of a pamphlet targeted at appropriate and inappropriate management of stormwater, and distribute to the landholders.	VH	Refer 3.5.1	Refer 3.5.1	COB	L
			EA2	Traders in CBA of Ballarat to be targeted in an education campaign to improve stormwater management practices. Eg, leaflet designed to discourage traders sweeping and washing shop floor out on footpath, sweeping rubbish from shopfront into gutters, pouring unwanted substances down side entry pits etc. City of Ballarat to work with the Ballarat Chamber of Commerce, who have participated in this process to arrange for launch of the campaign, and follow up reminders of the best practice.	VH	Refer 5.5.1d	Refer 5.5.1d	COB, BCC	L
			EA3	Develop side entry pit stencil designs that increase community awareness that stormwater drains to receiving waterway environments. The stencil designs to be run in conjunction with local schools as a competition. The stencils to highlight a local receiving waterway environment - eg Lake Burrumbeet, Yarrowee River, Lake Wendouree.	VH	\$2,000	\$0	COB	L
			EA4	Sub-regional, district and neighbourhood commercial centres to receive targeted campaigns, tailored from the information developed in EA2. This would include running workshops and/or personal contact with individual commercial property owners to explain the relevance of improved stormwater management, and provide assistance with effective implementation.	H	\$500	\$0	COB	L
			EA10	Ensure effective implementation of existing Waste Management Program to encourage landholders to dispose of household garbage responsibly. This will need to include an effective monitoring program.	M	Refer 6.5.1b	Refer 6.5.1b	COB, CHW	M
			MO1	Review Council's parks and gardens maintenance and works contract to include improve maintenance practices including the following: protection and effective management of in-stream vegetation, appropriate litter collection in parks (especially prior to grass cutting), grass cutting disposal, herbicide use, vegetation selection to eliminate use of weed species. Reference to Best Practice Environmental Management of Urban Stormwater is to be made.	H	as per 3.5.4c		COB	M

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			ST3	Retrofit the Crompton Street Retarding Basin with a low flow treatment wetland as recommended in the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report'.	VH	as per 5.5.5b	as per 5.5.5b	COB, CCMA	L
			ST4	Retrofit the Hillside Drive Retarding Basin with an ephemeral wetland to treat frequently occurring runoff events from the local residential catchment. Refer to the recent report to council titled 'Retarding Basin Retrofit Wetlands Design Report' for design concept details.	M	as per 5.5.5b	as per 5.5.5b	COB, CCMA	L
			ST5	Construct a wetland at Marks Reserve to treat low flows from Gnarr Creek and local catchment.	H	\$45,000	\$2,250	COB, CCMA	L
			ST6	Retrofit the Morshead Park Retarding Basin with a stormwater treatment wetland to treat local catchment flows prior to discharging into Redan Creek.	VH	\$35,000	\$1,750	COB, CCMA	L
			ST7	Construct the Yarrowee-Redan Confluence Wetland. This system will reduce the litter and sediment load from the Redan Creek catchment entering the Yarrowee River.	VH	\$750,000	\$7,500	COB, CCMA, VSAP	L
			ST12	Provide sediment traps at the inlets to Winter Swamp.	M	as per 3.5.9	as per 3.5.9	COB	L
			ST18	Construct a sidecast weir at Brown Hill Reserve (adjacent to Scout Hall), to direct event-flows onto a re-contoured floodplain, containing a series of densely vegetated ephemeral water quality treatment cells, graded back to the Yarrowee River channel. This will promote water quality treatment during minor storms.	M	\$63,000	\$3,150	COB	L
			ST22	Install side entry pit traps in the CBD areas that are currently not treated downstream by the Bridge Mall CDS unit. A cleaning frequency of once a month in areas with high litter loads is required.	VH	\$15,000	\$10,500	COB	L
			ST24	Install a GPT (recommended circular screen type) on the Grant St outfall to the Yarrowee River. As a minimum design feature the trap should be sized to treat the 3 month ARI event.	H	\$37,500	\$3,750	COB, CCMA	L
			ST25	Install side entry pit traps at the entrance to drains within commercial areas of the Redan Creek catchment. A cleaning frequency of once a month in areas with high litter loads will be required.	H	\$5,000	\$3,500	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 51</b>									
Yarrowee River Lower Reach	6.5.1c	The planning scheme and other strategic planning documents need to recognise the value of floodplains and riparian zones and provide guidance on appropriate land uses.	LU1	Amend the Ballarat Planning Scheme MSS to include information recently developed through the municipal stormwater management plan, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. An amendment could do this by setting out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describing Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identifying the issues and priority actions from the stormwater management plan, including objectives and strategies for dealing with stormwater in future development and identifying implementation measures such as overlays and local planning policy.	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU9	Amend the Ballarat Planning Scheme to incorporate floodplain zones and overlays. These should discourage urban development in floodplains and receive input and support from relevant Referral Agencies. Link to structure planning for new areas.	VH	as per 5.5.1b	as per 5.5.1b	COB	M
<b>STRATEGY 52</b>									
Yarrowee River Lower Reach	6.5.1d	Potential mining leachate on any future opportunities for stormwater quality treatment wetlands in the floodplain, however leachate should be addressed before development commences.	LU1	as per 6.5.1c	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU9	as per 6.5.1c	VH	as per 5.5.1b	as per 5.5.1b	COB	M
			MO2	Develop Management Plans for all existing and proposed water quality treatment wetlands to clearly outline maintenance requirements, and establish clear roles and responsibilities where more than one agency is responsible for the wetland.	H	\$5,000	\$0	COB, Developer	L
			MO12	Prior to construction of any of the proposed wetlands in this plan, detailed design and investigation is required to address detailed site design issues, including opportunities for integrating multiple benefits in design development.	VH	\$25,000	\$0	COB, Developer	L
<b>STRATEGY 53</b>									
Redan Creek	6.5.2a	Future infrastructure works associated with stormwater management impacting on the heritage values of the bluestone channel and road drainage system.	LU10	Amend the Ballarat Planning Scheme to identify and protect components of Ballarat's cultural history and character that could be affected by environmental improvements in the stormwater plan. This may include using the Heritage Overlay (where it does not already apply).	VH	as per 4.5.3b	as per 4.5.3b		
			MO7	Engineering design standards and guidelines to include protection of heritage values of the bluestone, brick and timber-lined drains that are of heritage significance to ensure protection of these values in any works where modification to the channel may be required.	VH	as per 4.5.3b		COB	M
<b>STRATEGY 54</b>									
Redan Creek	6.5.2b	Impact of litter in channel on visual landscape values.	RE3	as per 6.5.1b	M	as per 5.5.1c	as per 5.5.1c	COB	M
			EA1	as per 6.5.1b	VH	as per 3.5.1	as per 3.5.1	COB	L
			EA2	as per 6.5.1b	VH	as per 5.5.1d	as per 5.5.1d	COB, BCC	L
			EA3	as per 6.5.1b	VH	\$2,000	\$0	COB	L
			EA4	as per 6.5.1b	H	\$500	\$0	COB	L
			EA10	as per 6.5.1b	M	as per 6.5.1b	as per 6.5.1b	COB, CHW	M
			ST25	as per 6.5.1b	H	as per 6.5.1b	as per 6.5.1b	COB	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 55</b>									
Redan Creek	6.5.2c	Lack of water quality treatment in the Morshead Park Retarding Basin.	ST6	as per 6.5.1b	VH	as per 6.5.1b	as per 6.5.1b	COB, CCMA	L
<b>STRATEGY 56</b>									
Redan Creek	6.5.2d	Unsealed road verges contribute high sediment loads to the stream reducing in-stream values.	MO2	Develop Management Plans for all existing and proposed water quality treatment wetlands to clearly outline maintenance requirements, and establish clear roles and responsibilities where more than one agency is responsible for the wetland.	H	\$5,000	\$0	COB, Developer	L
			MO12	as per 6.5.1d	VH	\$25,000	\$0	COB, Developer	L
<b>STRATEGY 57</b>									
Redan confluence with Yarrowee River	6.5.3a	Future wetland and infrastructure design needs to protect the heritage values associated with gold mining in this area.	LU10	as per 6.5.2a	VH	as per 4.5.3b		COB	M
			MO7	as per 6.5.2a	VH	as per 4.5.3b		COB	M
<b>STRATEGY 58</b>									
Redan confluence with Yarrowee River	6.5.3b	This wetland has the potential to be a good demonstration project to improve community awareness of best practice stormwater management in the city. A lack of resources to successfully promote this with well developed education and visitor facilities and ongoing maintenance may limit this.	LU1	as per 6.5.1c	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU9	as per 6.5.1c	VH	as per 5.5.1b	as per 5.5.1b	COB	M
			MO4	Develop management plans for all existing wetland sites with environmental significance in the City to ensure effective ongoing protection and management of them.	H	\$5,000	\$0	COB	L
			MO10	Establish a Stormwater Management Forum within Council, include CMAs and EPA. Use the Forum as an information exchange and integrating/coordinating mechanism for planning/infrastructure decision making and SWMP implementation. Integrate flood management and rural catchment issues.	VH	as per 4.5.1c		COB, EPA, CMA	M
<b>STRATEGY 59</b>									
Redan confluence with Yarrowee River	6.5.3c	High sediment load from unsealed road verges causing a decline to instream values.	MO11	Develop a design for unsealed road verges in the Gnarr Ck and Redan Ck catchments (and others where appropriate) that improves water quality treatment via vegetated swales and integrates with the historical urban character of these wide road verges. Once the design has been developed and approved, this work could be progressively implemented as part of Council's roadside maintenance and upgrade program.	VH	as per 5.5.5d	as per 5.5.5d	COB	M
			ST7	as per 6.5.1b		as per 6.5.1b	as per 6.5.1b	COB, CCMA, VSAP	L

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 60</b>									
Yuilles Station Park and Wetlands	6.5.4a	Flatness in grade of this floodplain causing the high litter load to deposit in the floodplain. This decreases the recreational and visual landscape values of the open space corridor.	RE3	as per 6.5.1b	M	as per 5.5.1c	as per 5.5.1c	COB	M
			EA1	as per 6.5.1b	VH	as per 3.5.1	as per 3.5.1	COB	L
			EA2	as per 6.5.1b	VH	as per 5.5.1d	as per 5.5.1d	COB, BCC	L
			EA3	as per 6.5.1b	VH	\$2,000	\$0	COB	L
			EA4	as per 6.5.1b	H	\$500	\$0	COB	L
			EA10	as per 6.5.1b	M	as per 6.5.1b	as per 6.5.1b	COB, CHW	M
			MO1	as per 6.5.1b	H	as per 3.5.4c		COB	M
		ST17	as per 6.5.1b	H	as per 6.5.1b	as per 6.5.1b	COB, CCMA, VSAP	L	
<b>STRATEGY 61</b>									
Yuilles Station Park and Wetlands	6.5.4b	Increased flows causing channel incision and further isolation of the creek from the floodplain.	LU1	as per 6.5.1c	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU9	as per 6.5.1c	VH	as per 5.5.1b	as per 5.5.1b	COB	M
			FC4	as per 6.5.1a	H	as per 5.5.5a	as per 5.5.5a	COB	L
			FC5	as per 6.5.1a	L	as per 5.5.5a	as per 5.5.5a	COB	L
			FC6	as per 6.5.1a	M	as per 5.5.5a	as per 5.5.5a	COB	L
			FC7	as per 6.5.1a	VH	as per 6.5.1a	as per 6.5.1a	COB	L
			FC8	as per 6.5.1a	M	as per 6.5.1a	as per 6.5.1a	COB	L
			FC9	as per 6.5.1a	M	as per 6.5.1a	as per 6.5.1a	COB	L
			FC10	as per 6.5.1a	M	as per 6.5.1a	as per 6.5.1a	COB	L
			FC11	as per 6.5.1a	M	as per 6.5.1a	as per 6.5.1a	COB	L
		FC13	as per 6.5.1a	M	as per 6.5.1a	as per 6.5.1a	COB	L	

## Strategies for Canadian Creek Sub-catchment

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 62</b>									
Canadian Creek	7.5.1a	Impact of future urban development on instream and riparian habitat values, including water quality and in-stream erosion. This will also impact on recreational values of the riparian corridor.	LU1	Amend the Ballarat Planning Scheme MSS to include information recently developed through the municipal stormwater management plan, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. An amendment could do this by setting out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describing Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identifying the issues and priority actions from the stormwater management plan, including objectives and strategies for dealing with stormwater in future development and identifying implementation measures such as overlays and local planning policy.	VH	as per 3.5.1		COB	M
			LU2	Incorporate and implement a local planning policy for stormwater management in the Ballarat Planning Scheme to indicate how development will be treated in the planning process. Include assessment of land subdivision to infill development and the treatment of unsealed roads and verges. Specific issues identified in the municipal stormwater management plan include site layout and design to incorporate structural measures to reduce peak storm flows and pollutant loads, management of waste storage areas to reduce blown litter, ongoing management arrangements for structural measures and construction site management (unless incorporated in local law). Integrate with ResCode.	VH	as per 3.5.1		COB	M
			LU3	Develop model to review or prepare structure plans for major development areas based on the findings of the municipal stormwater management plan; incorporate plans in the Ballarat Planning Scheme. Provide development setbacks from waterways to protect floodplains and natural drainage/environmental functions. Avoid back fences to increase surveillance of open space corridors along waterways, improve appreciation and enjoyment of waterways by new residents. Identify structural measures for flood protection, reduced peak storm flows and treatment of pollutant loads by location (avoid floodplains), approximate size and type, development staging, funding and management. Identify open space for residents independent of land required for drainage functions/scheme. Integrate retarding basins and wetlands with open space. Integrate with urban design guidelines.	VH	\$2,000	\$0	COB	M
			LU6	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Canadian Creek catchment: Ballarat East, Mt Clear and Mt Helen (see LU3 for detail).	VH	\$15,000	\$0	COB	L
			LU9	Amend the Ballarat Planning Scheme to incorporate floodplain zones and overlays. These should discourage urban development in floodplains and receive input and support from relevant Referral Agencies. Link to structure planning for new areas.	VH	as per 5.5.1b		COB	M

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
			LU12	Based on the information and principles recently developed in the municipal stormwater management plan, review Council engineering subdivision and site development standards for private development. These should respond to the model for local structure plans and encourage use of appropriate stormwater management systems and materials to minimise any increase in the quantity of stormwater runoff, improve water quality and encourage water reuse options.	VH	as per 3.5.1		COB	M
			FC7	Construct the Kinnersley Avenue Retarding Basin (and wetland) in accordance with the design recommendations in the 1999 Ecological Engineering report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'. Set the outlet from the retarding basin to maximise the attenuation of the peak 50 year ARI flow. The 50yr ARI flow is targeted so as to reduce the frequency of flooding in the Yarrowee River as discussed in the Technical Report.	VH	as per 6.5.1a	as per 6.5.1a	COB	L
			FC8	Construct a retarding basin on tributary of Canadian creek at Richards Street (RB C in the 1996 GHD study "Canadian Creek Catchment Flood Study"). This basin should be constructed after the Kinnersley Avenue Retarding Basin and with its outlet set to maximise attenuation of the peak 50yr ARI flow as recommended in the report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'.	M	as per 6.5.1a	as per 6.5.1a	COB	L
			FC9	Construct a retarding basin on Specimen Creek near Blairs Lane (RB G in the 1996 GHD study "Canadian Creek Catchment Flood Study"). This basin should be constructed after RBC and with its outlet set to maximise attenuation of the peak 50yr ARI flow as recommended in the report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'.	M	as per 6.5.1a	as per 6.5.1a	COB	L
			FC10	Construct a retarding basin on Specimen Creek near Stawell Street (RB D in the 1996 GHD study "Canadian Creek Catchment Flood Study"). This basin should be constructed after the RBG and with its outlet set to maximise attenuation of the peak 50yr ARI flow as recommended in the report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'.	M	as per 6.5.1a	as per 6.5.1a	COB	L
			FC11	Construct a retarding basin on Canadian Creek about 250m south of Olympic Avenue (RB A in the 1996 GHD study "Canadian Creek Catchment Flood Study"). This basin should be constructed after RB D and with its outlet set to maximise attenuation of the peak 50yr ARI flow as recommended in the report titled 'Canadian Lakes Estate Retarding Basin and Wetlands Technical Report'.	M	as per 6.5.1a	as per 6.5.1a	COB	L
<b>STRATEGY 63</b>									
Canadian Creek	7.5.1b	Future infrastructure works associated with stormwater management need to protect the heritage values of the bluestone and timber lined channel section of the creek.	LU10	Amend the Ballarat Planning Scheme to identify and protect components of Ballarat's cultural history and character that could be affected by environmental improvements in the stormwater plan. This may include using the Heritage Overlay (where it does not already apply).	VH	as per 4.5.3b		COB	M
			MO7	Engineering design standards and guidelines to include protection of heritage values of the bluestone, brick and timber-lined drains that are of heritage significance to ensure protection of these values in any works where modification to the channel may be required.	VH	as per 4.5.3b		COB	M

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 64</b>									
Canadian Creek	7.5.1c	Future development needs to be appropriately designed to avoid decreasing existing floodplain storage capacity of the creek. This includes the appropriate use of planning provisions to protect the capacity of the creek and its floodplain.	LU1	as per 7.5.1a	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU2	as per 7.5.1a		as per 3.5.1			
			LU3	as per 7.5.1a		\$2,000			
			LU6	as per 7.5.1a		\$15,000			
			LU9	as per 7.5.1a		as per 5.5.1b			
			LU12	as per 7.5.1a	VH	as per 3.5.1		COB	M
<b>STRATEGY 65</b>									
Canadian Creek	7.5.1d	Litter degrading environmental and recreational values of the waterway.	RE3	Consider enforcement of litter regulations where education programs are not effective.	M	as per 5.5.1c	as per 5.5.1c	COB	M
			EA3	Develop side entry pit stencil designs that increase community awareness that stormwater drains to receiving waterway environments. The stencil designs to be run in conjunction with local schools as a competition. The stencils to highlight a local receiving waterway environment - eg Lake Burrumbeet, Yarrowee River, Lake Wendouree	VH	\$2,000	\$0	COB	L
			EA4	Sub-regional, district and neighbourhood commercial centres to receive targeted campaigns, tailored from the information developed in EA2. This would include running workshops and/or personal contact with individual commercial property owners to explain the relevance of improved stormwater management, and provide assistance with effective implementation	H	\$500	\$0	COB	L
			EA10	Ensure effective implementation of existing Waste Management Program to encourage landholders to dispose of household garbage responsibly. This will need to include an effective monitoring program.	M	Refer 6.5.1b	Refer 6.5.1b	COB,CHW	M
			ST26	Install GPT(s) (recommended circular screen type) on Humphray st drain outfall to Canadian Creek	H	\$250,000	\$12,500	COB, CCMA	L
<b>STRATEGY 66</b>									
Canadian Creek	7.5.1e	Existing review of extent of development areas and planning documents need to consider best practice stormwater management, including flood storage capacity of floodplain.	LU1	as per 7.5.1a	VH	as per 3.5.1		COB	M
			LU3	as per 7.5.1a	VH	as per 3.5.1		COB	M
			LU6	as per 7.5.1a	VH	as per 7.5.1a		COB	L
			LU9	as per 7.5.1a	VH	as per 5.5.1b		COB	M
<b>STRATEGY 67</b>									
Tributaries to Canadian Creek	7.5.2	Future infrastructure works associated with stormwater management impacting on the heritage values of the bluestone channels.	LU10	as per 7.5.1b	VH	as per 4.5.3b		COB	M
			MO7	as per 7.5.1b	VH	as per 4.5.3b		COB	M

## Strategies for Buninyong Township Sub-catchment

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 68</b>									
Buninyong Creek (Un ion Jack Creek and 'Cemetery Creek')	8.5.1	The existing ODP does not include stormwater management issues, which will result in future urban development causing a decline to water quality and the environmental values of the waterways.	LU1	Amend the Ballarat Planning Scheme MSS to include information recently developed through the municipal stormwater management plan, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. An amendment could do this by setting out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describing Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identifying the issues and priority actions from the stormwater management plan, including objectives and strategies for dealing with stormwater in future development and identifying implementation measures such as overlays and local planning policy.	VH	as per 3.5.1		COB	M
			LU3	Develop model to review or prepare structure plans for major development areas based on the findings of the municipal stormwater management plan; incorporate plans in the Ballarat Planning Scheme. Provide development setbacks from waterways to protect floodplains and natural drainage/environmental functions. Avoid back fences to increase surveillance of open space corridors along waterways, improve appreciation and enjoyment of waterways by new residents. Identify structural measures for flood protection, reduced peak storm flows and treatment of pollutant loads by location (avoid floodplains), approximate size and type, development staging, funding and management. Identify open space for residents independent of land required for drainage functions/scheme. Integrate retarding basins and wetlands with open space. Integrate with urban design guidelines.	VH	\$2,000		COB	M
			LU7	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Buninyong catchment: Buninyong Township (see LU3 for detail).	VH	\$5,000		COB	L
<b>STRATEGY 69</b>									
The gong	8.5.2	The existing decline in water quality is decreasing the heritage values of the reserve associated with the Gong.	RE2	With the EPA, address compliance with EPA regulations. Give priority to industrial sites and estates.	VH	as per 3.5.1	as per	COB, EPA	M
			MO13	Develop management plans for reserves with significant water bodies which may be used for recreational purposes. This is to allow for integration of a number of recreational, heritage, environmental and water quality improvement outcomes.	M	?	?	COB	L
			ST8	Construct a stormwater treatment wetland at the eastern end of the The Gong to treat local rural and residential catchment runoff. The design of the wetland should ensure treatment for flows up to the 3 month ARI event.	M	\$40,000	\$2,000	COB	L
<b>STRATEGY 70</b>									
Hasties Creek	8.5.3	Colemans Springs has high e.coli levels which pose a significant risk to human health, as water is collected from the spring drinking water.	M014	Investigate the cause of high E.coli levels at Colemans Springs to identify if this can be rectified to allow continued collection of drinking water from this spring.	H	\$10,000	\$1,000	COB, CHW	L

# Strategies for Winter Creek Sub-catchment

## WINTER CREEK

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
<b>STRATEGY 71</b>									
Winter Creek East Branch including Banyule Drain	9.5.1a	Reduction in floodplain capacity has reduced potential for future water quality treatments in this area.	LU1	Amend the Ballarat Planning Scheme MSS to include information recently developed through the municipal stormwater management plan, to highlight stormwater management as a strategic issue and to establish the rationale for other changes to the Planning Scheme. An amendment could do this by setting out the strategic context of Ballarat in the Glenelg-Hopkins and Corangamite catchments (relating to urban stormwater), describing Ballarat's waterways, waterbodies, floodplains, riparian zones and drainage network and the values/relationships between these, identifying the issues and priority actions from the stormwater management plan, including objectives and strategies for dealing with stormwater in future development and identifying implementation measures such as overlays and local planning policy.	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU9	Amend the Ballarat Planning Scheme to incorporate floodplain zones and overlays. These should discourage urban development in floodplains and receive input and support from relevant Referral Agencies. Link to structure planning for new areas.	VH	as per 5.5.1b	as per 5.5.1b	COB, CMA	M
<b>STRATEGY 72</b>									
Winter Creek East Branch including Banyule Drain	9.5.1b	Restricted capacity and poor water quality of Banyule Drain.	RE2	With the EPA, address compliance with EPA regulations. Give priority to industrial sites and estates.	VH	as per 3.5.1	as per 3.5.1	COB, EPA	M
			ST9	Construct the Lawrie Drive Retarding Basin and wetland to treat local catchment stormwater runoff	M	\$350,000	\$17,500	COB, Developer, Other Funds	L
<b>STRATEGY 73</b>									
Winter Creek East Branch including Banyule Drain	9.5.1c	Impact of industrial runoff and re-development on the proposed water quality treatment wetlands as part of future residential development.	RE1	Implement a municipal local law to address construction site management.	VH	as per 3.5.1	as per 3.5.1	COB	M
			RE2	as per 9.5.1b	VH	as per 3.5.1	as per 3.5.1	COB, EPA	M
			ST10	Construct a stormwater treatment wetland in the land bounded by Wiltshire Lane and Latrobe St, to treat industrial runoff prior to discharging to the downstream environment.	M	\$440,000	\$44,000		
<b>STRATEGY 74</b>									
Winter Creek Middle Branch	9.5.2a	Reduction in the flood storage capacity and natural valley form of Winter Creek.	LU1	as per 9.5.1a	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU9	as per 9.5.1a	VH	as per 5.5.1b	as per 5.5.1b	COB, CMA	M
			FC12	Construct the Lawrie Drive Retarding Basin and wetland system to provide a flow management function for discharges from the local catchment into the Banyule Drain as recommended in the recent report to council titled 'Lawrie Drive Retarding Basin and Wetland Functional Design Report'	VH	\$100,000	\$3,000	COB	L
<b>STRATEGY 75</b>									

Location	PMI No.	Priority Management Issue	Action No.	Action	Priority	Cost		Responsibility	Extent of Application
						Capital	Ongoing		
Winter Creek Middle Branch	9.5.2b	Existing planning documents do not include adequate stormwater management guidelines, which will lead to degradation of receiving waterway values in future development.	LU1	as per 9.5.1a	VH	as per 3.5.1	as per 3.5.1	COB	M
			LU3	Develop model to review or prepare structure plans for major development areas based on the findings of the municipal stormwater management plan; incorporate plans in the Ballarat Planning Scheme. Provide development setbacks from waterways to protect floodplains and natural drainage/environmental functions. Avoid back fences to increase surveillance of open space corridors along waterways, improve appreciation and enjoyment of waterways by new residents. Identify structural measures for flood protection, reduced peak storm flows and treatment of pollutant loads by location (avoid floodplains), approximate size and type, development staging, funding and management. Identify open space for residents independent of land required for drainage functions/scheme. Integrate retarding basins and wetlands with open space. Integrate with urban design guidelines.	VH	as per 5.5.1b	as per 5.5.1b	COB, CMA	M
			LU8	Based on the model and relevant actions from the municipal stormwater management plan, revise structure plans (ODP) for Winter Creek catchment: Sebastapol/West Sebastapol, Alfredton and Delacombe (see LU3 for detail).	VH	\$15,000	\$0	COB	L
<b>STRATEGY 76</b>									
Winter Creek Middle Branch	9.5.2c	CHW sewerage line follows the creek alignment which restricts the installation of retarding basins and water quality treatment wetlands.	MO15	CHW to review sewer alignment in Winter Creek Catchment, and liaise with other agencies to determine future provision of sewers and depths prior to installation.	H	?	?	CHW, COB	L
<b>STRATEGY 77</b>									
Winter Creek Middle Branch	9.5.2d	Impact of Ballarat Saleyards on water quality in Winter Creek and tributaries	M016	Develop an Environmental Site Management Plan for the Ballarat Saleyards to effectively manage stormwater and effluent from the site.	H	\$10,000	\$500	Ballarat Saleyards	L