INTEGRATED WATER MANAGEMENT PLAN for the RURAL COMMUNITIES OF GOOLWA and HINDMARSH ISLAND

Alexandrina Council
October 2012

FINAL REPORT

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Integrated Water Management Plan for Goolwa and Hindmarsh Island

- Integrated Water Management Plan
- Alexandrina Council

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Executive Summary

Overview

The Alexandrina Council (the Council) is committed to the responsible stewardship of natural resources, ensuring that water resources are protected and use of alternative (sustainable) water resources is maximised. This Integrated Water Management (IWM) Plan for the Rural Communities of Goolwa and Hindmarsh Island has been prepared to identify the most sustainable mix of water supply solutions for the community through the consideration and incorporation of all water sources including reticulated potable water, rainwater, stormwater, groundwater and recycled wastewater.

Climate change forecasts suggest that the region will trend toward warmer and drier average conditions over the next 20-60 years (Hayman et al, 2011). Surface water availability across the entire Murray-Darling Basin is expected to decline due to climate change and inflows to the state from the River Murray will be reduced (CSIRO, 2008). The Alexandrina Council and community have been concerned about the unprecedentedly low water levels in the Lower Lakes and River Murray in recent years. In addition to climate variability and climate change, land use activities and other pressures act to increase demand for available water resources. While drought conditions may ease, water availability in the SA MDB region is likely to remain constrained.

The 30-Year Plan for Greater Adelaide (DLPG, 2010) estimates that the townships within the Alexandrina Council area will increase by around 75% of the current population, which reflects a significant increase in water resource demand within the region. In particular the townships of Goolwa and Hindmarsh Island are predicted to experience significant growth, from a current total population of around 6,500 people to an increased population of around 15,600 people by 2040.

Responsibilities for IWM in Goolwa and Hindmarsh Island are divided between the agencies and community responsible for the various aspects of water supply, treatment, use and management including SA Water, the Alexandrina Council, the South Australian Murray-Darling Basin NRM Board and the community. External funding bodies such as the State and Federal Government have an important role in enabling implementation of IWM initiatives. Successful IWM requires good communication and cooperation between all stakeholders and an agreed vision for the future.

Objectives and Action Plan

The objective of this Integrated Water Management Plan (IWMP) is to provide for the sustainable, resilient development of Goolwa and Hindmarsh Island through the identification of 'fit for purpose' water supplies for the Council, residential, commercial, agricultural and industrial uses, considering the pressures of reduced water availability and urban growth. Increasing the diversification of water sources is a key objective, to be achieved through increasing the use of recycled stormwater, wastewater and rainwater and thereby reducing reliance on River Murray water.

By 2040 total demand for fit for purpose water for the irrigation of public open space within Goolwa and Hindmarsh Island is estimated to be 141 ML per annum. A key priority of the plan is to provide a strategy to maximise use of alternative water sources such that new public open space is independent of potable water supplies, in accordance with the *Greater Adelaide 30 Year Plan.*

A range of water management actions were investigated throughout development of the Plan. These actions related to both infrastructure development and policy and planning recommendations. The objective of Water Sensitive Urban Design (WSUD) options such as vegetated swales, wetlands and infiltration basins is to increase the volume of stormwater infiltration, thereby reducing the amount of runoff to be managed, and reducing the runoff that would otherwise wash pollutants into the stormwater system (DPLG, 2009).

A Triple Bottom Line Assessment (TBL) process was used to determine the preferred infrastructure scenario (group of actions). The water management actions recommended for Goolwa and Hindmarsh Island are summarised in Table ES1. A detailed Action Plan for each township has been developed which breaks the actions down into smaller components and identifies priorities, responsibilities, and links to relevant goals, benefits and outputs.

Table ES-1: Summary of integrated water management recommended actions for Goolwa and Hindmarsh Island

Infrastructure Actions - Goolwa
▪ Water Sensitive Urban Design (WSUD) treatments through the growth / new development areas. In particular this will include construction of green corridors which would incorporate vegetated swales and will promote infiltration and treatment of the stormwater. This is expected to result in average infiltration of 230ML/year. An additional 420ML/year of evaporation/infiltration of stormwater would occur through construction of wetlands for stormwater harvesting (of total 1570ML of stormwater generated).
• Stormwater reuse of approximately 390ML/year by 2040 through harvesting from three new wetlands with total capacities of 90ML, 10ML and 17 ML for irrigation of public open spaces (190ML/year), and harvesting from household rainwater tanks (200ML/year).
• Reuse of 75ML/year of treated wastewater for irrigation of public open space.
▪ Reuse of 635ML/year treated wastewater for irrigation (proposed to support development of local horticultural industry).
▪ Managed Aquifer Recharge (MAR) viability investigations to consider how adequately particular locations would achieve cost effective storage and reuse of stormwater/wastewater for irrigation
Infrastructure Actions – Hindmarsh Island
▪ Transfer 130ML/year wastewater to Goolwa for treatment and reuse
▪ Construction of bio-infiltration basins at low points throughout the catchment area. This is expected to result in average infiltration/evaporation of 240ML/year of the total 310ML/year generated.
Planning Actions – Goolwa and Hindmarsh Island
▪ Mandate rainwater tanks in Development Plan
▪ Update Residential Development Code and Development Plan
Capacity Building and Governance – Goolwa and Hindmarsh Island
▪ Community education and awareness

▪ Training for Council staff and decision-makers
Water Conservation (Demand Management) – Goolwa and Hindmarsh Island
Monitoring and Review – Goolwa and Hindmarsh Island

Predicted Impacts of Climate Change

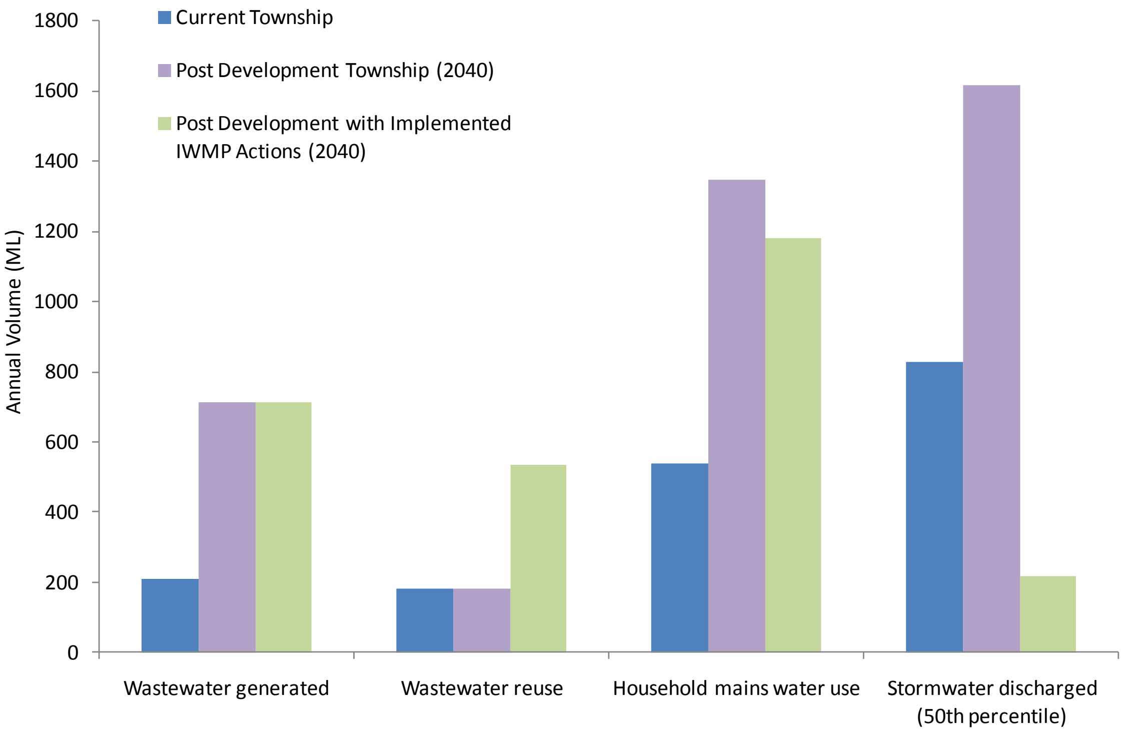
To inform this project, the South Australian Research and Development Institute (SARDI) completed climate change modelling for the Alexandrina Council area to provide an estimate of the changes to temperature, rainfall and evaporation expected over the 30 year lifespan of the IWMP (Hayman et al, 2011).

The combined effects of higher temperature, lower rainfall and higher evaporation may pose challenges to management of South Australia's water resources, and water shortages are likely to result (SA Government, 2010). In order for South Australia to adapt to climate change, sustainable water management measures must be incorporated into planning and infrastructure decisions now (SA Government, 2010). Integrated water management will be an imperative for diversifying water sources, reducing reliance on River Murray water and maximising reuse.

For both Goolwa and Hindmarsh Island, the annual volumes of runoff are predicted to decrease by a small amount (approx 5%) as a result of the climate change projections in comparison with the large increase (approx 250%) to the stormwater runoff volumes that are estimated as a result of the urban development. Subsequently the expected impacts of recommended infrastructure action were calculated used historic climate data.

Major Elements of Urban Water System

Figure ES-1 compares estimates of the volumes of the major elements of the water system for Goolwa and Hindmarsh Island now, in 2040 for a situation where no water management actions are implemented, and in 2040 if the preferred IWM actions are implemented. The graph demonstrates that the volumes of stormwater generation, and household mains water use are estimated to more than double by 2040 as a result of the growth if improved water management actions are not undertaken. The estimated volumes for the 2040 development with IWM action show that substantial improvements would result from the infrastructure and planning initiatives proposed in the Action Plan. Increasing reuse of treated wastewater and stormwater, reducing volumes of stormwater discharge to the Goolwa Channel and increasing the proportion of fit for purpose water use would result in a range of environmental and community benefits for the region.



- **Figure ES-1: Comparison of current (2011) and future (2040) water volumes for Goolwa and Hindmarsh Island**

Table ES-2 and Table ES-3 provide the annual volumes used within the water balance for the current township, and future township in 2040 with implementation of the recommended actions. The stormwater discharge and reuse volumes depend on climate conditions, so the 20th percentile (dry year), 50th percentile (medium) and 80th percentile (wet year) estimates have been included in the Tables to show variation for dry, average and wet years.

For Goolwa, approximately 640ML/year of stormwater is estimated to be infiltrated/evaporated through implementation of WSUD features (including swales and wetlands) in the new development areas. The recommended WSUD treatments include the construction of green corridors incorporating vegetated swales that will promote infiltration and treat stormwater. There would be around 470ML/year of stormwater reuse, of which around 270ML/year would be harvested from wetlands and used for irrigation of public open spaces and 200ML/year would be harvested from household rainwater tanks and reused within gardens, toilet and hot water systems in the new development areas. Around 600ML/year of stormwater runoff would remain unused, of which around 360 ML/year is required to maintain pre-development flows from the catchment; however the rest (240ML) would be available for harvesting and reuse by the Council through the provision of additional treatment measures and associated storage, further to that proposed in this Plan. It is proposed that all wastewater generated would be used for irrigation of local horticulture; however this will depend upon the future demand from local industry.

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For Hindmarsh Island, around 240ML/year would be infiltrated as a result of constructing bio-infiltration basins throughout the growth areas. Around 70ML/year of stormwater would be discharge to the Goolwa Channel, and around 60ML/year of this is required to maintain pre-development flows. Wastewater would be transferred to Goolwa and treated at the Goolwa WWTP.

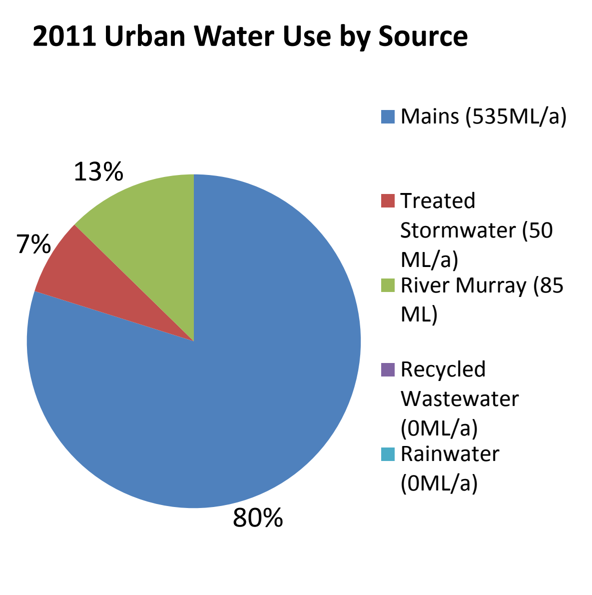
- **Table ES-2: Water supply and use volumes for major elements of the urban water system for the current townships (2011)**

Stormwater	Stormwater generated (ML/year)	Stormwater infiltration & evaporation (ML/year)	Stormwater reused for irrigation as at Dec 2011 (ML/year)	Maintenance of pre-development flows to watercourse	Stormwater available for additional alternative uses[1] (ML/year)
Goolwa	790	40 (50^{th} percentile)	50	340	360 (50^{th} percentile)
Hindmarsh Island	130	Unknown	0	60	70 (50^{th} percentile)
Total	920	40 (50^{th} percentile)	50	400	430 (50^{th} percentile)

Wastewater	Wastewater generated (ML/year)	Wastewater reuse (ML/year)	Wastewater excess (ML/year)
Goolwa	180	180	0
Hindmarsh Island	30	0	30
Total	210	180	30

Mains	Household mains water use (ML/year)	Irrigation mains water use (Council) (ML/year)
Goolwa	535	5.5
Hindmarsh Island	0	1
Total	535	6.5

River Murray Water	Irrigation River water use (ML/year)
Goolwa	85
Hindmarsh Island	0
Total	85



Note 1: Subject to additional treatment and adequate storage.

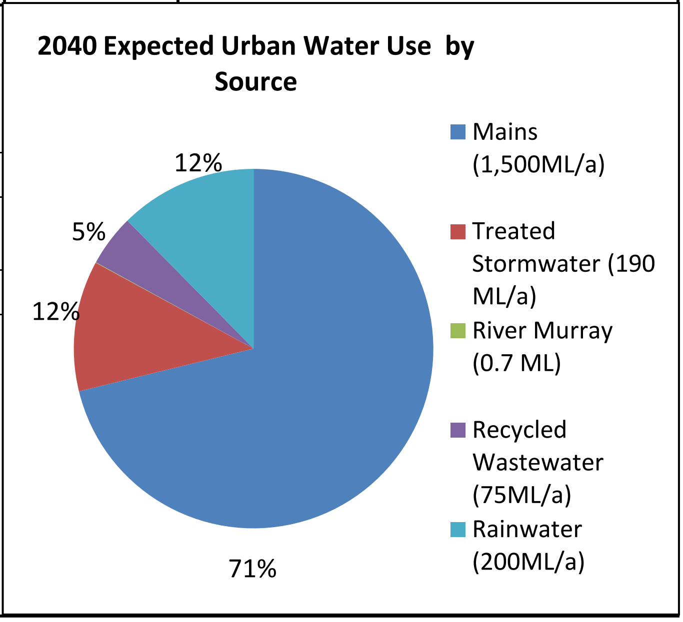
Table ES-3: Expected water supply and demand volumes for major elements of the urban water system post development (2040) with implementation of preferred IWMP actions

Stormwater	Stormwater generated (ML/year)	Stormwater infiltration & evaporation (ML/year)	Rainwater capture (additional) (ML/year)	Stormwater reused (irrigation ML/year)	Maintenance of pre-development flows to watercourse	Stormwater available for additional uses[4] (ML/year)
Goolwa	1570	640	160	190 (50th percentile)	340	240 (50th percentile)
Hindmarsh Island	310	240[3]	40	0	60[3]	0
Total	1880	880	200	190 (50th percentile)	400	240 (50th percentile)

Wastewater	Wastewater generated (ML/year)	Wastewater demand[1] (ML/year)	Wastewater excess[1] (ML/year)
Goolwa	580	535[2]	175[2]
Hindmarsh Island	130		
Total	710	535	175

Mains	Household mains water demand (ML/year)	Irrigation mains water use (Council) (ML/year)
Goolwa	1000	0
Hindmarsh Island	150	0
Total	1150	0

River Murray Water	Irrigation River water use (ML/year)
Goolwa	0
Hindmarsh Island	0.7
Total	0.7



Note 1: Wastewater demand is based upon current known users.

Note 2: Wastewater from Goolwa and Hindmarsh Island considered together as combined for treatment. Turf farm use up to 460 ML/year (subject to availability) and Irrigated Public Open Space (IPOS) 75 ML/year

Note 3: Infiltration from the proposed basins is likely contribute to maintenance of pre-development flow to the Goolwa Channel via sub-surface flow

Note 4: Subject to additional treatment and adequate storage

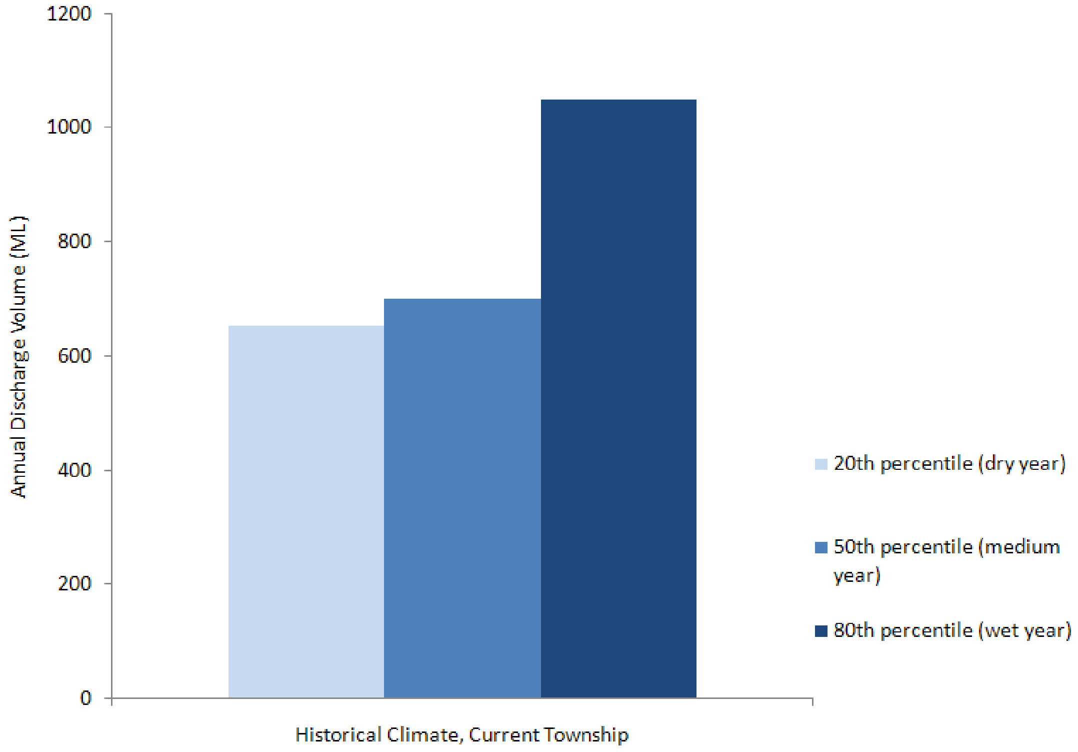
Technical details including a planning policy review, options identification report, water quality (MUSIC) modelling, Triple Bottom Line analysis outcomes and details of Net Present Value cost estimates are included in the Appendices of this report.

Water Security

Implementation of the recommended actions will assist future water supply security for the townships of Goolwa and Hindmarsh Island. In particular, this includes:

- Maintaining the amenity of public open space and recreational areas. The volume of stormwater treated for reuse for irrigation of public open space would increase from 50ML/year to 190ML/year. The volume of treated wastewater reused for irrigation will increase to 75ML/year.
- Minimising water use per household. The requirement for all new residences to have a minimum of 5kL rainwater tanks plumbed for toilet and hot water use will reduce the annual mains water consumption by around 25% from around 150kL/household/year to 110kL/household/year for new developments.
- Providing up to 635ML treated wastewater per annum for private industry for the irrigation of crops, including 460ML per year for the turf farm.

The variability of water sources can be illustrated by the variation in stormwater runoff to Goolwa Channel for dry, medium and wet years. Figure ES-2 shows the volume of urban stormwater that is discharged to the Goolwa Channel for the current township. The 20th percentile, 50th percentile and 80th percentile rainfall years from the historical rainfall record (1871 – 2010), were used to show the difference in the volume of urban runoff for a dry, medium and wet year.



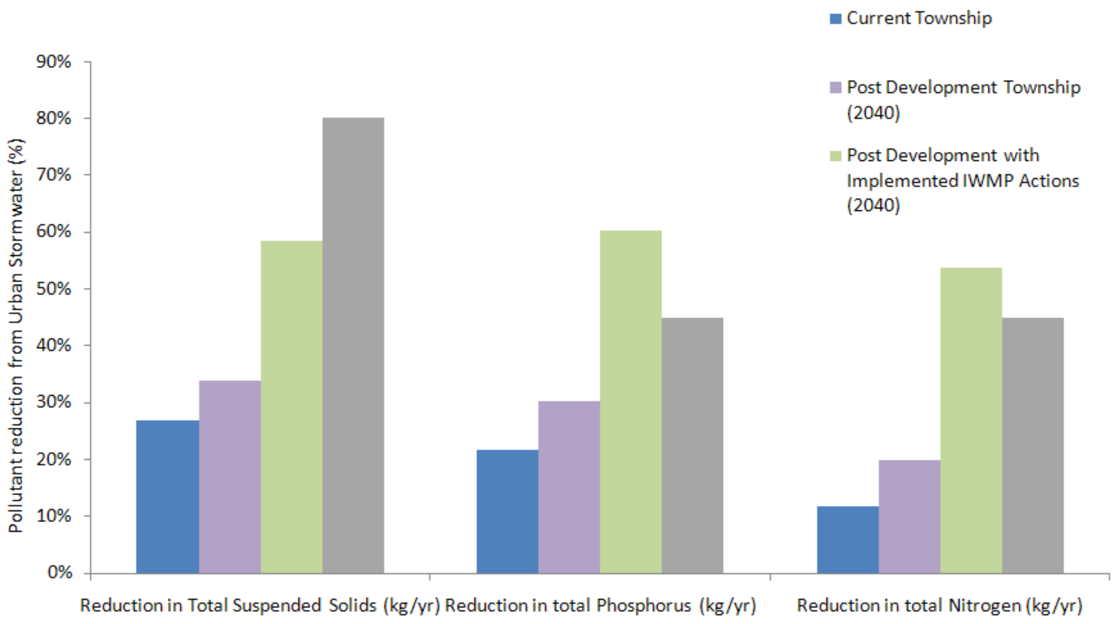
- **Figure ES-2: Estimate of the volume of stormwater discharged to Goolwa Channel from the current Goolwa township (2011)**

Water Quality Benefits

Stormwater runoff from urban areas is subject to pollution as it passes over impervious (paved) areas, including oils, sediments and excess nutrients (Department of Planning and Local Government, 2009). The amount of impervious area compared to pervious (open space/landscaped) areas affects the total volume of runoff because it affects the total volume of infiltration.

The SA MDB NRM Board has developed a set of targets related to WSUD to guide the Board's input into strategic and development plan policy and developments within the SA MDB Region (SA MDB NRMB, 2011). The stormwater management actions that are recommended in this Plan have been developed in consideration of the WSUD targets. By implementing initiatives to maximise stormwater infiltration, treatment, storage and re-use, the proportion of stormwater that is ultimately discharged to the region's watercourses and Lake Alexandrina will be of the quality described in Figure ES-3.

The Figure compares the total pollutant removal estimated from stormwater runoff from the urban catchments of Goolwa and Hindmarsh Island for the current township (2011), post development township (2040) without implementation of IWM actions, and post development township (2040) with implementation of the IWMP actions, in particular development scale WSUD (swales and wetlands). The SA MDB NRM Board WSUD targets for pollutant removal are also shown on the graph for comparison. It shows that the current township and post development township without implementation of IWM actions both fall significantly short of the WSUD targets. For the post-development township with implementation of the IWMP actions, the percentage reduction for Nitrogen and Phosphorus exceed the target however the removal of suspended solids is still around 15% below the target. The appropriate application of additional WSUD treatments such as permeable pavements and buffer strips would be expected to further improve stormwater quality. These features were not specifically included due to the conceptual nature of the model.



- **Figure ES-3: Comparison of current and future water quality parameters for Goolwa and Hindmarsh Island**

Liveability/ Amenity/ Microclimate benefits

The recommended actions will also impact positively on the quality of life of the Goolwa and Hindmarsh Island communities. The specific benefits will include:

- Community benefit from new combined wetland and parkland/public open spaces. These features should be designed as high value public open space, with community access and facilities.
- New green bike corridors combined with vegetated swales will promote healthy community lifestyle and provide a desirable community feature. WSUD features are also likely to be accepted an appreciated as a visual and obvious water savings and water treatment approach.
- Rainwater tanks to all new development areas will provide community education and awareness of water conservation.

- An urban forest has been included on the structure plan to the west of the growth areas, to provide a buffer between the town and future industrial/horticultural areas. This concept was an outcome of a workshop with the community.

1. Introduction

The Alexandrina Council and community have been concerned about the unprecedentedly low water levels in the Lower Lakes and River Murray in recent years. With a range of studies indicating a future with less water, the Council is taking steps to address the prospect of a drier climate. A range of water saving and water reuse initiatives have already been implemented within the region, including reuse of treated stormwater and recycled wastewater.

In addition, the 30-Year Plan for Greater Adelaide (DLPG, 2010) identified areas for development and subsequent population growth in Alexandrina Council that will increase demand for water resources within the region. In particular the townships of Goolwa and Hindmarsh Island are predicted to experience significant growth, with an increase in population from around 6,400 (2011) to 15,600 people by 2040, and as such they are the focus of this Integrated Water Management Plan. Assessment of the potential impacts of climate change on the availability of water and comprehensive planning are required to ensure that the growing communities can be sustained while reducing reliance on the traditional water resources of the River Murray and Lower Lakes. Predictions of a drier climate resulting in reduced River flows, along with reduced water quality will require alternative water sources to be found to maintain security of supply.

The Alexandrina Council is committed to the responsible stewardship of natural resources, ensuring that water resources are protected and restored. The Council initiated the “Alexandrina – Securing a Freshwater Future” campaign in 2009 in response to the recent drought, providing leadership to the community on the importance of sustainable water management.

This Integrated Water Management Plan (IWMP) is seeking to provide for the sustainable, resilient development of Goolwa and Hindmarsh Island through the identification of ‘fit for purpose’ water supplies for the Council, residential, commercial, agricultural and industrial uses. It aims to maintain and enhance the valued amenity and open space features of these towns and protect and restore the local environment.

The development of this IWMP has been funded by the Australian Government’s *Strengthening Basin Communities Program.* This Plan will assess the risks and implications associated with providing water for growing communities in an uncertain climate future. It will allow the Alexandrina Council to plan for future investment in water savings initiatives and provide input to development plan policy.

1.1. Project Overview

Sinclair Knight Merz (SKM) and collaborating consultants URPS, were engaged by the Council to prepare this IWMP.

The objectives of the IWMP are to provide management actions:

- for the sustainable management of all water resources within, impacted or drawn upon by the townships and their planned growth areas;

- for the preservation, or enhancement where possible, of the ecological function of the region's watercourses;
- for productive, sustainable, liveable, socially inclusive towns that are well placed to meet future challenges and growth;
- for sufficient water supplies to maintain public open space for amenity and recreational values, while protecting the health and wellbeing of the community in a warming climate;
- for water use that is "fit for purpose", i.e. water treated to an appropriate standard in keeping with its intended use;
- for clearly articulated connections and directions to the different sections of the Council's business, e.g. Planning and Engineering, Operations, and Strategy;
- for resilient townships capable of responding to an uncertain climate future;
- for water infrastructure that addresses the water-energy nexus;
- for water infrastructure with a minimised carbon footprint across its life-cycle; and
- for leadership to the community and clear direction as to how water will be managed within growth areas and existing townships subject to the plan.

1.2. Methodology and Key Tasks

Table 1-1 summarises the key tasks and outputs that were completed during the development of this IWMP.

Table 1-1: Summary of Methodology and Tasks

KEY TASKS	METHOD	OUTPUTS
Consult stakeholders (Council, community, agencies and developers)	A Council and government agency stakeholder workshop was held in August 2010 to identify and articulate the goals, issues and opportunities for integrated water management in the Rural Communities of Goolwa and Hindmarsh Island. Interviews were conducted with known land owners and developers of future growth areas. A community workshop was also held in November 2010 to discuss the community's goals and their desired future for water management in Goolwa and Hindmarsh Island. Additional consultation with Council and stakeholders was ongoing through the project.	Goals for IWM - Summary in Section 2 Consultation notes included in Appendix A (Options report)
Undertake Policy and Planning Review	A Policy Review was prepared summarising the key strategic planning directions and statutory planning policy context for integrated water management relating to the Alexandrina Council.	Policy and Planning Review - summary in Section 3.2 Full report in Appendix A
Gather information regarding water supply and use, population and predicted growth	An analysis of the current population, future population growth and the baseline demand forecast for Goolwa and Hindmarsh Island was conducted to ensure that the water management options and recommendations of actions for the next 30 years could be based on robust assumptions.	Summary in Sections 3 and 4 Demand Analysis Full report in Appendix C: Demand Analysis

KEY TASKS	METHOD	OUTCOMES
Calculate impacts of development on water balance	The impacts of development on stormwater and wastewater generation, and water demand were modelled using MUSIC and a water balance model.	This report Section 5
Calculate impacts of predicted climate change on water balance	Stormwater generation in 2040 with and without development was modelled using the climate change prediction developed by Hayman et al, 2011.	This report Section 6
Identify actions for IWM and develop scenarios	A range of actions were developed for Integrated Water Management in the Rural Communities of Goolwa and Hindmarsh Island. These actions were developed following a review of the relevant background documents, discussions with Council staff and a site visit to Goolwa and Hindmarsh Island. Scenarios were developed, starting with the base level of action required, and increasing in complexity and resource requirements for implementation.	This report Section 7 and 8
Compare scenarios through Triple Bottom Line Assessment to identify preferred scenario	The water management scenarios were assessed through a Triple Bottom Line (TBL) approach, to compare the relevant economic, environmental and social impacts of each scenario. A workshop with relevant stakeholders was conducted on the 21/03/2011 to complete the assessment. A range of technical information was gathered to assist in decision making during the workshop.	This report Section 8 and 9
Reporting final recommendations	The final recommendations contained within this report have been developed in consultation with the Alexandrina Council and South Australian Murray-Darling Basin NRM Board.	This report Section 11

1.3. Structure of the Integrated Water Management Plan

This Report outlines the Integrated Water Management Plan for the Rural Communities of Goolwa and Hindmarsh Island. The plan is structured as follows:

- **Section 1**: This section; an introduction to the project.
- **Section 2:** Summarises the goals that were identified for Integrated Water Management within the Rural Communities of Goolwa and Hindmarsh Island.
- **Section 3:** Provides a description of the population, growth and planning and policy context of the Rural Communities of Goolwa and Hindmarsh Island.
- **Section 4:** Provides a description of the current water resources of the Rural Communities of Goolwa and Hindmarsh Island, including natural watercourses, stormwater, groundwater, potable water supply and wastewater.
- **Section 5:** Provides a description of the impacts that urban development in Goolwa and Hindmarsh Island would have on the major elements of the urban water system by 2040.
- **Section 6:** Provides a description of the impacts that climate change projections would have on the major elements of the urban water systems in Goolwa and Hindmarsh Island.
- **Section 7:** Identifies potential actions for IWM in Goolwa.
- **Section 8:** Describes the process that was undertaken to develop infrastructure development scenarios (groups of actions) and assess these scenarios using a Triple Bottom Line (TBL) process for Goolwa.
- **Section 9:** Identifies potential actions for IWM in Hindmarsh Island.
- **Section 10:** Describes the process that was undertaken to develop infrastructure development scenarios (groups of actions) and assess these scenarios using a Triple Bottom Line (TBL) process for Hindmarsh Island.
- **Section 11:** Presents an action plan and final recommendations for Integrated Water Management for Goolwa, over the 30 year lifespan of the Plan to the year 2040.
- **Section 12:** Presents an action plan and final recommendations for Integrated Water Management for Hindmarsh Island, over the 30 year lifespan of the Plan to the year 2040.

1.4. Integrated Water Management

Integrated Water Management (IWM) is defined as providing the most sustainable mix of water solutions for the community through the consideration and incorporation of all water sources including reticulated potable, rain, stormwater, groundwater and wastewater.

Figure 1-1 shows the interactions between these water sources and the cycle of supply, demand, treatment and storage.

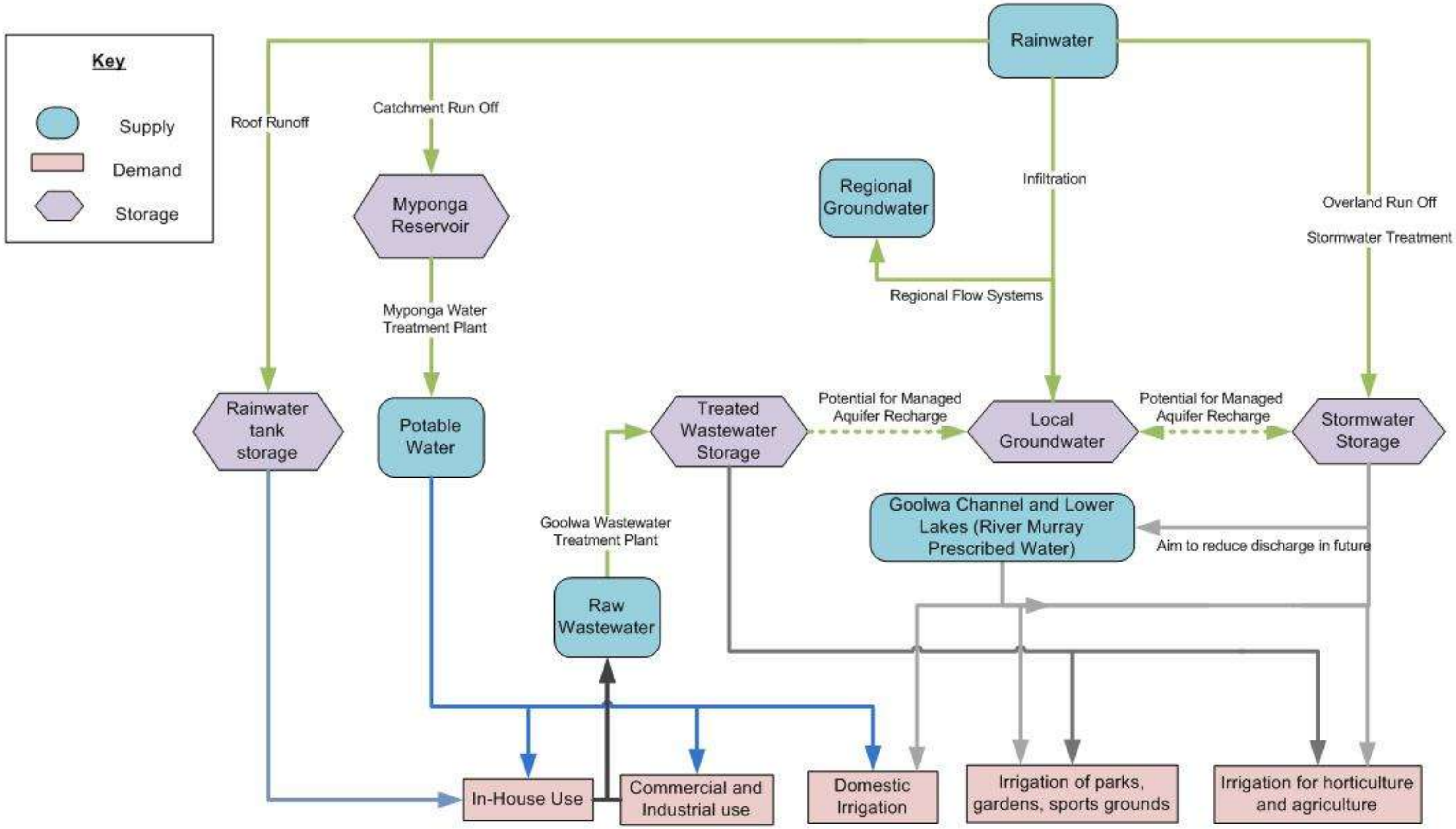


Figure 1-1: Integrated Water Management: Interactions between a range of Water Sources for Goolwa and Hindmarsh Island

IWM integrates social, economic, environmental and technical considerations in managing water. It links areas that in the past have often been managed as distinct isolated resources, such as:

- Land use and water use;
- Water quantity and quality;
- Water movement in rivers and aquifers;
- Wastewater and stormwater suitable for treatment and reuse;
- Upstream and downstream interests; and
- The relative use of other resources when managing water such as energy and materials.

As well as technical issues IWM addresses social issues such as:

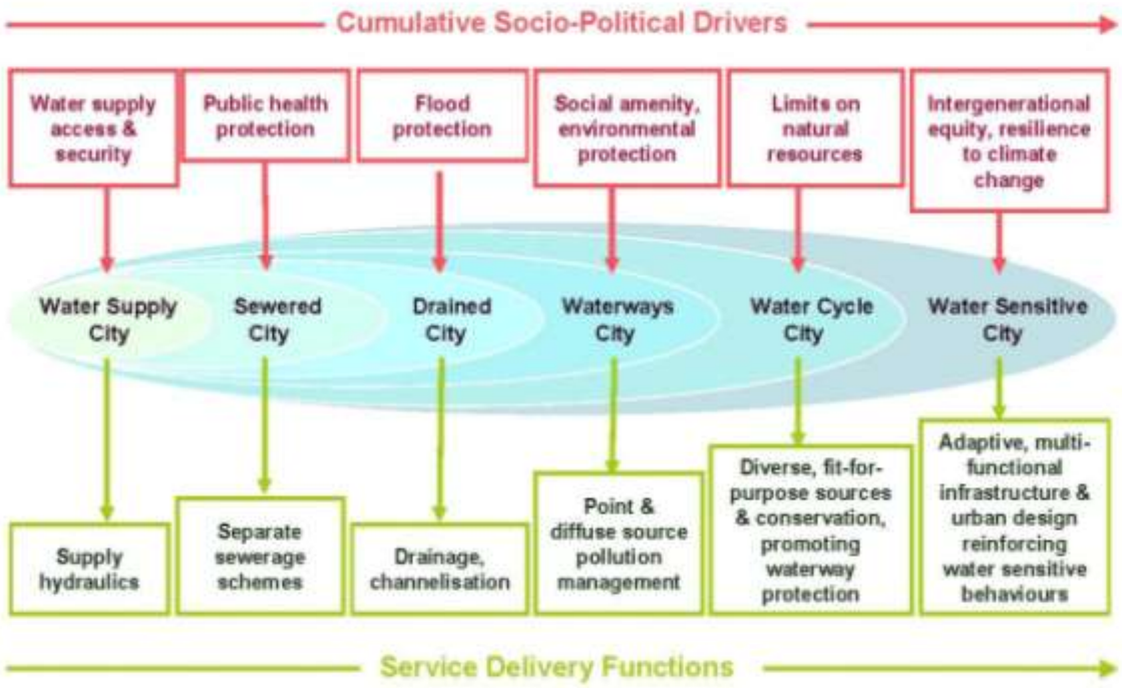
- Coordination of different levels of government and governance, from local to national and global, in water policy making and management;
- Involvement of stakeholders in the decision-making process;
- Accounting for the impact on water resources of policies and planning in other areas, such as food, transport, energy and population;
- The provision of adequate information to support decision making; and
- Influencing water users to recognise the need for long-term viability of water resources and to use water accordingly.

1.5. Transitioning to a water sensitive town

The recommended actions from this plan aim to promote the townships of Goolwa and Hindmarsh Island as 'Water Sensitive Cities'. Brown et. al (2009) propose a framework for benchmarking the development of urban water management in cities. It presents six categories or states which urban cities transition through when moving toward sustainable urban water management. The purpose of the spectrum is to assist urban water managers with transitioning to the ultimate goal of water sensitive cities.

Figure 1-2 describes each of the states.

Communities have emerged from the basic service provisions of a 'water supply' city, which solely provides access to water. In contrast, at the high extreme of the spectrum, a 'water sensitive city' provides sustainable water management, with resilience to climate change and water sensitive behaviours. The townships of Goolwa and Hindmarsh Island are currently in between a "Waterways City" and a "Water Cycle City". A suite of infrastructure, policy, governance and capacity building initiatives will be required to assist Goolwa and Hindmarsh Island to transition towards "Water Sensitive Communities".



- **Figure 1-2: Urban Water Management Transitions Framework (Brown et al., 2009)**

1.6. Responsibilities for IWM in Goolwa and Hindmarsh Island

Responsibilities for IWM are divided between the agencies and the community responsible for the various aspects of water supply, treatment, use and management; SA Water (mains water supply), the Alexandrina Council (wastewater, stormwater, flooding and watercourse management on Council land), the South Australian Murray-Darling Basin NRM Board (natural resources in the region including water and biodiversity) and the community who as landholders may have and use rainwater tanks, and use mains water and groundwater for domestic use and irrigation.

Successful IWM requires good communication and cooperation between all stakeholders and an agreed vision for the future. In addition, the Council has a role in the education and support of their community to better manage their water resources.

1.7. Context for Future Water Resources Management

Over the 30 year lifespan of this plan, there are a number of factors that may affect how water is managed throughout Goolwa and Hindmarsh Island and which may require review and consideration of previously more expensive water management options. These factors will influence the development of IWM options, and priorities for IWM actions, and they are described below.

- **Unknowns associated with growth**

The 30 year Plan for Greater Adelaide has identified significant areas for residential development within Goolwa and Hindmarsh Island. There are uncertainties associated with rapid growth which will affect Integrated Water Management Planning. These include:

  - Uncertainty to do with the actual (versus planned) rate of growth
  - Locations and spatial distribution of the growth over time
  - Reductions to other areas previously identified for growth, increasing demand for land in Goolwa
  - Developer attitudes toward open space and water resource management

- **Unknowns associated with the future health of the River Murray**

The River Murray and Lower Lakes are key features of the townships of Goolwa and Hindmarsh Island. As well as being a key recreational and amenity feature, the River provides water for irrigation of farmlands and for maintaining public open space areas. Predictions of reduced rainfall and increased temperature as a result of climate change would result in lower River flows, and a decline in water quality is also predicted. There is uncertainty associated with the timing and magnitude of these effects, and the resultant impacts on the townships of Goolwa and Hindmarsh Island. The Council desires a fresh water solution to the Lower

Lakes, and this is a key driver for diversifying water sources and utilising fit for purpose sources throughout the towns.

- **Increased volumes of stormwater and wastewater**

Urban growth will result in greater volumes of stormwater and wastewater generated from Goolwa and Hindmarsh Island. Careful planning will be required to manage these additional volumes, as well as to work toward the Council goal of maintaining no discharge of treated wastewater to the Goolwa Channel. These alternative water sources also present an opportunity for council.

- **Flood risk with Current stormwater drainage network near capacity**

The current stormwater drainage networks throughout Goolwa are near capacity, and would require upgrade to cope with increased stormwater flows as a result of new development. There is an imperative to ensure that stormwater from new urban growth areas is appropriately managed to limit increased discharges to the existing network.

- **Increased cost of potable water**

Securing a potable water supply that is not impacted by climate change (i.e. desalinated water) has already resulted in increases in the cost of potable water supply across South Australia. Further cost increases may improve the viability of and increase demand for alternate supplies and make it more important to diversify water sources and utilise fit for purpose sources.

- **EPA requirement for no on site disposal of wastewater at Hindmarsh Island in future**

EPA requirements are implemented to protect water quality, and future requirements must be considered by the Council. The EPA have advised that there should be no on site disposal of wastewater on Hindmarsh Island in the future. To comply with this, all existing and new developments in Hindmarsh Island will require management of wastewater via community scale schemes.

- **Impacts on receiving waters**

Stormwater runoff from urban areas is subject to pollution as it passes over impervious (paved) areas, including oils, sediments and excess nutrients (Department of Planning and Local Government, 2009). To prevent negative impacts to receiving waters, stormwater treatment initiatives should be implemented in order to achieve the SA MDB NRM Board WSUD Targets (Section 3.2). Rates of stormwater discharge will also need to be managed to prevent erosion to receiving waterways at the point of discharge.

2. Stakeholder Consultation and Goals for Integrated Water Management

In the early stages of development of this IWMP, workshops and interviews were conducted with Councils, government agencies, land owners, developers and the community in order to identify and articulate the goals, issues and opportunities for integrated water management in the communities of Goolwa and Hindmarsh Island. This Section describes the outcomes of the workshops, with more details provided in Appendix B.

2.1. Consultation and Goals from Council and Government Agencies

A Council and government agency stakeholder workshop was held on the 9th August 2010 to identify and articulate the goals, issues and opportunities for integrated water management in the Alexandrina Council and for the identified growth areas in Goolwa and Hindmarsh Island that are the subject of the IWMP project. The goals were further refined by the Council following the workshop.

The goals that were identified from Council and Government Agency stakeholders for Integrated Water Management within the Alexandrina Council are summarised below. Appendix B contains a comprehensive summary of the findings of the workshop, including a more detailed description of each goal. The recommended actions from this IWMP were developed to work toward achievement of these goals.

Goal 1: Minimise adverse impacts on the environment

Any approach to integrated water management should minimise adverse impacts to the environment, including recognition of the environmental values of existing waterways, maintaining natural groundwater balance, improvement to water quality and managing development in a sustainable way.

Goal 2: Use a Water Balance Approach to Match 'Fit for Use' Water Supply

There is a need to ensure an ongoing supply of water to service a growing population, and opportunities to capture and reuse stormwater and wastewater should be maximised to meet this need. These capture and release opportunities should be integrated into the overall design of development, and combined with open space and recreation opportunities. A range of opportunities should be investigated to ensure the matching of fit for purpose water supply with its end use.

Goal 3: Establish an Economic Model to Deliver the IWMP

Ensuring that an appropriate funding model is in place to deliver on the directions proposed by the IWMP is a critical element to the IWMP's success. This funding model needs to be a partnership between the State government, developers and the Council and there is also a need to ensure that adequate personnel are allocated to support the implementation of the IWMP at the local level.

Goal 4: A Supportive Legislative Framework that delivers Integrated Water Management

For the IWMP to be successfully implemented, a supportive legislative framework needs to be in place.

Goal 5: Strong Partnerships and a Commitment to Integrated Water Management

The successful implementation of the IWMP will be dependent on a strong partnership approach between the Council, developers and other stakeholders. It will require a sustained commitment by the Council to the overall vision and objectives of integrated water management. One of the threats to the IWMP could be a shift in the Council's priorities and therefore, there needs to be a strong commitment established across the Council to the IWMP's overall vision.

Goal 6: An Integrated Water Management Structure Plan for Goolwa North

A goal which speaks directly to the need for the preparation of an integrated water management structure plan for Goolwa North was considered necessary in order to emphasise the importance of ensuring the area is designed and develops into the future with integrated water management as one of its central drivers. This approach recognises the uncertain water future and the need to secure water supplies for new (and existing) development that come from a range of sources, including stormwater capture and reuse and wastewater reuse.

2.2. Consultation and Goals from Community

A separate workshop was held with community members on the 2nd November 2010. During the workshop, community goals for integrated water management were identified, and these are described below. The recommended actions from this IWMP were developed to work toward achievement of these goals.

Goal C1: Minimise the carbon footprint of all water management actions

The options identified for future water management options should be selected to minimise energy use.

Goal C2: An aware community

The community needs to be an engaged and active player in integrated water management and work with the Council and developers to achieve integrated water management outcomes.

Goal C3: Manage demand for water

The importance of managing (community) demand for water was highlighted as an important way to manage water resources. A move towards permanent water restrictions of some nature was raised.

Goal C4: Create high value open space in new developments

Moving away from small pockets of open space and towards more centralised better planned open space will create higher value areas for recreation and leisure.

Goal C5: Integrate shared access (bike/walking) paths with wetland and biodiversity corridors

Linking open space and stormwater treatment wetlands with corridors designed to maximise shared access and biodiversity will provide recreation and amenity benefits.

2.3. Consultation with Developers

A number of interviews and meetings were undertaken with developers and land owners to:

- Understand developers' development program, including staging plans;
- Obtain developers' feedback on a range of water related natural resources management policies and procedures.

The information gathered was considered during the preparation of the Goolwa and Hindmarsh Island structure plans and actions recommended from this Integrated Water Management Plan.

The interview questions and a summary of responses are contained in Appendix B. Key points from the responses are provided below,

Purchasers Preferences

Although many developers desire to incorporate good stormwater management and WSUD outcomes into their developments, these features are rarely associated with a purchaser's willingness to pay a higher allotment price.

Stormwater Management and Drainage Reserves

Developers all agreed in-principle, that planning policies should seek to require on-site detention to ensure runoff from the development does not exceed pre-development rates. However, the implementation of such planning policy should allow for some level of flexibility to have regard to specific site conditions.

There was significant feedback regarding the common practice of councils' and developers' negotiations regarding what amount of the 12.5% open space requirement can also be used for drainage reserve, particularly when the drainage reserve is likely to be dry for most of the year.

Developers clearly stated that good design (including Water Sensitive Urban Design (WSUD)) is not fundamentally based on the amount of public open space allocated to a development. The integration and quality of the open space within the development (rather than the amount) is a key determinant to urban design outcomes.

Developers argue that if they financially contribute to these capital urban design improvements and that the majority of the drainage reserve is usable for most of the year, there should be greater flexibility in the use of the 12.5% open space requirement for drainage reserve purposes.

Introduction of Targets

In principle the concept of specific water reduction and re-use targets was not opposed, subject to (i) the target being justified with the development industry and (ii) the targets are implemented with a reasonable level of flexibility, noting that they will not always be able to be met.

Rainwater Tanks

Although developers did not oppose the current rainwater tank policies, they generally disagreed with the concept of rainwater tanks on private property for the flowing reasons:

- *(a) can't effectively control how the water will be used (if at all);*
- *(b) can't measure outcomes / benefits; and*
- *(c) can't control their long term management / maintenance.*

3. Policy and Planning Review

A Policy Review was prepared summarising the key strategic planning directions and statutory planning policy context for integrated water management relating to the Alexandrina Council. This Section describes the expected growth within the townships of Goolwa and Hindmarsh Island, the development of a structure plan for Goolwa's growth areas, and describes the policy review that was conducted.

The planning and policy information was used as a basis for developing infrastructure and policy opportunities and actions for IWM.

3.1. Population and Growth

In 2006, the populations of the Goolwa and Hindmarsh Island townships were 5,882 and 534 respectively (ABS, 2006). Population projections for Goolwa and Hindmarsh Island over the 30 year lifespan of the plan were derived using the information presented in the 30-Year Plan for Greater Adelaide (DPLG, 2010), Census data and the Council's GO2030 plan (Refer Appendix C). Their combined population was predicted to increase significantly to around 15,600 people by 2040, with most of the growth occurring in Goolwa. It is predicted that the average number of residents per household will decrease over this period from around 2.3 to 2.0 people.

It should be noted that since the development of this IWMP, updated population projections for growth in Goolwa and Hindmarsh Island have been prepared by Informed Decisions (.ID). Alexandrina Council engaged Informed Decisions (.ID http://home.id.com.au/), a specialist in geographical and spatial analysis, to prepare population and dwelling projections by township within their LGA. Their final report will be published online during mid to late November 2011. Preliminary reports from ID have identified a population for Alexandrina LGA of 32,423 by 2031 (30,578 to 2026). DPLG 2011 identifies 31,119 to 2026 which is marginally higher by 541 persons). Alexandrina Council understands that .ID prepares independent population forecasts (albeit mindful of the policy environment) and apply birth and death rates at a local level (which may have contributed to different forecasts and age structure to DPLG 2011 population figures).

While the outcomes of the updated population projections should be noted, the DPLG (2010) predictions of a population of 15,600 people in Goolwa and Hindmarsh Island by 2040 have been used throughout this report, in order to provide timely delivery of the IWMP, and due to ongoing uncertainties associated with the final growth predictions. This equates to a Goolwa population of 13,150 and Hindmarsh Island population of 2,450.

As part of the IWMP process, a preliminary structure plan focused on water infrastructure requirements was developed to represent the likely growth to the areas north of the current Goolwa town centre. The structure plan was developed in consultation with the Alexandrina Council and South Australian Murray-

Darling Basin Natural Resources Management Board (SA MDB NRMB), and forms a basis for Integrated Water Management Planning.

Figure 3-1 provides a current map of the townships of Goolwa and Hindmarsh Island, and Figure 3-2 shows the structure plan that was developed for Goolwa. The potential development area at Goolwa North indicated on the structure plan is considerably smaller than the area identified for future growth in the 30-Year Plan (DPLG, 2010). This is because it was found that the likely area required to meet the population growth targets for Goolwa is smaller than what was provided in the 30-year Plan.

3.1.1. Structure Planning

Structure planning for the new development areas throughout Goolwa is currently in progress and the key features and strategy for the structure plan were discussed with the Council and developers. Understanding the proposed features of the structure plan for the township was important in guiding the IWMP opportunities, including the locations and areas of new development for modelling stormwater and wastewater generation and potential for reuse. Figure 3-2 shows the preliminary structure plan that was developed for the purposes of the IWMP. It should be noted that this is not the final version of the plan, and may change significantly as the structure planning process continues.

When creating the preliminary structure plan for Goolwa the following were considered:

- Preliminary Master plan layout for the Skewes Trust
- The following rates of yearly development and allotment sizes from Developer and Council consultation:
  - 150 houses/year for the first 10 years
  - 75 houses/year for years 11-30
  - 800m^2 blocks in low density residential areas (with allowance for roads and open space, low density residential is assumed to require 1000m^2).
  - 450m^2 blocks in medium/high density residential areas
- Inclusion of a Local Centre which will include shops, medical services and a school
- Maintaining all remnant vegetation
- 50m wide ‘green-ways’ follow each creek. These will include a narrow artificial creek channel and wider floodplain that may be used for recreation such as bike riding, play grounds and other community uses.
- Separation distances from sewage treatment works (EPA requirements)

Figure 3-1 Current Development Extent - Goolwa and Hindmarsh Island

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Integrated Water Management Plan - Goolwa and Hindmarsh Island

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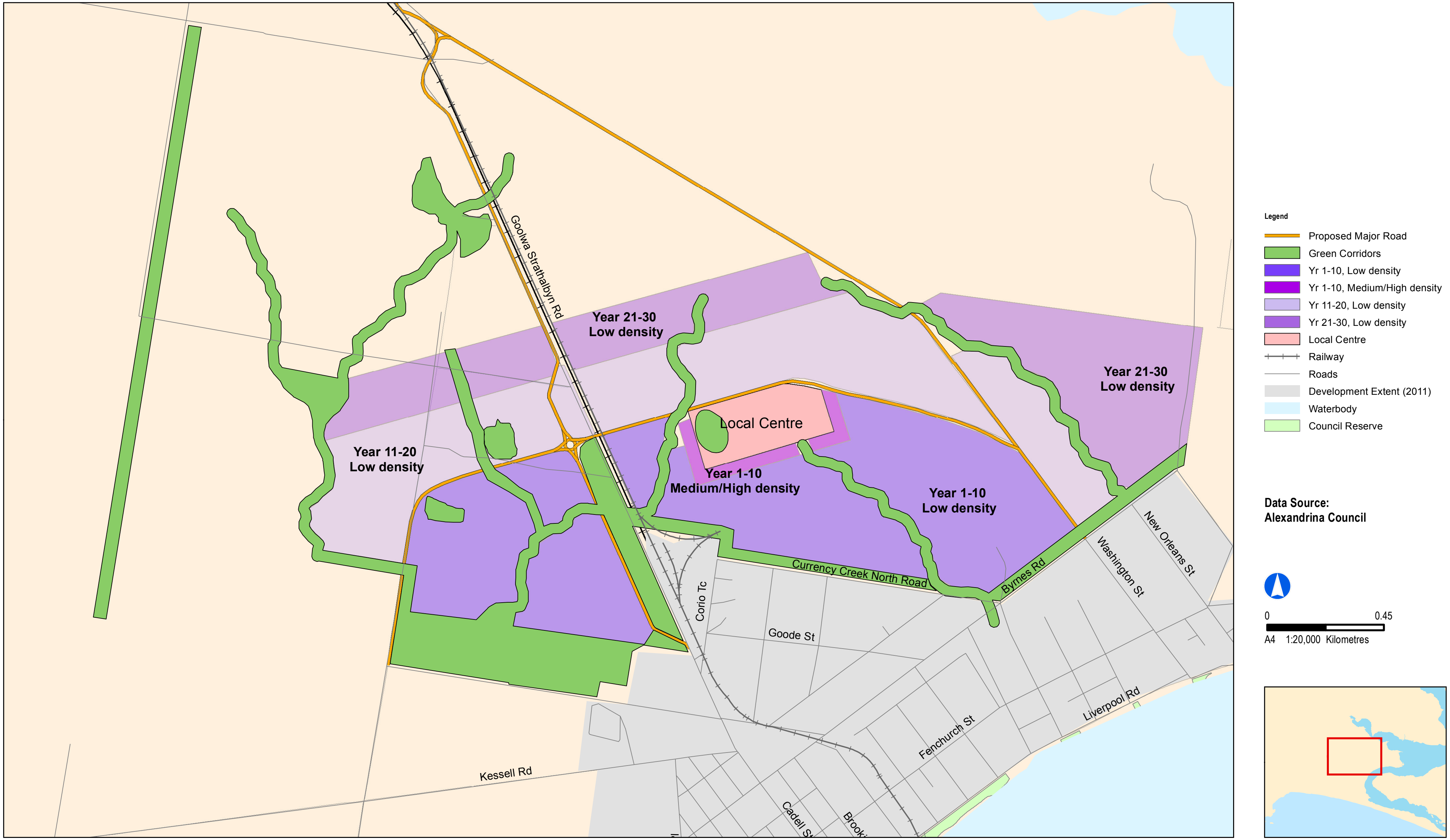

Figure 3-2 Preliminary Structure Plan for Goolwa North Development

Integrated Water Management Plan - Goolwa and Hindmarsh Island v1

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3.2. Policy and Planning Review

There are a range of State, regional and local planning processes and documents which drive planning policy and provide the strategic and statutory policy context for integrated water management. These range from high level strategic planning documents such as the 30 Year Plan for Greater Adelaide, to regional plans such as SA Murray-Darling Basin Natural Resources Management Plan, to local plans such as the Council's Development Plan.

Understanding this context is important, as it is this strategic and statutory policy context which will assist in delivering the directions proposed by this IWMP "on the ground" via new and possibly (in some cases) retrofitted development. The Policy Review (Appendix A) provides more detail about this policy context.

3.2.1. 30 Year Plan for Greater Adelaide

The *30-Year Plan for Greater Adelaide*, adopted in February 2010, provides land use and development direction for the Greater Adelaide region for the next 30 years. The Plan is predicated on achieving an additional 560, 000 people and 258,000 new homes in the region over the next 30 years. This high rate of growth will be increasingly concentrated in the existing urban area, with 70% of new housing growth to be accommodated in transit oriented development, along transit corridors and in higher density developments in strategic locations. However, the expected high rates of growth means that outward urban growth expansion will continue, with new greenfields development to occur in places such as Goolwa.

The Plan identifies anticipated population growth in the Fleurieu region (which includes Alexandrina Council) of 22,000 people and an additional 14,500 dwellings to be accommodated in existing townships.

In terms of water, the Plan identifies 'water efficiency' as a challenge for the Plan to respond to, noting that 'securing water supplies for a growing population and economy is fundamental to economic, social and environmental wellbeing'. It is in this context that the Plan notes that the actions of the Water for Good are being implemented and will ensure that Greater Adelaide has sufficient water supplies in coming years. The Plan also notes that urban form presents an opportunity to reduce water consumption, insomuch as increasing housing densities and improved water efficiency of buildings will result in more efficient use of water across the urban area overall. The Plan's direction in terms of water can be summarised as:

- Raising the standards for water efficiency in new residential, commercial and industrial buildings through a wider roll-out of WSUD techniques (including incorporating WSUD techniques in areas undergoing structure planning)
- Mandating WSUD for all new developments by 2013
- Reducing reliance on mains water supply
- Protecting water supply catchments, key watershed areas and potential locations for stormwater harvesting

- Reducing domestic water consumption through the shift to smaller accommodation, in line with demographic trends, at higher densities

- Ensuring new public open space is independent of potable water supplies

- Developing infrastructure to maximise the re-use of wastewater

Key WSUD policies and targets identified by the Plan include:

Policies

- Incorporate water-sensitive urban design (WSUD) techniques in new developments to achieve water quality and water efficiency benefits.

- Require WSUD techniques to be incorporated in Structure Plans and Precinct Requirements for State Significant Areas.

- Mandate WSUD for new developments (including residential, retail, commercial, institutional, industrial and transport developments) by 2013 (consistent with Water for Good).
The Climate Change, Housing Affordability and Sustainable Neighbourhoods Task Force will advise the State Government on the most effective way to implement this policy without compromising housing affordability.

- Require new greenfield developments that are subject to Structure Plans from 2011 to source water for outdoor use from non-mains water supplies.
This recognises the need to plan alternative water sources at the commencement of new large greenfield developments, rather than retrofit these sources for latter stages of the development.

- Identify and protect locations for potential stormwater harvesting schemes, including those areas identified in Map D22.

- Ensure appropriate policy links and consistency between Stormwater Management Plans, Structure Plans and Development Plans to address stormwater and flood management matters.

Targets

- Reduce demand on mains water supply from new development through the introduction of water-sensitive urban design. (This target will be quantified once the WSUD mandating scheme is determined.)

- Require all new dwellings to be connected to alternative water sources, which must supply at least 15 per cent of the internal water needs of these households.

The Rainwater Tank Size Selection Table prepared for Goolwa by the SA MDB NRMB indicates that a 9000L tank (minimum modelled volume) connected to 100m^2 roof area would meet medium internal uses (dual flush toilet, AAA-rated shower head, 100% laundry) 37% of the time (SA MBD NRMB, 2011b).

A 5000L tank for the same area has been calculated using the University of South Australia's Tank Size Estimation Tool would meet the same demand 25% of the time, assuming medium (50th percentile climate data).

- Achieve independence from mains water supplies for new public open spaces in transit corridors through WSUD techniques.
- Achieve alternatives to mains water for outdoor use through WSUD techniques in all new greenfield developments that are subject to Structure Plans and Precinct Requirements after 2011.

3.2.2. Water For Good

Water for Good is the State Government's integrated water management plan that provides strategic directions and over 90 actions to ensure the State's long term water supply needed to support economic, cultural and social development. At the heart of the document is new policy which aims to diversify water supplies to reduce reliance on the River Murray and other rain-dependent sources, and transition to a variety of water sources, including desalination, harvested stormwater and treated wastewater.

Stormwater Strategy-The Future of Stormwater Management

The Department for Water has also released the Stormwater Strategy, a high-level 'road map' for the future of stormwater management in South Australia.

The Stormwater Strategy includes nine actions to improve stormwater management in Adelaide in a way that integrates it with other urban water resources. Under the Strategy, the South Australian Government will develop a 'blueprint for urban water' to bring together stormwater and wastewater alongside other water resources in the Adelaide region, guide future infrastructure investment and policy requirements across Adelaide, and assist transition to a water sensitive city.

Part of this Strategy includes introducing interim targets for water sensitive urban design, completing further studies to improve the knowledge and management of public health risks relating to the recycling of stormwater, and ensuring a strong scientific basis for our future approach to urban water management.

A key action identified by this Strategy includes:

> *Before the end of 2011, introduce interim targets for water sensitive urban design, ahead of developing and implementing the best regulatory approach to mandate water sensitive urban design.*

3.2.3. Regional NRM Plan

The SAMDB NRM Plan calls for the sustainable use of water resource and the improvement of water quality. Key targets relate to the reuse of wastewater, fit for purpose water supplies and minimising urban settlements' impact on water assets. Integrated water management planning can assist to deliver on these strategic directions and targets as it is underpinned by the concept of considering the whole of water cycle and identifying ways to capture, treat and reuse water.

SA MDB NRM Board WSUD Targets and Water Quality

The SA MDB NRM Board has developed a set of targets related to WSUD to guide the Board's input into strategic and development plan policy and developments within the SA MDB Region (SA MDB NRMB, 2011). These targets have yet to be endorse by the Board but are used operationally by staff to guide input on policy and to comment in Development Applications.
The opportunities for IWM that are included in this Plan have been developed in consideration of the WSUD targets. The four targets that have been developed are summarised below, with further details provided in Appendix A.

Target 1: Reducing Mains Water Consumption

- Reduction of mains water use by 30% (compared with baseline year of 2003).
- Minimum of 40% of water supply for new development areas to be supplied from an alternative water source.

Target 2: Improving Stormwater Quality

- Reductions to total suspended solids, nitrogen and phosphorus of 80%, 45% and 45% respectively, as compared with an urban catchment with no water quality management controls.
- Retention of litter greater than 50mm and no visible oils for flows up to the 3 month ARI.

Target 3: Managing Stormwater Quantity

- For the 5 year ARI pre development flows are not exceeded, the time to peak matches that of the pre-development case as far as practical and runoff is contained within designated flow paths.
- For the 5 – 100 year ARI, flooding to buildings is avoided and time to peak and the peak flow matches that of the pre-development case, as far as practical unless catchment wide benefits can be demonstrated.

Target 4: Managing Volumes of Runoff

- The maximum percentage of impervious area that is directly connected to drainage infrastructure for residential, commercial, industrial and other development types (including but not limited to recreational, social and institutional development) is 50%, 80%, 70% and 50% respectively.

3.2.4. Council Plans

Alexandrina Council's Strategic Plan makes multiple references to different aspects of integrated water management. It is apparent that an integrated approach to managing stormwater, implementing water re-use initiatives and the roll-out of water sensitive urban design are strategic level commitments for the Council. The Council could further strengthen its commitment to integrated water management in its Strategic Plan by giving greater attention to wastewater re-use and developing localised fit-for-purpose water supplies.

The Alexandrina Council Development Plan, while addressing general issues such as adequately managing stormwater, basic water sensitive design treatments and protecting water sources from pollution and contamination, lacks clearer direction in terms of a more integrated approach to water management in terms of whole of cycle water utilisation, wastewater re-use and fit-for-purpose water supplies.

The Council is in an excellent position to make changes to water related planning and policy documents that will ensure the growth in Goolwa meets their desired water management goals.

4. Current Water Resources and Water Use

4.1. Introduction

The major elements of urban water management systems include wastewater, stormwater (including rainwater), mains (potable) water and groundwater. IWM aims to utilise and manage these elements to maximise reuse so that future demand is met. Each of the elements has different volumetric availability and water quality, which has implications for the purposes for which it can be used. Historically, urban water supply in the Alexandrina region has relied largely on mains water for a range of uses including household use, irrigation of open spaces, industrial and commercial uses.

Stormwater has been treated through detention basins and gross pollutant traps in strategic locations and system upgrades present opportunities. Recycled stormwater and wastewater is re-used for the irrigation of public open space opportunistically, however these resources are largely under-utilised. Irrigation of public open space has historically relied upon a mixture of mains water and River Murray allocations. This has enabled modest quantities or stormwater to be harvested for reuse in recent years.

'Fit for purpose' water use refers to matching a demand for water with a source that has appropriate availability, reliability and water quality. An example is the use of passively treated stormwater for irrigation of open spaces; the quality of treated stormwater is suitable for irrigation and its use results in energy and resource savings through reduction of potable water demands and reduction in stormwater discharge to the environment.

Each of the major elements of the urban water management system has been described for the township of Goolwa and Hindmarsh Island. Where possible, the water volumes for a dry, average and wet year have been quantified. This information was used as a basis for development of IWM opportunities and the infrastructure and policy actions from this IWMP.

4.2. Current Water Resources - Goolwa

4.2.1. Natural Watercourses

The township of Goolwa is located to the south west of Lake Alexandrina, just downstream of the point where Currency Creek outflows to the Goolwa Channel. From the Goolwa Channel, water flows south east toward the River Murray mouth.

Downstream of Goolwa, the Goolwa Barrage traverses the Goolwa Channel. This is one of 5 barrages that were constructed in the vicinity of the River Murray mouth in the late 1930's in order to prevent salt water ingress and maintain the freshness of the River Murray and Lower Lakes (Discover Murray, 2011). In 2009, low water levels caused by drought and over allocation of water resources resulted in the construction of two additional temporary flow regulators in the Goolwa Channel, one of these was located in the Goolwa Channel near Clayton Bay, and the other was located at the mouth of Currency Creek (DENR, 2010). These resulted in rising water levels in the Lower Lakes to prevent exposure of acid sulfate soils and associated environmental degradation. The temporary structures are in the process of being removed in response to high flows through the River Murray mouth in 2010/11.

4.2.2. Stormwater

Stormwater runoff from Goolwa is captured in several detention basins totalling 70ML capacity, collected in the Murray Smith Reserve storage basin and then pumped to storage lagoons adjacent to the wastewater treatment plant (WWTP). The stormwater is then reused for irrigation of the Goolwa oval and other public open spaces, with a total estimated yearly reuse volume of around 50 megalitres (ML). All other stormwater from the township is released directly to the Goolwa Channel. The Council is in the process of constructing a new 52 ML storage lagoon for stormwater storage adjacent to the WWTP.

Figure Figure 4-2 shows the current public open space and stormwater catchment map for the Goolwa Township. It illustrates the volumes of runoff (yield) expected from each major stormwater catchment for a year of average rainfall and evaporation. It also indicates the existing stormwater harvesting distribution and major storage.

Estimate of Stormwater Volumes for Current township: MUSIC Modelling

An estimate of the volume of stormwater runoff from the current Goolwa Township was completed, using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). MUSIC was developed by the Co-Operative research Centre for Catchment Hydrology (CRCCH), and it includes the following key components:

- Simulation of the hydrologic behaviour of catchments
- Generation of pollutant loads for suspended solids, total phosphorus and total nitrogen
- Pollutant removal achieved by the individual stormwater treatment components

MUSIC was considered the most suitable model for this investigation as it is able to model both the inflows to the catchment and the water quality improvements resulting from the Water Sensitive Urban Design (WSUD) infrastructure.

The following data were used to set up the MUSIC model:

- Daily rainfall for Goolwa for the period from 1871 to 2010, supplied from the BOM (Station 23718). The data was analysed and the 20th percentile (1901), 50th percentile (1976) and 80th percentile (1985) rainfall years were selected from the series to investigate stormwater variability for dry, average and wet climate conditions.
- Monthly evaporation data for Goolwa (BOM)
- Current urban catchment areas from analysis of contour map of the township

- Percentage of impervious for urban catchments from analysis of DWLBC landuse data (2008) for the town and consideration of the % of the catchment connected to the stormwater network through kerb and gutter infrastructure. See table below for impervious fractions used.

Catchment Name	Area (ha)	Impervious Fraction from Landuse Analysis	% kerbed/ connected to stormwater network
Golf Course	71	15%	40%
East	182	30%	90%
Murray Smith	191	34%	90%
South	273	34%	90%

A range of assumptions and exclusions were made as part of the MUSIC modelling. These include:

- Rainwater tanks were not explicitly included in the MUSIC Model, however the complications of a 5,000 litre tank per household were simulated by modifying the effective impervious area of the growth areas.
- All water quality modelling was undertaken using the default quality parameters for stormwater within the MUSIC model. More accurate results would be obtained using actual water quality data from urban stormwater in Goolwa.
- The MUSIC model only includes runoff from urban areas, and there would be additional runoff from the agricultural areas surrounding Goolwa. The urban runoff has been quantified separately, as it forms the focus of IWMP opportunities and actions. The low impervious fraction of agricultural areas, local sandy soils and the local flat terrain mean the runoff from these areas would be low.

Figure 4-1 shows the schematic of the MUSIC model for the current Goolwa Township. The model includes three urban catchment nodes which have been labelled East Goolwa, Murray Smith Reserve, South Goolwa and Golf Course. Runoff from the Murray Smith Reserve Catchment enters the Murray Smith Reserve wetland, from which around 50ML/year is reused. Excess stormwater is routed to the Junction node, which represents discharge of the stormwater to the Goolwa Channel. The spatial location of the nodes on the schematic only depicts indicative locations of elements of the system; however this has no effect on the results of the modelling. The flow and water quality outputs from each node of the model are included in Appendix G

Figure 4-1: Schematic of the MUSIC Model for Goolwa for Current Township

Figure 4-2 shows the current public open space and stormwater catchment map for the Goolwa Township. It illustrates the volumes of runoff (yield) expected from each major stormwater catchment for a year of average rainfall and evaporation. It also indicates the general flow direction of runoff from each catchment.

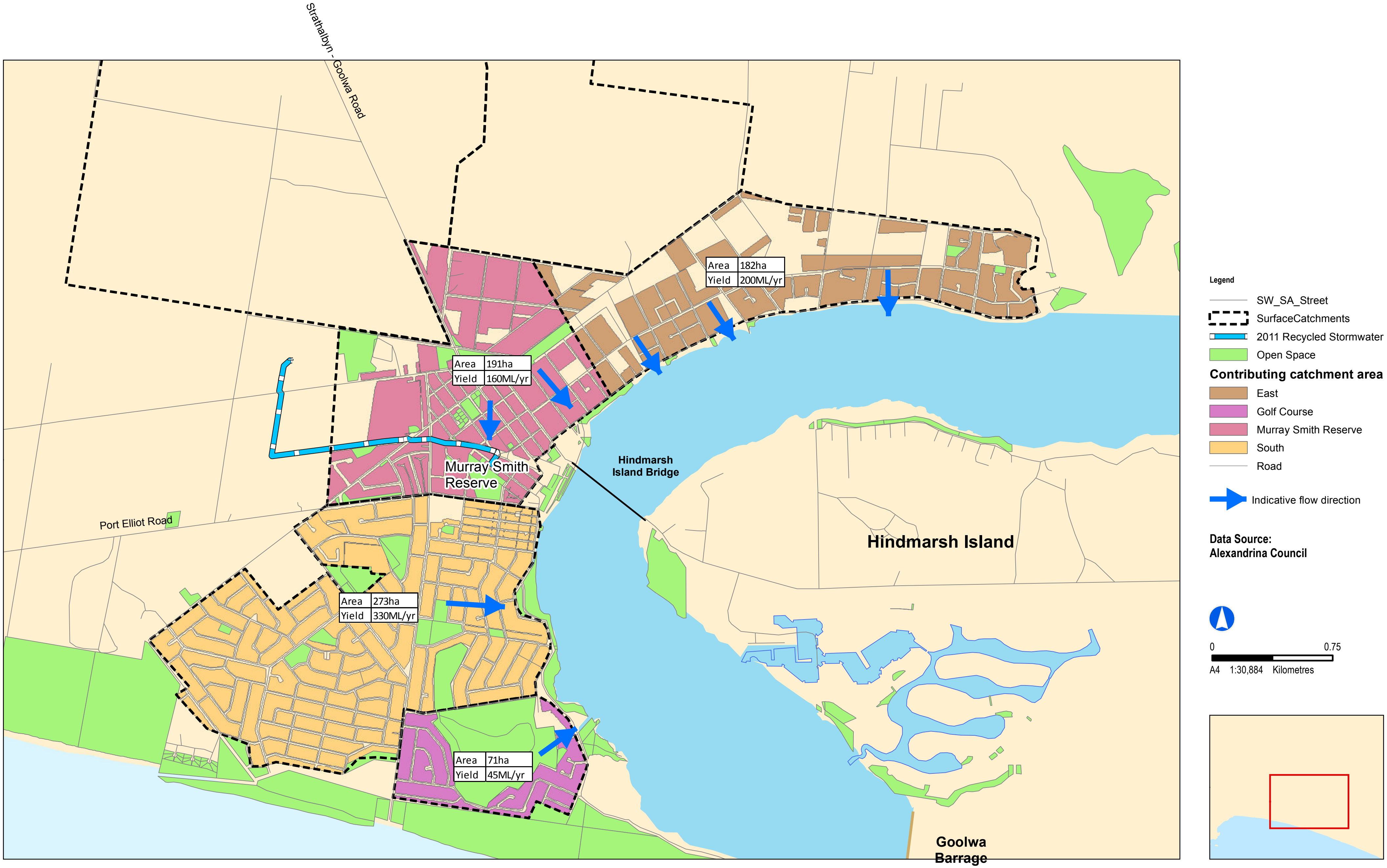

Figure 4-2 Stormwater Runoff - Goolwa 2011

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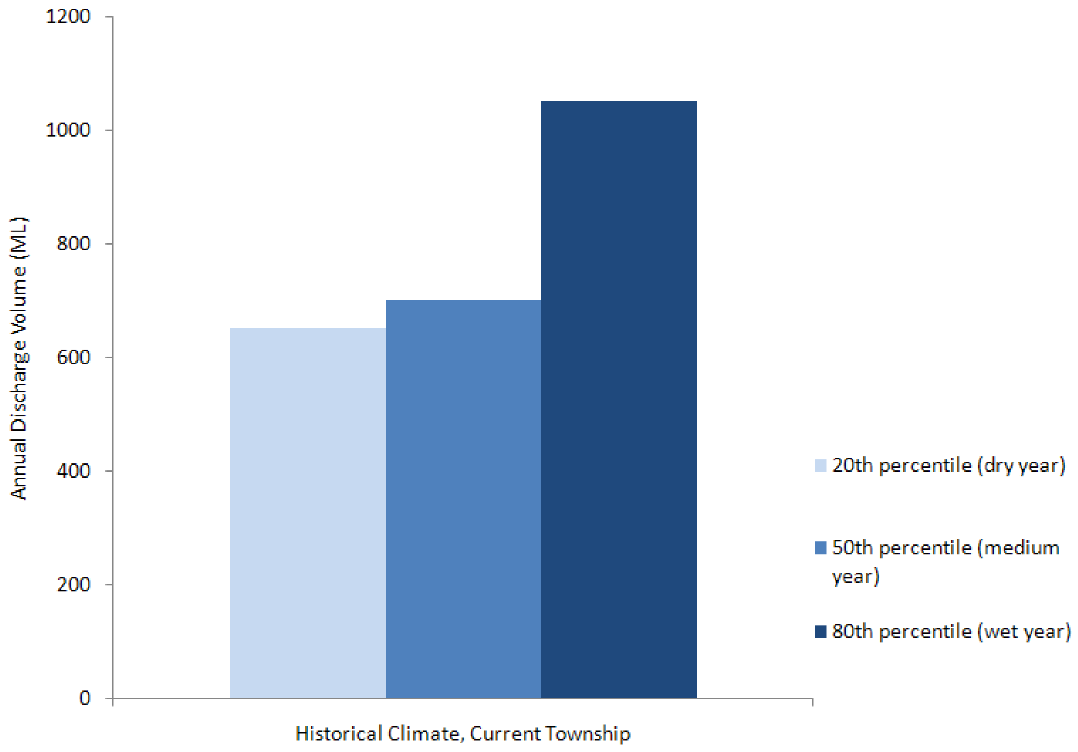
Figure 4-3 shows the volume of urban stormwater that is discharged to the Goolwa Channel for the current township, as estimated by the MUSIC Model. The 20th percentile, 50th percentile and 80th percentile rainfall years from the historical rainfall record (1871 – 2010), were used to show the difference in the volume of urban runoff for a dry, average and wet year.



- **Figure 4-3: Estimate of the volume of stormwater discharged to Goolwa Channel from the current Goolwa township (2011)**

Estimate of Stormwater Quality for Current township: MUSIC Modelling

The quality of stormwater runoff from urban areas can deteriorate as it passes over impervious (paved) areas, including oils, sediments and excess nutrients (Department of Planning and Local Government, 2009). The amount of impervious area compared to pervious (open space/landscaped) areas affects the total volume of runoff because it affects the total volume of infiltration. The SA MDB NRM Board has developed a set of targets including stormwater quality targets to guide the Board's input into strategic and development plan policy and developments within the SA MDB Region (SA MDB NRMB, 2011).

Table 4-1 provides an estimate of the current water quality parameters for Goolwa, derived using the MUSIC model for the current township. The water quality was modelled using assumed water quality for urban areas in Adelaide, as supplied as a default parameter in the MUSIC model, rather than using measured data. The Table also demonstrates how the water quality for the current township is estimated to perform relative to the WSUD Targets.

- **Table 4-1: Estimate of Water Quality for the current Goolwa Township (2011)**

	WSUD Targets (SA MDBNRMB, 2011)		
	Pollutant Load Reduction Target	**Average annual pollutant load reduction %**	**Average annual pollutant removal (Kg)**
Total suspended solids	80%	30%	42480
Nitrogen	45%	14%	284
Phosphorus	45%	24%	77
Gross Pollutants	No percentage target	29%	9830

4.2.3. Groundwater

A desktop study was conducted to investigate the current groundwater resources around the Goolwa area. Information on the general aquifer properties, current rates of extraction, current uses and water quality was used for developing the IWM opportunities and actions that are described later in the plan. Further details are provided in Appendix H – Groundwater Report.

Aquifer Systems

Goolwa is situated on the flat undulating plains of the Eastern Mount Lofty Ranges (EMLR), bordering on Lake Alexandrina. Barnett (2008) carried out an investigation into groundwater resources within the Currency Limestone Groundwater Management Area (CL GMA) which is located approximately 6 km north of Goolwa and part of the Eastern Mt Lofty Ranges Prescribed Water Resource Area.

The Murray Group Limestone is the only source of irrigation supplies in the CL GMA and has reported salinities ranging from 600 mg/L in the west to 4,000 mg/L in the east toward Lake Alexandrina (Barnett, 2007). The main source of recharge to the Murray Group Limestone is via lateral recharge from the Permian Sands Formation.

The unconfined Quaternary aquifer system comprises a 10-20 m thick sequence of sediments consisting of clays, silt, sand and occasional gravels (Barnett, 2007). Clayey members of the Quaternary sediments act as the confining layer to the Murray Group Limestone aquifer (Barnett, 2007).

These sedimentary aquifers underlie the area around Goolwa and groundwater is very minimally accessed for stock and domestic purposes.

Current Extraction of Groundwater

The prescription of the water resources of the EMLR was announced in September 2005. Currently, metered extraction within the project extent is minor with six metered wells located in the northern portion of the project extent within the CL GMA (Figure 4-4).

A licence to extract groundwater is not currently required for stock and domestic purposes. It is therefore difficult to report such volumes and so only an estimate can be provided for stock and domestic use. Around Goolwa, stock and domestic extraction (from the Murray Group Limestone aquifer) is estimated at less than 1 ML/yr (SA MDB NRMB, 2008). Licensed (metred) extraction occurs further away from Goolwa, west of Currency Creek. There are five currently operational monitoring wells within the project extent as per the DFW, Obswell database with numerous other observation wells located in the CL GMA (Figure 4-4).

All currently operational wells within the study area and their classified purpose as obtained via the Department for Water's Drillhole Enquiry System (DES) are presented in Figure 4-5.

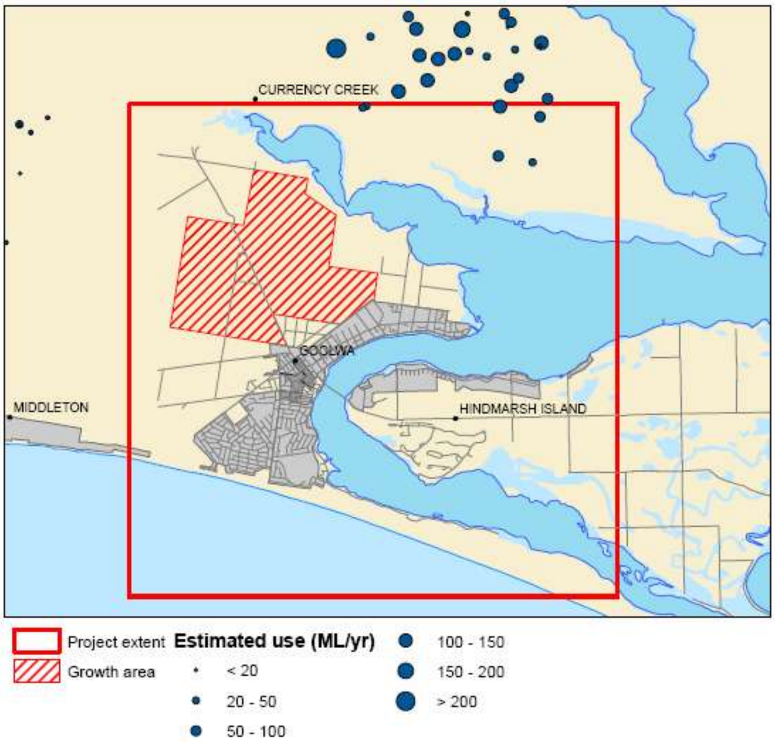


Figure 4-4: Estimated use from prescribed wells

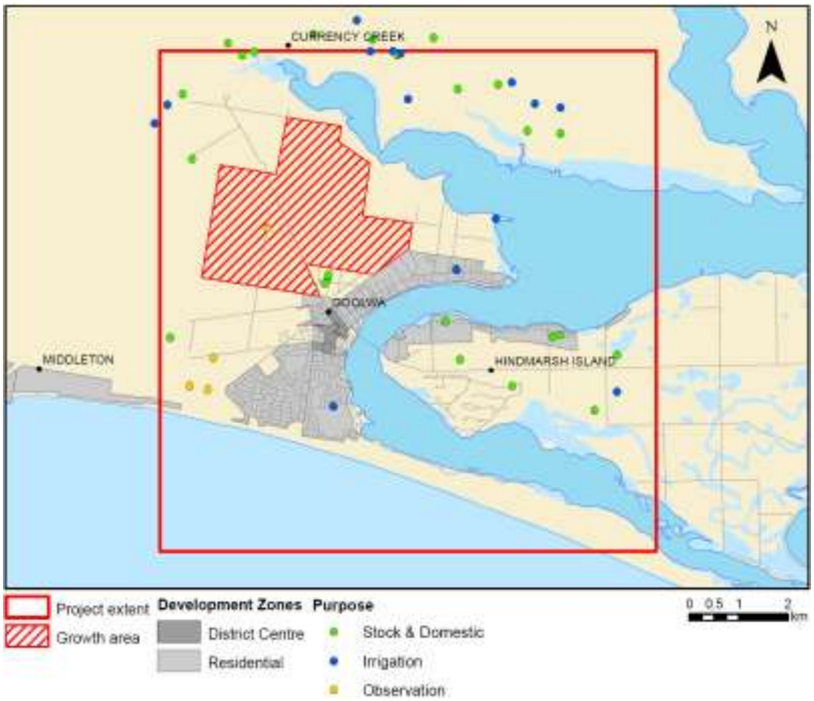


Figure 4-5: Purpose of wells around Goolwa

Groundwater salinity and yield

Barnett (2007) mapped the extent of fresh groundwater (<1,500 mg/L) in the CL GMA based on 1990 and 2007 data. A dramatic reduction in the area of fresh groundwater was observed. This raises doubts about the long term sustainability of the groundwater resource at the current extraction rate (Barnett, 2007). It is believed that downward leakage from the overlying high salinity Quaternary aquifer appears to be the dominant cause of salinity increase (Barnett, 2007). It is likely that similar trends are experienced around Goolwa and Hindmarsh Island although lower local extraction may mean a slower rate of change.

Groundwater salinity and well yields recorded in wells since 1990 is shown on Figure 4.6. Whilst there are relatively few wells in the area, in general high salinity corresponds with low well yields reflecting the lack of flushing that occurs in less permeable aquifers. Groundwater with salinity measured as TDS greater than 5000mg/L may adversely affect irrigated grass, with species including fescue and couch having salinity tolerances of 3000mg/L and 5000mg/L respectively (DWLBC, Factsheet 32, undated).

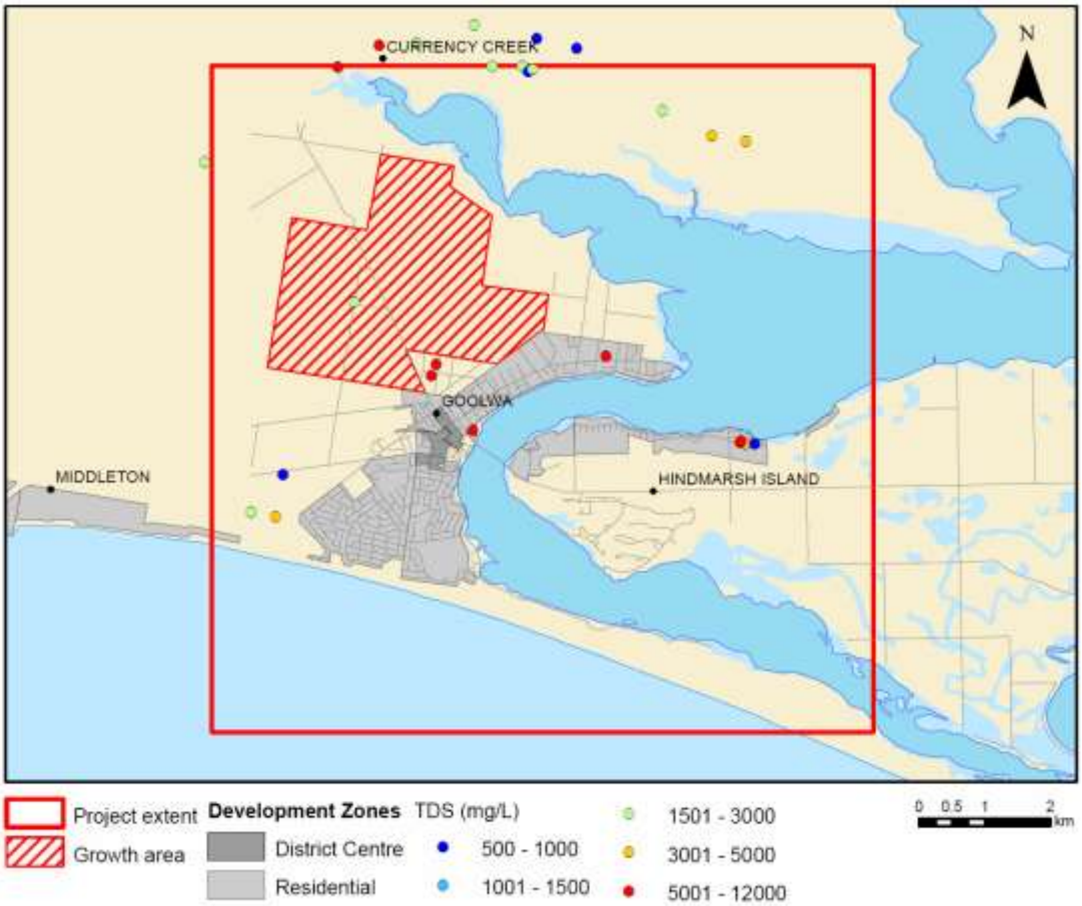


Figure 4.6: Groundwater salinity recorded since 1990

4.2.4. Household mains water

Household mains water is another important element of the urban water system. SA Water is responsible for supply of household mains water to Goolwa, supplied from the Myponga reservoir catchment after treatment at the Myponga water treatment plant. In 2007/08, the total potable consumption for the Alexandrina area was around 1,320 ML and of this around 1,050 ML was residential and the remaining 270 ML was non-residential. Average per capita consumption decreased by around a quarter from 68 kilolitres (kL) per capita in 2001/02 to 46 kL per capita in 2007/08, and this is most likely due to water restrictions and increased water conservation awareness as a result of several years of very low rainfall and low water levels in the River Murray and Lower Lakes.

Estimate of household mains water consumption for current township (2011)

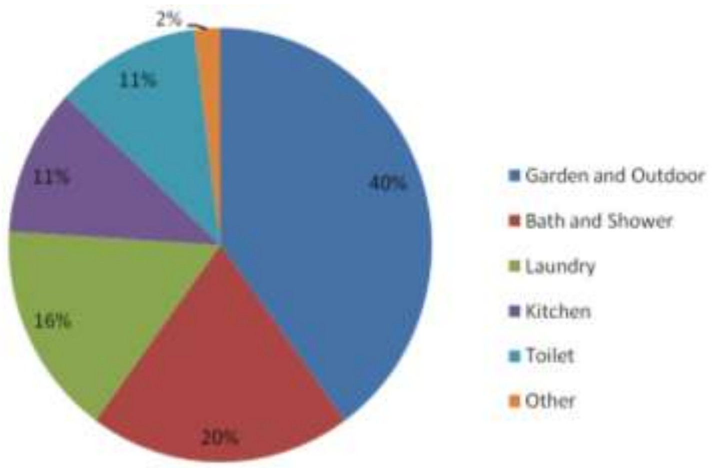
The water use per person was estimated in order to quantify the current household mains water consumption for Goolwa. Total potable demand is made up of in-house uses, as well as outdoor uses such as garden watering. It has been assumed that household mains water demand for the current township would be relatively independent of climatic conditions.

In-house demand per household is presented in Coombes (2003) *Analysis of Performance of Rainwater Tanks in Australian Capital Cities*. Coombes (2003) presents the data in Table 4-2, showing that water use will range depending on numbers of occupants. Wastewater generation numbers provided by the Alexandrina Council (pers. Comm. N. Styan, 15/11/2011), indicate that the in-house generation of wastewater is around 150L/person/day in the Alexandrina area, which correlates relatively closely with the demand per household shown in Table 4-2 for a 2 person house.

- **Table 4-2: In house demands based on number of persons (L/household/Day)**

In-house demand (number of occupants)				
1	2	3	4	5+
180	325	470	615	760

SA Water have estimated that typically 40% of residential water use is for outdoor use, as shown in Figure 4-7. Assuming 150 L/person/day for in-house use, the total use per person would therefore be around 250 L/person/day, giving a household use of 500 L/household/day (assuming an average of two persons per household). This total value is consistent with analysis of SA Water data for the years 2001 – 2009 by the Australian Bureau of Statistics (ABS, 2011).



- **Figure 4-7: Residential water use locations (source SA Water)**

For the current township of Goolwa, with population of around 5,900, a volume of 535ML was estimated as the total yearly township household mains water consumption (inside and outside).

4.2.5. Rainwater Tanks

Current use of rainwater tanks has not been included in the estimates of mains water use. Heyworth, et al, (2011) indicates that over 70% of Fleurieu residents use rainwater for drinking, however the percentage is likely to be lower in urban centres such as Goolwa. Hence the volume of current mains use may be less than the estimated volume, due to use of rainwater tanks through the current township.

4.2.6. Irrigation Mains Water Use

Mains water is also used for the irrigation of some public (Council) reserves, including Amelia Park, Garden Reserve, Goolwa Medical Centre, Goolwa Skate Park / Regional Centre, Goolwa Wharf and Heinicke Reserve. An estimated 6.5ML/year of mains water is used on these reserves. These are shown in Figure 7-1 Irrigated Open Space).

4.2.7. Irrigation River Murray Water Use

River Murray water is pumped from the Goolwa Channel for irrigation of 2 Council reserves (Richard Ballard Park and Signal Point). Part of the irrigation water supply for the South Lakes Golf Course is sourced from the River. An estimated 85ML/year of River water is used for irrigation.

4.2.8. Wastewater

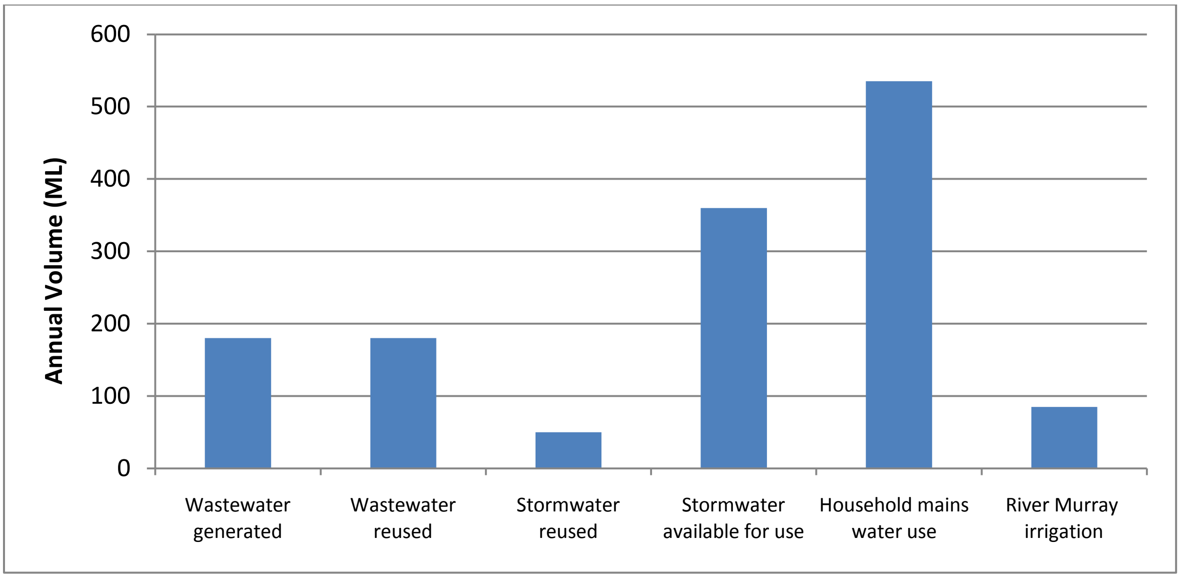
Wastewater from Goolwa is currently treated at a Council owned treatment plant, located on the North Western outskirts of the existing urban centre. The treatment plant's current capacity is around 1.5 ML/day and the Council have indicated that upgrade of aerators could increase its capacity to around 3 ML/day at relatively low cost. The current yearly volume of wastewater treated is around 180 ML/year, and it is treated to Class B effluent standard under former South Australian reclaimed water guidelines (SA EPA, 1999). Class B standard requires full secondary treatment plus disinfection and is suitable for use for agricultural (where food crops not consumed raw) and industrial purposes (Recycled Water in Australia, 2011).

Currently, around 180 ML/year of treated wastewater is transferred from a storage lagoon at the WWTP to be reused at a turf farm (irrigated by centre pivot) to the west of Goolwa. There is no discharge of treated wastewater to the Goolwa Channel.

A vacuum pump station has recently been commissioned to North East of Goolwa, which transfers sewage from residential developments to the Goolwa WWTP. The pump station has been designed with capacity to service around 2,000 houses, with a suction radius of service of around 3km. The pump station currently services a residential area consisting of ultimately 400 houses, and there is potential for it to service a majority of the new development areas in future, as they fall within the operational radius of the station.

4.2.9. Summary of major urban water elements

Figure 4-8 and Table 4-3summarise the estimates of the main components of the water system for the current Goolwa Township. The plot shows that all wastewater is currently reused; however there is a significant volume of stormwater that is not currently reused. There is the potential to utilise this source in order to decrease the current irrigation mains water demand through fit for purpose reuse.



- **Figure 4-8: Major urban water elements for the Current Goolwa Township (2011)**

Table 4-3: Water Supply and Use figures for major elements of the Urban Water system for the current Goolwa township (2011)

Stormwater	**Stormwater generated (ML/year)**	**Stormwater infiltration & evaporation (ML/year)**	**Stormwater reused for irrigation Dec 2011 (ML/year)**	**Maintenance of pre-development flows to watercourse (ML/year)**	**Stormwater available for additional alternative uses (ML/year)**
Goolwa	790	40 (50th percentile)	50	340	360 (50th percentile)
Wastewater	**Wastewater generated (ML/year)**	**Wastewater reuse (ML/year)**	**Wastewater excess (ML/year)**		
Goolwa	180	180	0		
Mains	**Household mains water use (ML/year)**	**Irrigation mains water use (Council) (ML/year)**			
Goolwa	535	7			
River Murray Water	**Irrigation River water use (ML/year)**				
Goolwa	85				

4.3. Current Water Resources - Hindmarsh Island

4.3.1. Natural Watercourses

Hindmarsh Island is located on the opposite side of the Goolwa Channel to the township of Goolwa, and the two communities are connected by a bridge which traverses the Channel. Similar consideration of natural watercourses as included in Section 4.2.1 for Goolwa apply for Hindmarsh Island, due to the close proximity of the two Townships.

4.3.2. Stormwater

All stormwater runoff from the urban areas of Hindmarsh Island is discharged directly to the Goolwa Channel via an informal drainage system.

Estimate of Stormwater Volumes – MUSIC Modelling

An estimate of the volume of stormwater runoff from the current Hindmarsh Island Township was completed, using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) and the same data sources and assumptions as described for Goolwa in Section 4.2.2. Figure 4-9 shows the stormwater catchments for the current Hindmarsh Island Township.

Figure 4-10 shows a schematic of the MUSIC model for the current Hindmarsh Island Township. The model includes six urban catchment nodes which represent different existing urban catchment areas in Hindmarsh Island. All runoff from the catchments is directed to a receiving node, which represents the discharge of all stormwater runoff to the Goolwa Channel. The spatial location of the nodes on the schematic only depicts indicative locations of elements of the system; however this has no effect on the results of the modelling. The flow and water quality outputs from each node of the model are included in Appendix G.

Figure 4-9 Stormwater Runoff - Hindmarsh Island 2011

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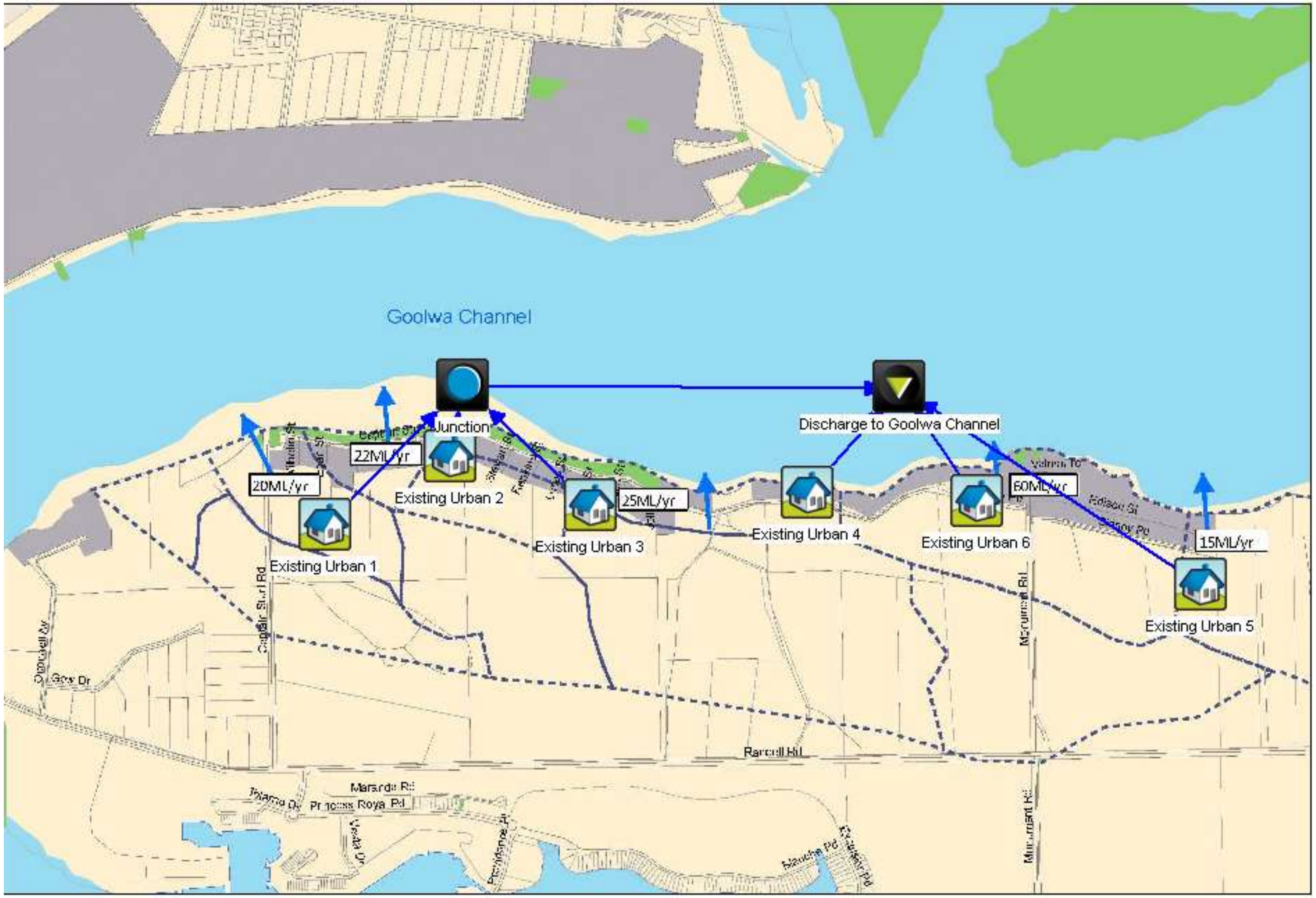
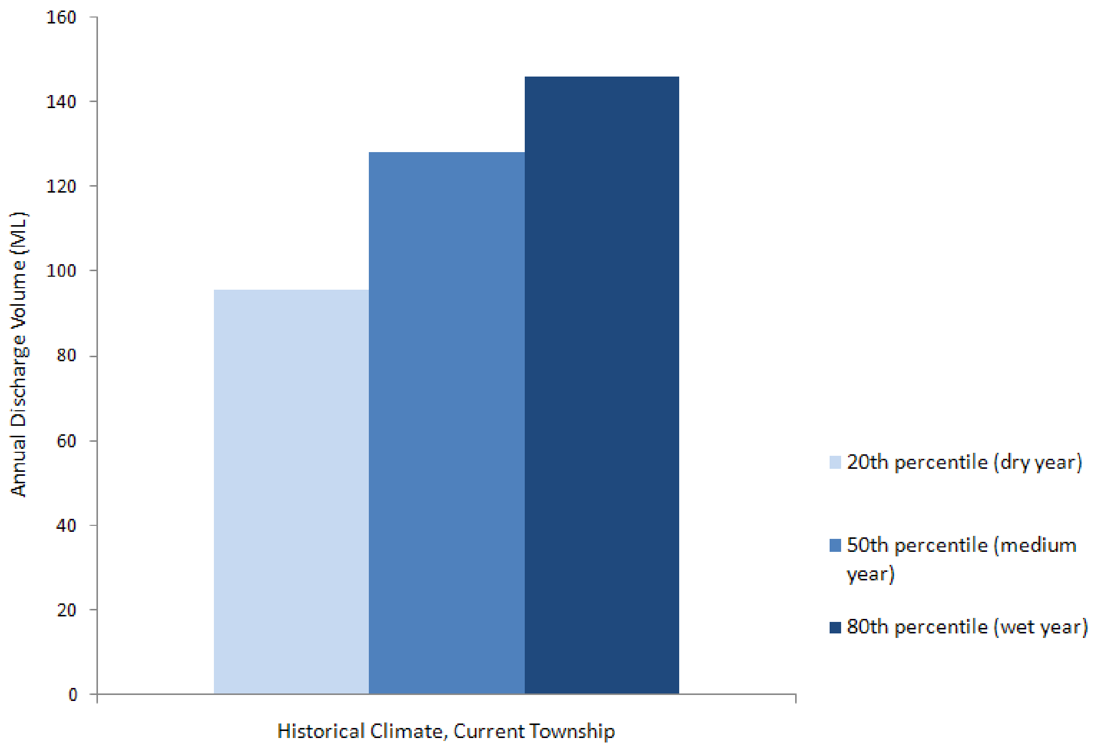


Figure 4-10: Schematic of the MUSIC Model for Hindmarsh Island for current township

Figure 4-11 shows the volume of urban stormwater that is discharged to the Goolwa Channel for the current township, as estimated by the MUSIC Model. The 20th percentile, 50th percentile and 80th percentile rainfall years from the historical rainfall record (1871 – 2010), were used to show the difference in the volume of urban runoff for a dry, average and wet year.



- **Figure 4-11: Estimate of the volume of stormwater discharged to Goolwa Channel from the current Hindmarsh Island township**

Estimate of Stormwater Quality for Current township: MUSIC Modelling

As described in Section 4.2.2, stormwater quality is an important parameter for urban water management. Since there are no major stormwater treatment features in the current Hindmarsh Island Township, the removal of suspended solids, nitrogen and phosphorus from stormwater runoff was estimated to be negligible.

4.3.3. Groundwater

Due to the close proximity of Hindmarsh Island to Goolwa, the same groundwater considerations apply to Hindmarsh Island as described for Goolwa (Refer Section 4.2.3). A licence to extract groundwater is not currently required for stock and domestic purposes.

4.3.4. Household mains water consumption

Historically, the Hindmarsh Island Township was not connected to SA Water mains, and so relied on harvesting and reuse from rainwater tanks for all of their water supply (SA Water, 2009). In times of low rainfall, household tanks were topped up with mains water that was carted from an SA Water main which passes from Goolwa to Hindmarsh Island under the Bridge connecting the two townships.

In 2010, an extension to the existing water main was completed, which extends the main to the East of the island. This provided opportunities for existing households to connect to the SA Water mains, and will enable mains water to be supplied to new developments for domestic uses and for stock. The water is chlorinated and supplied from the Myponga Reservoir and Water Treatment Plant.

Estimate of Household mains water consumption for Current township

It was assumed that the household mains water consumption for the current township is close to zero, since it was primarily reliant on rainwater before installation of the new pipeline in 2010.

4.3.5. Irrigation Mains Water Use

Mains water is also used for the irrigation of some public (Council) reserves, including the reserve on Excelsior / Wentworth Parade and two reserves on Wentworth Parade (East and West). An estimated 4.5ML/year of mains water is used on these reserves. These are shown in Figure 7-1 Irrigated Open Space.

4.3.6. Wastewater

The majority of wastewater throughout Hindmarsh Island is currently treated using on-site septic systems, however the EPA has indicated that there should be no further on-site disposal of wastewater in the future. In order to comply with this, concept design investigations have been completed into a pipeline to carry wastewater from Hindmarsh Island over the bridge to connect into the Goolwa WWTP (HDS, 2010). This would service all of the new residential developments (estimated 300 allotments initially, with expansion to up to 800 houses in total from future stages), as well as a large number of existing allotments.

The volume of wastewater that is generated and discharged from existing on-site septic systems was estimated to be around 30ML/year, using the same assumptions for wastewater generation (150L per person per day for a population of 534) as discussed in Section 4.2.8.

4.3.7. Summary of volumes for all major urban water elements

Error! Reference source not found. summarises the volumes estimates of the main components of the ater system for the current Goolwa Township.

- **Table 4-4: Water Supply and Use figures for major elements of the Urban Water system for the current Hindmarsh Island township**

Wastewater	**Wastewater generated (ML/year)**	**Wastewater reuse (ML/year)**	**Wastewater excess (ML/year)**		
Hindmarsh Island	30	0	30		
Stormwater	**Stormwater generated (ML/year)**	**Stormwater infiltration & evaporation (ML/year)**	**Stormwater reused for irrigation as at Dec 2011 (ML/year)**	**Maintenance of pre-development flows to watercourse**	**Stormwater available for additional alternative uses (ML/year)**
Hindmarsh Island	130	Unknown	0	60	70 (50^{th} percentile)
Mains	**Household mains water use (ML/year)**	**Irrigation mains water use (Council) (ML/year)**			
Hindmarsh Island	0	4.5			
River Murray Water	**Irrigation River water use (ML/year)**				
Hindmarsh Island	0				

5. Impacts to Water Resources due to Development by 2040

5.1. Introduction

As described in Section 3.1, the populations of Goolwa and Hindmarsh Island are projected to increase significantly to around 15,600 people by 2040, with most of the growth occurring in Goolwa. The growth will impact significantly to the main elements of the urban water system in both Townships.

This Section describes the main impacts of the development to the main elements of the urban water supply system. Where possible, the water volumes for a dry, average and wet year have been quantified. This information was used as a basis for development of IWM opportunities and the determination of infrastructure and policy actions from this IWMP.

The preliminary structure plan was used to identify the major features of the proposed development north of Goolwa. Future development on Hindmarsh Island was determined from discussions with the Alexandrina Council.

5.2. Goolwa

5.2.1. Stormwater

The stormwater network for the existing Goolwa township is currently at capacity. Urban development upstream of the existing township must therefore adopt best practice stormwater management methods that ensures design peak flows through the networks are not exceeded. This can be achieved by expanding the existing stormwater harvesting network and adopting water sensitive urban design features into the development.

The preliminary structure plan (refer Section 3.1.1) has been used to determine the catchment areas and open space plan for Goolwa in 2040. Figure 5-1 shows the open space and stormwater catchment map for Goolwa in 2040, following development.

Figure 5-1 Stormwater Runoff - Goolwa 2040 without IWM Action

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Estimate of Stormwater Volumes for developed Township: MUSIC Modelling

An estimate of the volume of stormwater runoff from the developed Goolwa Township was completed, using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). The same methodology and assumptions was used as is described in Section 4.2.2 for the current Goolwa Township.

The following data were used to set up the MUSIC model:

- Daily rainfall for Goolwa for the period from 1871 to 2010, supplied from the BOM (Station 23718). The data was analysed and the 20th percentile (1901), 50th percentile (1976) and 80th percentile (1985) rainfall years were selected from the series to investigate stormwater variability for dry, average and wet climate conditions.
- Monthly evaporation data for Goolwa (BOM)
- Future catchment areas from analysis of contour map of the township, and information from the preliminary structure plan.
- Percentage impervious for urban catchments from analysis of DWLBC landuse data (2008) for the current town, and predictions of growth in new development areas. See table below for impervious fractions used.

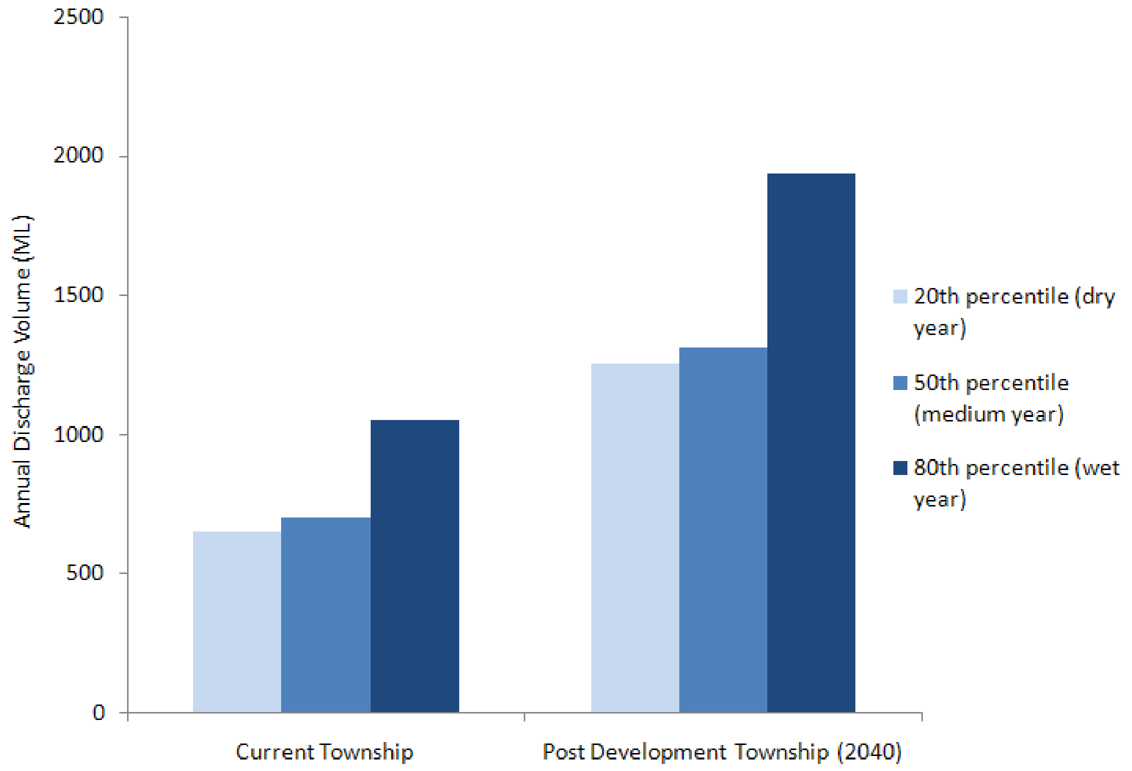
Catchment Name	Area (ha)	Impervious Fraction Used
Golf Course	71	15%
East	182	30%
Murray Smith	191	34%
South	273	34%
Goolwa North – West	200	41%
Goolwa North - East	165	41%

Figure 5-2 shows a schematic of the MUSIC model for the developed Goolwa Township. The model includes the existing urban catchment nodes, as well as four new development nodes, which represent the residential and commercial development areas planned for the Goolwa North area. Similar to the current township, runoff from the Murray Smith Reserve Catchment enters the Murray Smith Reserve wetland, from which around 70ML/year is reused. Runoff from two of the newly developed catchments enters the existing East Goolwa Wetland, however there is no reuse proposed associated with it. Excess stormwater from all catchments is routed to a receiving node, which represents discharge of the stormwater to the Goolwa Channel. The spatial location of the nodes on the schematic only depicts indicative locations of elements of the system; however this has no effect on the results of the modelling. The flow and water quality outputs from each node of the model are included in Appendix G.

■ **Figure 5-2: Schematic of the MUSIC Model for the Goolwa Township Post Development, without implementation of IWMP actions**

Figure 5-3 shows the volume of urban stormwater that is estimated to be discharged to the Goolwa Channel (ie runoff minus evaporation and infiltration) for the developed Goolwa township (2040). The 20th percentile, 50th percentile and 80th percentile rainfall years from the historical rainfall record (1871 – 2010), were used to show the difference in the volume of urban runoff for a dry, average and wet year.

The Figure shows that the volumes of runoff are predicted to approximately double as a result of the development. This emphasises the need for implementation of IWM actions, in order to manage this increased volume of runoff.



- **Figure 5-3: Estimate of the volume of stormwater discharged from the developed Goolwa township (2040) compared with current (2011) township with no IWM actions**

Table 8-3 provides an estimate of the water quality parameters for the developed Goolwa Township without implementation of the IWMP actions, derived using the MUSIC model for the developed township. The water quality was modelled using assumed water quality for urban areas in Adelaide, as supplied as a default parameter in the MUSIC model, rather than using measured data. The Table also demonstrates how the water quality for the developed township without IWMP actions is estimated to perform relative to the WSUD Targets.

- **Table 5-1: Estimate of Water Quality for the developed Goolwa Township, without IWMP actions**

	WSUD Targets (SA MDBNRMB, 2011)		
	Pollutant Load Reduction Target	Average annual pollutant load reduction %	Average annual pollutant removal (Kg)
Total suspended solids	80%	39%	101840
Nitrogen	45%	23%	826
Phosphorus	45%	34%	198
Gross Pollutants	No percentage target	35%	19720

5.2.2. Groundwater

The development in Goolwa is not predicted to significantly change the volumes of groundwater extracted around the Goolwa Township in the future.

5.2.3. Household mains water consumption

It has been assumed that household mains water for the developed Goolwa Township would be supplied by SA Water, in a similar way as it is supplied to the current township.

The same methodology and assumptions as described in Section 4 for the current Goolwa Township were used to estimate the household mains water consumption for the developed Goolwa Township. For the future population of around 13,200 (Goolwa only), the total household annual mains water consumption was estimated to be around 1200ML.

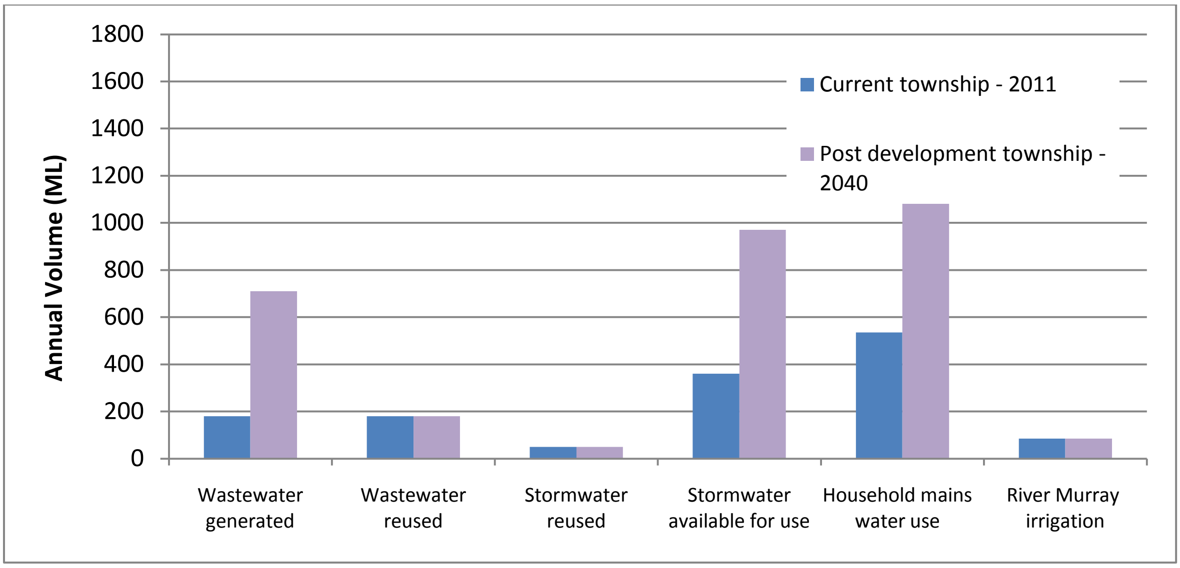
5.2.4. Wastewater

With no implementation of IWM, management of wastewater post development would remain similar to the current situation however the excess wastewater volume would increase. The existing vacuum pump station would be utilised to its full capacity.

The same assumptions were used to estimate the volumes of wastewater effluent for the developed township as described for the current township in Section 4.2.8. It has been assumed that wastewater generation and reuse are reasonably independent of climatic variations. Although it is acknowledged that during the recent drought, household water use decreased as a result of water restriction, which saw discharge of household wastewater to the sewer decrease in relation to long term averages.

5.2.5. Summary of major urban water elements

Figure 5-4 summarises the volumes estimates of the main components of the water system for the developed Goolwa Township. The plot shows that the volumes of wastewater generated, household mains water use and stormwater available for use are increase as a result of the development. There is the potential to utilise these sources in order to decrease the future household mains water demand and irrigation River Murray reuse volumes through fit for purpose reuse.



- **Figure 5-4: Major urban water elements for the 2040 Developed Goolwa Township, without implementation of IWMP actions**

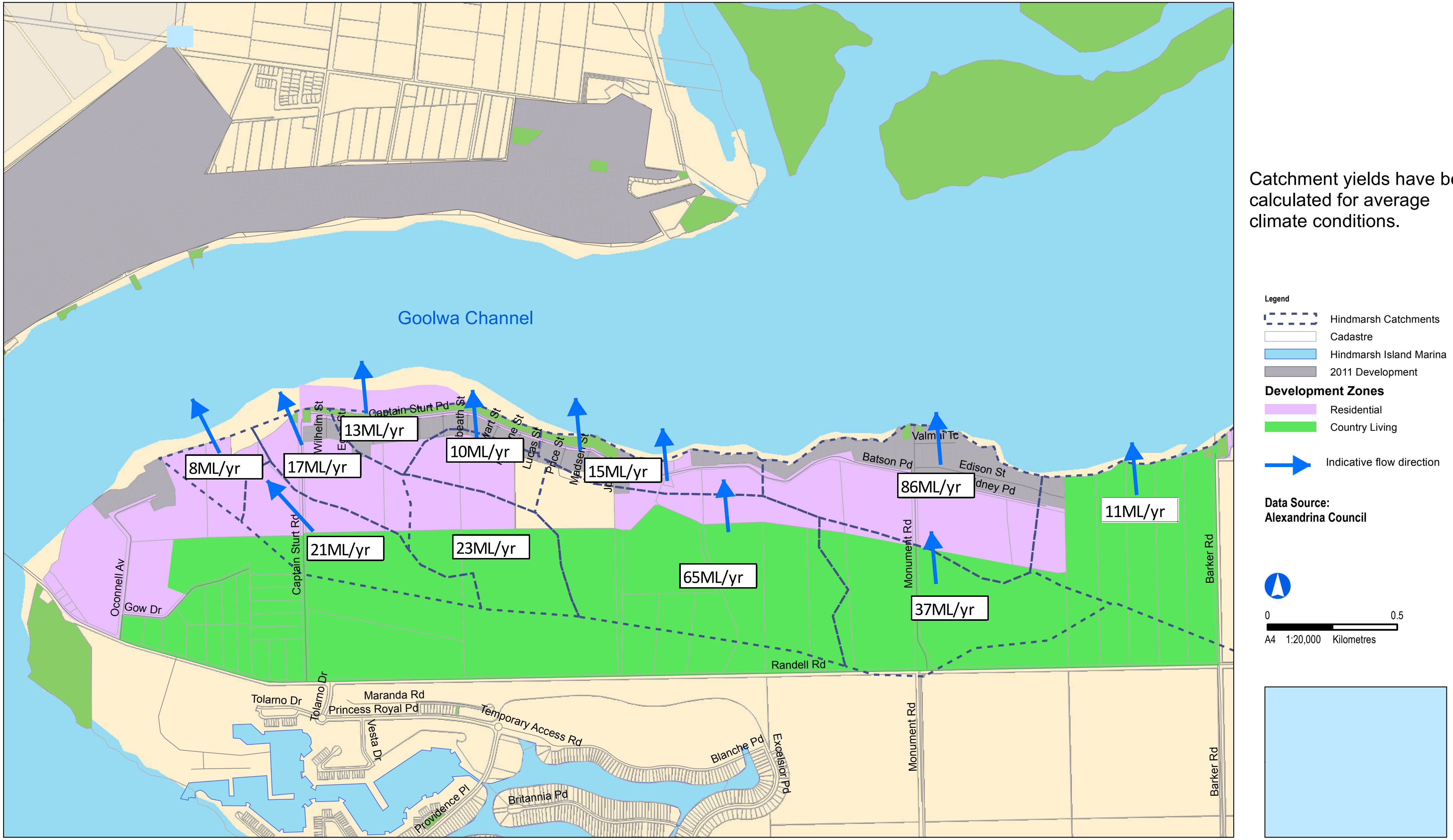
Table 5-2: Water Supply and Use figures for major elements of the Urban Water system for the current and developed Goolwa township without implementation of IWMP actions

Stormwater	Stormwater Generated (ML/year)	Stormwater Infiltration & Evaporation (ML/year)	Stormwater reused (ML/year)	Maintenance of pre-development flows to watercourse (ML/year)	Stormwater available for additional alternative uses (ML/year)
Goolwa current	790	40 (50^{th} percentile)	50	340	360 (50^{th} percentile)
Goolwa post development	1600	220	50	340	990
Wastewater	**Wastewater generated (ML/year)**	**Wastewater reused (ML/year)**	**Wastewater excess (ML/year)**		
Goolwa current	180	180	0		
Goolwa post development	580	180	400		
Mains	**Household Mains Use (ML/year)**	**Irrigation mains water use (Council) (ML/year)**			
Goolwa current	535	7			
Goolwa post development	1200	100			
River Murray Water	**Irrigation River water use (ML/year)**				
Goolwa current	85				
Goolwa post development	85				

5.3. Hindmarsh Island

5.3.1. Stormwater

Stormwater management associated with recent land division on Hindmarsh Island commonly include infiltration basins to detain, treat, and reduce stormwater volumes (via infiltration and evaporation) prior to discharge to the Goolwa Channel. Figure 5-5 shows the open space and stormwater catchment map for Hindmarsh Island in 2040, following development, indicate stormwater yields from residential and country living zones.



Catchment yields have been calculated for average climate conditions.

Figure 5-5 Stormwater Runoff - Hindmarsh Island 2040 without IWM Action

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Estimate of Stormwater Volumes for developed Township: MUSIC Modelling

An estimate of the volume of stormwater runoff from the developed Hindmarsh Island Township was completed, using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC). The same methodology and assumptions was used as is described in Section 4.3.2 for the current Hindmarsh Island Township.

The following data were used to set up the MUSIC model:

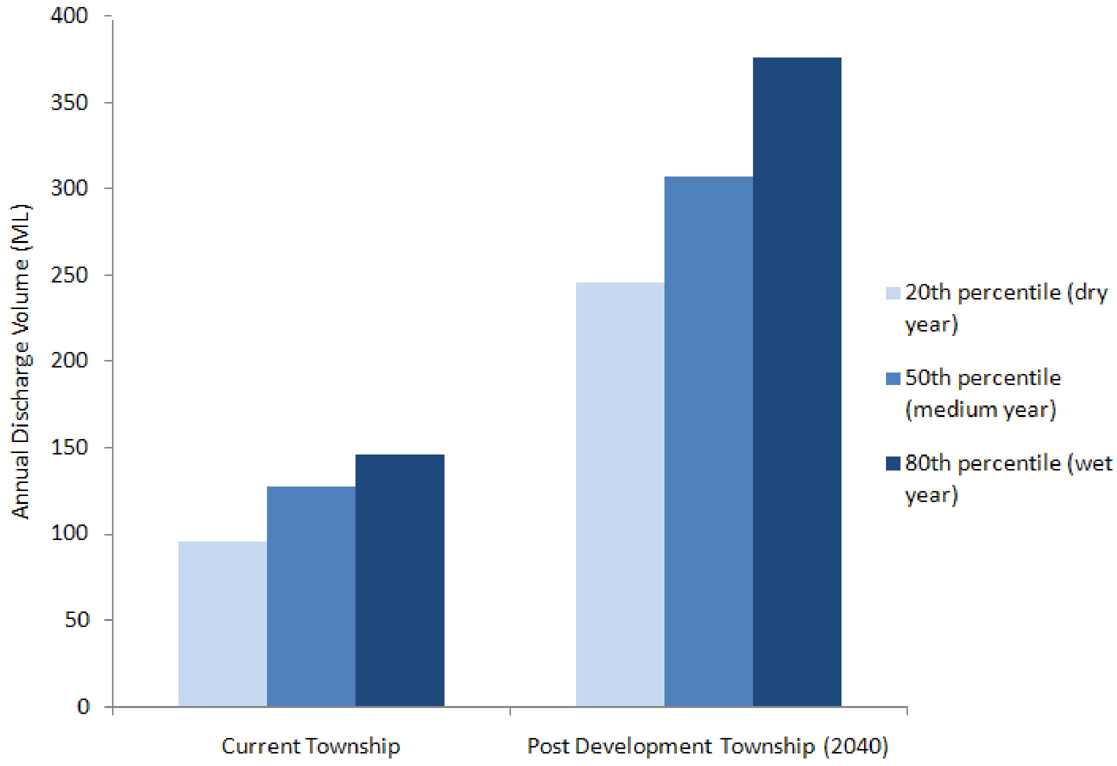
- Daily rainfall for Goolwa for the period from 1871 to 2010, supplied from the BOM (Station 23718). The data was analysed and the 20th percentile (1901), 50th percentile (1976) and 80th percentile (1985) rainfall years were selected from the series to investigate stormwater variability for dry, average and wet climate conditions.
- Monthly evaporation data for Goolwa (BOM)
- Future catchment areas from analysis of contour map of the township, and information from the preliminary structure plan.
- Percentage impervious for urban catchments from analysis of aerial photography of current town, and predictions of growth in new development areas.

Figure 5-6 shows a schematic of the MUSIC model for the developed Hindmarsh Island Township. The model includes 22 urban catchment nodes, which represent the residential development areas planned for Hindmarsh Island. All runoff from the catchments is directed to a receiving node, which represents the discharge of all stormwater runoff to the Goolwa Channel. The spatial location of the nodes on the schematic only depicts indicative locations of elements of the system; however this has no effect on the results of the modelling. The flow and water quality outputs from each node of the model are included in Appendix G.

- **Figure 5-6: Schematic of the MUSIC Model for the Hindmarsh Island Township Post Development, without implementation of IWMP actions**

Figure 5-7 shows the volume of urban stormwater that is discharged to the Goolwa Channel for the developed Hindmarsh Island Township, as estimated by the MUSIC Model. The 20th percentile, 50th percentile and 80th percentile rainfall years from the historical rainfall record (1871 – 2010), were used to show the difference in the volume of urban runoff for a dry, average and wet year.

The Figure shows that the volumes of runoff are predicted to approximately double as a result of the development. This emphasises the need for implementation of IWM actions, in order to manage this increased volume of runoff.



- **Figure 5-7: Estimate of the volume of stormwater discharged from the developed Hindmarsh Island Township without implementation of IWMP actions**

Estimate of Stormwater Quality for Developed Township: MUSIC Modelling

As described in Section 4.2.2, stormwater quality is an important parameter for urban water management. One infiltration basin on the northern side of the Island takes water from a relatively small catchment. The majority of current development spread out along the lake shore has no stormwater treatment features, and hence the removal of suspended solids, nitrogen and phosphorus from stormwater runoff was estimated to be negligible.

5.3.2. Groundwater

The development in Hindmarsh Island is not predicted to significantly change the volumes of groundwater utilised in the area in the future.

5.3.3. Household mains water consumption

It has been assumed that household mains water for all new developments within the Hindmarsh Island Township would be supplied by SA water, while the existing houses would remain reliant on rainwater tanks. There are approximately 800 new houses predicted for the Hindmarsh Island Township, and using a household demand of 500L/day, a total volume of 150ML/year was estimated.

5.3.4. Wastewater

The EPA have indicated that there shall be no further on-site disposal of wastewater in the future, so it has been assumed that wastewater from the new development areas of Hindmarsh Island would be treated at the Goolwa WWTP. This is consistent with concept design investigations which have been completed into a pipeline to carry wastewater from Hindmarsh Island over the bridge to connect into the Goolwa WWTP (HDS, 2010).

Opportunities for the wastewater reuse on Hindmarsh Island should be investigated as development progresses.

5.3.5. Summary of major urban water elements

Table 5-3 summarises the volumes estimates of the main components of the water system for the developed Hindmarsh Island Township. The plot shows that the volume of household mains water demand is predicted to more than double as a result of the development. There are also increased volumes of wastewater and stormwater from the developed township which could be utilised through fit for purpose reuse.

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Table 5-3: Water Supply and Use figures for major elements of the Urban Water system for the current and developed Hindmarsh Island township (2040), without implementation of IWMP actions

Stormwater	Stormwater Generated (ML/year)	Stormwater Infiltration & Evaporation (ML/year)	Stormwater reused (ML/year)	Maintenance of pre-development flows to watercourse (ML/year)	Stormwater available for additional alternative uses (ML/year)
Hindmarsh Island current (2011)	130	Unknown	0	60	70 (50th percentile)
Hindmarsh Island current (2011)	310	Unknown	0	60	250
Wastewater	**Wastewater generated (ML/year)**	**Wastewater reused (ML/year)**	**Wastewater excess (ML/year)**		
Hindmarsh Island current (2011)	30	0	30		
Hindmarsh Island post development (2040)	134	0	134		
Mains	**Household Mains Use (ML/year)**	**Irrigation mains water use (Council) (ML/year)**			
Hindmarsh Island current (2011)	0	4.5			
Hindmarsh Island post development (2040)	150	4.5			
River Murray Water	**Irrigation River water use (ML/year)**				
Hindmarsh Island current (2011)	0				
Hindmarsh Island post development (2040)	0				

6. Impacts to Water Resources due to Climate Change

6.1. Introduction

Climate change projections indicate reductions in rainfall and increases in temperature and evaporation across most of South Australia.

To inform this project, the South Australian Research and Development Institute (SARDI) completed climate change modelling for the Alexandrina Council area to provide an estimate of the changes to temperature, rainfall and evaporation expected over the 30 year lifespan of the IWMP (Hayman et al, 2011).

The Climate Change Scenarios Report (Hayman et al, 2011) highlights the uncertainty in climate predictions which results from the use of different climate models and different emission scenarios. Of particular note to this IWM project is the change in uncertainty over time. For predictions to 2030, there is a lower level of uncertainty and the main source of uncertainty is due to differences in comparisons of different climate models. There is increased uncertainty for the 2070 predictions due to the uncertainties associated with the magnitude of future emissions, and how sensitive climate will be to the emissions.

The combined effects of higher temperature, lower rainfall and higher evaporation may pose serious challenges to management of South Australia's water resources, and water shortages are likely to result (SA Government, 2010). The threat to South Australia's water security will impact on urban and rural water supplies, primary industries and regional economies. Adverse impacts are also expected to river and wetland ecosystems and groundwater systems throughout South Australia.

In order for South Australia to adapt to climate change, sustainable water management measures must be incorporated into planning and infrastructure decisions now (SA Government, 2010). Integrated water management will be imperative for diversifying water sources, reducing reliance on a single source of water (rainfall) and maximising reuse.

The following issues were amongst those identified in the South Australian government report '*Prospering in a Changing Climate (2010)*' to be taken into consideration when developing adaptation responses for water resources:

- The need for environmental water;
- The ability for surface water and groundwater storages to cope with flood, low flow and recharge events;
- The sustainability of water supply sources;
- The impact of reduced rainfall on runoff volumes and groundwater recharge; and
- The impact of increased temperature on water demand.

This Section describes the impacts of projected climate change impacts to the volumes of stormwater runoff and stormwater runoff from the Goolwa and Hindmarsh Island Townships. This information was used as a basis for development of IWM opportunities and the determination of infrastructure and policy actions.

This report has focused on the impacts of climate change on stormwater runoff. Recent dry years have seen reduced household consumption of mains water and subsequent reductions in wastewater generation across South Australia, which may also occur in a drier climate. These impacts have not been modelled for this project.

6.2. Estimate of Climate Change Impacts to Stormwater Volumes for Goolwa

An estimate of the impact of climate change projections (Hayman et al, 2011) to the volume of stormwater runoff from the current and developed Goolwa Township was completed. The same methodology and assumptions were used as is described in Section 4.2.2 for the current Goolwa Township, and in Section 4.3.20 for the developed Goolwa Township.

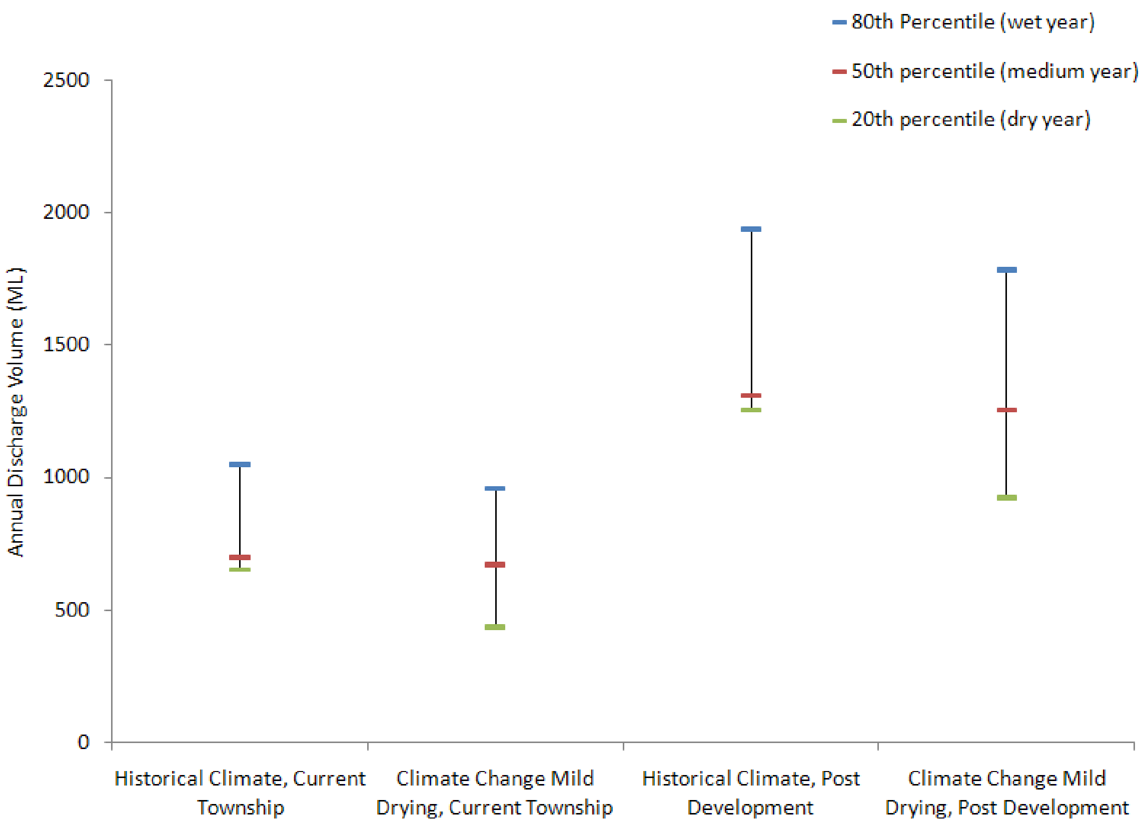
The results provided by the Climate Change Scenarios Report (Hayman et al, 2011) suggested the use of a "mild drying" climate scenario. This was adopted by concurrent projects undertaken in the South Australian Murray-Darling Basin area considering future climate change. For the Alexandrina region in 2030, the SARDI modelling predicts around a 0.7 – 0.8°C increase to average annual temperature, 2.7– 11.4% decrease to annual rainfall and a 42.9 – 55.0mm increase to annual evaporation. Refer to Appendix E for plots showing the monthly modelling results for Goolwa and Hindmarsh Island.

The following data were used to set up the MUSIC model:

- Daily rainfall for Goolwa for the period from 1871 to 2010, supplied from the BOM (Station 23718). The data was analysed and the 20th percentile (1901), 50th percentile (1995) and 80th percentile (1985) rainfall years were selected from the series to investigate stormwater variability for dry, average and wet climate conditions. The rainfall series were adjusted by the projected changes to rainfall from the SARDI Mild Drying climate change scenario.
- Monthly evaporation data for Goolwa (BOM), adjusted by the projected changes to evaporation from the SARDI Mild Drying climate change scenario.
- Future catchment areas from analysis of contour map of the township, and information from the preliminary structure plan.
- Percentage impervious for urban catchments from analysis of aerial photography of current town, and predictions of growth in new development areas.

Figure 6-1 shows a comparison between the volume of urban stormwater that is discharged to the Goolwa Channel for the historical climate and the Mild Drying climate change projection, for both the current Goolwa Township, and the developed Township. The 20th percentile, 50th percentile and 80th percentile rainfall years for both the historical and climate change scenario were used to show the difference in the volume of urban runoff for a dry, average and wet year.

The Figure shows that the volumes of runoff are predicted to decrease by a small amount as a result of the climate change projections. In comparison with the larger increase to the stormwater runoff volumes that are estimated as a result of the urban development in Goolwa, the climate change impacts are relatively minor.



- **Figure 6-1: Impacts of climate change projections to the volume of stormwater runoff from the current (2011) and developed (2040) Goolwa Townships**

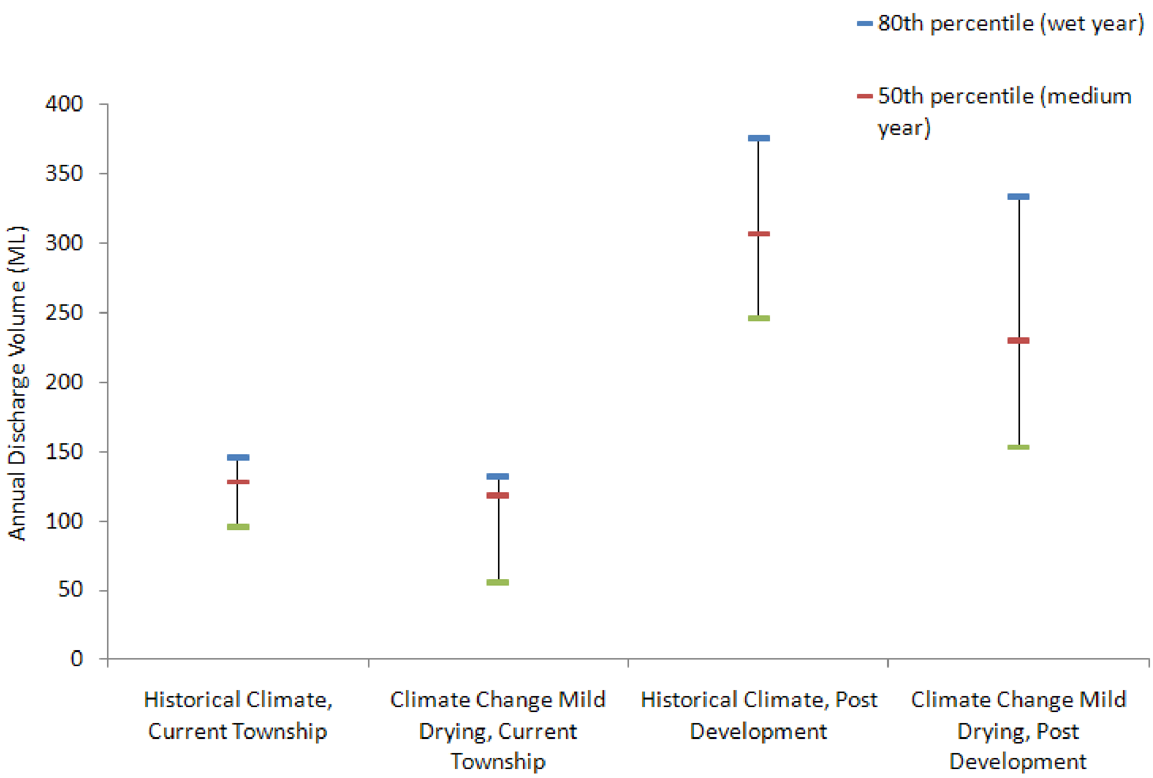
6.3. Estimate of Climate Change Impacts to Stormwater Volumes for Hindmarsh Island

The same process as described in Section 6.2 was used to estimate the impacts of the SARDI Mild Drying climate change projections to the volume of stormwater runoff in Hindmarsh Island.

Figure 6-2 shows a comparison between the volume of urban stormwater that is discharged to the Goolwa Channel for the historical climate and the Mild Drying climate change projection, for both the current

Hindmarsh Island Township, and the developed Township. The 20th percentile, 50th percentile and 80th percentile rainfall years for both the historical and climate change scenario were used to show the difference in the volume of urban runoff for a dry, average and wet year.

Similar to the result for Goolwa, the Figure shows that the volumes of runoff are predicted to decrease by a small amount as a result of the climate change projections. In comparison with the large increase to the stormwater runoff volumes that are estimated as a result of the urban development in Hindmarsh Island, the climate change impacts are relatively minor.



- **Figure 6-2: Impacts of climate change projections to the volume of stormwater runoff from the current and developed Hindmarsh Island Townships**

6.4. Summary of Projected Climate Change Impacts

For both Goolwa and Hindmarsh Island, the volumes of runoff are predicted to decrease by a small amount (5%) as a result of the climate change projections in comparison with the large increase (250%) to the stormwater runoff volumes that are estimated as a result of the urban development. Subsequently the expected impacts to the main water elements as a result of recommended infrastructure action were calculated used historic climate data.

7. Integrated Water Management Actions for Goolwa

7.1. Introduction

This section outlines in detail the range of Integrated Water Management actions that were identified for Goolwa. The major benefits of each opportunity are discussed, and the impacts that each action would have to the major elements of the urban water system are included.

The actions were developed in alignment with the IWMP goals, in consideration of the priorities for the Goolwa Township and future considerations that may affect water resources management. The actions were developed following a review of the relevant background documents, a site visit to the Alexandrina Council area and in consultation with the SA MDB NRM Board and Alexandrina Council.

Rainwater tanks have been included in the Planning Actions as their implementation would require the Development Plan to be amended to mandate their installation.

Appendix B contains the Options Report and contains a description of all IWM actions that were considered.

The key actions are:

- Wastewater reuse
- Stormwater harvesting and reuse
- WSUD treatments
- Flood mitigation in green corridors
- MAR investigations
- Purple pipe network
- Planning actions (including mandating rainwater tanks)
- Capacity building and governance
- Advocacy
- Water conservation – demand management

7.2. Wastewater Reuse

Currently, treated wastewater is directed from the storage lagoon at the WWTP to be reused at a turf farm of approximate area 46Ha to the west of Goolwa, serviced by two centre pivots. In 2011 the turf farm was able to use all available recycled wastewater (180ML/year) and has capacity to take up to 460ML/annum, subject to suitable winter storage of wastewater. Council and the community have indicated support for local horticulture and woodlots to the west of Goolwa.

To implement this initiative, a wastewater storage lagoon could be constructed to the west of Goolwa to store recycled wastewater for reuse, as indicated on Figure 7-3. A preliminary size of volume of 92ML, and 4Ha surface area was used for estimating the cost of construction for the storage.

Note: Since the preparation of this report, Council has since prepared designs for a proposed 150ML storage at the site (September, 2012).

There is an existing pump and pipeline from the water treatment plant to the turf farm, so this could be used to distribute water to the proposed storage. The wastewater is currently treated to Class B, and no additional treatment would be required to use the water for irrigated horticulture purposes.

The key benefits of wastewater reuse are:

- Sustain irrigated horticulture and industry in the area by providing up to 460 ML total treated wastewater for the turf farm.
- Provide up to 210 ML/annum for irrigated open space, subject to provision of further treatment, development of appropriate management plans and additional storage facilities to increase the diversity of water sources improving security of supply.
- Encourage growth of other horticultural industries in the vicinity, subject to rate of growth in demand by existing users.

A preliminary estimate of the Net Present Value was developed for this initiative, for the purpose of comparison with other water management options during the TBL process. The present value of the major components of the costs and revenue are included in Table 7-1 below. All assumptions included in the cost estimate and a breakdown of the inclusions and unit rates used is included in Appendix F.

Table 7-1 Estimated Costs for Wastewater Reuse

Cost Component	Preliminary Cost Estimate (present value)
Total capital costs (includes wastewater storage basin, distribution pipe work and pumps)	$7.1 M
Annual maintenance and operational costs	$100,000
Average yearly revenue from sale of water (based on assumed 950ML/annum of reuse, and a price of 50c/kL)	$475,000
Total net present value (over 30 year timeframe)	$39,000
Total net present value per ML of reuse (over 30 year timeframe)	$1.6/ML (Revenue)

7.3. Stormwater Harvesting and Reuse

Stormwater management infrastructure should be designed to improve runoff water quality and reduce the volume of water discharged to the Goolwa Channel. The urban growth to the north of Goolwa will result in additional volumes of stormwater runoff, and there is potential to provide wetlands for storage and treatment of this water. There is also potential for increasing the volume of stormwater reuse by extending the existing stormwater reuse network to other open space areas throughout the town.

Currently a 52 ML stormwater storage is being constructed next to the WWTP (Refer Section 4.2.8). Additional to this, there is the opportunity to provide an amenity wetland of approximately 90ML capacity to the east and north of the WWTP, which could be linked to the stormwater reuse network, as shown in Figure 7-3. The area could incorporate public open space for community use, with features such as bike paths, parks and ovals nearby, hence providing community and amenity value. Preliminary MUSIC modelling of this wetland indicated that an average of around 270ML/year of stormwater could be treated and be available for reuse for a year of average climate conditions. Concept and detailed design of this wetland should ensure that detention of up to the 100 year ARI is provided to prevent downstream flooding of the township.

There is also the opportunity to provide two wetlands in the Goolwa North area for storage of stormwater up to the 5 year ARI (Annual Recurrence Interval), with overflow for larger rainfall events, shown in Figure 7-3. They could also be linked to the stormwater reuse network.

The key benefits of these opportunities for stormwater reuse are:

- Reduced volume of runoff to Goolwa Channel by an average of around 915 ML of stormwater per annum by 2040 (through evaporation, infiltration and reuse). As discussed in Section 4.2.2, stormwater runoff commonly contains a range of pollutants; hence treatment and reduction in the volume discharged would result in protection of aquatic ecosystems in Currency Creek and the Goolwa Channel.
- Improved quality of water discharged to Goolwa Channel through reduction in total annual load of P (275kg), N (1,510kg) and total suspended solids (115,540kg) by 2040.
- Replacement of up to 270ML of River Murray or mains water with fit for purpose water source (for irrigation of public open space or other suitable uses).
- Increased diversity of water sources improving security of supply.

A preliminary estimate of the Net Present Value was developed for this initiative, for the purpose of comparison with other water management options during the TBL process. The present value of the major components of the costs and revenue are included in Table 7-2 below. All assumptions included in the cost estimate and a breakdown of the inclusions and unit rates used is included in Appendix F.

Table 7-2 Estimated Costs for Stormwater Harvesting and Reuse

Cost Component	Preliminary Cost Estimate (present value)
Total capital costs (includes 8.8Ha wetland at the WWTP site, 2 small wetlands (1Ha and 1.7Ha) in new development areas of Goolwa North), and extension of open space irrigation network.	**$14.1M** for 8.8Ha and WWTP site **$4.2M** for 2 small wetlands (1Ha and 1.7Ha) at Goolwa North developments (assumed as a cost to developers for TBL assessment) **$2.2M** for extension of stormwater reuse network Total Capital cost estimate = **$20.5M**
Annual Maintenance and operational costs	$325,000
Average yearly revenue from use of water (based on assumed 390ML/annum of reuse, and a price of 50c/kL)	$195,000
Total net present value (over 30 year timeframe)	-$26.0M
Total net present value per kL of reuse (over 30 year timeframe)	-$3,850/ML (cost)

7.4. Irrigation of Open Space

Water supply for open space irrigation is currently met through a combination of treated stormwater, mains water and River Murray water (from the Goolwa Channel). During recent drought periods and associated low River Murray water levels, irrigation of some reserves was ceased. Securing a sustainable water supply for irrigation will enable the amenity and micro-climate benefits of open space irrigation to be maintained.

Figure 7-1 shows the irrigated public open space map for Goolwa. It shows that there are a number of public open spaces that are currently irrigated with SA Water mains supply. There is potential to replace this demand with recycled stormwater. As well as Council reserves, other opportunities for reuse of stormwater include Goolwa Oval, Investigator College, Goolwa Primary School and the Goolwa Camping and Tourist Park.

Table 7-3 describes Council's irrigated reserves and the South Lakes Golf Course, their associated irrigation volumes and identifies the current and potential irrigation sources. The table shows that over 55ML of irrigation currently sourced from SA Water could be substituted with recycled stormwater. Irrigation of reserves on Hindmarsh Island with river water has been identified as a potential source if the current river allocation is replaced by recycled stormwater.

Table 7-3 Irrigated Public Open Space (2011)

Reserve Name	Area (m2)	Irrigation Requirement (ML/year)	Current Irrigation Source	Potential Irrigation Source
Goolwa				
Amelia Park	3,900	1.5	SA Water	Stormwater reuse
Brooking Street Roundabout	120	0.05	SA Water	SA Water
Galpin Reserve	3,500	1.3	Stormwater reuse[2]	Stormwater reuse
Garden Reserve	3,000	1.1	SA Water[2]	Stormwater reuse
Goolwa Oval	25,000	15	Stormwater reuse	Stormwater reuse
Goolwa Medical Centre	270	0.1	SA Water	SA Water
Goolwa Skate Park / Regional Centre	500	0.2	SA Water[2]	Stormwater reuse
Goolwa Wharf	3000	1.1	SA Water	Stormwater reuse
Heinicke Reserve	4000	1.5	SA Water[2]	Stormwater reuse
Heritage Club	1000	0.4	Stormwater reuse	Stormwater reuse
Jaralde Park	2,700	1.0	Stormwater reuse	Stormwater reuse
Murray Smith Reserve	2200	0.8	Stormwater reuse	Stormwater reuse
Neighbour Reserve	5,000	1.9	Stormwater reuse	SA Water
Richard Ballard Park	10,000	3.8	River Murray	Stormwater reuse
Signal Point	2000	0.8	River Murray	Stormwater reuse
Town Square	1,300	0.5	Stormwater Reuse	Stormwater reuse
South Lakes Golf Course	388,000	105	River (55ML) and Stormwater Reuse (50ML)[3]	Stormwater Re-use[1]
Goolwa-Total	455,500	136		
Hindmarsh Island				
Wentworth Pde (East) (HM)	800	0.3	SA Water	River Murray
Wentworth Pde (West) (HM)	400	0.3	SA Water	River Murray
Excelsior / Wentworth Pde Hindmarsh Marina (HM)	700	0.2	SA Water	River Murray
Hindmarsh Island Total	1900	0.7		

Note 1: Only in dry years when River Murray water not available

Note 2: During 2011/12 irrigation season these reserves ceased being irrigated. It is intended that irrigation will recommence once sufficient stormwater becomes available.

Note 3: During 2011/12 irrigation season this facility converted back to River Murray water for irrigation.

Table 7-4 summarises additional open space that may be irrigated in the future. It includes the green corridors identified in the preliminary structure plan, as well as additional open space required by development. It is assumed that all areas apart from the recreation hub would be irrigated with stormwater.

NOTE – It has been estimated that only a small proportion (10%) of the green corridors would be irrigated.

- **Table 7-4 Additional Irrigated Public Open Space (2040)**

Location	Estimated Irrigated Area (m2)	Irrigation Requirement (ML/year)
Investigator College	18000	11.3
Goolwa Camping and Tourist Park	10000	3.8
Goolwa Primary School	15000	9.4
Byrnes Road Corridor	12500	4.7
Green corridors	10000	3.8
New reserves in development area (to meet planning open space requirements)	45000	16.9
Proposed Recreational Hub	50,000	75[1]
TOTAL	165,000	124.7

Note 1 – This is proposed to be met through use of recycled wastewater

The total irrigation demand of the developed Goolwa and Hindmarsh Island townships (2040) has been estimated to be up to 262ML/year (50th percentile year). For the wetlands that have been modelled for this investigation, the volume of available treated water for an average climate year is 450ML/year. There is more than enough demand in the developed townships to utilise this volume of water. Larger or additional storages could be implemented in order to supply enough treated stormwater to meet the total irrigation demand.

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Figure 7-1 Irrigated Public Open Space

Integrated Water Management Plan - Goolwa and Hindmarsh Island

v1

Goolwa Barrage

GDA 94 MGA z54

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I:\VESA\Projects\VE23421\Technical\Spatial\ArcGIS\111018 Alexandrina report 2 structure plan.mxd

7.5. WSUD Treatments

WSUD features should be included throughout the new development areas of Goolwa, and should be implemented gradually as the new development areas are constructed. A range of treatments such as swales, buffer strips, pervious pavements and bio retention basins should be considered and implemented where most appropriate. Council has indicated that they favour an approach of more centralised WSUD options, predominantly located in the proposed green corridors for ease of maintenance and maximising amenity. The proposed WSUD features are briefly described in Table 7-4.

The key benefits that WSUD will provide are:

- Minor flooding attenuation. While the treatments will have little effect for major flood events, they will contribute to attenuation of minor flooding through slowing down runoff throughout the catchment, and infiltration.
- Reduction to the volume of stormwater runoff, through infiltration. The estimated average yearly volume of infiltration through the swales that were modelled for the project is estimated to be 230ML. Reducing stormwater quantity is beneficial to prevent excess discharge (above pre-development flows) to the Goolwa Channel. This is protects aquatic ecosystems in Currency Creek and the Goolwa Channel through reducing the potential for erosion and discharge of pollutants.
- Improved quality of water discharged to Goolwa Channel through reduction in total annual load of P (65kg), N (655kg) and total suspended solids (36,900kg) by 2040.

The locations of WSUD treatments should be chosen to best integrate stormwater management throughout all new developments. Figure 7-3 shows preliminary locations for green corridors, which would serve a dual purpose of stormwater conveyance, treatment and infiltration by WSUD features, as well as bike paths linking open space areas to each other.

- **Table 7-4: Description of WSUD Treatments (Department of Planning and Local Government, 2009)**

WSUD Feature	Description	Example Visualisation
Swales	Swales are linear depressions which are used to convey runoff, capture sediments and pollutants and reduce runoff through infiltration. They can be densely vegetated and can be incorporated along streets and within parklands.	
Buffer strips	Buffer strips are broad, sloped areas of dense vegetation which remove pollutants from runoff and reduce the volume of runoff through infiltration.	
Pervious pavements	Pervious pavements allow infiltration of runoff through the paving substrate and into the underlying soil. Hence they reduce the total volume of runoff and reduce transport of pollutants.	
Bio retention basins	Bio retention basins are vegetated filtration systems that can temporarily detain runoff, allowing it to infiltrate and improve the water quality. They are densely vegetated and contain a filter media for filtration of the runoff.	

A preliminary estimate of the Net Present Value was developed for this initiative, for the purpose of comparison with other water management options during the TBL process. The present value of the major components of the costs and revenue are included in Table 7-5 below. All assumptions included in the cost estimate and a breakdown of the inclusions and unit rates used is included in Appendix F.

- **Table 7-5 Estimated Costs for WSUD Treatments**

Cost Component	Preliminary Cost Estimate (present value)
Total Capital Costs (includes a total of 8.25km of swales, of top width 20m and base width 6m). It is intended that these would be integrated with bike tracks.	$4.7M
Annual Maintenance and Operational costs	$735,000
Average yearly revenue from use of water (based on assumed 70ML/annum of reuse, and a price of 50c/kL)	No sale of water
Total Net Present Value (over 30 year timeframe)	$16.7M
Total Net present Value per kL of reuse (over 30 year timeframe)	No water reuse

7.6. Flood mitigation in green corridors

It is Council's preference for stormwater management at the growth areas to the North of Goolwa to include kerb and gutter drainage to route stormwater to green corridors. The green corridors would incorporate vegetated and will promote infiltration and treatment of the stormwater.

There is potential for the design of the green corridors to incorporate low lying areas, which will be designed for flood mitigation to protect surrounding infrastructure. These areas may include ovals, green open spaces or urban forests/woodlots that would only be inundated during major flood events. At other times, the areas would provide aesthetic and community values. For effective flood mitigation detailed flood investigations would be required to inform the size and location of the areas.

Figure 7-3 indicates a significant urban forest proposed on the western edge of the Goolwa Township as a buffer to rural land uses, to provide amenity and microclimate benefits.

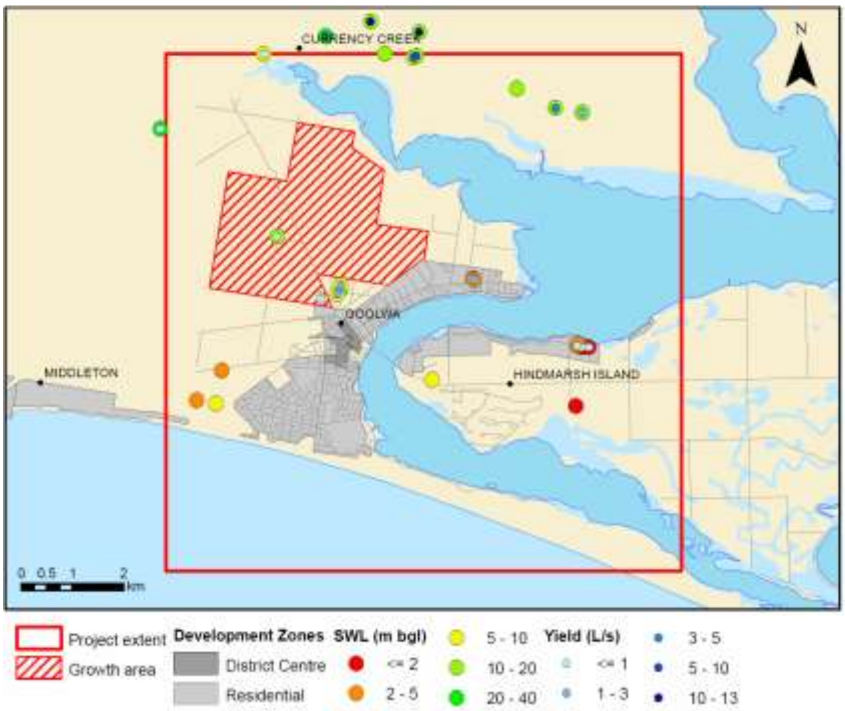
7.7. Opportunities for MAR

The potential for managed aquifer recharge (MAR) in the Goolwa vicinity is uncertain due the lack of groundwater data for the area. The area is however underlain by the Tertiary Murray Group Limestone which does provide good supplies of groundwater to the northwest in the Currency Creek area and further north in the Angas Bremer Prescribed Wells Area. This aquifer may be prospective for MAR dependent on the salinity which is known to be very high in other areas.

Figure 7-2 overlays recorded yield on standing water levels. This data indicates that MAR may be prospective.

It is recommended that a feasibility assessment be conducted for any future MAR operation considered for Goolwa. More detailed hydrogeological assessments and investigations would be required, using data from existing wells and drilling investigations. The feasibility assessment would consider how adequately particular locations would achieve cost effective storage and reuse of stormwater/wastewater for irrigation. An example of this would be whether a viable injection/extraction point would be located close enough to the area to be irrigated to minimise pipe and pump costs. Additionally, a cost-benefit analysis of any proposed scheme would be required to compare MAR with above ground storage.

There are also water quality implications for MAR, and the water quality must meet the EPA’s requirements in order to obtain approvals for injection of stormwater. Treatment of stormwater using wetland systems, or other forms of treatment is often required prior to injection, and this cost would be considered as part of the viability assessment.



■ **Figure 7-2 Standing water levels and yields recorded since 1990**

7.8. Purple Pipe Network

The option of implementing a purple pipe network to supply treated wastewater to the new development areas in Goolwa North was investigated as part of the TBL assessment process. The purple pipe would increase the volume of wastewater that could be reused within the township, and reduce the volume of mains water required at each house. The water could be used for domestic supply (toilet, laundry, outdoor use), however would require additional treatment of the wastewater to meet Class A standard in order to be fit for household use.

The key benefits of the purple pipe network for stormwater and wastewater reuse are:

- Increased diversity of water sources improving security of supply
- Household use is a reliable demand for the water increasing opportunities for use. It was estimated that the demand for treated wastewater supply in households within the new development areas would be around 530ML/year in 2040. This would provide demand for more than the total volume of treated wastewater effluent that will be available for reuse in 2040 (an additional 400ML to the current 180ML which is already reused on the turf pivot).

A preliminary estimate of the Net Present Value was developed for this initiative, for the purpose of comparison with other water management options during the TBL process. The present value of the major components of the costs and revenue are included in Table 7-6 below. All assumptions included in the cost estimate and a breakdown of the inclusions and unit rates used is included in Appendix F.

Table 7-6 Estimated Costs for Purple Pipe Network

Cost Component	Preliminary Cost Estimate (present value)
Total capital costs (includes cost of purple pipe network, 92ML capacity wastewater storage basin, and cost for upgrading wastewater treatment to Class A quality).	**$40.2M** for purple pipe network **$7.1M** for wastewater storage basin Total Capital cost estimate = **$47.2M**
Annual maintenance and operational costs	$1.2M for purple pipe network $55,000 for wastewater storage basin
Average yearly revenue from use of water (based on assumed 70ML/annum of reuse, and a price of 50c/kL)	$1.3M
Total net present value (over 30 year timeframe)	-$38.9M
Total net present value per kL of reuse (over 30 year timeframe)	-$3000/ML (cost)

Figure 7-3 Opportunities for Integrated Water Management

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7.9. Planning Actions for Goolwa

There are a range of opportunities for the planning context to be improved in order to deliver better integrated water management outcomes. These opportunities are not restricted to Goolwa and Hindmarsh Island and many, if implemented, would deliver benefits at the Council-wide and/or regional level.

7.9.1. Mandate particular rainwater tank sizes and in-house use for all new developments

Maximising the capture and reuse of rainwater within all new (and existing) homes would reduce the volumes of stormwater that need to be managed on a larger scale and reduce reliance on potable mains water supply. The investigations undertaken for the TBL assessment (refer Appendix D) determined the following recommendations:

- 5,000 litre (L) household rainwater tanks to be plumbed to laundry, toilets and hot water supply will maximise the volume that can be reused within each home. It is estimated that by 2040, around 100ML/year of rainwater would be captured and used through this scheme.

The Alexandrina Council Development Plan should be amended to provide policy guidance regarding:

- Minimum size and connection (use) requirements of rain water tanks for all new development (5,000 L)
- The design and siting of rain water tanks. For example, this guidance should address how to accommodate a tank on a smaller allotment (e.g. under the eaves of a house) and opportunities to combine the use of tanks in residential flat buildings.

Another opportunity is to seek amendments to legislation to mandate minimum rainwater tank sizes. Relevant legislation that could be amended in this way includes:

- Building Code of Australia
- Residential Development Code (Schedule 4 of the Development Regulations)

It should be noted that currently, the Residential Development Code does not apply to new dwellings constructed in the Alexandrina Council, although this is anticipated to change in the future.

7.9.2. Update the Residential Development Code to addresses WSUD

The Residential Development Code does not currently include any Water Sensitive Urban Design (WSUD) criteria against which new residential development is assessed. There is opportunity therefore to amend the Code to include WSUD. This would result in new residential development needing to address WSUD criteria in order to be assessed under the Code.

It is noted that amendments to the Residential Code will require a change to the Development Regulations. Making an amendment to the Development Regulations is governed by the Subordinate Legislation Act 1978. The power to make regulations and amendments is vested in the Governor pursuant to Section 108 of the Development Act 1993.

7.9.3. Council's Development Plan Complying and on-Merit Provisions

Concurrently, with updates to Development Regulations (Schedule 4), Council could also consider updating its "complying" on "on-merit" Development Plan provisions via a Development Plan Amendment process to encourage the use of rainwater tanks, integrated water management outcomes and natural resources management policies.

7.9.4. Amend Schedule 5 of the Development Regulations

Schedule 5 of the Development Regulations describes the required information that must be submitted with development applications. There is opportunity to require applicants to provide WSUD and/or stormwater management plans with their development applications via amendment to Schedule 5 of the Development Regulations.

7.9.5. Protection of riparian areas

The 30 Year Plan for Greater Adelaide identifies a number of water related policies including the need to "*Incorporate the protection of relevant coastal and riparian areas and Ramsar wetlands in Structure Plans and Development Plans*". (Water Policy 6, The 30-Year Plan for Greater Adelaide (pg 142).

It is therefore recommended that in any future structure planning or Development Plan Amendment process, such as those relating to the Goolwa development area, relevant riparian or Ramsar wetlands (including Lake Alexandrina) are identified in the Council's Development Plan or relevant Structure Plan/s.

7.9.6. Structure Planning

In developing the structure plan for Goolwa North (via a Development Plan Amendment process), conceptually identify major open space (associated with water sensitive urban design) corridors linked with water reuse and natural flow corridors in Goolwa North. Further, identify significant native vegetation areas for protection.

7.9.7. Outdoor Water Use – Greenfield Developments

Implement the State's policy of *"Require new Greenfield developments that are subject to Structure Plans from 2011 to source water for outdoor use from non-mains water supplies. This recognises the need to plan alternative water sources at the commencement of new large Greenfield developments, rather than retrofit these sources for latter stages of the development."* (Water Policy 4, The 30-Year Plan for Greater Adelaide (pg 142).

7.9.8. Wastewater reuse and water harvesting

To further promote the use of wastewater reuse and water harvesting techniques, Council could update its Development Plan provisions to favour such an approach. Wastewater reuse and water harvesting policy would be particularly useful if it can be triggered at the land division stage of a development.

7.9.9. Discount Open Space Contribution

Draft Development Plan policy that promotes Council receiving less that the 12.5% of open space contribution, subject to Developers addressing a range of integrated water management and urban design outcomes, beyond what is already required as a minimum standard.

7.9.10. Developer Contributions

Consider changes to the Development Act that require developers to contribute to off-site infrastructure requirement as a result of their proposed developments. Currently, developers fund all on-site stormwater construction works only. This option also needs to be considered within the broader context of the State's objective for more affordable housing.

7.9.11. Conversion of Development Plan Amendment (DPA)

Complete Council's Conversion Better Development Plan DPA. Completion of the DPA will at the very least incorporate many of the existing useful natural resources management policies of the State Planning Policy Library into Council's Development Plan.

7.10. Capacity Building and Governance

The capacity of the community and the Council has been identified as a key impediment to the achievement of integrated water management outcomes.

Key issues identified include the lack of awareness by the wider community of the benefits that simple water conservation measures can deliver, and the changes they can make at a household level to reduce their water use and reliance on potable water sources.

One example of a relatively straight forward initiative that can deliver benefits to households and the wider community is the installation and proper use of a rainwater tank. Rainwater tanks can deliver cost savings to households and are an asset to home purchasers, and these aspects can be emphasised to the wider community in order to encourage their uptake.

Challenges to delivering better uptake of rainwater tanks include overcoming the perception that a large tank, and therefore space, is required for the tank to be of any benefit and providing guidance around the design and siting of tanks, particularly on small allotments.

At the same time, there is also a lack of knowledge about how to appropriately use a rain water tank as a household water source, and therefore the wider community needs to be better educated about its use and management so that their contribution to integrated water management can be maximised. Historically many South Australians with rainwater tanks have used them sparingly, but frequent use via plumbed systems is required to make a difference to potable water consumption and stormwater generation.

7.10.1. Community Education and Awareness

Opportunities for raising awareness and educating the community about water management include:

- Preparing information materials that are easy to read and detail changes people can make at the household level to contribute to better water management. Messages that should be emphasised include the benefits of such changes (e.g. cost savings, environmental benefits).
- Providing links to information sources, such as websites, that provide information that relates to integrated water management.
- Establishing an interactive web page which calculates a household's current water use and shows how by making changes (e.g. installation and use of a rain water tank, low flow shower head, half flush toilets etc) can reduce their water use.
- Promoting good news stories about water in the local media.
- Holding a water festival or similar event that celebrates water and recognises the positive action that is being taken in the community (including industry, Council, business, householders etc) to manage water.
- Considering ways to support action by providing community grants for projects that are contributing to integrated water management.

By increasing the awareness, knowledge, skills and capacity of the community it is hoped that individuals will take action to change their behaviours to better manage their water demand and recognise the integrated nature of water resource management.

7.10.2. Training of Decision-Makers

Opportunities (e.g. training and workshops) should be facilitated that increase the capacity of local government Elected Members, Development Assessment Panel members, staff and applicants to better understand water management (e.g. water recycling and WSUD), natural resources management outcomes and the value these bring.

Capacity building of Council staff is a critical element to be addressed, particularly in relation to the application of WSUD. The Council engineers and planners need access to information and guidelines to assist them with the application of WSUD. It is recommended that an implementation guide be prepared which identifies different WSUD treatments for different scales of development (e.g. 1 allotment versus 30 allotments).

The development industry also has a key role to play, and the Council needs to educate developers about expectations around integrated water management and hold them to account via the development assessment process. This will require clear and consistent application of the Council policy direction to all new developments which in turn will require that the Council as a whole organisation is committed to achieving integrated water management.

Up-skilling of engineers and planners will be required to ensure they are knowledgeable about the content of IWMPs that have been prepared for their Council areas, understand how to apply recommendations and are committed to their implementation. In this way, Councils can ensure that relevant messages will be communicated to applicants regarding their development proposals and that the relevant information will be taken into account during the assessment process.

7.10.3. Identify Champions within the Council for Integrated Water Management

It is recommended that at least one Champion for IWM be identified within the Council staff who has the ability to influence the practices of engineering design, development assessment, infrastructure maintenance to maximise the implementation of the Integrated Water Management Plans and adoption of WSUD principles in new development and Council infrastructure projects. Training should be provided to fill any knowledge gaps of the Champion.

An additional staff or elected member who has the technical understanding and communication skills to advocate in the public domain for the implementation of the Integrated Water Management Plans and Water Sensitive Urban Design could also be identified. If this person has any knowledge gaps, the necessary training would need to be provided.

7.10.4. Explanatory Guidelines

It is recommended that the Council prepare guidelines which provide further local specific details to the generally broad WSUD/NRM policies currently outlined within Development Plans. Guidelines could value-add to the existing DPLG WSUD documentation by providing “on the ground” examples of WSUD treatments already being utilised in the Council area. Such guidelines, while not recognised by Courts, will provide additional guidance to planning authorities, designers and applicants in achieving the intent of policies. The District Council of Mount Barker’s Sustainable Development Fact Sheets that were partly funded by the SA MDB NRM Board are a good example of this additional guidance.

7.10.5. Government Agencies Schedule 8 (Development Regulations) Responses

Schedule 8 of the Development Regulations articulates the instances where a planning authority such as a Council, is required to refer a development application to a referral body. It has been identified that when these referral bodies provide advice and planning conditions to the Council, at times, their advice may be based on non-Development Plan policy.

Similar to the requirement of a planning authority to assess a development application against the existing Development Plan policies, there is a similar requirement that the advice (including planning conditions) provided by State Government agencies be based on existing Development Plan policy and not necessarily their own codes and/or Departmental policy. This implies that when agencies provide comments to planning authorities, they would need to refer to the relevant Council Development Plan.

While a referral body's delegate will bring to its assessment a range of knowledge and considerations that are non-Development Plan policy based (including codes and policies), it is necessary that the advice provided be primarily based on existing Development Plan policy. Accordingly, a delegate of the relevant referral body will need to consider the relevant Development Plan in forming his or her advice.

It is therefore recommended that referral agencies have access to appropriate information that supports their review of development applications in relation to a Council's Development Plan, as well as guidelines which assist with drafting valid planning conditions.

7.10.6. Branding

One of the goals of the IWM is to promote the Alexandrina Council as a water sensitive city/community via use of appropriate branding to signal to future developers and members of the community expectations with respect to the nature and quality of future growth within the Council area. This could include:

- Appropriate site specific signage showing residents and visitors where The Council is investing in water management actions.
- A regular 'water' spot in the local newspaper (The Times).
- Increased visibility of water related information on the Council website.
- On-going communication with residents through existing newsletters.

This action could be undertaken concurrent with community education and awareness however it is important to distinguish that the primary objective of this action is to benefit the Council, rather than the community.

7.11. Advocacy

7.11.1. Government Funding

Lobby State and Federal Government for funding to support (i) detailed structure planning process for identified growth areas, (ii) preparation of Stormwater Management Plans as required by the Local Government Act, (iii) construct public WSUD features and other associated water related infrastructure, to support the growth areas identified in the 30-Year Plan for Greater Adelaide.

7.11.2. NRM and WSUD Overlays

Initiate discussions with the Department of Planning and Local Government and NRM Boards strengthen Water Sensitive Urban Design policies and other related Natural Resources Management overlays to be incorporated within the State's Planning Policy library. The role of these overlays will be to provide a broader perspective on NRM/WSUD objectives and will be used to guide appropriate development at a multi-zone level.

7.12. Water Conservation – Demand Management

7.12.1. Domestic/Commercial/Industrial Uses

Urban water demand, including the management of demand for public open spaces, can be managed through a mix of restrictions, pricing and water efficiency (NWC, 2011). Whilst restrictions and pricing are outside the direct control of the Council, water efficiency measures can be encouraged and supported by the Council. Greater water use efficiency means less water will be required. The national Water Efficiency Labelling Scheme (WELS) requires mandatory labelling and minimum standards for agreed appliances, allowing consumers to make informed purchases.

Residential water demand has been modelled at 650 litres/**household** per day based upon the discussion included in Section 4.2.4. Modelling for the impacts that may be caused by implementation of water efficiency measures has not been included in the analysis.

Rebates from SA Water are available towards the purchase of water efficient garden goods, stand-alone rainwater tanks and retrofitting water efficient fixtures and fittings. SA Water rebates for showerheads, dual flush toilets, hot water re-circulators, pool covers and cover rollers and home water audits are no longer available.

Establishment of a target for a reduction in water use per capita would underpin any future demand management strategies. A community education and awareness program should include demand management as a key element.

8. Integrated Water Management Infrastructure Development Scenarios for Goolwa

8.1. Introduction

A range of actions for IWM in Goolwa were developed following consideration of the major elements of the urban water supply system and the impacts that are expected as a result of urban development and climate change projections. (See Section 7).

This Section describes the process that was undertaken to develop infrastructure development scenarios (groups of actions) and assess these scenarios using a Triple Bottom Line (TBL) process. The TBL process was used to determine which of the scenarios is preferred.

It is acknowledged that the availability of funding will influence which scenarios are implemented, as well as the timing of implementation.

8.2. Scenario Development

To optimise the selection of infrastructure options for integrated water management to meet the project's goals, four scenarios (groups of actions) that represent different outcomes and levels of investment were generated. These scenarios were focussed on growth areas identified in the 30 Year Plan for Greater Adelaide (DPLG, 2010) in the Hindmarsh Island and Goolwa areas.

A workshop was held with Council following submission of the Options Report to agree to a shortlist of feasible and desirable actions to include in the scenario assessment. Table 8-1 shows the scenarios that were determined from this discussion. Each scenario contains several options, and each scenario builds upon previous scenarios meaning they increase in complexity.

Table 8-1: Integrated water management scenarios for Goolwa

Scenario	Description
Scenario 1: Base Case	• The current stormwater reuse initiatives would be continued, however the volumes of reuse would remain at the current levels. • Provide a new wastewater storage lagoon near irrigated farmland to the west of Goolwa, and encourage an increase in irrigated horticulture to the area. • The additional volumes of stormwater resulting from the urban growth would be discharged to the River.
Scenario 2: Stormwater Reuse and WSUD	• Includes all of the infrastructure and policy options that would be required in the future in order to cater for increased development and population. • Implement demand management measures such as efficient shower

	fittings and water restrictions • Provide a new wastewater storage lagoon near irrigated farmland to the west of Goolwa, and encourage an increase in irrigated horticulture to the area. • Expand the capacity of the stormwater lagoons at the WTP location and convert them into an amenity wetland, which will be linked to the stormwater reuse network. This will provide flood attenuation for up to the 100 year ARI. • Provide two large wetlands in the Goolwa North development area for storage of stormwater up to the 5 year ARI, with overflow for larger rainfall events. They will be linked to the stormwater reuse network. Extend stormwater reuse network to irrigate the council land on foreshore and the Golf course • Implement roadside WSUD strategies to reduce runoff volumes. • As part of this provide green bike path corridors linking green areas (these can be integrated with irrigation pipeline routes)
Scenario 3: Maximum Household Rainwater Tank Use	• Would include similar community infrastructure to Scenario 2 but would include maximum reuse of rainwater within individual houses. • Mandate particular rainwater tank sizes and in house use (garden, toilet, hot water system) for all new developments.
Scenario 4: Purple Pipe to New Development Areas	• Would include similar community infrastructure to Scenario 2 but would include a 'purple' pipe to each new residence for domestic irrigation and toilet uses • Provide purple pipe to supply mixed stormwater and wastewater for domestic use, irrigation of open space and irrigation of horticultural land.

8.3. Triple Bottom Line Assessment Process

A Triple Bottom Line (TBL) assessment process was used to prioritise and optimise the IWM actions described in the four scenarios. The assessment was conducted using a tool developed by SKM and based on the Melbourne Water Triple Bottom Line (TBL) Guidelines, Department of Treasury and Finance Gateway Lifecycle Guidance material. The criteria used included relevant financial, environmental and social factors and were developed using Council's Procurement Policy and Tender Evaluation Procedure.

8.3.1. Criteria and Weightings

The TBL evaluation used a multi-criteria assessment (MCA) process. MCA is a management tool that enables monetary and non-monetary data of various options to be considered. A range of criteria were developed to compare and assess each of the IWM scenarios by each of the financial, environmental and social themes. Weights were assigned to each criteria or theme. The SA Water recommended approach to the preliminary scoring and weighting was used as a start point, which assigns equal weighting to all themes.

- **Table 8-2: Criteria used in the Triple Bottom Line Assessment process**

Theme	Criteria	Description
Financial	Net Present Value	An estimate of the Net present value of each scenario, calculated over 30 years. It includes capital costs, annual maintenance costs, annual operating costs and revenue from sale of recycled water.
Environmental	Volume of yearly stormwater reused/discharged.	This considers the environmental benefits associated with increased stormwater reuse and decreased stormwater discharge associated with each scenario.
	Volume of yearly wastewater reused/discharged.	This considers the environmental benefits associated with increased wastewater reuse and decreased wastewater discharge associated with each scenario.
	Reduction to household potable water demand.	This considers how much of the household water demand is supplied from fit for purpose sources.
	Operational energy usage.	This considers the relative energy consumption (hence greenhouse gas emissions) associated with each of the scenarios.
	Adaptability to climate change.	This considers how well the scenario would be able to adapt to decreased total rainfall, increased evaporation and higher intensity storms.
	Quality of water discharged to receiving waters.	This considers any impacts that the scenario will have on the quality of stormwater discharged to receiving waters.
Social	Maintenance required by Community.	This considers any household maintenance of the infrastructure
	Community ownership and acceptance.	This considers whether the initiatives raise community awareness of water conservation, and whether the community is likely to accept the initiatives.
	Creation of high quality green space.	This considers the amount and value of open space that the initiative provides
	Flooding attenuation.	This considers the social benefits associated with a reduction to minor flooding from improved stormwater management.

8.4. Description of technical work to provide information to TBL assessment

The following sub sections describe a range of technical calculations that were used in the TBL workshop. Not all of the criteria could be assessed quantitatively. In these cases agreement on a score was reached through the discussions at the workshop. A detailed description of the TBL outcomes is included in Appendix D.

8.4.1. Stormwater reuse volumes and water quality

The impacts of each of the IWM scenarios on stormwater runoff and the quality of water discharged to the Goolwa Channel were estimated using MUSIC modelling, modified from the approach described in Section 5.2.1

Figure 8-1 shows the stormwater catchment boundaries for the developed Goolwa township, with implementation of the IWMP actions (Scenarios 1-3). The volume of runoff is significantly reduced from the newly developed townships as a result of stormwater harvesting and reuse, and infiltration in WSUD features.

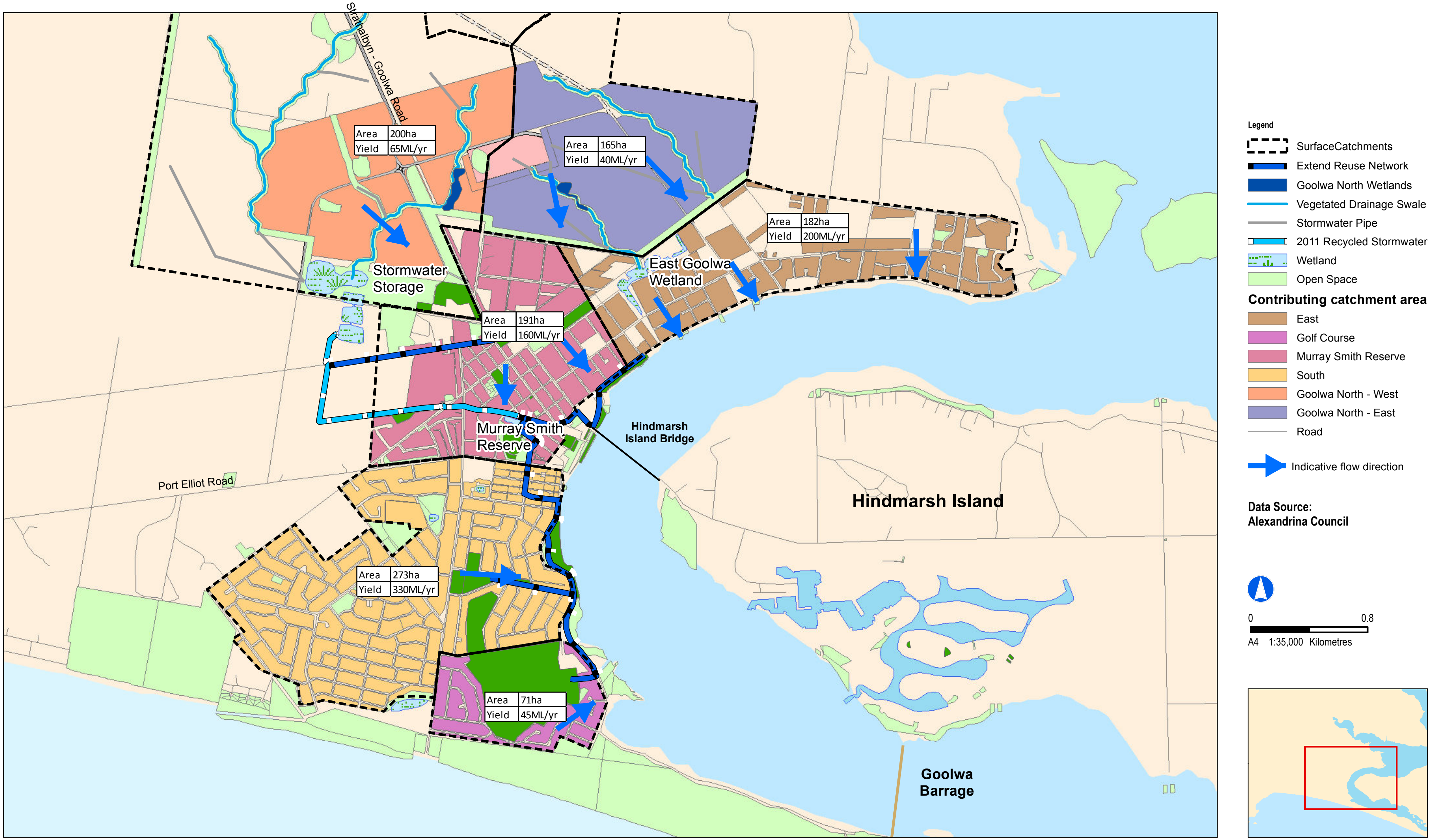

Figure 8-1 Stormwater Runoff - Goolwa 2040 with IWM Action

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Figure 8-2 shows a schematic of the MUSIC model for the developed Goolwa Township, with the stormwater IWM actions included. The model includes the existing urban catchment nodes, as well as four new development nodes, which represent the residential and commercial development areas planned for the Goolwa North area. Runoff from the new development areas is directed to two proposed wetlands at Goolwa North, and four swale nodes have been added to the model to represent the implementation of WSUD features throughout the new development areas. A large wetland has been included near the Goolwa WWTP, where stormwater from some of the newly developed areas is directed, as well as water from the existing Murray Smith Reserve catchment. Excess stormwater from all catchments is routed to a receiving node, which represents discharge of the stormwater to the Goolwa Channel. The location of the nodes on the schematic depict indicative locations of elements of the system; however this has no effect on the results of the modelling. The flow and water quality outputs from each node of the model are included in Appendix G.

- **Figure 8-2: Schematic of the MUSIC Model for the Goolwa Township Post Development, with implementation of all stormwater IWM options**

A range of additional assumptions were made as part of the MUSIC modelling of the IWM options. These are:

- Rainwater tanks were not explicitly included in the MUSIC Model. The 5,000 litre rainwater tanks which are recommended as an action of the plan were simulated by adjusting the impervious area for each of the housing allotments in the new development areas. The volume of water reuse from implementation of the rainwater tanks was estimated separately using the University of South Australia's tank size estimation tool.

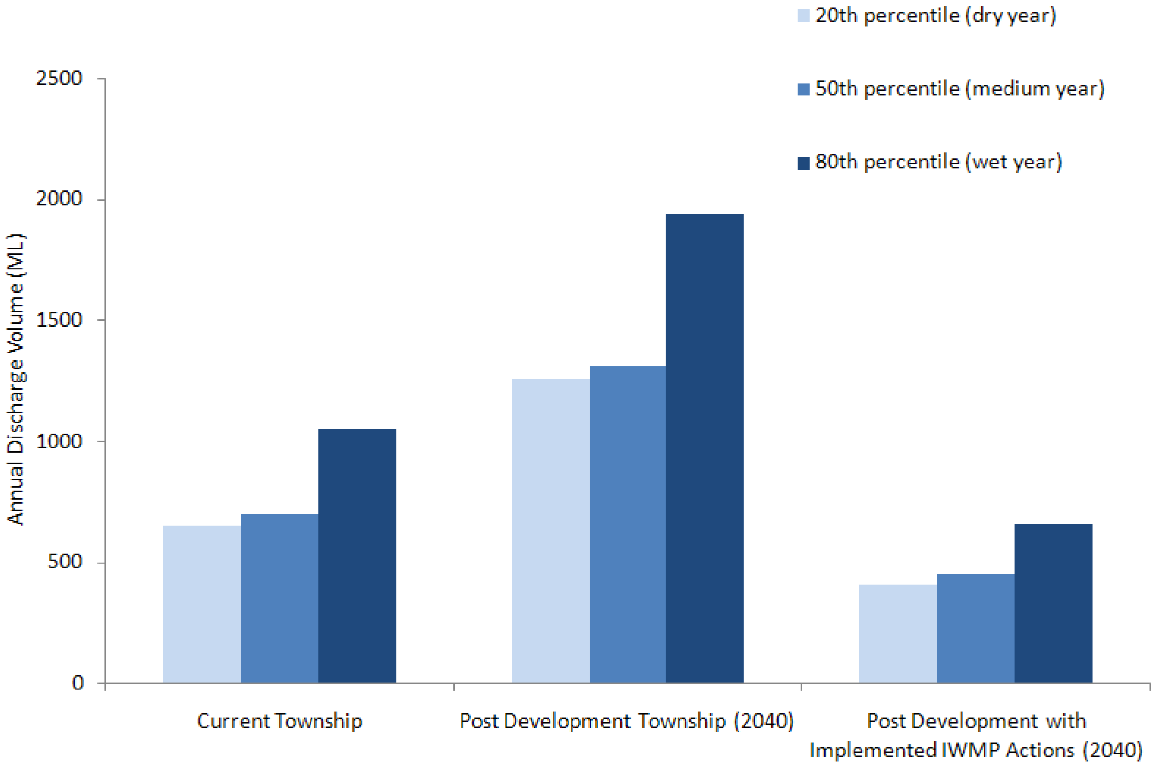
- The green corridors buffering the creek lines are a minimum of 50m wide and function as vegetated swales. Within the model, runoff is discharged from the urban areas into the swales at the highest point. From there, the water runs through the length of the swales, and the infiltration and treatment is modelled in this way.

- All water quality modelling was undertaken using the default quality parameters for stormwater within the MUSIC model. More accurate results would be obtained using actual water quality data from urban stormwater in Goolwa.

- The model includes urban nodes for the various urban catchments in Goolwa, and directs stormwater from each catchment to the wetlands or swales. Within the wetland nodes, the volume of water that undergoes treatment in the wetland is calculated, and this is the volume that is taken to be available for reuse. During high flow events, some of the water bypasses the wetland and this excess runoff is directed to the Goolwa Channel, as it assumed that it would be discharged. The water quality results are for the excess stormwater as it is discharged, prior to dilution within the Goolwa Channel.

Figure 8-3 shows the volume of urban stormwater that would be discharged to the Goolwa Channel for the developed Goolwa township, as estimated by the MUSIC Model for the current township, developed township without implementation of the stormwater IWMP options, and the developed township with implementation of all of the stormwater IWMP options. The 20th percentile, 50th percentile and 80th percentile rainfall years from the historical rainfall record (1871 – 2010), were used to show the difference in the volume of urban runoff for a dry, average and wet year.

The Figure shows that the volumes of runoff for the developed township are predicted to reduce to similar volumes to the current township as a result of implementation of all of the IWM stormwater options.



- **Figure 8-3: Estimate of the volume of stormwater discharged from the Goolwa township**

Table 8-3 provides an estimate of the water quality parameters for the developed Goolwa Township with implementation of the IWMP actions, derived using the MUSIC model for the developed township. The water quality was modelled using assumed water quality for urban areas in Adelaide, as supplied as a default parameter in the MUSIC model, rather than using measured data. The Table also demonstrates how the water quality for the developed township with implemented IWMP actions is estimated to perform relative to the WSUD Targets.

- **Table 8-3: Estimate of Water Quality for the developed Goolwa Township, with implementation of the IWMP actions**

	WSUD Targets (SA MDBNRMB, 2011)		
	Pollutant Load Reduction Target	Average annual pollutant load reduction %	Average annual pollutant removal (Kg)
Total suspended solids	80%	57%	152430
Nitrogen	45%	52%	2170
Phosphorus	45%	60%	340
Gross Pollutants	No percentage target	57%	31720

8.4.2. Rainwater Harvesting Volumes – UniSA Rainwater Tank Optimisation Tool

The University of South Australia's Tank Size Estimation Tool was used to estimate the optimal size of rainwater tanks for the Goolwa and Hindmarsh Island townships, and to estimate the volume of reuse that would result if rainwater tanks were mandated for all new developments. The model was also used to investigate the variability in the volume harvested for dry, average and wet years using the 20th percentile, 50th percentile and 80th percentile rainfall years within the modelling.

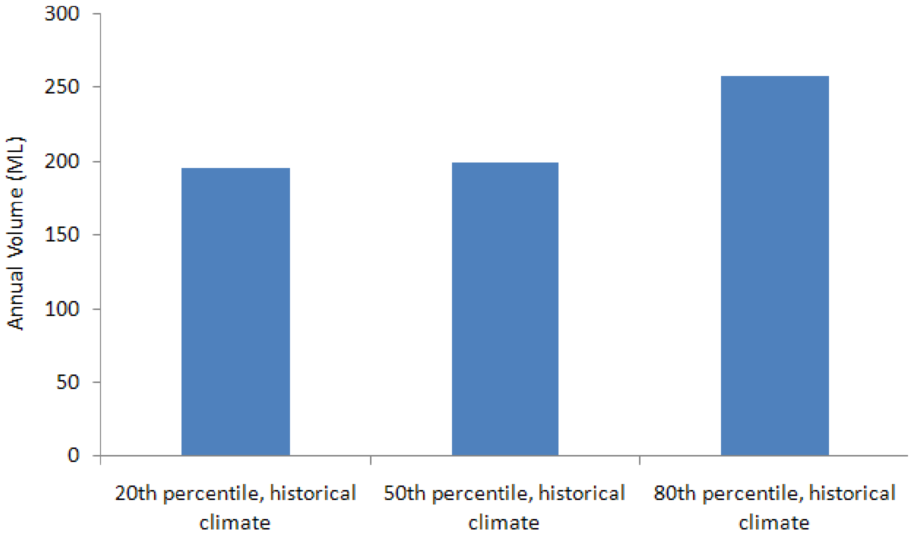
The following inputs were used within the model:

- Daily rainfall for Goolwa for the period from 1871 to 2010, supplied from the BOM (Station 23718). The data was analysed and the 20th percentile (1901), 50th percentile (1976) and 80th percentile (1985) rainfall years were selected from the series to investigate stormwater variability for dry, average and wet climate conditions.
- 100m^2 assumed average garden area for watering
- 150 m^2 assumed average roof area connected to tanks
- 130 L/day: assumed laundry demand supplied by rainwater
- 70 L/day assumed toilet demand supplied by rainwater

(for in house use rates, refer to Section 8.3 of "WSUD (Argue, 2004): basic procedures for 'source control' of stormwater " (Argue 2004))

From the Tank Size Estimation Tool, the optimal size of 5000L was selected. Figure 8-4 shows the estimated volume of rainwater harvested and reused within households if 5000L rainwater tanks were implemented for all new developments within Goolwa and Hindmarsh Island. The volume harvested varies depending on the rainfall each year, so the 20th, 50th and 80th rainfall percentiles were modelled to show the variation in the estimated harvest volume for a dry, average and wet year. For an average year, the volume harvested is around 200ML.

For the water balance, the harvest volumes were combined with the MUSIC modelling results to determine the total estimated reuse volume for 2040 for the scenario where the recommended actions of the plan are implemented.



- **Figure 8-4: Estimate of rainwater harvest volume for 5000L rainwater tanks to all new developments (by 2040) within Goolwa and Hindmarsh Island for the 20th, 50th and 80th percentile rainfall**

8.4.3. Net Present Value Calculations

An estimate of the Net Present Value (NPV) was made for each IWM scenario. The NPV was calculated for duration of 30 years and included the following costs:

- Capital costs
- Annual maintenance costs
- Annual operating costs
- Revenue from sale of recycled water

A discount rate of 6% and an escalation rate of 3.5% were applied, which are both consistent with the rates used by SA Water for infrastructure projects.

Due to the high level nature of this study, a range of assumptions were made as part of the estimation of costs and revenue for each scenario. The intent of the NPV calculations is to enable comparison of the economic value of each of the scenarios, and should not be used for any other purpose.

Section 7 contains a summary of the NPV for each IWM option, and Appendix F contains a detailed breakdown of costs and assumptions.

8.4.4. Consideration of climate change impacts during Triple Bottom Line Assessment process

The climate change impacts for the various scenarios for Goolwa and Hindmarsh Island were evaluated as part of the Triple Bottom Line (TBL) assessment. Within the environmental theme the assessment criteria titled 'adaptability to climate change' was used to consider how well the scenario would allow adaptation to decreased total rainfall and increased evaporation.

Climate change adaptability was assessed qualitatively using the principles contained in the following table:

Table 8-4 Climate Change Impacts Considered in the TBL Assessment

IWMP Infrastructure Option	Climate Change Impacts Considered for TBL Assessment
Water Sensitive Urban Design features	▪ Vegetated WSUD features such as swales or bioretention systems are likely to dry out more frequently due to decreased rainfall, increased temperature and increased evaporation. Hence they may require more maintenance.
Stormwater harvesting and reuse	▪ If stormwater is available to water public open spaces this would reduce reliance on other sources. Additional water sources increases reliability and resilience. ▪ Design of stormwater storages should take into account reduced average rainfall and increased evaporation.
Wastewater reuse	▪ Wastewater reuse will provide an additional climate independent water source for local farms and public open spaces. Additional water sources increases reliability and resilience. ▪ Household wastewater reuse within a purple pipe network would provide a climate independent (non-potable) water source to households, which will reduce reliance on mains water. (This option was investigated during the planning process, but not recommended.
Rainwater Tanks	▪ Household use of rainwater will reduce potable water demand. Additional water sources increases reliability and resilience.

8.5. TBL Assessment Outcomes

Through the decision making undertaken during the workshop, Scenario 3 was the preferred scenario, resulting in the following IWM infrastructure developments. (See Section 7 for further details)

8.5.1. Wastewater Reuse

The TBL assessment indicated that local wastewater reuse should be a high priority action from this plan, due to the benefits that it could provide and the need for additional wastewater management as population increases. As described in Section5.2.4, the volume of wastewater generated is expected to increase by around 400ML/year by 2040, and this additional volume would be available for reuse. Confirmed future demand for wastewater will need to be determined as a first step in implementing the scheme, to more accurately size the wastewater storage and estimating the volume of water that will be reused.

Total net present value (over 30 year timeframe)	$39,000
Total net present value per ML of reuse (over 30 year timeframe)	$1.6/ML (Revenue)

8.5.2. Stormwater Harvesting and Reuse

Stormwater reuse of around 270 ML/ annum by 2040 through harvesting from wetlands for irrigation of public open spaces, and through harvesting from household rainwater tanks.

The TBL assessment indicated that local stormwater reuse should be a high priority action from this plan, due to the water quality benefits that it could provide, confirmed existing and future open space irrigation demands, the need for stormwater management due to growth and the fact that existing infrastructure has already been developed.

Total net present value (over 30 year timeframe)	-$26.0M
Total net present value per kL of reuse (over 30 year timeframe)	-$3,850/ML (cost)

8.5.3. WSUD Treatments

In particular this will include construction of green corridors which would incorporate vegetated swales and will promote infiltration and treatment of the stormwater. This is expected to result in average annual infiltration of 400ML.

WSUD treatments for new development areas should be a high priority action from this plan due to the benefits that they will provide, and efficiencies associated with implementing them at the time of development. WSUD treatments should also be retrofit opportunistically throughout the existing township, and these opportunities should be sought as infrastructure is upgraded. Meeting the Council's preference for these features to be located in the green corridors will mean the corridors will need to be wide enough to incorporate the range of features recommended. Additional details are provided in Appendix D.

Total Net Present Value (over 30 year timeframe)	$16.7M
Total Net present Value per kL of reuse (over 30 year timeframe)	No water reuse

8.5.4. Managed Aquifer Recharge (MAR) viability investigations.

It is recommended that a feasibility assessment be conducted for a future MAR operation. The feasibility assessment would consider how adequately particular locations would achieve cost effective storage and reuse of stormwater/wastewater for irrigation. Additionally, a cost-benefit analysis of any proposed scheme would be required to compare MAR with above ground storage.

8.5.5. Mandate rainwater tanks

Maximising the capture and reuse of rainwater within all new (and existing) homes would reduce the volumes of stormwater that need to be managed on a larger scale and reduce reliance on potable mains water supply. The investigations undertaken for the TBL assessment (refer Appendix D) determined the following recommendations:

- 5,000 litre (L) household rainwater tanks to be plumbed to laundry, toilets and hot water supply will maximise the volume that can be reused within each home.

It is estimated that by 2040, around 100ML/year of rainwater would be captured and used through this scheme.

8.5.6. Other Actions

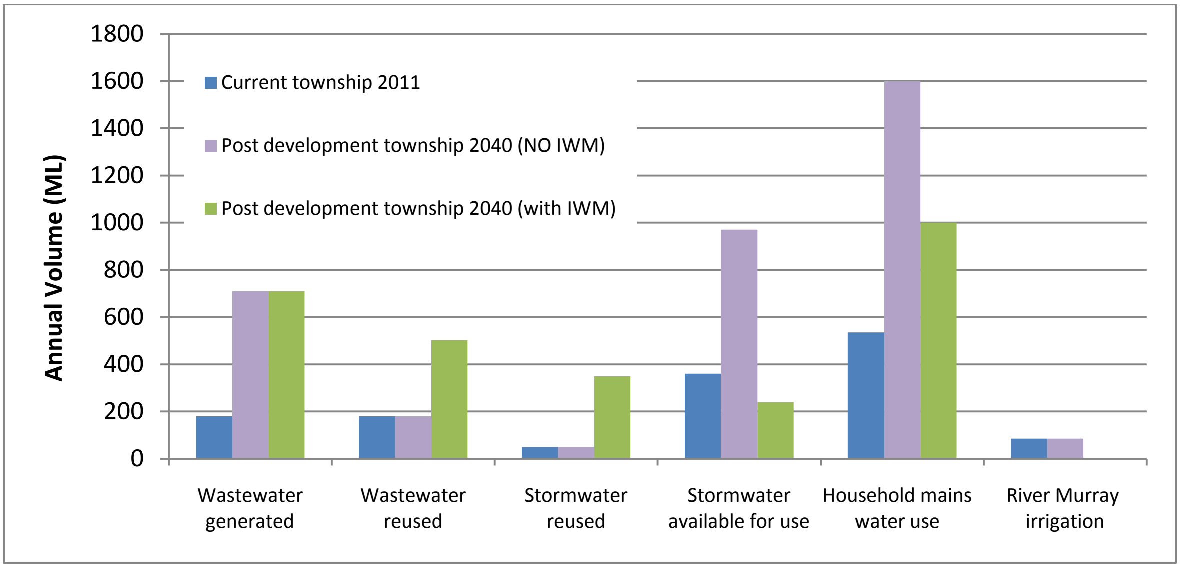
Other infrastructure actions were considered in the TBL assessment process and ruled out due to poor performance against the TBL assessment criteria.

During the TBL process, the benefits and costs of the purple pipe network were considered and compared with the other water management options. As a result of the TBL, the purple pipe option was not recommended primarily based on the estimated costs for the scheme. Other opportunities for stormwater and wastewater reuse were considered to be more economical.

8.6. Impacts of Preferred Infrastructure on Water Resources

As discussed in Section 6, for both Goolwa and Hindmarsh Island, the volumes of runoff are predicted to decrease by a small amount as a result of the climate change projections in comparison with the large increase to the stormwater runoff volumes that are estimated as a result of the urban development. Subsequently the expected impacts to the main urban water elements as a result of recommended infrastructure action were calculated used historic climate data.

Figure 8-5 and Table 8-5 compare the major urban water elements for Goolwa for the current township, post development township without implementation of IWM actions, and post development township with implementation of the IWMP actions (Scenario 3).



- **Figure 8-5: Comparison of the major urban water elements for Goolwa for the Current township (2011), Post development township (2040) without implementation of IWM actions, and Post development township (2040) with implementation of the IWMP actions**

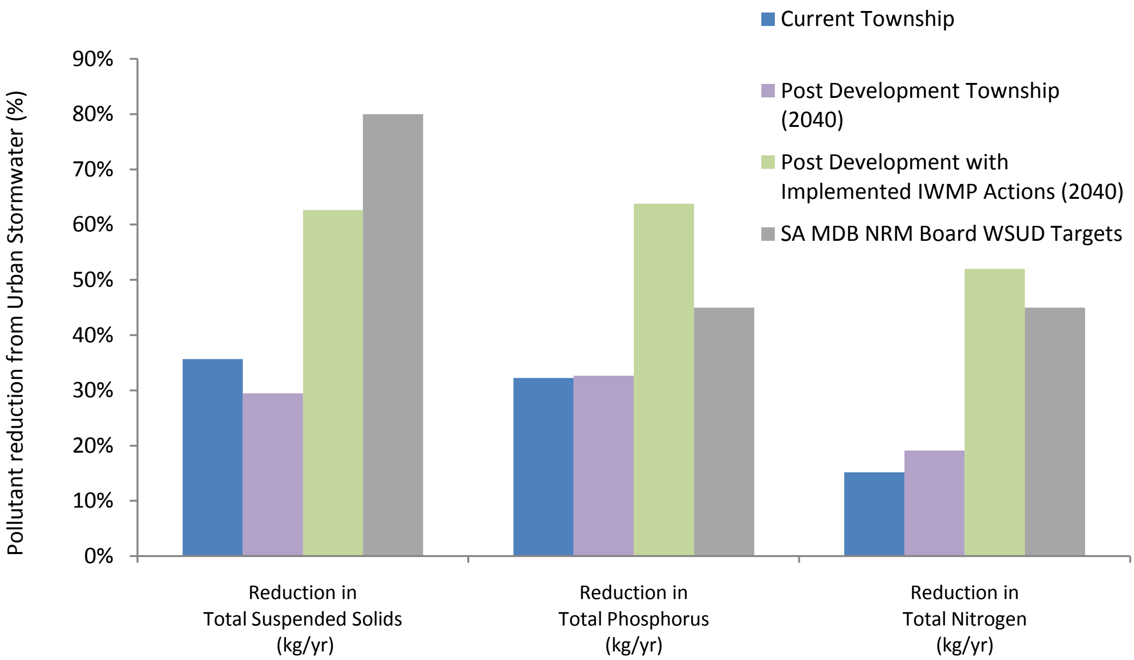
Table 8-5: Water Supply and Use figures for major elements of the Urban Water system for the current township (2011), developed Goolwa township (2040) without implementation of IWMP actions, and developed Goolwa township (2040) with implementation of IWMP actions

Stormwater	**Stormwater Generated (ML/year)**	**Stormwater Infiltration & Evaporation (ML/year)**	**Rainwater (additional) (ML/year)**	**Stormwater reused (ML/year)**	**Maintenance of pre-development flows to watercourse (ML/year)**	**Stormwater available for additional alternative uses (ML/year)**
Goolwa current (2011)	790	40	0	50	340	360
Goolwa post development (2040)without IWMP actions	1570	220	0	50	340	970
Goolwa post development (2040), with IWMP actions	1570	640	160	190	340	240
Wastewater	**Wastewater generated (ML/year)**	**Wastewater reused (ML/year)**	**Wastewater excess (ML/year)**			
Goolwa current (2011)	180	180	0			
Goolwa post development (2040)without IWMP actions	580	180	400			
Goolwa post development (2040), with IWMP actions	580	503[1]	77			
Mains	**Household Mains Use (ML/year)**	**Irrigation mains water use (Council) (ML/year)**				
Goolwa current (2011)	535	5.5				
Goolwa post development (2040)without IWMP actions	1200	5.5				
Goolwa post development (2040), with IWMP actions	1000	0				
River Murray Water	**Irrigation River Water Use (ML/year)**					
Goolwa current (2011)	85					
Goolwa post development (2040)without IWMP actions	85					
Goolwa post development (2040), with IWMP actions	0					

Note 1 – The report has combined Goolwa and Hindmarsh Island wastewater as they would be treated together. This number assumes 80% of the turf farm irrigation demand is met by the Goolwa proportion of wastewater.

8.7. Impact of Preferred Infrastructure on Stormwater Quality

Figure 8-6 shows compares the total pollutant removal estimated from stormwater runoff from the urban catchments of Goolwa for the Current township, Post development township without implementation of IWM actions, and Post development township with implementation of the IWMP actions. The SA MDB NRM Board WSUD targets for pollutant removal are also shown on the graph for comparison. It shows that the current township and post development township without implementation of IWM actions both fall significantly short of the WSUD targets. For the post development township with implementation of the IWMP actions, the percentage reduction for Nitrogen and Phosphorus exceed the target however the removal of suspended solids is still around 15% below the target.



- **Figure 8-6: Comparison of the percentage removal of pollutants for Goolwa for the current township (2011), post development township (2040) without implementation of IWM actions, and post development township (2040) with implementation of the IWMP actions**

9. Integrated Water Management Actions for Hindmarsh Island

9.1. Introduction

This section outlines in detail the range of Integrated Water Management actions that were identified for Hindmarsh Island. The major benefits of each of the actions are discussed, and the impacts that each option would have to the major elements of the urban water system are included.

The actions were developed following a review of the relevant background documents and a site visit to the Alexandrina Council area. The list of actions was developed in consultation with the SA MDB NRM Board and Alexandrina Council, and formed a comprehensive list of possibilities. Appendix B contains the Options Report and contains a description of all IWM actions that were considered.

9.2. Wastewater Management and Reuse

New development of approximately 800 allotments is expected on Hindmarsh Island, which is currently serviced by individual septic systems. The EPA has advised that there should be no on-site disposal of wastewater in the future. Construction will commence in 2012 on a community wastewater management system for Hindmarsh Island to cater for the anticipated growth. This project will pump sewage from Hindmarsh Island residences through a pipeline to Goolwa, where it would be integrated with the Goolwa sewage and treated at the Goolwa WWTP. The treated wastewater would then be reused within the same network as wastewater from Goolwa. A concept design investigation has already been completed for this option (HDS Australia, 2010), and it would produce the same benefits as described for wastewater reuse in Goolwa (refer Section 7.2).

During the TBL assessment, this option was classified as a high priority, as it is necessary for compliance with EPA requirements.

9.3. Stormwater Management and Reuse

There is potential to design stormwater management infrastructure to improve runoff water quality and reduce the volume of water discharged from Hindmarsh Island to the Goolwa Channel. The urban growth within Hindmarsh Island will result in additional 180 ML of stormwater runoff, and there is potential to provide WSUD treatments to improve the quality and reduce the volume of discharge. The Council have indicated that urban development in Hindmarsh Island will consist of kerb & gutter drainage.

One opportunity for stormwater treatment and storage is to provide several bio-infiltration basins at locations where stormwater runoff naturally collects within the catchment, as shown in Figure 10-1.

Bio-infiltration basins are vegetated filtration systems that can temporarily detain runoff, allowing it to infiltrate and improve the water quality. They are densely vegetated and contain a filter media for filtration of the runoff. Water would discharge from the kerb and gutter drainage systems into the basins, and infiltrate rather than directly running off and being discharged to the Goolwa Channel.

The main benefits that would result from the implementation of the bio-infiltration basins include:

- Minor flooding attenuation. While the treatments will have little effect for major flood events, they will contribute to attenuation of minor flooding through slowing down runoff throughout the catchment, and infiltration.
- Reduction to the volume of stormwater runoff, through infiltration. The estimated average yearly volume of infiltration through the bio infiltration basins that were modelled for the project is estimated to be 240ML. Reducing stormwater quantity is beneficial to prevent excess discharge (above pre-development flows) to the Goolwa Channel. This is protects aquatic ecosystems in Currency Creek and the Goolwa Channel through reducing the potential for erosion and discharge of pollutants.
- Improved quality of water discharged to Goolwa Channel through reduction in total annual load of P (50kg), N (360kg) and total suspended solids (28,000kg) by 2040.

A preliminary estimate of the Net Present Value was developed for this initiative, for the purpose of comparison with other water management options during the TBL process. The present value of the major components of the costs and revenue are included in Table 9-1 below. All assumptions included in the cost estimate and a breakdown of the inclusions and unit rates used is included in Appendix F.

Table 9-1 Estimated Costs for bio retention basins

Cost Component	Preliminary Cost Estimate (present value)
Total Capital Costs (includes excavation, construction of liner and filter and re vegetation).	$1.1M
Annual Maintenance and Operational costs	$80,000
Average yearly revenue from use of water	None
Total Net Present Value (over 30 year timeframe)	$2.7M
Total Net present Value per kL of reuse (over 30 year timeframe)	None

9.4. Description of Planning Actions for Hindmarsh Island

The same planning, education, water conservation and monitoring and review opportunities exist for Hindmarsh Island as were provided for Goolwa in Sections 7.12.

10. Identification and Assessment of Integrated Water Management Scenarios for Hindmarsh Island

10.1. Introduction

A range of actions for IWM on Hindmarsh Island were developed following consideration of the major elements of the urban water supply system and the impacts that are expected as a result of urban development and climate change projections. The actions were developed in alignment with the IWMP goals, in consideration of the priorities for the Hindmarsh Island Township and future considerations that may affect water resources management.

This Section describes the process that was undertaken to develop scenarios (groups of actions) and assess these scenarios. A description of the Triple Bottom Line Assessment process that was used to determine which of the scenarios should be recommended as actions from this plan is also included.

It is acknowledged that the availability of funding will influence which actions are implemented, as well as the timing of implementation.

10.2. Scenario Development

To optimise the selection of infrastructure options for integrated water management to meet the project's goals, three scenarios (groups of actions) that represent different outcomes and levels of investment were generated. These scenarios were focussed on growth areas identified in the 30 Year Plan for Greater Adelaide (DPLG, 2010) in the Hindmarsh Island area.

A workshop was held with Council following submission of the Options Report to agree to a shortlist of feasible and desirable actions to include in the scenario assessment. Table 8-1 shows the scenarios that were determined from this discussion. Each scenario contains several options, and each scenario builds upon previous scenarios meaning they increase in complexity.

■ **Table 10-1 Integrated Water Management Scenarios for Hindmarsh Island**

Scenario	Description
Scenario 1: Base Case (Wastewater Management)	• New development of approximately 300 allotments is expected on Hindmarsh Island, which is currently serviced by individual septic systems. • The EPA has advised that there should be no on-site disposal of wastewater in the future. • This option would provide a community wastewater management system and then pump the sewage through a pipeline to Goolwa, where it would be integrated with the Goolwa sewage and treated at the Goolwa wastewater treatment plant.
Scenario 2: Wastewater Management and WSUD features	• This Scenario includes the wastewater management system proposed for the Base Case as well as construction of several bio-infiltration basins at locations where stormwater runoff naturally collects within the catchment. • This would reduce the volume of water discharged to the Lower Lakes System, and decrease the risk of flooding to new development areas.
Scenario 3: Wastewater Management, WSUD features and constructed wetland	• Includes the wastewater and WSUD features described for Scenario 2, as well as a constructed wetland, which would improve the quality of water discharged to Lower Lakes System.

10.3. Triple Bottom Line Assessment Process

The same Triple Bottom Line Assessment Process was use for Hindmarsh Island as was described in Section 8.3 for the Goolwa Township.

10.3.1. Criteria and Weights

The same criteria and weights were used for the Hindmarsh Island TBL as was described in Section 8.3.1 for the Goolwa Township.

10.4. Description of Technical work to provide information to TBL assessment

The following sub sections describe the technical calculations that were undertaken to provide information that was used in the TBL workshop to compare each of the IWM scenarios by assigning scores to each of the assessment criteria.

Not all of the criteria could be assessed quantitatively, and an important component of the TBL workshop was discussion of the subjective criteria with the project stakeholders to agree on a score using qualitative reasoning.

A detailed description of the TBL outcomes is included in Appendix D.

10.4.1. Stormwater volumes and water quality – MUSIC Modelling

The impacts of each of the IWM scenarios to stormwater runoff and the quality of water discharged to the Goolwa Channel were completed using MUSIC modelling. The MUSIC model that was described in Section 0 for the developed Hindmarsh Island Township was modified to include each of the IWM scenario options.

Figure 10-1 shows the stormwater catchment map for the developed Hindmarsh Island township, with implementation of the IWMP actions. The volume of runoff is significantly reduced from the newly developed townships as a result of construction of the bio infiltration basins.

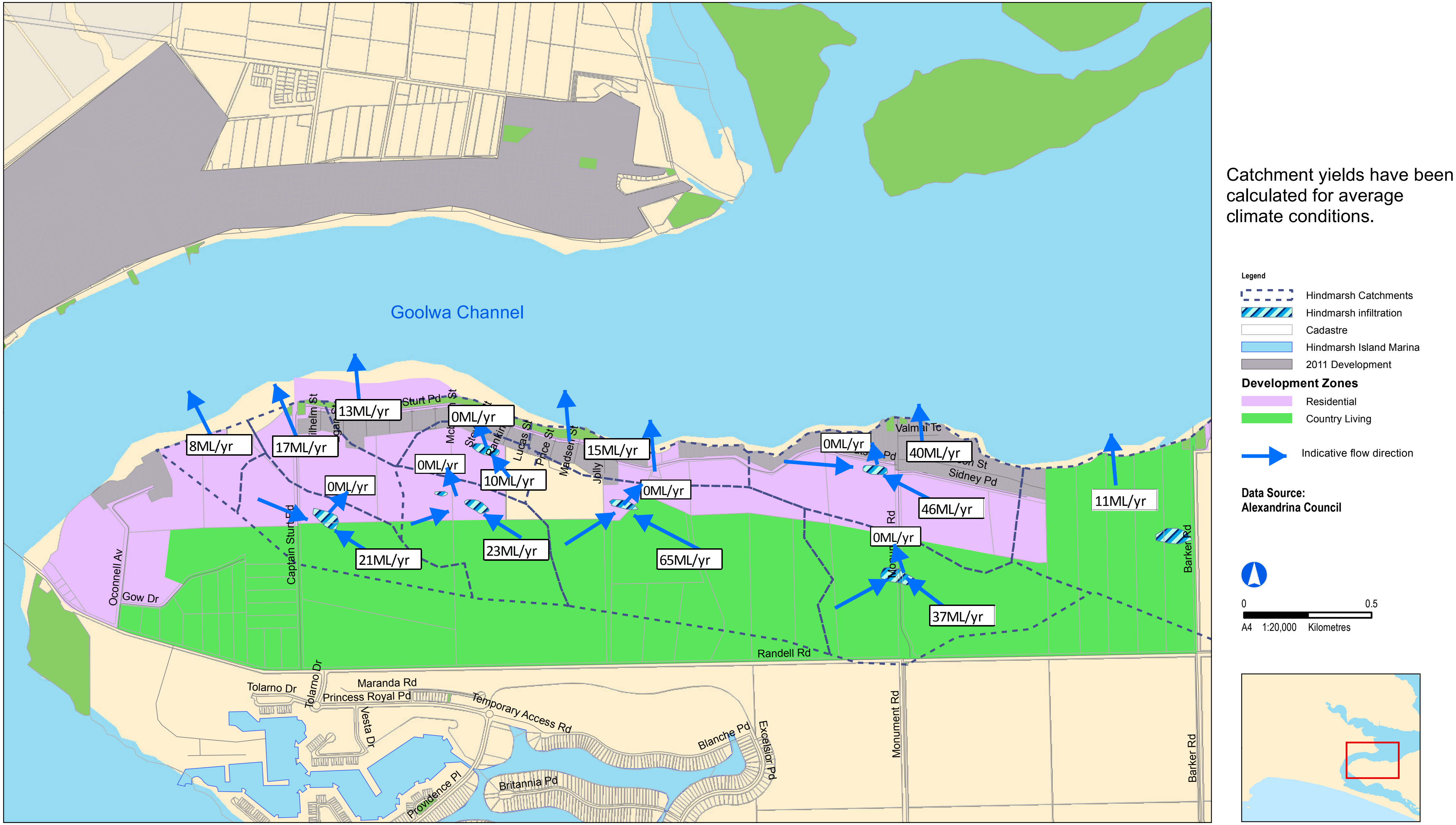


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Figure 10-1 Stormwater Runoff - Hindmarsh Island 2040 with IWM Action

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Integrated Water Management Plan - Goolwa and Hindmarsh Island

v1

October 18, 2011

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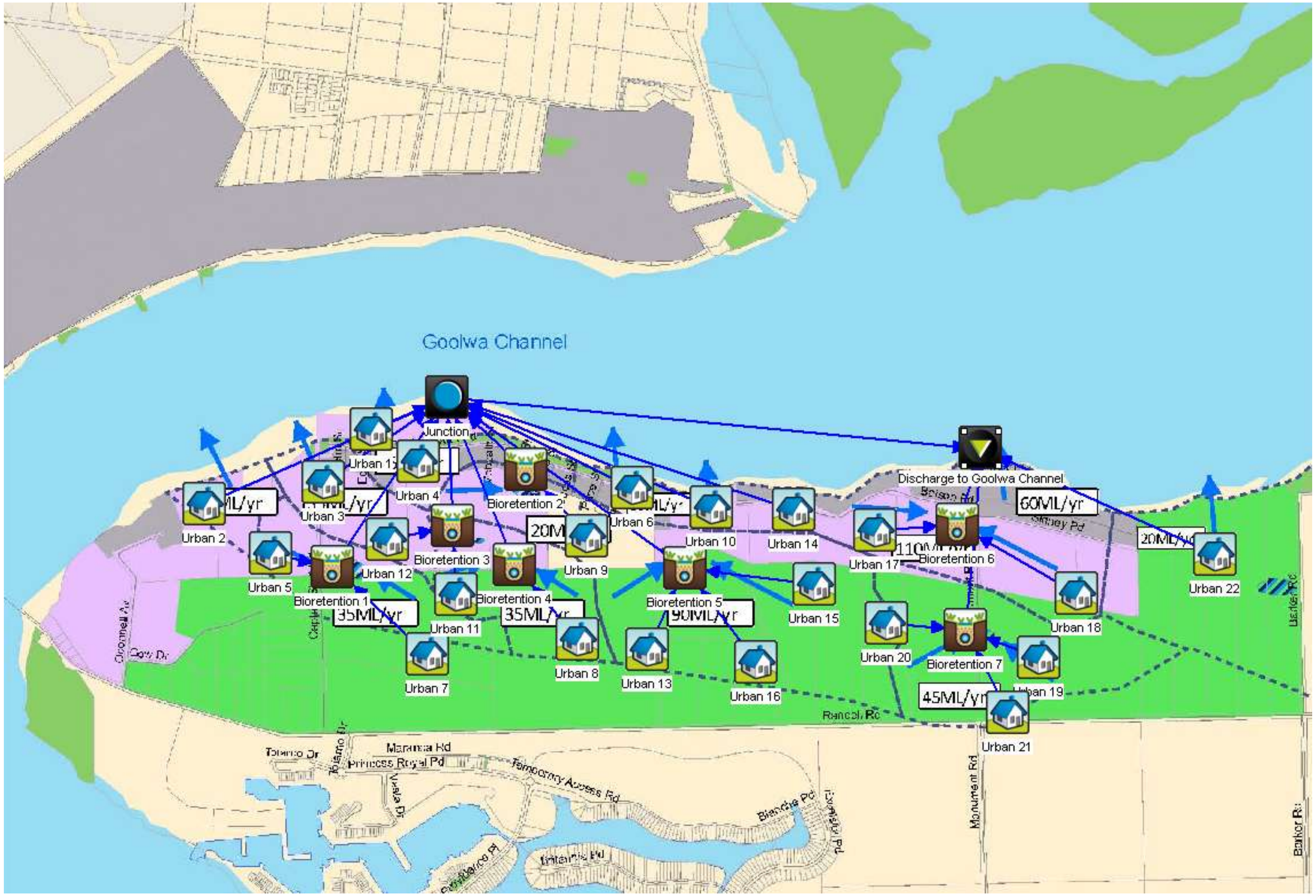
Figure 10-2 shows a schematic of the MUSIC model for the developed Hindmarsh Island Township, with the stormwater IWM actions included. The model contains 22 urban catchment nodes, which represent the developed Hindmarsh Island Township. Seven bio retention basins have been added to the model, in low points of the catchment areas. All overflow from the bioretention basins and other catchments is discharged to the Goolwa Channel. The spatial location of the nodes on the schematic only depicts indicative locations of elements of the system; however this has no effect on the results of the modelling. The flow and water quality outputs from each node of the model are included in Appendix G.

An additional assumptions were made as part of the MUSIC modelling of the IWM options. These include:

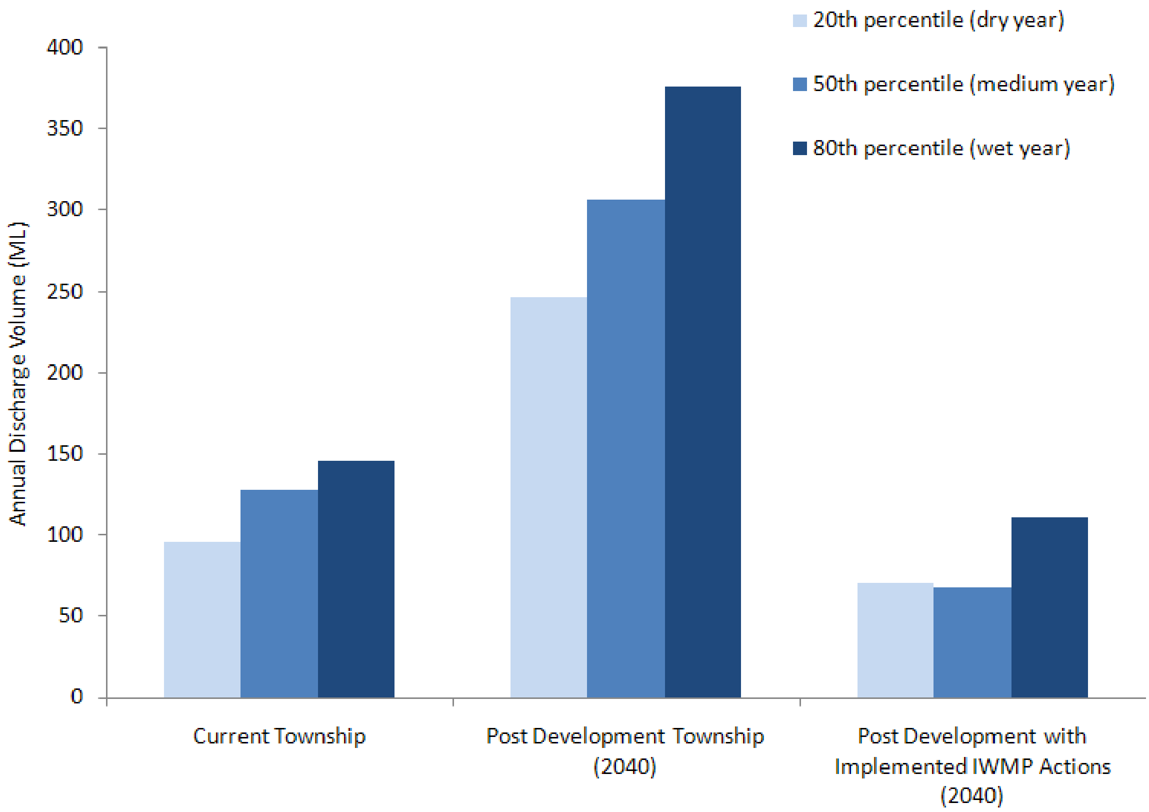
All water quality modelling was undertaken using the default quality parameters for stormwater within the MUSIC model. More accurate results would be obtained using actual water quality data from urban stormwater in Hindmarsh Island.

Figure 10-3 shows the volume of urban stormwater that would be discharged to the Goolwa Channel for the developed Hindmarsh Island Township, as estimated by the MUSIC Model for the current township, developed township without implementation of the stormwater IWMP options, and the developed township with implementation of all of the stormwater IWMP options. The 20th percentile, 50th percentile and 80th percentile rainfall years from the historical rainfall record (1871 – 2010), were used to show the difference in the volume of urban runoff for a dry, average and wet year.

The Figure shows that the volumes of runoff for the developed township are predicted to reduce to slightly less than for the current township as a result of implementation of all of the IWM stormwater options.



- **Figure 10-2: Schematic of the MUSIC Model for the Hindmarsh Island township post development, with implementation of all stormwater IWM options**



- **Figure 10-3: Estimate of the volume of stormwater discharged from the Hindmarsh Island township**

Table 10-2 provides an estimate of the water quality parameters for the developed Hindmarsh Island Township with implementation of the IWMP actions, derived using the MUSIC model for the developed township. The water quality was modelled using assumed water quality for urban areas in Adelaide, as supplied as a default parameter in the MUSIC model, rather than using measured data. The Table also demonstrates how the water quality for the developed township with implemented IWMP actions is estimated to perform relative to the WSUD Targets.

Table 10-2: Estimate of water quality for the developed Hindmarsh Island Township, with implementation of the IWMP actions

	WSUD Targets (SA MDBNRMB, 2011)		
	Pollutant Load Reduction Target	Average annual pollutant load reduction %	Average annual pollutant removal (Kg)
Total suspended solids	80%	70%	28,000
Nitrogen	45%	65%	360
Phosphorus	45%	70%	50
Gross Pollutants	No percentage target	60%	3,740

10.4.2. Net Present Value Calculations

The same process for estimating the net present value for each of the IWM scenarios was undertaken for the Hindmarsh Island TBL as described in Section 8.4.3 for the Goolwa Township.

10.4.3. Consideration of climate change impacts during Triple Bottom Line Assessment process

The same process for considering the climate change impacts of each of the IWM scenarios was undertaken for the Hindmarsh Island TBL as described in Section 8.4.4 for the Goolwa Township.

10.5. Summary of Priority Actions for Hindmarsh Island

Through the decision making undertaken during the workshop, Scenario 2 was the preferred option, rsuling in the the following IWM infrastructure actions recommended for the action plan:

- Transfer wastewater to Goolwa for treatment and reuse
- Construction of bio-infiltration basins at low points throughout the catchment area. This is expected to result in average annual infiltration/evaporation of 370ML.

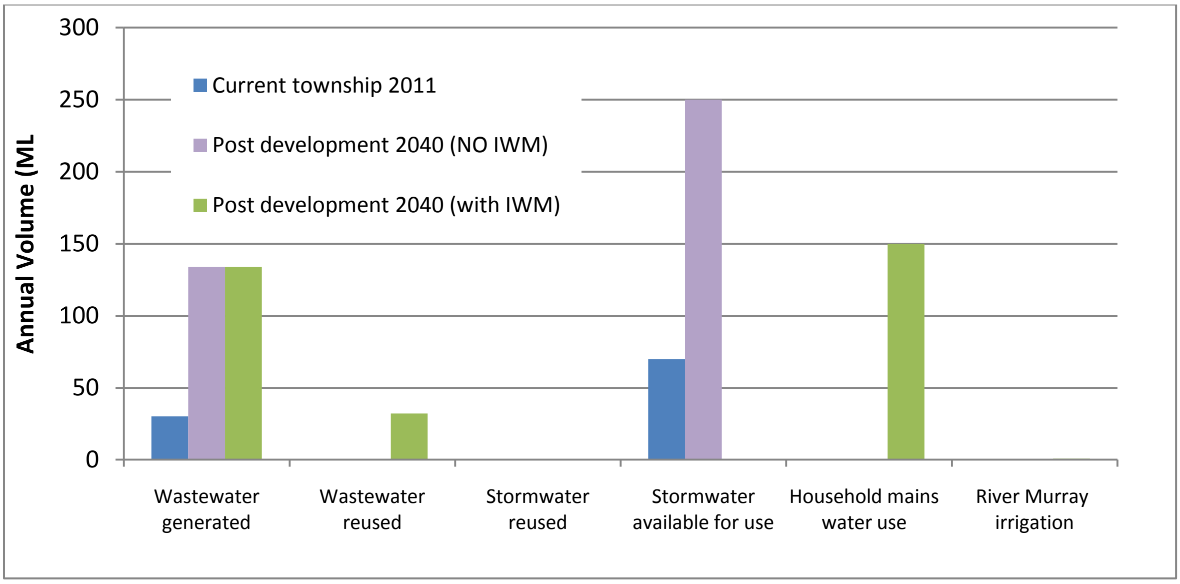
10.5.1. Stormwater Management and Reuse (Bioinfiltration Basins)

During the TBL assessment, the bio-infiltration option was classified as being a high priority, due to the minor flooding benefits and water quality improvements that they would be expected to provide.

Total Net Present Value (over 30 year timeframe)	$2.7M
Total Net present Value per kL of reuse (over 30 year timeframe)	None

10.6. Impacts of Preferred Infrastructure Development to Water Resources

Figure 10-4 and Table 10-3 compare the major urban water elements for Hindmarsh Island for the current township, post development township without implementation of IWM actions, and post development township with implementation of the IWMP actions.



- **Figure 10-4: Comparison of the major urban water elements for Hindmarsh Island for the current township (2011), post development township (2040) without implementation of IWM actions, and post development township (2040) with implementation of the IWMP actions**

Table 10-3: Water supply and use figures for major elements of the urban water system for the current and developed Hindmarsh Island township, with and without implementation of IWMP actions

Stormwater	Stormwater Generated (ML/year)	Stormwater Infiltration & Evaporation (ML/year)	Rainwater capture (additional) (ML/year)	Stormwater reused (ML/year)	Maintenance of pre-development flows to watercourse (ML/year)	Stormwater available for additional alternative uses (ML/year)
Hindmarsh Island current (2011)	130	Unknown	0	0	60	70
Hindmarsh Island post development (2040), without IWMP actions	310	Unknown	0	0	60	250
Hindmarsh Island post development (2040), with IWMP actions	310	240	40	0	60[1]	0

Wastewater	Wastewater generated (ML/year)	Wastewater reused (ML/year)	Wastewater excess (ML/year)
Hindmarsh Island current (2011)	30	0	30
Hindmarsh Island post development (2040), without IWMP actions	134	0	134
Hindmarsh Island post development (2040), with IWMP actions	130	0	0

Mains	Residential Mains Use (ML/year)	Irrigation mains water use (Council) (ML/year)
Hindmarsh Island current (2011)	0	0.7
Hindmarsh Island post development (2040), without IWMP actions	150	0.7
Hindmarsh Island post development (2040), with IWMP actions	150	0

River Murray Water	Irrigation River water use (ML/year)
Hindmarsh Island current (2011)	0
Hindmarsh Island post development (2040), without IWMP actions	0
Hindmarsh Island post development (2040), with IWMP actions	0.7

10.7. Impact of Preferred Infrastructure on Storm Water Quality

Figure 10-5 compares the total pollutant removal estimated from stormwater runoff from the urban catchments of Hindmarsh Island for the Current township, Post development township without implementation of IWM actions, and Post development township with implementation of the IWMP actions. The SA MDB NRM Board WSUD targets for pollutant removal are also shown on the graph for comparison.

Since there are no major stormwater treatment features in the current Hindmarsh Island Township of the post development township without implementation of IWMP actions, the removal of suspended solids, nitrogen and phosphorus from stormwater runoff was estimated to be negligible. The Figure shows that for the post development township with implementation of the IWMP actions, the percentage reduction for Nitrogen and Phosphorus exceed the target however the removal of suspended solids is still around 10% below the target.

- **Figure 10-5: Comparison of the percentage removal of pollutants for Hindmarsh Island for the current township, post development township without implementation of IWM actions, and post development township with implementation of the IWMP actions**

11. Action Plan: Goolwa

The actions recommended for Integrated Water Management for Goolwa have been summarised in Table 11-1, under each of the following categories infrastructure; planning, capacity building and governance; water conservation and monitoring and review. The table includes explanation of the priority of each action, key benefits, the outputs that will result, cost estimate information, and the timing for implementation. For actions that are to be implemented opportunistically, cost estimate information has not been presented as it will depend highly on funding opportunities and timing of implementation.

As described in Section 1.6, responsibilities for IWM are divided between the community and agencies responsible for the various aspects of water supply, treatment, use and management including SA Water, the Alexandrina Council and the SA MDB NRM Board. This Action Plan has prioritised those actions the Council can directly control, along with other actions where the Council can influence the water management decisions of others.

Many of the actions relating to planning, capacity building and governance are highlighted to occur in the next 1-5 years. Most of these actions are required to provide the foundations for IWM action, in particular implementation of WSUD and assessment of new development applications.

▪ Table 11-1: Summary Integrated Water Management Action Plan for Goolwa

<table>
<tr><th rowspan="2">Action</th><th rowspan="2">Priority</th><th rowspan="2">Responsibility</th><th rowspan="2">Relevant Goals (Section 2)</th><th rowspan="2">Key benefits and risks addressed</th><th rowspan="2">Output</th><th rowspan="2">Estimated Cost</th><th colspan="3">Timing (year)</th></tr>
<tr><th>2012-2015</th><th>2015-2025</th><th>2025-2040</th></tr>
<tr><td colspan="10">Infrastructure Actions</td></tr>
<tr><td rowspan="3">Wastewater Reuse</td><td rowspan="3">High</td><td>Council</td><td rowspan="3">Goal 1, Goal 2, Goal C4</td><td rowspan="3">▪ Diversification of water resources
▪ Increased security of supply</td><td>Identification of demand for wastewater to west of Goolwa</td><td rowspan="3">NPC to Council of - $40,000 estimated during TBL assessment (indicative only)</td><td></td><td></td><td></td></tr>
<tr><td>Council</td><td>Design of wastewater storage to West of Goolwa, and distribution network</td><td></td><td></td><td></td></tr>
<tr><td>Council</td><td>Construction of wastewater storage and distribution network</td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">Stormwater Reuse</td><td rowspan="4">High</td><td rowspan="4">Council (may look to funding partnerships with others)</td><td rowspan="4">Goal 1, Goal 2, Goal C4, Goal C5</td><td rowspan="4">▪ Reduced volumes of stormwater discharged to Goolwa Channel
▪ Diversification of water resources
▪ Increased security of supply</td><td>Design of wetland (8.8Ha), integrated with open space area near WWTP</td><td rowspan="2">NPC to Council of $20.5M estimated during TBL assessment (indicative only)</td><td></td><td></td><td></td></tr>
<tr><td>Construction of wetland and open space area near WWTP</td><td></td><td></td><td></td></tr>
<tr><td>Design and construction of wetlands at Goolwa North (1Ha and 1.7 Ha)</td><td>NPC to Council of $1.4M estimated during TBL assessment, assuming Developers would pay for capital costs (indicative only)</td><td></td><td></td><td></td></tr>
<tr><td>Design and construction of extended stormwater reuse network</td><td>NPC to Council of $1.7M estimated during TBL assessment (indicative only)</td><td></td><td></td><td></td></tr>
<tr><td>WSUD Treatments</td><td>High</td><td>Council (may look to funding</td><td>Goals 1, Goal C4, Goal C5</td><td>▪ Improved water quality of stormwater discharge to Goolwa Channel</td><td>Integration of WSUD treatments to new development areas,</td><td>NPC to Council of $12.5M estimated during TBL assessment</td><td></td><td></td><td></td></tr>
</table>

Action	Priority	Responsibility	Relevant Goals (Section 2)	Key benefits and risks addressed	Output	Estimated Cost	Timing (year)		
							2012-2015	2015-2025	2025-2040
		partnerships with others)		▪ Reduced volumes of stormwater discharged to Goolwa Channel ▪ Minor flood mitigation benefits	opportunistic WSUD treatments to existing urban areas	(indicative only)			
Flood Mitigation in Green Corridors	High	Council (may look to funding partnerships with others)	Goals 1, Goal C4, Goal C5	▪ Flood mitigation throughout new development areas of Goolwa North. ▪ Secondary aesthetic and community benefits.	Detailed flood investigations, followed by design and construction of flood mitigation infrastructure.	Not costed – will depend upon the timing and extent of investigations.			
Investigate MAR	Medium Further investigation required to determine viability	Council /SA MDB NRMB	Goal 1, Goal 2	▪ Underground storage of wastewater or stormwater would reduce evaporative losses.	Detailed analysis of potential MAR locations, including drilling investigations	Not costed – will depend upon the extent of investigations.	Implement opportunistically throughout lifetime of plan		
Purple Pipe network	Not a current priority (from results of TBL assessment)	Council (may look to funding partnerships with others)	Goal 1, Goal 2	▪ Provide reliable demand for treated wastewater and stormwater ▪ Diversification of water resources ▪ Increased security of supply	Design and construction of purple pipe network	NPC to Council of $28M estimated during TBL assessment (indicative only)			
Planning									
Mandate particular rainwater tank sizes and in-house use for all new developments	High	Council	Goal 1, Goal 2, Goal 4	▪ Reduced volumes of stormwater discharged to Goolwa Channel ▪ Diversification of water resources ▪ Increased security of supply	Development plan policy requiring all new developments to include a 5kL rainwater tank	Not costed – internal costs to Council			
Update the Residential Development Code	High	Council	Goal 1, Goal 4, Goal C4	▪ Ensure all new development addresses WSUD	Update to Residential Code	Not costed – internal costs to Council			

Action	Priority	Responsibility	Relevant Goals (Section 2)	Key benefits and risks addressed	Output	Estimated Cost	Timing (year)		
							2012-2015	2015-2025	2025-2040
Council's Development Plan Complying and on-Merit Provisions	High	Council	Goal 1, Goal 2, Goal 4, Goal C4	▪ Encourage the use of rainwater tanks, integrated water management outcomes and natural resources management policies	Update to Development Plan provisions	Not costed – internal costs to Council			
Amend Schedule 5 of the Development Regulations	High	Council	Goal 1, Goal 4, Goal C4	▪ Ensure all development applications include information that show how they address WSUD	Update to Development Regulations	Not costed – internal costs to Council			
Protection of riparian areas	High	Council	Goal 1, Goal 4	▪ Watercourses will be better protected through Structure and Development Plans	Updates to Structure Plans and Development Plans	Not costed – internal costs to Council			
Structure Planning	High	Council	Goal 1, Goal 4, Goal 5, Goal 6, Goal C4, Goal C5	▪ Identification of key open space corridors and water reuse opportunities	Conceptual structure plan	Not costed – internal costs to Council			
Outdoor Water Use – Greenfield Developments	High	Council	Goal 1, Goal 2, Goal 4, Goal C4	▪ Identification of fit for purpose water supplies at the commencement of Greenfield developments	Fit for purpose water reuse solutions	Not costed – internal costs to Council			
Update Development Plan Provisions for fit for purpose water reuse	High	Council	Goal 1, Goal 2, Goal 4	▪ Further promotion of fit for purpose water use	Update to Development Plan provisions	Not costed – internal costs to Council			
Discount Open Space Contribution	High	Council	Goal 1, Goal 4, Goal C4	▪ Promotion of integrated water management and urban design outcomes	Update to Development Plan Policy	Not costed – internal costs to Council			
Ensure water infrastructure does not	High	Council	Goal 1, Goal 4, Goal C4	▪ Promotion of integrated water management and urban design outcomes	Update to Development Plan Policy	Not costed – internal costs to Council			

Action	Priority	Responsibility	Relevant Goals (Section 2)	Key benefits and risks addressed	Output	Estimated Cost	Timing (year)		
							2012-2015	2015-2025	2025-2040
encroach upon 12.5% open space contribution									
Changes to Development Act to require Developer Contributions	High	Council	Goal 1, Goal 3, Goal 4	▪ Developer contributions to off-site infrastructure requirements as a result of their proposed developments	Amendment to Development Act	Not costed – internal costs to Council			
Conversion of Development Plan Amendment (DPA)	High	Council	Goal 1, Goal 4	▪ Incorporate natural resources management policies of the State Planning Policy Library into Council's Development Plan	Development Plan Amendment	Not costed – internal costs to Council			
Capacity Building and Governance									
Community Education and Awareness	High	Council and AMLR NRM Board	Goal 1, Goal C2	▪ Improve community awareness and knowledge, key steps on the way to enabling behaviour change	Various, including Information materials, updating Council website, media stories, community grants	Not costed – will depend on available budget and support			
Training of Decision-Makers	High	Council	Goal 1	▪ Provide Council staff with improved basis for decision making on development and water management	Better skilled decision makers	Not costed – internal costs to Council			
Identify IWM Champions	High	Council	Goal 1, Goal 5	▪ Integrate IWM into all areas of Council and provide advocacy and support	Responsibility for IWM identified	No cost			
Develop Explanatory Guidelines	Medium	Council	Goal 1, Goal C2	▪ Guidance to Council staff on intent and implementation of water-related policies within the Development Plan	Explanatory guidelines	Not costed – internal costs to Council			
Government Agencies	Medium	Council	Goal 1, Goal 4	▪ Obtain timely and relevant responses to water management	Updated response schedule	Not costed – internal costs to Council			

Action	Priority	Responsibility	Relevant Goals (Section 2)	Key benefits and risks addressed	Output	Estimated Cost	Timing (year)		
							2012-2015	2015-2025	2025-2040
Schedule 8 (Development Regulations) Responses				development issues					
Branding	Medium	Council	Goal 1, Goal C2	▪ Promote the Council as a water sensitive city	Various, including demonstration sites, media stories, website development	Not costed			
State Government Funding	High	Council	Goal 1, Goal 3, Goal 5	▪ State Government support would enable greater implementation of IWMP actions	Improved implementation of IWMP actions	Not costed – internal costs to Council			
NRM and WSUD Overlays	Medium	Council	Goal 1	▪ Provide a broader perspective on NRM/WSUD objectives to guide appropriate development	NRM and WSUD Overlays	Not costed – internal costs to Council			
Water Conservation									
Demand management measures	Medium	Council	Goal 1, Goal C3	▪ Encourage and support community water use efficiency	Community education, grants or rebates for water efficient fixtures	Not costed – will depend on measures adopted			
Monitoring and Review									
Finalise and implement Monitoring and Reporting Plan	High	Council	All	▪ Monitor progress and maximise opportunities for implementation ▪ Reporting to inform community	Regular report cards of progress and updates to IWM Action plan	Not costed – internal costs to Council	Annual monitoring and reporting required		

11.1.1. Monitoring and Review of Action Plan - Goolwa

The actions and recommendations included in this plan should be reviewed periodically over the next 30 years to monitor progress and maximise opportunities for implementation.

A team should be set up to continually track achievement of the actions outlined in the plan, and to have overall accountability for implementation of the actions. This team should be comprised of members of the Alexandrina Council, the SAMDB NRM Board, and other relevant stakeholders. An important function of this team will be to update the actions outlined in the plan as situations change, and water management risks emerge. Many of the actions included in the plan are to be implemented 'opportunistically', and this team will be responsible for seeking and identifying these opportunities to ensure that the actions are completed.

A proposed monitoring framework is suggested in the table below. For each of the goals, potential monitoring indicators, suggested targets and timeframes for the achievement of targets have been identified.

A reporting framework should be developed that describes how the information collected will be reported back to stakeholders and the community. A regular report card could form part of the Council's community education and awareness program.

- **Table 11-2: IWMP Monitoring Framework**

IWM Goals	Potential Indicators	Suggested Targets and Timeframes	Comments
Goal 1: Minimise adverse impacts on the environment	Proportion of new developments that apply appropriate WSUD treatments	100% over the life of the IWMP	The scale of appropriate WSUD applicable to a development must be considered however there are treatments available for all scales of development.
	Quality of water discharged to natural watercourses	To meet SA MDB NRM Board targets for WSUD treatments	Achievable through implementation of WSUD features and treatment and storage in wetlands
Goal 2: Use a Water Balance Approach to Match 'Fit for Use' Water Supply	Volume of urban stormwater captured and reused	Utilise at least 80% of stormwater runoff that is not required to maintain pre-development flows for fit for purpose use.	Achievable through stormwater storages and reuse (see Section 7.3)
	Volume of wastewater captured and reused for irrigation	100% by 2040	Achievable through additional wastewater storage, provided opportunities for reuse can be found.

IWM Goals	Potential Indicators	Suggested Targets and Timeframes	Comments
Goal 3: Establish an Economic Model to Deliver the IWMP	Funding model from a partnership between the State government, developers and the Council	Funding model developed by 2015	Model should allow flexibility for changes to funding opportunities in the future.
	Allocation of local personnel to be responsible for implementation of the IWMP action plan	Roles defined and allocated by 2013	Will be imperative in tracking progress and implementing IWMP actions
Goal 4: A Supportive Legislative Framework that delivers Integrated Water Management	Implementation of all of the actions relating to legislation from Table 11-1.	Timeframes as suggested in Table 11-1.	Progress should be monitored and reviewed regularly, as with the other actions from the plan.
Goal 5: Strong Partnerships and a Commitment to Integrated Water Management	Allocation of local personnel to be responsible for implementation of the IWMP action plan	Roles defined and allocated by 2013	Will be imperative in tracking progress and implementing IWMP actions
Goal 6: An Integrated Water Management Structure Plan for Goolwa North	Development of an IWM structure plan for Goolwa	Structure plan developed by 2013	To be led by the Council, with input from Developers, NRM Board and other stakeholders.
	Review and update of the structure plan as development progresses	Ongoing throughout lifetime of plan	
Goal C1: Minimise the carbon footprint of all water management actions	Proportion of water management projects considering carbon footprint	100% of projects over the life of the plan to consider carbon footprint	Every project should consider the carbon footprint and alternative measures for reducing the carbon footprint.
Goal C2: An aware community	Number of community awareness/involvement events related to IWM planned each year	At least 1 event/initiative each year until 2040	Initiatives should aim to involve a wide spectrum of the community
Goal C3: Manage demand for water	Per capita community usage of potable water	Realistic target set in consultation with Council by 2013, monitored yearly over lifetime of plan	Usage should decline due to water restrictions/conservation initiatives and increased fit for purpose uses.
Goal C4: Create high value open space in new developments	Proportion of open space created that can be considered 'high value'	80% of all open space over lifetime of plan	'High value' open space is accessible by the community, and has recreational and

IWM Goals	Potential Indicators	Suggested Targets and Timeframes	Comments
			aesthetic qualities.
Goal C5: Integrate shared access (bike/walking) paths with wetland and biodiversity corridors	Implementation of stormwater reuse and WSUD actions from Table 11-1.	Timeframes as suggested in Table 11-1.	Progress should be monitored and reviewed regularly, as with the other actions from the plan.

12. Action Plan: Hindmarsh Island

The actions recommended for Integrated Water Management for Hindmarsh Island have been summarised in Table 12-1. The table includes explanation of the priority of each action, key benefits, the outputs that will result, cost estimate information, and the timing for implementation. For actions that are to be implemented opportunistically, cost estimate information has not been presented as it will depend highly on funding opportunities and timing of implementation.

As described in Section 1.6, responsibilities for IWM are divided between the community and agencies responsible for the various aspects of water supply, treatment, use and management including SA Water, the Alexandrina Council and the SA MDB NRM Board. This Action Plan has prioritised those actions the Council can directly control, along with other actions where the Council can influence the water management decisions of others.

Table 12-1: Summary Integrated Water Management Action Plan for Hindmarsh Island

Action	Priority	Responsibility	Relevant Goals (Section 2)	Key benefits and risks addressed	Output	Estimated Cost	Timing (year)		
							2012-2015	2012-2015	2012-2015
Infrastructure Actions									
Transfer wastewater to Goolwa for treatment and reuse	High	Council	Goal 1, Goal 2, Goal C4	▪ For compliance with EPA requirements for no on-site wastewater disposal	Detailed design of transfer system and connections to existing wastewater treatment in Goolwa	NPC to Council of $750,000 estimated during TBL assessment (indicative only)			
		Council			Construction of transfer system and connections to existing wastewater treatment in Goolwa				
Bio-infiltration basins at low points throughout the catchment area	High	Council	Goal 1, Goal C4	▪ Improved water quality of stormwater discharge to Goolwa Channel ▪ Reduced volumes of stormwater discharged to Goolwa Channel ▪ Minor flooding mitigation benefits	Design and construction of bio-infiltration basins throughout new development areas	NPC to Council of $2.7M estimated during TBL assessment (indicative only)			
Planning, Education, Water Conservation, Monitoring and Review									
As provided in the Action Plan for Goolwa.									

12.1.1. Monitoring and Review of Action Plan – Hindmarsh Island

The actions and recommendations included in this plan should be reviewed periodically over the next 30 years to monitor progress and maximise opportunities for implementation. Please refer to Section 11.1.1 for details of a monitoring plan which relates to Goolwa and Hindmarsh Island.

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Appendix A: Milestone 1 Report – Policy Review

D1014961

Integrated Water Management Plans for the SA Murray-Darling Basin Greater Adelaide Region

Policy Review–Alexandrina Council

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Contents

List of Acronyms/Glossary of Terms

AMLR NRM Board	Adelaide & Mount Lofty Ranges Natural Resources Management Board
BDP	Better Development Plan
DPA	Development Plan Amendment
IWMP	Integrated water management plan
MAT	Management action target
RCT	Resource condition target
SAMDB NRM Board	South Australian Murray Darling Basin Natural Resources Management Board
WSUD	Water sensitive urban design

1.0 Introduction

1.1. Background to the Project

The aim of the *Integrated Water Management Plans for the SA Murray-Darling Basin Greater Adelaide Region* project is to provide a plan for sustainable, resilient townships across the region, through the identification of 'fit for purpose' water supplies for Council, residential, commercial and industrial uses.

For this project, Integrated Water Management Plans (IWMPs) will be prepared for particular locations within the District Council of Mount Barker, Alexandrina Council and the Rural City of Murray Bridge. These IWMPs will identify future demand for water, and match that demand with fit for purpose supply.

Informing this process, is an understanding of the strategic and statutory planning policy context. This understanding is important, as it is this strategic and statutory policy context which will assist in delivering the directions proposed by each IWMP "on the ground" via new and (possibly in some cases) retrofitted development.

The alignment of this policy context with the IWMPs is therefore critical and a review process will identify the strategic policy context that can help drive the IWMPs forward. The review process will also identify any existing strengths or weaknesses to be addressed by each Council to better deliver on the directions proposed by the IWMPs.

In conjunction with this project, the Rural City of Murray Bridge is currently leading a project on behalf of eleven SA Murray-Darling Basin Councils, including Alexandrina Council, to prepare an Integrated Water Management (IWM) Development Plan Amendment DPA. The purpose of the IWM DPA is to ensure future growth of the region is sustainable in terms of both water quality and quantity under predicted future climatic conditions. The policy proposed under IWM DPA will give effect to the recommendations of the various Integrated Water Management Plans, where relevant.

1.2. Aim of this Report

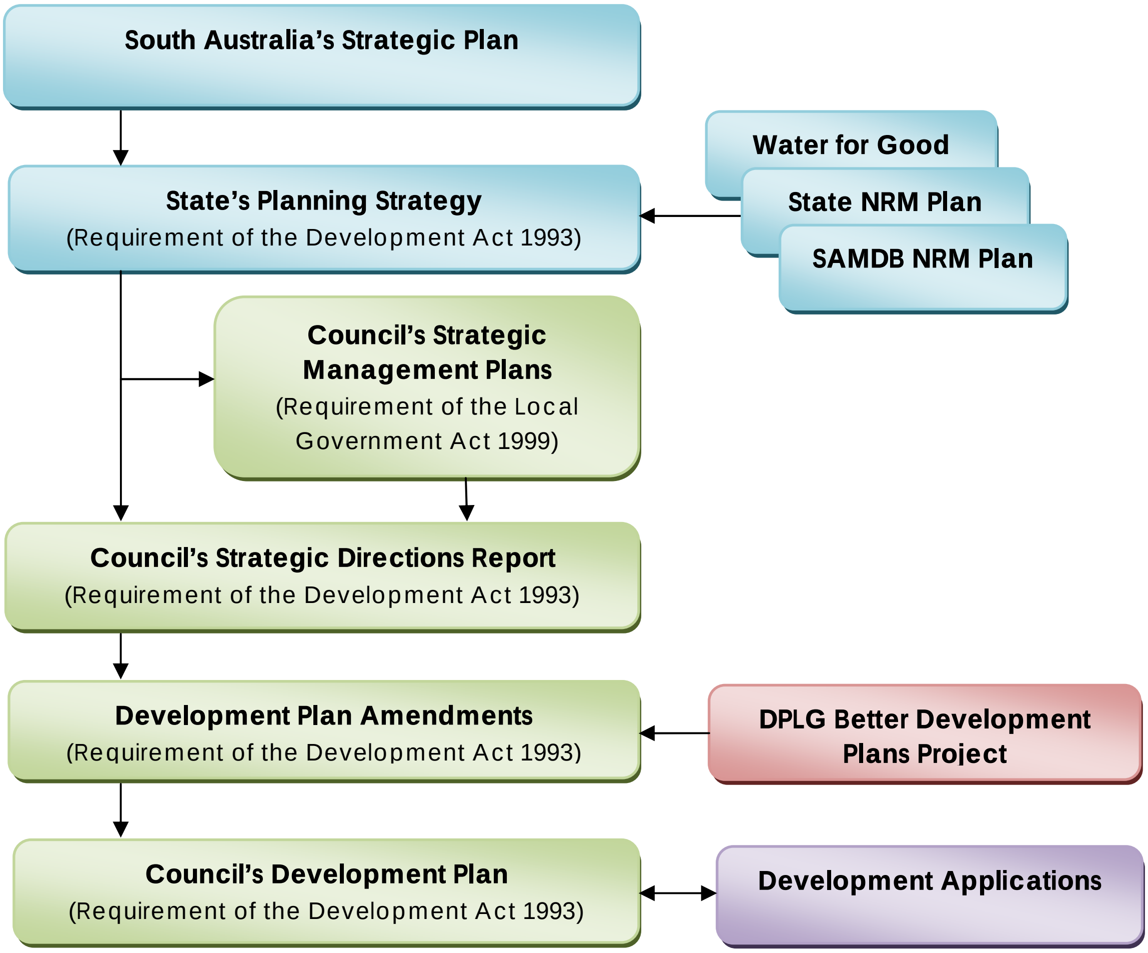
This report summarises the key strategic planning directions and statutory planning policy context for integrated water management relating to Alexandrina Council.

This policy review includes a summary of the broader strategic planning context which Council planning processes sit within such as the *South Australia's Strategic Plan* and *Water for Good* as well as Council's Strategic Plan. Additionally, Council's Development Plan is assessed to identify strengths and weaknesses of existing planning policies in terms of integrated water management.

2.0 Strategic Context

2.1. Overview of the Strategic Planning Framework

The following flowchart illustrates the relationship of relevant State and Local Government strategic planning processes and documents. It is important to understand the role of these processes as their recommendations directly drive planning policy. Each of these is described in more detail in the following sections.



State and Local Government Strategic Planning Processes

2.1.1. South Australia's Strategic Plan

South Australia's Strategic Plan is a whole of government plan that is driven by the Premier's office. All State Government corporate / business planning processes should be aligned to the objectives and targets of the Plan. The *South Australian Strategic Plan* identifies six key objectives. For each of the objectives a range of initiatives and targets are identified which will contribute to the achievement of the Plan's objectives.

Relating specifically to integrated water management, *South Australia's Strategic Plan* states that

> *the sustainable use of water is one of our most urgent resource challenges. While much has been done to protect our water resources, without further innovation and improved management practices, our economy, our health and the quality of our environment will suffer.*

The Plan contains three targets related to water:

- South Australia's water resources are managed within sustainable limits by 2018
- Increase environmental flows by 500GL in the River Murray by 2009 as a first step towards improving sustainability in the Murray-Darling Basin, with a longer term target of 1500GL by 2018
- South Australia maintains a positive balance on the Murray-Darling Basin Commission salinity register[1]

Implications for Integrated Water Management Plan

At a state strategic level the impetus is provided for the sustainable use of water and the need for improved management practices to ensure the long term availability of the resource.

2.1.2. Water for Good

Water for Good is the State Government's integrated water management plan that provides strategic directions and over 90 actions to ensure the State's long term water supply needed to support economic, cultural and social development. At the heart of the document is new policy which aims to diversify water supplies to reduce reliance on the River Murray and other rain-dependent sources, and transition to a variety of water sources, including desalination, harvested stormwater and treated wastewater.

The Plan also emphasises improving water conservation and efficiency and modernising the water industry. Key actions from the Plan include doubling the

[1] The Salinity register is a salinity-based accounting system that underpins the Basin Salinity Management Strategy, providing an accounting record of Basin state actions that affect river salinity (*Murray–Darling Basin Authority Annual Report 2009–10*)

capacity of the desalination plant, increasing the amount of stormwater harvesting and wastewater reuse, continuing to roll-out Water Sensitive Urban Design (WSUD) techniques through the planning system and increasing the price of water to better reflect the true cost of supply.

Key targets contained in *Water for Good* include:

- Developing the capability to harvest 20 GL of stormwater per annum in Greater Adelaide for non-drinking uses by 2013, with a target of 35GL per annum by 2025
- 45% or urban wastewater being recycled by 2013 (currently at 30%)
- Maintaining permanent water conservation measures

Stormwater Strategy-The Future of Stormwater Management

The Department for Water has also released the Stormwater Strategy, a high-level 'road map' for the future of stormwater management in South Australia.

The Stormwater Strategy includes nine actions to improve stormwater management in Adelaide in a way that integrates it with other urban water resources. Under the Strategy, the South Australian Government will develop a 'blueprint for urban water' to bring together stormwater and wastewater alongside other water resources in the Adelaide region, guide future infrastructure investment and policy requirements across Adelaide, and assist transition to a water sensitive city.

Part of this Strategy includes introducing interim targets for water sensitive urban design, completing further studies to improve the knowledge and management of public health risks relating to the recycling of stormwater, and ensuring a strong scientific basis for our future approach to urban water management.

A key action identified by this Strategy includes:

> *Before the end of 2011, introduce interim targets for water sensitive urban design, ahead of developing and implementing the best regulatory approach to mandate water sensitive urban design.*

Implications for Integrated Water Management Plan

Water for Good identifies key actions and targets which emphasise the need for integrated water management including recycling and reuse of wastewater, harvesting and reuse of stormwater, WSUD and water conservation. The Stormwater Strategy also emphasises the importance of introducing targets for WSUD.

The Integrated Water Management Plan for Alexandrina Council will be consistent with the Actions and Targets within *Water for Good* and the Stormwater Strategy.

2.1.3. State Planning Strategies

The *Development Act 1993* requires the State to prepare planning strategies. Section 22 of the *Development Act 1993* states that the Planning Strategy may incorporate documents, plans, policy statements, proposals and other material designed to facilitate strategic planning and co-ordinated action at a State-wide, regional or local level. The Planning Strategy provides the physical and policy framework to assist in reaching the various targets outlined in *South Australia's Strategic Plan*. Importantly the Act requires that Council Development Plans should seek to promote the provisions of the Planning Strategy. However, the Planning Strategy cannot be referred to when assessing development applications.

The State Planning Strategies set out the State Government's vision for development in different regional locations throughout South Australia and indicate strategic directions for future growth and development for the community, the private sector and local government.

The Planning Strategy currently comprises four volumes based on geographical areas:

- The 30-Year Plan for Greater Adelaide (February 2010)
- The Planning Strategy for Regional SA (January 2003, as amended at February 2010)
- The Yorke Peninsula Regional Land Use Framework (December 2007)
- The Greater Mount Gambier Master Plan (February 2008)

Regional Land Use Frameworks are being progressively prepared for each government administrative region, with a view to eventually replacing the Planning Strategy for Regional SA with a series of regional plans.

The Alexandrina Council is entirely contained within the geographical boundaries of the Greater Adelaide region and thus the 30 Year Plan for Greater Adelaide is the relevant planning strategy.

Implications for Integrated Water Management Plan

The relevant Planning Strategy relating to Alexandrina Council is the 30 Year Plan for Greater Adelaide (refer to section 3 for more detailed discussion).

2.1.4. State Natural Resources Management Plan

The State Natural Resources Management Plan (NRM Plan) contains goals, themes and principles that seek to promote the objectives of the NRM Act and regional NRM Plans. The State's Planning Strategy (including the 30-Year Plan for Greater Adelaide) should have regard to the State NRM Plan.

The State NRM Plan identifies a 50-year vision for natural resources management in South Australia and sets out policies, milestones and strategies to achieve that vision. The Plan fits within an extensive policy framework of international, national, state, regional and local policies, legislation, agreements and strategies. The vision of the State NRM Plan is as follows:

> *Vision: South Australia, a capable and prosperous community managing natural resources for a good quality of life within the capacity of our environment for the long term.*

The Plan is based on a set of guiding principles that aim to clarify the thinking and intent behind successful and sustainable natural resources management. It charts key directions for natural resources management under the following four main goals:

> *Goal 1: Landscape scale management that maintains healthy natural systems and is adaptive to climate change.*
>
> *Goal 2: Prosperous communities and industries using and managing natural resources within ecologically sustainable limits.*
>
> *Goal 3: Communities, government and industries with the capability, commitment and connections to manage natural resources in an integrated way.*
>
> *Goal 4: Integrated management of biological threats to minimise risk to natural systems, communities and industry.*

A number of Milestones under Goal 2 are particularly relevant to this project and include:

Milestone 2.4: By 2010, all water resources will be managed within ecologically sustainable limits (excluding the River Murray).

Milestone 2.5: By 2018, the River Murray will be managed within ecologically sustainable limits.

Milestone 2.6: By 2010, NRM-relevant statutory plans will address the impacts of land use change and climate change.

Milestone 2.7: By 2010, the impacts of salinity and diffuse pollution on water resources will be decreasing.

Milestone 2.8: By 2020, alternative water sources will fulfil 25% of household, secondary industry, recreational and commercial premises consumptive demand.

Implications for Integrated Water Management Plan

The State NRM Plan calls for the sustainable use of water resources and identifies the need for alternative water sources to meet the demands of residential, recreational, industrial and commercial development.

Integrated water management can assist to deliver on these directions by considering the whole of water cycle and identifying fit for purpose water supplies.

2.1.5. South Australian Murray Darling Basin Natural Resources Management Plan

Volume 1 of the South Australian Murray Darling Basin Natural Resources Management Plan is the Strategic Plan which outlines the direction for NRM in the South Australian Murray-Darling Basin Natural Resources Management (SA MDB NRM) Region, as set by the SA MDB NRM Board and regional community.

Key goals of the Plan comprise:

1. Landscape-scale management that maintains healthy natural systems
2. Using and managing natural resources within ecologically sustainable limits
3. Communities, governments and industries with the capability, commitment and connections to manage natural resources in an integrated way
4. Integrated management of threats to minimise risks to natural systems, communities and industry

The Strategic Plan identifies 5 assets of which water is one. The asset vision for water is:

> *Water resources that are healthy, valued and supporting of communities and thriving ecosystems.*

The water asset components include surface water; groundwater; irrigated land; wetland and floodplain ecosystems; estuarine, coastal and marine ecosystems; water allocation planning; environmental water provisions.

Under water, three Resource condition targets (RCT) are identified and include:

- All water resources are managed sustainably by 2018
- Improve water quality to achieve the regionally endorsed environmental values by 2030
- Water is available to enhance and maintain the ecological character of water dependent ecosystems.

To assist with delivering on these RCTs, a number of management action targets (MATs) are also identified. Those most relevant MATs to this project include:

- 70% of treated wastewater generated in Region to be reused by 2014[1]
- At least one major settlement (>2000 people) with neutral or beneficial effects on water assets by 2014[2]
- By 2014, 70% of water used shall be taken from sources that are fit-for-purpose[3]

Note 1: As at 30 June 2010, the SA MDB NRM Board reported an achievement score of performance against this target as “ahead” with a “high” level of confidence.

Note 2: As at 30 June 2010, the SA MDB NRM Board reported an achievement score of performance against this target as "on track" with a "low to medium" level of confidence.

Note 3: As at 30 June 2010, the SA MDB NRM Board reported an achievement score of performance against this target as "on track" with a "low to medium" level of confidence.

Implications for Integrated Water Management Plan

The SAMDB NRM Plan calls for the sustainable use of water resource and the improvement of water quality. Key targets relate to the reuse of wastewater, fit for purpose water supplies and minimising urban settlements' impact on water assets.

Integrated water management planning can assist to deliver on these strategic directions and targets as it is underpinned by the concept of considering the whole of water cycle and identifying ways to capture, use, treat and reuse water.

2.1.6. Water Sensitive Urban Design Technical Manual for Greater Adelaide

The South Australian Government is seeking to integrate Water Sensitive Urban Design (WSUD) into all urban development and buildings to achieve a more secure and sustainable future for Greater Adelaide.

WSUD provides for the sustainable use and re-use of water within developments from various sources, including rainwater, stormwater, groundwater, mains water and wastewater (including 'greywater' and 'blackwater').

The WSUD Technical Manual is available on the Department for Local Government and Planning's website[2] and provides details about measures for integrating WSUD into development ranging from rainwater tanks through to wetlands, wastewater management and harvesting and reuse of rainwater.

Implications for Integrated Water Management Plan

The WSUD Technical Manual and the range of measures it identifies are aligned with the driving principles of the IWMP which is to identify future demand for water and match that demand with fit for purpose supply. Some of this water supply will be provided as a result of WSUD.

2.1.7. South Australian Murray Darling Basin Natural Resources Management Board WSUD Requirements

The SAMDB NRM Board has identified requirements relating to WSUD including targets and from the basis of the Board's formal (via Department of Natural Resources) and informal comments on land division proposals.

Baseline targets have been established to address the following:

[2] http://www.planning.sa.gov.au/go/wsud)

- Reducing mains water usage
- Improving stormwater quality
- Managing stormwater quantity
- Managing groundwater levels

Appendix A contains the Fact Sheet the SAMDB NRM Board has prepared regarding these targets.

Implications for Integrated Water Management Plan

The IWMP should be mindful of these targets that are aimed to be achieved for land divisions in the SAMDB NRM region.

2.1.8. Local Government Strategic Management Plans

Under Section 122 of the *Local Government Act 1999,* Councils are required to prepare a Strategic Management Plan (s). The objective of a Strategic Management Plan is to guide Council's strategic, corporate/business planning and budgetary processes. These plans often contain objectives and strategies that establish Council's policy position on a range of economic, environmental, social, planning and governance issues. The Act requires that Councils address a range of information in their Strategic Management Plan including:

- Council's objectives for its area over a period of at least 4 years;
- A clear indication of:
  - o The extent to which the council has participated with other councils, and with State and Commonwealth governments, in setting public policy objectives, and the extent to which the council's objectives are related to regional, State and Commonwealth objectives; and
  - o The extent to which the council has given consideration to regional, State and Commonwealth objectives and strategies which are relevant to the economic, social, physical and environmental development and management of its area; and
  - o The extent to which the council intends to co-ordinate with State and national governments in the planning and delivery of services in which there is a common interest.
- The principal activities that the Council intends to undertake to achieve its objectives;
- Estimating the revenues and expenses of Council over the relevant time period;
- The financial and non-financial measure to be used to monitor and assess the performance of Council over the relevant time period;

- Adoption of a process to ensure that members of the public are given reasonable opportunity to be involved in the development of the plan; and
- Identification of how the Plan is consistent with the State's Planning Strategy and the relevant Development Plan.

Implications for Integrated Water Management Plan

Council Strategic Management Plans guide corporate/business planning and budgetary processes and contain a Council's policy position on a variety of economic, environmental, social, planning and governance issues. Strategic Management Plans thus present an important opportunity for local government to facilitate integrated water management as a strategic objective and link it to actions and budgeting over a defined timescale.

It is therefore important for the delivery of the IWMP that is prepared for Alexandrina that Council's Strategic Management Plan reflects the need for integrated water management and the sustainable use of water.

The Alexandrina Council's latest Strategic Management Plan, *Future Directions 2004-2009* (updated in 2007) is reviewed in section 4 of this report.

2.1.9. Development Plans

All development applications (except for designated major projects pursuant to Section 46 of the *Development Act 1993*) are assessed against the Objectives, Desired Character Statements and Principles of Development Control contained in a Council's Development Plan. As a general rule, no other State strategy (including the Planning Strategy) or Local Government Strategy (including Strategic Management Plans, Section 30 Development Plan Reviews or draft Development Plan Amendments) can be referred to when assessing a development application. Therefore, it is critical that Development Plans are regularly updated.

Council Development Plans should seek to promote the provisions of the Planning Strategy. However, there is a natural lag time between the release of a new Planning Strategy and the alteration of Development Plans. Councils are required to review their Development Plan via the Section 30 Review/Strategic Directions Report process within twelve months of the adoption of a new Planning Strategy, with Development Plan Amendments to follow. As such, owing to the new 30-Year Plan for Greater Adelaide, Councils across the Greater Adelaide region will be reviewing and amending their Development Plans in coming years to reflect the new strategy.

Implications for Integrated Water Management Plan

Development applications received by a Council are assessed against policies contained in Council's Development Plan.

To assist with the delivery of integrated water management for new development, appropriate policies need to be provided in the Development Plan (note polices cannot be applied retrospectively to development).

The current Development Plan for the Alexandrina Council is reviewed in section 4 of this report and provides an assessment of the strengths and weaknesses of policies regarding integrated water management.

2.1.10. Section 30 Reviews/Strategic Directions Reports

Pursuant to Section 30 of the *Development Act 1993*, a Council must carry out periodic reviews (every 3 to 5 years) of its Development Plan for the purpose of determining:

- The appropriateness of any Development Plan that applies in relation to its area (or a part of its area); and
- The consistency of any such Development Plan with the State's Planning Strategy (note a review should take place within 12 months of the release of a new Planning Strategy)

A Council must prepare a report on the review and send a copy of the report to the Minister for Urban Development and Planning. The Council will not be taken to have completed the review until the report is received by the Minister.

These reviews of Council's Development Plans typically conclude with a work program that recommends amendments to Council's Development Plan policies.

The Strategic Plan *Community Strategic Plan 2009-2013* prepared by Alexandrina Council incorporated its requirements under the *Local Government Act* to produce a strategic plan and Section 30 requirements under the Development Act.

Implications for Integrated Water Management Plan

To meet its statutory requirements Council will be required to undertake a Section 30 Review by February 2011 which is 12 months from when the 30 Year Plan for Greater Adelaide was endorsed as the new Planning Strategy.

This project can influence the recommendations of the Section 30 Review process and assist with the implementation of key direction of the IWMP.

2.1.11. Development Plan Amendments

Development Plans are updated by the Development Plan Amendment (DPA) process. The process is documented in Section 24 of the *Development Act 1993*. Only the Minister for Urban Development and Planning or a Council(s) can update a Council Development Plan.

The process involves an extensive level of investigations and a two month public consultation process. The DPA requires the endorsement of the Minister for Urban Development and Planning (followed by a Government Gazette notice) for it to be authorised as an update to a Council's Development Plan. Once gazetted, Department for Planning and Local Government (DPLG) staff consolidate the DPA into the Council's Development Plan. A DPA process can take 1 – 3 years to complete. During this process, the DPA cannot be considered by the planning authority or the State's Environment Resources and Development Court in assessing a development application.

Implications for Integrated Water Management Plan

The DPA process is the key mechanism for translating recommendations identified by the IWMP into planning policy in Council's Development Plan, and thereby influence development outcomes.

2.1.12. Better Development Plans Project

The Better Development Plans (BDP) project seeks to enhance the South Australian planning system by increasing clarity, consistency and certainty in Development Plans. It also aims to develop better linkages between the Planning Strategy and Development Plans and promote a more efficient means for policy review including an improved Development Plan Amendment process.

At the heart of the BDP project is a new set of planning policies, or modules, that deal with issues common to most local councils, including a variety of water related issues, such as water sensitive design. The policies provided through the BDP project are consistent in content, expression and structure and provide greater certainty to all those who use them, enabling sharing of best practice between Councils. Additionally, the BDP project is seeking to eliminate repetition and promote Desired Character Statements to guide development and provide clearer context to the policy directions.

To assist Councils to convert their development Plans to the BDP format, a series of modules have been prepared by DPLG which relate to different development "issues" addressed by the Development Plan. For example, there is a residential development module, coastal areas module, animal keeping module and natural resources module.

In addition there are a series of zone modules which provide a basis for location specific policies. These zone modules provide a consistent approach to planning policy regarding certain types of development, for example residential development, but allow local variations to be inserted to reflect the particular character or issues of different localities across the State.

It is expected that all Councils in South Australia will undertake a BDP conversion of their Development Plan. In fact the 2008 Planning Reforms promoted the target of all Councils having initiated a Conversion Development Plan Amendment by 2010.

More information on the BDP Project is available online via the DPLG Better Development Plan website, where the full and latest version of the BDP 'policy library'[3] can be viewed.

Implications for Integrated Water Management Plan

The BDP policy library provides the basis for ensuring that key planning related issues are addressed in all Council Development Plans, whilst allowing for local additions to address local issues/circumstances. This means that when Councils undertake their BDP conversion, a minimum standard of planning provisions are incorporated into the Development Plan.

A review of how BDP addresses IWMP is provided in section 6.1.2 of this report.

2.1.13. Review of BDP NRM Policies

The Adelaide & Mount Lofty Ranges Natural Resources Management Board (AMLR NRM Board) in association with the SAMDB NRM Board and the Department of Planning and Local Government are currently undertaking the *Better Development Plan Review to Incorporate NRM Outcomes* project to review the BDP policy library from the perspective of natural resources management.

The final report will identify existing appropriate policies, policy gaps and suggested policy improvements that can be considered in stage two of the broader project.

Implications for Integrated Water Management Plan

If timing aligns with this project, consider recommendations of the *Better Development Plan Review to Incorporate NRM Outcomes* project when identifying recommendations for the IWMP final report.

2.1.14. Other water related legislation strategies, policies and code of practice

Environment Protection Act and Water Quality Policy

The *Environment Protection Act 1993* provides the regulatory framework to protect South Australia's environment, including land, air and water.

The Environment Protection Authority and other bodies administer the Act through a suite of legislative and non-legislative policies and regulatory tools to address environmental issues.

The EPA works to protect South Australian waters from the adverse impacts of pollution that might reduce their value to current and future generations. This includes creeks, streams, rivers, coastal waters, groundwater and aquifers. One of the EPA's roles is to work towards protecting SA's waters while allowing for economic

[3] Department of Planning and Local Government 2010 *Better Development Plans*, online, <http://www.planning.sa.gov.au/index.cfm?objectid=06291C15-96B8-CC2B-60D4FDE40CD2A16E>.

and social development. One of the tools used to achieve this includes the Environment Protection (Water Quality) Policy and other legislation.

The main objective of the Water Quality Policy is to:

"...achieve the sustainable management of waters, by protecting or enhancing water quality while allowing economic and social development".

The policy aims to achieve this objective by:

- setting environmental values and water quality objectives for streams, rivers, oceans and groundwater
- establishing obligations for industry and the community to manage and control different forms of pollution
- encouraging better use of wastewater by
    - avoiding its production
    - eliminating, or reducing it
    - recycling and re-using it
    - treating it to reduce potential harm to the environment
- promoting best practice environmental management
- promoting within the community environmental responsibility and involvement in environmental issues
- setting discharge limits for particular activities.

National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS) provides a national approach to improving water quality in Australia's waterways. The NWQMS is part of the Australian Government's $12.9 billion investment in strategic programs, Water for the Future.

Participants in NWQMS are working to protect the nation's water resources by improving their quality, reducing pollutants and at the same time supporting the businesses, industry and communities that depend on water for their continued development. The EPA's Water Quality Policy described above brings South Australia in line with the NWQMS.

Australian Guidelines for Water Recycling

The Environment Protection and Heritage Council, the Natural Resource Management Ministerial Council and the National Health and Medical Research Council have developed guidelines for the safe use of recycled water. These guidelines include:

- Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2): Stormwater Harvesting and Reuse

  These guidelines describe and support a broad range of water recycling options, and provide the scientific basis for implementing options in a safe and sustainable manner.

  In particular the document provides guidance on managing potential public health and environmental risks associated with the reuse of:

  - roofwater collected from non-residential buildings (including industrial buildings)
  - urban stormwater from sewered areas, including stormwater collected from drains, waterways and wetlands.

  The guidelines apply to nonpotable (ie non-drinking water) potential end uses of roofwater and stormwater.

- Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2): Managed Aquifer Recharge

  The guidelines provide a sound scientific basis to guide the development of managed aquifer recharge projects using recycled and natural water sources. These guidelines focus on the protection of aquifers and the quality of recovered water in managed aquifer recharge projects.

Code of Practice for Irrigated Public Open Space

The Code of Practice for Irrigated Public Open Space (IPOS) provides a template which can be used by open space managers to ensure the planning, management and reporting of water consumption in the urban environment is based on sound principles applied consistently at all levels of management.

The aim of the Code is to provide the tools and reporting models necessary to implement best practice irrigation management in the provision of public open space.

The Code seeks to provide the following to potential subscribers:

- The need for developing a Turf and Irrigation Management Plan.
- The benefits of adopting the Code.
- The tools and reporting models necessary to implement best practice irrigation management.

The Code provides a management framework for best practice turf and irrigation management for all irrigated public open space, including that managed by local government, the education sector and other IPOS managers. It forms the basis by which the industry can demonstrate efficient, effective resource management.

Implications for Integrated Water Management Plan

The IWMP, where appropriate, should align/reflect/implement key directions, strategies, guidelines, practices identified by the above.

3.0 The 30 Year Plan for Greater Adelaide

The *30-Year Plan for Greater Adelaide*[4], adopted in February 2010, provides land use and development direction for the Greater Adelaide region for the next 30 years.

The Greater Adelaide region encompasses the area previously covered by the Planning Strategy for Metropolitan Adelaide and the Planning Strategy for Outer Metropolitan Adelaide. For planning purposes, Greater Adelaide is made up of seven Government Administrative Regions plus the regional township of Murray Bridge. These Administrative regions are the Barossa, Adelaide Hills, Northern Adelaide, Western Adelaide, Eastern Adelaide, Southern Adelaide and Fleurieu and Kangaroo Island (but Kangaroo Island has its own Plan), together covering an area of approximately 9,000 square kilometres.

The Plan is predicated on achieving an additional 560, 000 people and 258,000 new homes in the region over the next 30 years. This high rate of growth will be increasingly concentrated in the existing urban area, with 70% of new housing growth to be accommodated in transit oriented development, along transit corridors and in higher density developments in strategic locations. However, the expected high rates of growth means that outward urban growth expansion will continue, with new greenfields development to occur in places such as Goolwa.

The Plan identifies anticipated population growth in the Fleurieu region (which includes Alexandrina Council) of 22,000 people and an additional 14,500 dwellings to be accommodated in existing townships.

In terms of water, the Plan identifies 'water efficiency' as a challenge for the Plan to respond to, noting that 'securing water supplies for a growing population and economy is fundamental to economic, social and environmental wellbeing'. It is in this context that the Plan notes that the actions of the *Water for Good* are being implemented and will ensure that Greater Adelaide has sufficient water supplies in coming years. The Plan also notes that urban form presents an opportunity to reduce water consumption, insomuch as increasing housing densities and improved water efficiency of buildings will result in more efficient use of water across the urban area overall. The Plan's direction in terms of water can be summarised as:

- Raising the standards for water efficiency in new residential, commercial and industrial buildings through a wider roll-out of WSUD techniques (including incorporating WSUD techniques in areas undergoing structure planning)
- Mandating WSUD for all new developments by 2013
- Reducing reliance on mains water supply
- Protecting water supply catchments, key watershed areas and potential locations for stormwater harvesting

[4] Government of South Australia (2010) *30 Year Plan for Greater Adelaide,* Department of Planning and Local Government, online, <www.plan4adelaide.sa.gov.au/>.

- Reducing domestic water consumption through the shift to smaller accommodation, in line with demographic trends, at higher densities
- Ensuring new public open space is independent of potable water supplies
- Developing infrastructure to maximise the re-use of wastewater

Key WSUD policies and targets identified by the Plan include:

Policies

- Incorporate water-sensitive urban design (WSUD) techniques in new developments to achieve water quality and water efficiency benefits.
- Require WSUD techniques to be incorporated in Structure Plans and Precinct Requirements for State Significant Areas.
- Mandate WSUD for new developments (including residential, retail, commercial, institutional, industrial and transport developments) by 2013 (consistent with Water for Good).

  The Climate Change, Housing Affordability and Sustainable Neighbourhoods Task Force will advise the State Government on the most effective way to implement this policy without compromising housing affordability.
- Require new greenfield developments that are subject to Structure Plans from 2011 to source water for outdoor use from non-mains water supplies.

  This recognises the need to plan alternative water sources at the commencement of new large greenfield developments, rather than retrofit these sources for latter stages of the development.
- Identify and protect locations for potential stormwater harvesting schemes, including those areas identified in Map D22.
- Ensure appropriate policy links and consistency between Stormwater Management Plans, Structure Plans and Development Plans to address stormwater and flood management matters.

Targets

- Reduce demand on mains water supply from new development through the introduction of water-sensitive urban design. (This target will be quantified once the WSUD mandating scheme is determined.)
- Require all new dwellings to be connected to alternative water sources, which must supply at least 15 per cent of the internal water needs of these households.
- Achieve independence from mains water supplies for new public open spaces in transit corridors through WSUD techniques.
- Achieve alternatives to mains water for outdoor use through WSUD techniques in all new greenfield developments that are subject to Structure Plans and Precinct Requirements after 2011.

Implications for Integrated Water Management Plan

The 30 Year Plan for Greater Adelaide sets the strategic context for land use planning and identifies the securing of water supplies as fundamental to the urban growth actively promoted by the Plan. WSUD, protection of catchments and reuse of wastewater are all identified as key directions to some extent by the Plan.

Areas identified for urban growth by the Plan such as adjacent Goolwa will need to plan for the management of water and provide the opportunity for innovative approaches to integrated water management.

4.0 Council's Strategic Management Plan

A Council's Strategic Management Plan guides corporate/business planning and budgetary process and contains a Council's policy position on a variety of economic, environmental, social, planning and governance issues. Strategic Management Plans thus present an important opportunity for local government to facilitate integrated water management as a strategic objective and link it to actions and budgeting over a defined timescale.

The Alexandrina Council's *Community Strategic Plan 2009-2013* serves as its Strategic Management Plan.

The Plan is guided by the following vision:

Preserving the Past, Securing the Future, Together Enhancing Our Lifestyle

The Plan is underpinned by four key goals:

- A vibrant, cohesive and diverse community providing a healthy, quality lifestyle
- Sustainable economic growth supporting industries and businesses
- Sustainable natural and built environments that meet the needs of a growing community and economy
- Progressive leadership, good governance, efficient and effective services

The Plan recognises the need to conserve and protect water resources and identifies the reuse of wastewater and stormwater as a key strategy to achieve this.

One of the outcomes identified by the Plan under the sustainable natural and built environment goal is the efficient use and integrated management of water resources. Strategies to deliver this outcome include:

- Assess and implement water conservation projects
- Promote appropriate water sensitive design features into development
- Support the sustainable management of all water resources in the Council area

Another outcome identified under this goal is the safe, effective and innovative management of waste water and stormwater. Strategies to deliver this outcome include:

- Provide effective management and maintenance of Council's stormwater infrastructure
- Plan, manage and regulate Community Wastewater Management Schemes (CWMS) in townships
- Provide effective management and maintenance of Council's flood control infrastructure
- Assess and implement water re-use initiatives

Implications for Integrated Water Management Plan

Alexandrina Council's Strategic Plan makes multiple references to different aspects of integrated water management. It is apparent that an integrated approach to managing stormwater, implementing water re-use initiatives and the roll-out of water sensitive urban design are strategic level commitments of Council. Council could strengthen its commitment to integrated water management in its Strategic Plan by giving greater attention to wastewater re-use and developing localised fit-for-purpose water supplies.

5.0 Council Development Plan Amendments

The Alexandrina Council is currently preparing the Rural Areas DPA which aims to address a number of issues primarily identified in Council's Rural Areas Strategy and Action Plan to assist in providing strong protection for viable primary production in the Council area. This DPA will review policies within a range of rural zones such as Grazing, Watershed Protection, General Farming and Flood Zones. The DPA is one of a number being funded under the Strengthening Basin Communities Program.

The Integrated Water Management DPA being undertaken concurrently with the Integrated Water Management Plan project, will provide for sustainable urban growth, promoting "fit for purpose" water use to ensure the protection of the region's water resources from both a water quality and quantity perspective. The Rural City of Murray Bridge is leading the project on behalf of eleven SA Murray-Darling Basin Councils, including Alexandrina Council.

Implications for Integrated Water Management Plan

There are no specific implications of current DPAs being undertaken by Council for this project.

6.0 Council's Development Plan

6.1.1. Current Development Plan (Consolidated 3 June 2010)

The Alexandrina Council Development Plan provides limited coverage on integrated water management issues.

The Plan contains provisions that seek to reduce reliance on mains water by avoiding the need for it, reducing its use and recycling where possible. Provisions speak to ensuring that development does not cause an over exploitation of surface or underground water or is located in area at risk of flooding. In terms of stormwater management, the Plan envisages stormwater treatment that is localised and incorporates treatments that improve the water quality by, for example, discharging stormwater into grassed swales. There are general provisions around reducing and preventing ground, surface and storm water pollution.

The Plan contains the typical land division provisions that seek to ensure that new allotments are provided with an adequate water supply and wastewater removal or treatment, as well as appropriate stormwater treatment and are located in areas not at risk of inundation in a 1 in 100 year flood event.

Part of the Alexandrina Council is located within the Mount Lofty Ranges watershed area. The Development Plan contains specific provisions seeking to protect the water quality in the watershed, which supplies 60% metropolitan Adelaide's water supply. Such provisions seek to protect water in the watershed from pollution and contamination, and maintain the quality of surface and underground waters.

Implications for Integrated Water Management Plan

The Alexandrina Council Development Plan, while addressing general issues such as adequately managing stormwater, basic water sensitive design treatments and protecting water sources from pollution and contamination, lacks clearer direction in terms of a more integrated approach to water management in terms of whole of cycle water utilisation, waste-water re-use and fit-for-purpose water supplies.

Integrated Water Management Plans are concurrently being developed for the District Council of Mount Barker, the Rural City of Murray Bridge and Alexandrina Council. In comparison with the other two councils, Alexandrina's Development Plan is the least well developed in terms of policies that address integrated water management. Undergoing a BDP conversion, and adopting provisions from the Natural Resources and Waste Modules would improve Alexandrina's Development Plan and ensure the Plan has a level of coverage of integrated water management issues that is comparable with the other councils involved with this IWMP project.

6.1.2. Better Development Plan Policies

The Alexandrina Council has not completed a BDP conversion.

The BDP policy library contains policies relevant to Integrated Water Management. Specifically, the Natural Resources module contains a series of provisions which seek to use natural resources, including water sources and watercourses, in an ecologically sustainable manner.

Within the natural resources module, there are a series of provisions under the heading of 'water sensitive design'. These provisions seek development which maximises the conservation of water, minimises consumption and encourages the re-use of water resources. Practically, provisions envisage the sustainable use of all forms of water, stormwater capture and re-use, stormwater management systems including techniques such as rainwater tanks, detention basins and aquifer recharge the minimisation of surface run-off, preventing soil erosion and water pollution, protecting and enhancing water-based ecosystems and their functions, and flood management. In many ways, these provisions represent an integrated approach to managing stormwater through the way flood and stormwater management are so closely linked with maximising the use of water resources and specific stormwater re-use techniques.

The BDP policies also address 'water catchment areas'. These provisions speak to the need to protect and enhance ecosystems and functions, such as watercourses, wetlands and natural flow regimes. Provisions address appropriate development adjacent to such areas, as well as principles to guide the location and construction of dams, water tanks and diversion drains.

The other relevant BDP policies are those in the Waste module which address wastewater re-use. These provisions include a management hierarchy that addresses re-using and recycling waste and wastewater. The specific wastewater re-use provisions provide guidance to maintain environmental and public health standards.

Implications for Integrated Water Management Plan

The BDP policies contained in the NRM Module and the Waste Module cover key aspects of IWMP. In this way, once Alexandrina Council undertakes the BDP conversion process and the DPA is gazetted, Council's Development Plan will contain the standardised structure and provisions to provide greater consistency and certainty and better address IWMP in its Development Plan. In addition, Council can include localised additions to supplement these policies to ensure that local conditions/requirements are addressed.

7.0 Appendix A

SAMDB NRM Board WSUD Targets

Targets for WSUD – Subdivision Scale

Baseline targets have been established to address the following four aspects:

T1. Reducing mains water usage

T2. Improving stormwater quality

T3. Managing stormwater quantity

T4. Managing groundwater levels

T1 - Reducing mains water usage

Table 1 Mains Water Use Targets

Description	Target
Reduction of mains water use (compared with 2003[1])	30%

Note 1: 2003 is the baseline in the South Australian Strategic Plan for Target 3.9 (South Australian water resources are managed within their limits). Baseline mains water consumption is the expected average daily mains water consumption that would be generated by the development if no water conservation measures were applied.

T2 - Improving stormwater quality

The baseline runoff quality targets refer to the reduction in average annual pollutant export compared to an equivalent urban catchment with no water quality management controls.

Table 2 Runoff Quality Targets

Parameter	Target[2]
Reduction in average annual total suspended solids (TSS)	80%
Reduction in average annual total phosphorus (TP)	45%
Reduction in annual average total nitrogen (TN)	45%

Note 2: % reduction refers to average annual pollutant load

For greater guidance on the removal of sediment refer to Table 3

Table 3 Runoff Quality Targets - Sediments

Pollutant	Description	Retention Criteria
Coarse Sediment	Coarse sand (=0.5mm)	80% of load for particles 0.5mm or less
Fine Particles	Fine Sand (=0.05mm)	50% of the load for particles 0.1mm diameter or less

If the nature and the scale of the development is such that there is a significant risk of the export of litter and oil and grease then the targets in Table 4 shall apply

Table 4 Gross Pollutant Targets

Parameter	Target
Litter/gross pollutants	Retention of litter greater than 50mm for flows up to the 3 month ARI peak flow
Oil and Grease	No visible oils for flows up to the 3 month ARI peak flow

T3 - Managing stormwater quantity

Managing both stormwater volumes and rates of runoff over time i.e. flow rate.

Table 5 Targets for rates of runoff

Performance Target	
For up to the 5 year ARI	Pre-development[4] peak flows not exceeded The time to peak matches that of the pre-development case, as far as practical, provided this does not exacerbate downstream flooding. Runoff is contained within designated flow paths that avoid unplanned nuisance flooding
For the 5 year up to the 100 year ARI	Flooding of residential, commercial, institutional, recreational and industrial buildings is avoided. The time to peak matches that of the pre-development case, as far as practical (provided this does not exacerbate downstream flooding), unless catchment wide benefits can be demonstrated (i.e. for 100 year ARI only) Pre-development peak flows not exceeded.

Note 4: Pre-development refers to the situation where there is **no development** on the site which is considered to constitute the following scenarios:

- If the site is currently developed, then no development case is where the runoff from the site assumes a cleared but grassed state;
- If the site is currently vegetated, then the no development case is where runoff from the site assumes the uncleared vegetated state.

T4 - Managing groundwater levels

Table 6 Maximum proportion of impervious area directly connected to drainage infrastructure.

Land Use	Maximum proportion of impervious area directly connected to drainage infrastructure
Residential	0.5 (or 50%)
Commercial	0.8 (or 80%)
Industrial	0.7 (or 70%)
Other[3]	0.5 (or 50%)

Note 3: Other refers to (but is not limited to) recreational, social and institutional developments.

Appendix B: Milestone 2 Report - Options Development

Includes:

Options Report (Goolwa and Hindmarsh Island)

Appendix A - Outcomes from Goals, Issues, Options Workshop (Stakeholder Consultation)

Appendix B - Summary of Developer Discussions

Appendix C - Outcomes from Community Consultation Workshop

Integrated Water Management Plan

Options Report – Alexandrina Council Area

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- V2

Integrated Water Management Plan

Options Report

- Milestone 2 - Options Report
- Alexandrina Council

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1. An Integrated Water Management Plan for Alexandrina Council

With many communities within the Murray-Darling Basin (MDB) impacted by drought conditions and a range of studies indicating the possibility of a future with less water, Basin communities are taking steps to better understand the impacts and opportunities presented by such a change. .The Alexandrina Council and community have been concerned about the unprecedentedly low water levels in the Lower Lakes and River Murray. The Council is advocating for a fresh water solution for the Lower Lakes and Goolwa Channel, and believe that it would be the best option for a sustainable future. A range of water saving and water reuse initiatives have already been implemented within the region, including reuse of stormwater and treated wastewater.

The 30-Year Plan for Greater Adelaide (DLPG, 2010) estimates that the townships within the Alexandrina Council area will increase in population by 15,400 people by 2039. This is an increase of almost 75% of the current population and reflects a significant increase to water resource demand within the region. In particular the townships of Goolwa and Hindmarsh Island are predicted to experience significant growth. Assessment of the potential impacts of climate change, and comprehensive planning are required to ensure that the growing communities can be sustained while reducing reliance on the River Murray as a water resource.

The Alexandrina Council is committed to the responsible stewardship of natural resources, ensuring that water resources are protected and restored. The Integrated Water Management Plan (IWMP) will provide for the sustainable, resilient development of Goolwa and Hindmarsh Island through the identification of 'fit for purpose' water supplies for Council, residential, commercial, agricultural and industrial uses.

It aims to maintain and enhance the valued amenity and open space features of these towns and protect and restore the local environment.

The development of this Plan has been funded by the Australian Government's *Strengthening Basin Communities Program.* This Plan will assess the risks and implications associated with providing water for growing communities in an uncertain climate future. It will allow the Alexandrina Council to plan for future investment in water savings initiatives and provide input to development plan policy.

1.1. Integrated Water Management

Integrated Water Management (IWM) is about providing the most sustainable mix of water solutions for the community through the consideration and incorporation of all water sources including reticulated potable, rain, storm, ground, waste and recycled. Figure 1-1 shows the interactions between these water sources and the cycle of supply, demand, treatment and storage.

IWM integrates social, economic, environmental and technical considerations in managing water. It links areas that in the past have often been treated as distinct, such as:

- Land use and water use;
- Water quantity and quality;
- Water movement in rivers and aquifers;
- "Useful" water and "waste" water;
- Upstream and downstream interests; and
- The relative use of other resources when managing water such as energy and materials.

As well as technical issues IWM addresses social issues such as:

- Coordination of different levels of government and governance, from local to national and global, in water policy making and management;
- Involvement of all stakeholders in the decision-making process;
- Accounting for the impact on water resources of policies and planning in other areas, such as food, transport, energy and population;
- The provision of adequate information to support decision making; and
- Influencing water users to recognise the need for long-term viability of water resources and to use water accordingly.

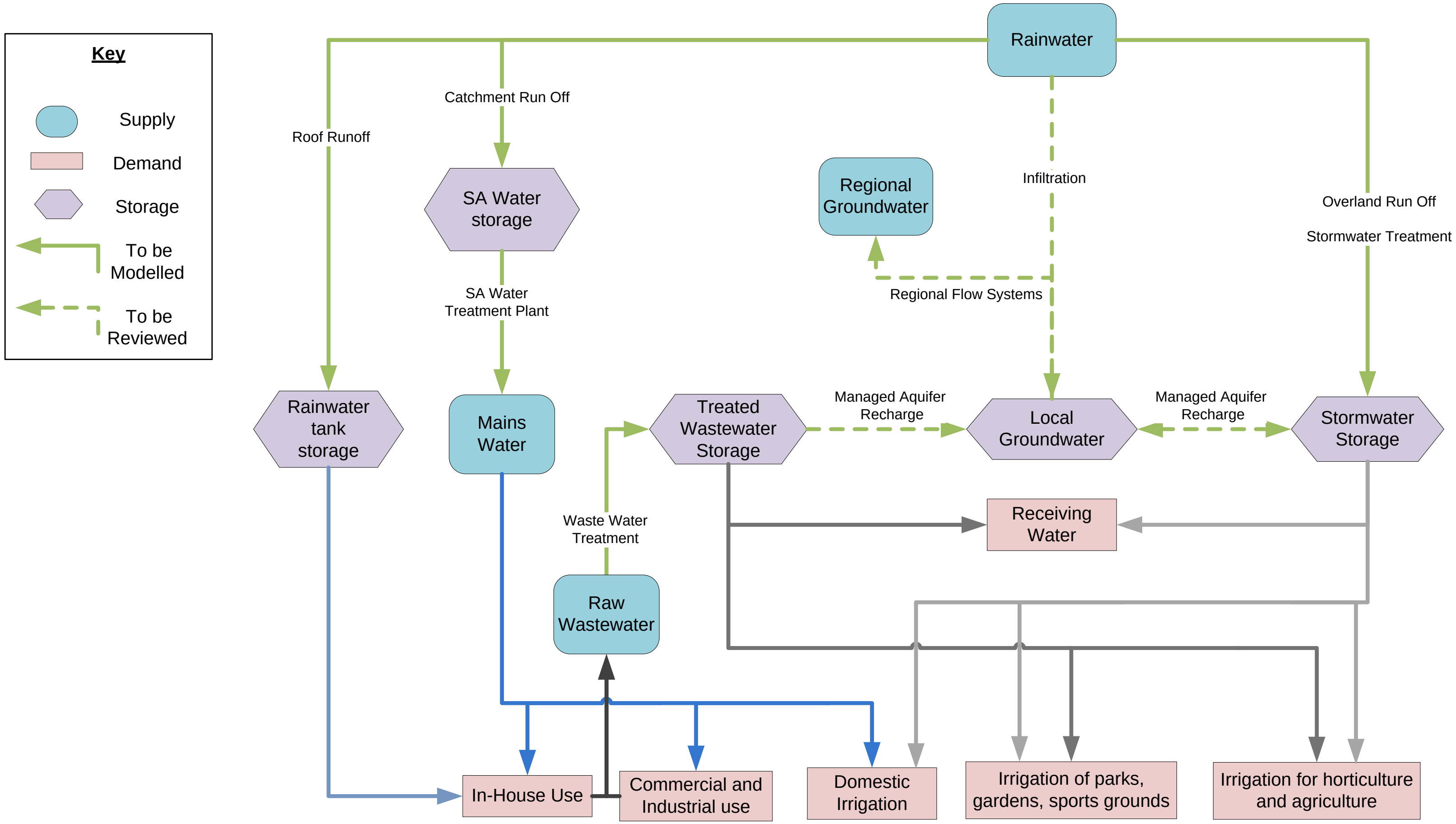
1.2. Project Tasks

The IWMP will include the completion of the following key tasks:

1) Policy Review (Milestone 1 report)
2) Stakeholder Consultation (Council, government agencies, developers and the community)
3) Water management options identification
4) Demand analysis
5) Water management options analysis
6) Reporting of final recommendations

1.2.1. Milestone 2 Report

This Report has been prepared to describe the outcomes of tasks 1 to 3. It describes the IWM goals developed with stakeholders during consultation, the water management options to be considered for the Alexandrina Council and the management scenarios against which the options will be assessed.



■ **Figure 1-1: Integrated Water Management: Interactions between a range of Water Sources**

2. Goals for Integrated Water Management

A Council and government agency stakeholder workshop was held was held to identify and articulate the goals, issues and opportunities for integrated water management in the Alexandrina Council and for the identified growth areas in Goolwa and Hindmarsh Island that are the subject of the IWMP project. The goals were further refined by Council following the workshop.

The goals that were identified for Integrated Water Management within the Alexandrina Council are summarised below. Appendix A contains a comprehensive summary of the findings of the workshop, including a more detailed description of each goal. In addition, community goals were identified at a workshop. These are described following the Council and agency goals.

Goal 1: Minimise adverse impacts on the environment

Any approach to integrated water management should minimise adverse impacts to the environment, including recognition of the environmental values of existing waterways, maintaining natural groundwater balance, improvement to water quality and managing development in a sustainable way.

Goal 2: Use a Water Balance Approach to Match 'Fit for Use' Water Supply

There is a need to ensure an ongoing supply of water to service a growing population, and opportunities to capture and reuse stormwater and wastewater should be maximised to meet this need. These capture and release opportunities should be integrated into the overall design of development, and combined with open space and recreation opportunities. A range of opportunities should be investigated to ensure the matching of fit for purpose water supply with its end use.

Goal 3: Establish an Economic Model to Deliver the IWMP

Ensuring that an appropriate funding model is in place to deliver on the directions proposed by the IWMP is a critical element to the IWMP's success. This funding model needs to be a partnership between the State government, developers and Council and there is also a need to ensure that adequate personnel are allocated to support the implementation of the IWMP at the local level.

Goal 4: A Supportive Legislative Framework that delivers Integrated Water Management

For the IWMP to be successfully implemented, a supportive legislative framework needs to be in place.

Goal 5: Strong Partnerships and a Commitment to Integrated Water Management

The successful implementation of the IWMP will be dependent on a strong partnership approach between Council, developers and other stakeholders. It will require a sustained commitment by Council to the overall vision and objectives of integrated water management. One of the threats to the IWMP could be a shift in Council's priorities and therefore, there needs to be a strong commitment established across Council to the IWMP's overall vision.

Goal 6: An Integrated Water Management Structure Plan for Goolwa North

A goal which speaks directly to the need for the preparation of an integrated water management structure plan for Goolwa North was considered necessary in order to emphasise the importance of ensuring the area is designed and develops into the future with integrated water management as one of its central drivers. This approach recognises the uncertain water future and the need to secure water supplies for new (and existing) development that come from a range of sources, including stormwater capture and reuse and wastewater reuse.

2.1. Community Goals

Goal C1: Minimise the carbon footprint of all water management actions

The options identified for future water management options should be selected to minimise energy use.

Goal C2: An aware community

The community needs to be an engaged and active player in integrated water management and work with Council and developers to achieve integrated water management outcomes.

Goal C3: Manage demand for water

The importance of managing (community) demand for water was highlighted as an important way to manage water resources. A move towards permanent water restrictions of some nature was raised.

Goal C4: Create high value open space in new developments

Moving away from small pockets of open space and towards more centralised better planned open space will create higher value areas for recreation and leisure.

Goal C5: Integrate shared access (bike/walking) paths with wetland and biodiversity corridors

Linking open space and stormwater treatment wetlands with corridors designed to maximise shared access and biodiversity will provide recreation and amenity benefits.

3. Options for Integrated Water Management

A range of options have been developed for integrated water management in the Alexandrina Council area. These options were developed following a review of the relevant background documents and a site visit to the Alexandrina Council area. The current list of options forms a comprehensive list of possibilities, which will be discussed with Council to narrow them down to a shortlist of feasible and desirable options to include in the scenario modelling.

A range of options for integrated water management have been listed below. The infrastructure options have been categorised for each geographic area or township within the Council area, and planning and policy options and water conservation options, which apply to all areas, are also included.

3.1. Infrastructure Options for Goolwa

A brief description of each infrastructure option for use in Goolwa is included in this section. The details of each option have been determined from personal communication with Alexandrina Council staff during the site visit, as well as background documents and reports.

IG1: Expand the capacity of the wastewater storage lagoon at its current location

The current wastewater storage lagoon is adjacent to the WTP and has capacity of around 40ML. This will need to be increased in future as the volume of wastewater generated increases through new development. This option would extend the storage lagoon at its current location, so the treated wastewater can be distributed from there to various users.

IG2: Provide a new wastewater storage lagoon near irrigated farmland to the west of Goolwa

An alternative option for increasing the capacity of the existing wastewater storage lagoon is to construct a second storage lagoon to the west of Goolwa. Currently, the wastewater is directed from the storage lagoon at the WTP to a turf farm (irrigated by centre pivot) to the west of Goolwa. In the future, there is potential to increase the amount of irrigated horticulture in this area to provide an increased demand for treated wastewater. An advantage of this approach is that there are less space constraints in this area than in the area adjacent to the WTP.

IG3: Expand capacity of stormwater lagoons at the WTP location and convert them into an amenity wetland

There are lagoons adjacent to the WTP which are currently used to store stormwater that is captured and pumped to them from the township. These are currently rectangular, isolated lagoons and their community and treatment values could be improved through converting them to a wetland system. The lagoons could be connected to form a combined stormwater storage and treatment facility, with beneficial community values and amenity value. The area could be extended north to form a community green space with bike paths, parks and ovals nearby.

IG4: Provide large wetland detention basins to Goolwa North area for storage of stormwater up to the 10 year ARI, with overflow for larger rainfall events

This option involves the provision of several large wetland basins to the newly developed areas North of Goolwa. They would be sized to store all stormwater up to the 10 year ARI, with overflow provided to Lake Alexandrina for larger events. Their purpose would be primarily for flood attenuation and to prevent discharge to the lake for storm events smaller than the 10 year ARI, rather than for reuse of the stormwater. This could be integrated with parks and green space to provide community benefits.

IG5: Provide large wetland detention basins and link them to the stormwater reuse network

This option would provide several large wetland basins to the newly developed areas North of Goolwa, similar to option IG4. The difference between the options would be that for this option, the wetland basins would be connected to the stormwater reuse network, rather than primarily having a detention function. Water would flow by gravity or be pumped from the basins to the stormwater storage lagoons near the WTP and be used to extend the stormwater reuse network throughout Goolwa.

IG6: Link the small existing detention basins to the stormwater reuse network

There are several existing small detention basins within Goolwa that are not currently linked to the stormwater reuse network. Their current function is primarily to attenuate flooding and prevent stormwater discharge to Lake Alexandrina for storm events less than the 5 year ARI. These small basins could be linked to the current stormwater reuse network to increase the volume that is reused.

IG7: Use of bio-retention as well as/instead of detention basins

This option would investigate the benefits of bio-retention basins as well as (or instead of) detention basins throughout Goolwa. Bio-retention basins would provide additional treatment and infiltration opportunities compared with detention basins or wetlands.

IG8: Extend stormwater reuse network to irrigate the council land on foreshore and the Golf course

Stormwater from Goolwa is currently captured in several detention basins throughout Goolwa and then pumped to storage lagoons adjacent to the wastewater treatment plant (WTP). The stormwater is then piped to the Goolwa oval for irrigation. This option would extend the stormwater reuse pipeline to the Golf Course and other Council owned green spaces to increase the volume of water that is reused.

IG9: Expand the turf farm to the west of Goolwa to provide an additional demand for treated wastewater

The turf farm currently uses around 180ML/year of treated wastewater and has indicated to Council that they could use at least double this volume, if it were available. As the new developments are constructed around Goolwa, there will be increased volumes of wastewater and this option provides an additional source of demand for reuse.

IG10: Encourage more irrigated horticulture to the land surrounding the turf farm to provide additional demand for treated wastewater

As well as expanding the turf farm to increase demand for treated wastewater, there is potential to create a hub of irrigated horticulture to the west of Goolwa (surrounding the current turf farm). Currently the land is used for dry-land farming and it would be necessary to encourage irrigated horticulture to develop in the area. This option would provide a greater demand for wastewater for irrigation, and hence increase the volume that can be reused.

IG11: Top up ornamental stormwater wetlands with treated wastewater when they dry out during summer

Where stormwater wetlands are provided as community features, an amenity issue may result during summer when the wetlands dry out. This can result in weed infestation and unsightly appearance of the wetland. Topping up these wetland basins when they dry out could provide a demand for treated wastewater.

IG12: Provide purple pipe to new development areas

Treated wastewater and stormwater could be connected into the new development areas via a ‘purple pipe’ network. This would increase the volume of stormwater and wastewater that can be reused within the township, and reduce the volume of mains water required at each house. The maintenance required to sustain such a system would be considered when investigating this option.

IG13: Maximise use of vacuum pump station for new development area

A vacuum pump station has recently been commissioned to service a new development to the North East of Goolwa. The pump station has been designed with a much higher capacity than it currently services, and the station has a radius of service of at least 3km. This option involves using the vacuum pump station to service a majority of the new development areas, as they fall within the operational radius of the station.

IG14: Provide green bike path corridors linking green areas (these can be integrated with irrigation pipeline routes)

This option involves providing green bike path corridors to link other green areas around the current and new developments in Goolwa. This would provide high community value, and connectivity of the green space areas. The paths could be located along the irrigation pipeline routes, which would enable convenient irrigation to the paths, as well as access to the pipelines for maintenance.

IG15: Provide 'community woodlots' in open space areas for infiltration, flood attenuation and community values

Council could specify that the new developments include ‘community woodlots’, which would be green open space areas that are planted with native vegetation. These could have recessed areas for stormwater detention during storm events, and be designed for infiltration of stormwater. Housing could be designed to surround and face towards the woodlots to provide maximum community benefit.

IG16: Investigate MAR potential and assess benefits

Although there are no sites highlighted as having high MAR potential within or near Goolwa, the benefits of any areas with potential for MAR would be assessed to determine whether further investigations would be justifiable. This would include the distance from the township, injection and harvesting capacity, salinity, and availability of other storage options.

3.2. Infrastructure Options for Hindmarsh Island

A brief description of each option for use in Hindmarsh Island is included in this section. The details of each option have been determined from personal communication with Alexandrina Council staff during the site visit, as well as background documents and reports.

IH1: Additional detention basins to collect up to 10 year ARI, with overflow for larger storm events

This option would involve provision of stormwater detention basins, sized to retain all flows up to the 10 year ARI event. Their purpose would be primarily for flood attenuation and to prevent discharge to the lake for storm events smaller than the 10 year ARI, rather than reuse of the stormwater. This could be integrated with parks and green space to provide community benefits.

IH2: Link stormwater detention basins to reuse network for green areas

This option would provide stormwater detention basins similar to option IH 1, however for this option, the wetland basins would be connected to a reuse network, rather than primarily having a detention function. The council-owned green areas within Hindmarsh Island could be irrigated with the reused stormwater.

IH3: Direct all stormwater to Goolwa and link it into reuse network

This option involves detaining the stormwater from Hindmarsh Island and pumping it over to Goolwa, to integrate with Goolwa's existing reuse scheme. This would increase the total volume reused, as there is more potential for stormwater demand in Goolwa than in Hindmarsh Island. The stormwater pipeline could follow the same alignment as the proposed wastewater pipe.

3.3. Infrastructure Options for both Goolwa and Hindmarsh Island

IGH1: Pipeline to transport wastewater from Hindmarsh Island to Goolwa WTP

New development of approximately 300 allotments is expected on Hindmarsh Island, which is currently serviced by individual septic systems. The EPA has advised that there should be no on-site disposal of wastewater in the future. This option proposes to provide a community wastewater management system and then pump the sewage through a pipeline to Goolwa, where it would be integrated with the Goolwa sewage and treated at the Goolwa WTP.

IGH2: Implement roadside WSUD strategies to reduce runoff volumes

A range of WSUD strategies could be investigated and implemented throughout the existing and new development areas of Goolwa and/or Hindmarsh Island. Potential options to reduce the volume of stormwater runoff include rain gardens, pervious pavements, bio-retention systems, swales and buffer strips. For this option, a combination of these methods would be used to reduce the volume of stormwater runoff, and hence reduce the volume to be managed and reused.

IGH3: Provide water treatment (wetlands or bio-retention) before stormwater discharge to River

This option would involve ensuring that all stormwater discharged to Lake Alexandrina exceeds a certain level of quality through treatment in a wetland or bio-retention system. It is unlikely that all stormwater will be able to be reused; hence environmental benefits would result if the quality of the discharge water is improved.

3.4. Planning and Policy Options

Legislation

L1: Mandate particular rainwater tank sizes and in-house use for all new developments

This option involves investigating the effect of different rainwater tank sizes that are mandated to be included in all new developments. Maximising reuse within each home would reduce the volumes of stormwater that need to be managed on a larger scale and reduce potable mains water supply. Scenarios' to be considered within this option include the following:

- Based on roof area (and/or allotment area), determine an optimal size for the rainwater tanks to maximise the volume that can be reused within each home.
- Determine if tanks must be plumbed into the home (eg toilets and laundry).

Having regard to the anticipated "roll-out" of the Residential Code (ie Schedule 4 of the Development Regulations) to areas within the "Greater Adelaide Region" any mandating of rainwater tanks will need to be associated with an amendment to the Schedule 4 of the Development Regulations and/or the Building Code.

L2: Update the Residential Code to addresses WSUD

Amend Schedule 4 of the Development Regulations to ensure Water Sensitive Urban Design (WSUD) outcomes are incorporated within the Residential Code particularly relating to the construction of new dwellings.

L3: Developer Contributions

Consider changes to the Development Act that that require developers to contribute to off-site infrastructure requirement as a result of their proposed developments. Currently, developers fund all on-site stormwater construction works only. This option also needs to be considered within the broader context of the State's objective for more affordable housing.

Development Plan Policy

P1: Council's Development Plan Complying and On-Merit Provisions

Concurrently, with updates to Development Regulations (Schedule 4), Council can also consider updating its "complying" on "on-merit" Development Plan provisions via a Development Plan Amendment process to encourage the use of rainwater tanks, integrated water management outcomes and natural resources management policies.

P2: Structure Plans

Incorporate structure plans (via a Development Plan Amendment process), that conceptually identify major open space (associated with water sensitive urban design) corridors linked with water reuse and natural flow corridors in Goolwa North (see also IG13). Further, identify significant native vegetation areas for protection.

P3: Outdoor Water Use – Greenfield Developments

Implement the State's policy of *"Require new Greenfield developments that are subject to Structure Plans from 2011 to source water for outdoor use from non-mains water supplies. This recognises the need to plan alternative water sources at the commencement of new large Greenfield developments, rather than retrofit these sources for latter stages of the development."* (Water Policy 4, The 30-Year Plan for Greater Adelaide (pg 142).

P4: Protection of relevant coastal and riparian areas

Implement the State's policy of "*Incorporate the protection of relevant coastal and riparian areas and Ramsar wetlands in Structure Plans and Development Plans*". (Water Policy 6, The 30-Year Plan for Greater Adelaide (pg 142).

P5: Wastewater reuse and water harvesting

To further promote the use of wastewater reuse and water harvesting techniques, Council could update its Development Plan provisions to favour such an approach. Wastewater reuse and water harvesting policy would be particularly useful if it can be triggered at the land division stage of a development.

P6: State's Better Development Plan (BDP) Library

Initiate discussions with the Department of Planning and Local Government (DPLG) to strengthen Water Sensitive Urban Design policies and other related Natural Resources Management policies in the BDP library that can be incorporated into Council's Development Plan during the BDP Conversion Development Plan Amendment.

P7: Conversion of Development Plan Amendment (DPA)

Complete Council's Conversion Better Development Plan DPA. Completion of the DPA will at the very least incorporate many of the existing useful BDP natural resources management policies of the BDP Library into Council's Development Plan.

P8: Discount Open Space Contribution

Draft Development Plan policy that promotes Council receiving less that the 12.5% of open space contribution, subject to Developers addressing a range of integrated water management and urban design outcomes, beyond what is already required as a minimum standard.

Education and Guidelines

E1: Training of Decision-Makers

Facilitate opportunities (eg training and workshops) that increase the capacity of local government Elected Members, Development Assessment Panel members, staff and applicants to better understand water management (eg water recycling and WSUD), natural resources management outcomes and the value these bring.

E2: Explanatory Guidelines

Prepare guidelines which provide further local specific details to the generally broad WSUD/NRM policies currently outlined within Development Plans. Guidelines could value add to the existing DPLG WSUD documentation.

E3: Government Agencies Schedule 8 (Development Regulations) Responses

Review systems that promote State Government referral agencies to respond within legislative timeframes and ensure responses have regard to relevant Development Plan policy and protocols for drafting valid planning conditions.

Advocacy

A1: Mandate WSUD.

Encourage the State Government to implement their policy to "*mandate WSUD for new developments by 2013*" (Water Policy 1, The 30-Year Plan for Greater Adelaide (pg. 141)).

A2: State Government Funding.

Lobby State Government for funding to support (i) detailed structure planning process for identified growth areas, (ii) preparation of Stormwater Management Plans as required by the Local Government Act, (iii) construct public WSUD features and other associated water related infrastructure, to support the growth areas identified in The 30-Year Plan for Greater Adelaide.

<u>**Council Project Management**</u>

C1: Dedicated Project Team.

Allocate personnel and resources to 'rollout' The 30-Year Plan for Greater Adelaide directions.

C2: Cost / Benefit Estimates.

Prepare cost/benefit estimates regarding integrated water management infrastructure provision for Goolwa North. Such an approach would need to consider the broader area's infrastructure provision and include provision common sewer etc.

3.5. Water Conservation Options

WC1: Implement demand management measures such as efficient fittings and water restrictions

Various demand management measures will be investigated to estimate the difference to demand and wastewater/stormwater that would result. These measures include efficient household appliances and fittings (toilets, showerheads, washing machines) and water restrictions.

3.6. Relating the Options to the Goals

Table 3-1 shows how each option for Goolwa and Hindmarsh Island relates to one or more of the integrated water management goals that are described in Section 2.

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Table 3-1: Integrated Water Management Options for Alexandrina Council Area

Option	Council and Stakeholder Organisation Goals						Community Goals				
	Goal 1: Minimise adverse impacts on the environment	**Goal 2:** Use a Water Balance Approach to Match Fit for Use Water Supply	**Goal 3:** Establish an Economic Model to Deliver the IWMP	**Goal 4:** A Supportive Legislative Framework that delivers IWM	**Goal 5:** Strong Partnerships and a Commitment to IWM	**Goal 6:** An IWM Structure Plan for Goolwa North	**Goal C1:** Minimise the carbon footprint of all water management actions	**Goal C2:** An aware community	**Goal C3:** Manage demand for water	**Goal C4:** Create high value open space in new developments	**Goal C5:** Integrate shared access (bike/walking) paths with wetland and biodiversity corridors
Infrastructure Options for Goolwa											
Expand the capacity of the wastewater storage lagoon at its current location											
Provide a new wastewater storage lagoon near irrigated farmland to the west of Goolwa											
Expand capacity of stormwater lagoons at the WTP location and convert them into an amenity wetland											
Provide large wetland detention basins to Goolwa North area for storage of stormwater up to the 10 year ARI, with overflow for larger rainfall events											
Provide large wetland detention basins and link them to the stormwater reuse network											
Link the small existing detention basins to the stormwater reuse network											
Use of bioretention as well as/instead of detention basins											
Extend stormwater reuse network to irrigate the council land on foreshore and the Golf course											
Expand the turf farm to the west of Goolwa to provide an additional demand for treated wastewater											
Encourage more irrigated horticulture to the land surrounding the turf farm to provide additional demand for treated wastewater											
Top up ornamental stormwater wetlands with treated wastewater when they dry out during summer											
Provide purple pipe to new development areas											
Maximise use of vacuum pump station for new development area											
Provide green bike path corridors linking green areas (these can be integrated with irrigation pipeline routes)											
Provide 'community woodlots' in open space areas for infiltration, flood attenuation and community values											
Investigate MAR potential and assess benefits											
Additional detention basins to collect up to 10 year ARI, with overflow for larger storm events											
Infrastructure Options for Hindmarsh Island											
Link stormwater detention basins to reuse network for green areas											
Direct all stormwater to Goolwa and link it into reuse network											
Pipeline to transport wastewater from Hindmarsh Island to Goolwa WTP											
Infrastructure Options for both Goolwa and Hindmarsh Island											
Implement roadside WSUD strategies to reduce runoff volumes											
Provide water treatment (wetlands or bioretention) before stormwater discharge to River											
Planning and Policy Options											

	Council and Stakeholder Organisation Goals						Community Goals				
Option	**Goal 1:** Minimise adverse impacts on the environment	**Goal 2:** Use a Water Balance Approach to Match Fit for Use Water Supply	**Goal 3:** Establish an Economic Model to Deliver the IWMP	**Goal 4:** A Supportive Legislative Framework that delivers IWM	**Goal 5:** Strong Partnerships and a Commitment to IWM	**Goal 6:** An IWM Structure Plan for Goolwa North	**Goal C1:** Minimise the carbon footprint of all water management actions	**Goal C2:** An aware community	**Goal C3:** Manage demand for water	**Goal C4:** Create high value open space in new developments	**Goal C5:** Integrate shared access (bike/walking) paths with wetland and biodiversity corridors
Mandate particular rainwater tank sizes and in house use for all new developments											
Update the Residential Code to addresses WSUD							V				
Developer Contributions											
Council's Development Plan Complying and On-Merit Provisions											
Structure Plans											
Outdoor Water Use – Greenfield Developments							V				
Protection of relevant coastal and riparian areas											
Wastewater reuse and water harvesting							V				
State's Better Development Plan Library											
Conversion of DPA											
Discount Open Space Contribution											
Explanatory Guidelines											
Government Agencies Schedule 8 (Development Regulations) Responses											
Mandate WSUD							V				
State Government Funding											
Dedicated Project Team											
Cost / Benefit Estimates											
Water Conservation Options											
Implement demand management measures such as efficient fittings and water restrictions											

4. Scenarios for Integrated Water Management

To optimise the selection of options for integrated water management to meet the project's goals, three groups of options (scenarios) that represent different outcomes and levels of investment will be modelled. Some options will be required in all scenarios, others may only be necessary to meet a certain scenario.

The focus of each of these scenarios, and the options included in each scenario has been discussed with the District Council of Alexandrina.

From preliminary discussions with the District Council of Alexandrina, the scenarios may be:

1) Baseline scenario. This scenario could include all of the infrastructure and policy options that would be required in the future in order to cater for increased development and population. The infrastructure included in the baseline scenario would form a water resources structure plan for the future of the area. This includes the provision for additional wastewater and stormwater treatment, storage and reuse options to ensure no discharge of water to Lake Alexandrina for storm events smaller than the 10 year ARI.
2) Maximum household rainwater tank use. This scenario would include similar community infrastructure to the baseline scenario but would include maximum reuse of rainwater within individual houses. An appropriate volume of rainwater tank for various dwelling sizes would be investigated as part of this. In order to maximise re-use within the home, rainwater would be used for domestic irrigation, toilet and hot water within each home. The changes to sizing required for community infrastructure would be taken into account as part of this option.
3) Purple pipe to new development areas. This scenario would include similar community infrastructure to the baseline scenario but would include a 'purple' pipe to each new residence for domestic irrigation, toilet and hot water. The changes to sizing required for community infrastructure would be taken into account as part of this option.

In Table 4-1 below, each integrated water management option has been labelled as belonging to one or more of the scenarios. The options that are not included in any scenario will be excluded from the modelling and a reason will be given in the final plan as to why they were not considered.

The infrastructure layout representing the baseline scenario is shown in Figure 4-1 to Figure 4-6. Figure 4-1 shows the 30 year plan area with 5 m contours, which were used to develop the surface water catchments and possible drainage paths shown in Figure 4-2.

Figure 4-3 shows possible new road alignments, with a bypass road to the west, and a new central commercial hub in the east. This road alignment utilises the existing S-bend crossing across the rail line to minimise construction effort, but comment has not been sought from road engineers as to the constructability, efficiency, or safety of any of the proposed possible road alignments shown here.

Figure 4-4 shows radii from the vacuum pump station, which were used with Figure 4-2 to develop Figure 4-5 showing sewage catchments. The eastern sewer area is shown draining to the vacuum pump station with the western area heading directly to the WWTP. The northernmost section of the 30 year plan area may be difficult to drain to the WWTP and may need a small pump station to move the sewage into either of the other two sewer catchments. The exact boundaries of these sewer catchments depends on the future performance of the vacuum pump station.

Figure 4-6 shows possible green corridors and park areas. Areas of remnant vegetation are preserved, and some drainage lines are shown with a 30 m wide green buffer (15 m each side), with the intention that bike tracks/walking paths could follow the drainage paths. Other green strips are provided to provide links and loops, to allow more people to use these areas to move across the town between their houses and schools / commercial areas. Some drainage paths and roads are not buffered with green strips to minimise maintenance, and because there are probably sufficient bike routes already provided along the routes shown. The green space presented in Figure 4-6 comprises approximately 10% of the 30 year growth plan area, leaving scope to include additional 25% green area in locations not yet shown.

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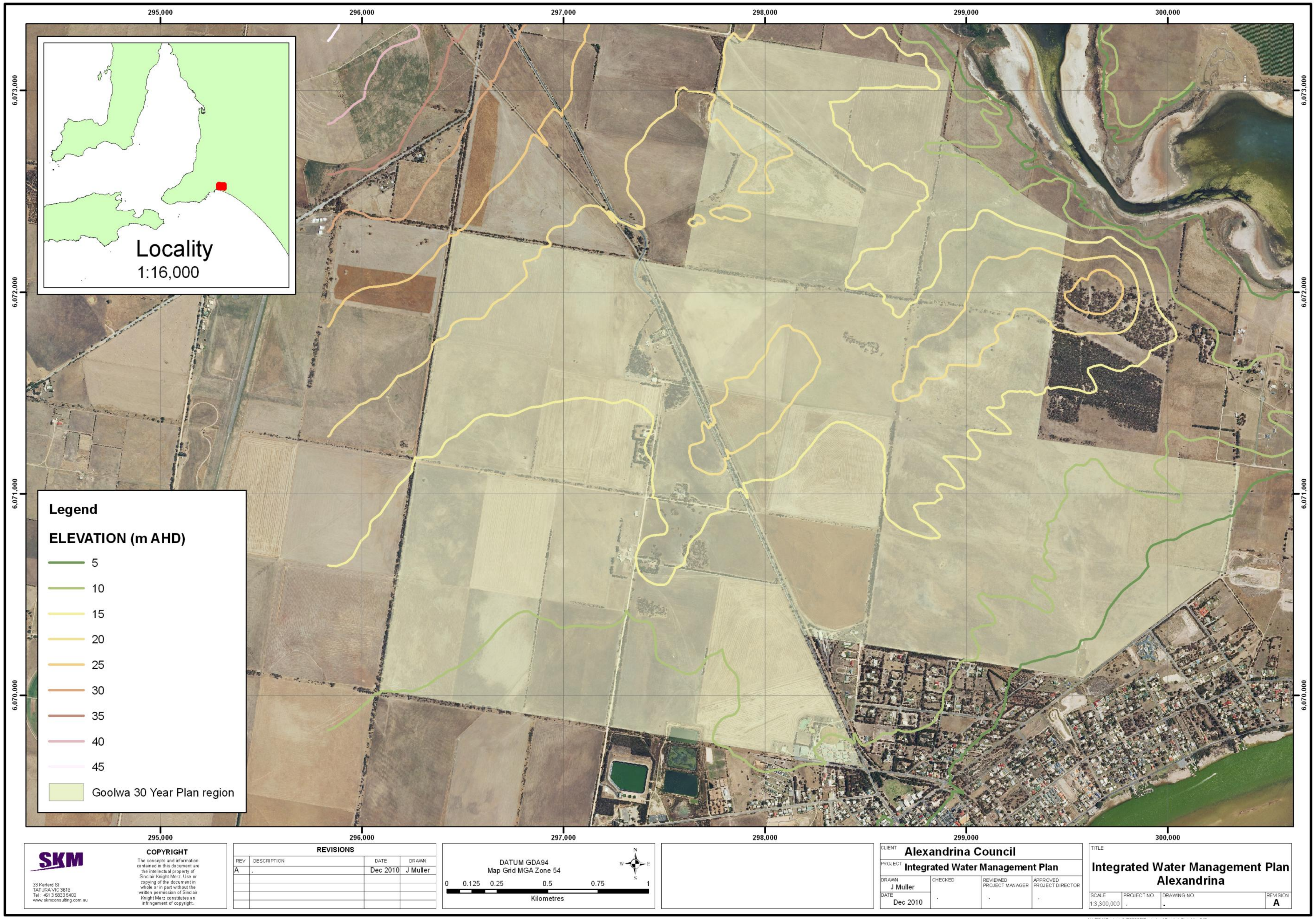
▪ Table 4-1: Scenarios for Goolwa

Option	Goals Met											Scenario 1 Base Case	Scenario 2 Maximum Use of Rainwater for Residential Reuse	Scenario 3 Purple Pipe to New Development Areas
Infrastructure Options for Goolwa														
Expand the capacity of the wastewater storage lagoon at its current location	■	■				■	■					■	■	■
Provide a new wastewater storage lagoon near irrigated farmland to the west of Goolwa	■	■				■						■	■	■
Expand capacity of stormwater lagoons at the WTP location and convert them into an amenity wetland	■	■				■		■		■	■	■	■	■
Provide large wetland detention basins to Goolwa North area for storage of stormwater up to the 10 year ARI, with overflow for larger rainfall events	■	■				■		■				■	■	■
Provide large wetland detention basins and link them to the stormwater reuse network	■	■				■						■	■	■
Link the small existing detention basins to the stormwater reuse network	■	■				■								
Use of bioretention as well as/instead of detention basins	■	■												
Extend stormwater reuse network to irrigate the council land on foreshore and the Golf course	■	■				■	■		■			■	■	■
Expand the turf farm to the west of Goolwa to provide an additional demand for treated wastewater	■	■			■		■		■			■	■	■
Encourage more irrigated horticulture to the land surrounding the turf farm to provide additional demand for treated wastewater	■	■							■			■	■	■
Top up ornamental stormwater wetlands with treated wastewater when they dry out during summer	■	■							■	■	■	■	■	■
Provide purple pipe to new development areas	■	■			■	■		■	■					■
Maximise use of vacuum pump station for new development area						■	■					■	■	■
Provide green bike path corridors linking green areas (these can be integrated with irrigation pipeline routes)	■	■			■	■	■	■		■	■	■	■	■
Provide 'community woodlots' in open space areas for infiltration, flood attenuation and community values	■	■				■	■	■		■	■			
Investigate MAR potential and assess benefits	■	■				■						■	■	■
Additional detention basins to collect up to 10 year ARI, with overflow for larger storm events	■					■						■	■	■
Infrastructure Options for Hindmarsh Island														
Link stormwater detention basins to reuse network for green areas	■	■				■								
Direct all stormwater to Goolwa and link it into reuse network	■	■				■								
Pipeline to transport wastewater from Hindmarsh Island to Goolwa WTP	■	■				■						■	■	■
Infrastructure Options for both Goolwa and Hindmarsh Island														
Implement roadside WSUD strategies to reduce runoff volumes	■					■	■	■				■	■	■
Provide water treatment (wetlands or bioretention) before stormwater discharge to River	■					■		■		■		■	■	■

Option	Goals Met	Scenario 1 Base Case	Scenario 2 Maximum Use of Rainwater for Residential Reuse	Scenario 3 Purple Pipe to New Development Areas
Mandate particular rainwater tank sizes and in house use for all new developments				
Planning and Policy Options				
Mandate particular rainwater tank sizes and in house use for all new developments				
Update the Residential Code to addresses WSUD				
Developer Contributions				
Council's Development Plan Complying and On-Merit Provisions				
Structure Plans				
Outdoor Water Use – Greenfield Developments				
Protection of relevant coastal and riparian areas				
Wastewater reuse and water harvesting				
State's Better Development Plan Library				
Conversion DPA				
Discount Open Space Contribution				
Explanatory Guidelines				
Government Agencies Schedule 8 (Development Regulations) Responses				
Mandate WSUD				
State Government Funding				
Dedicated Project Team				
Cost / Benefit Estimates				
Water Conservation Options				
Implement demand management measures such as efficient fittings and water restrictions				



■ **Figure 4-1: Goolwa 30 year plan area**

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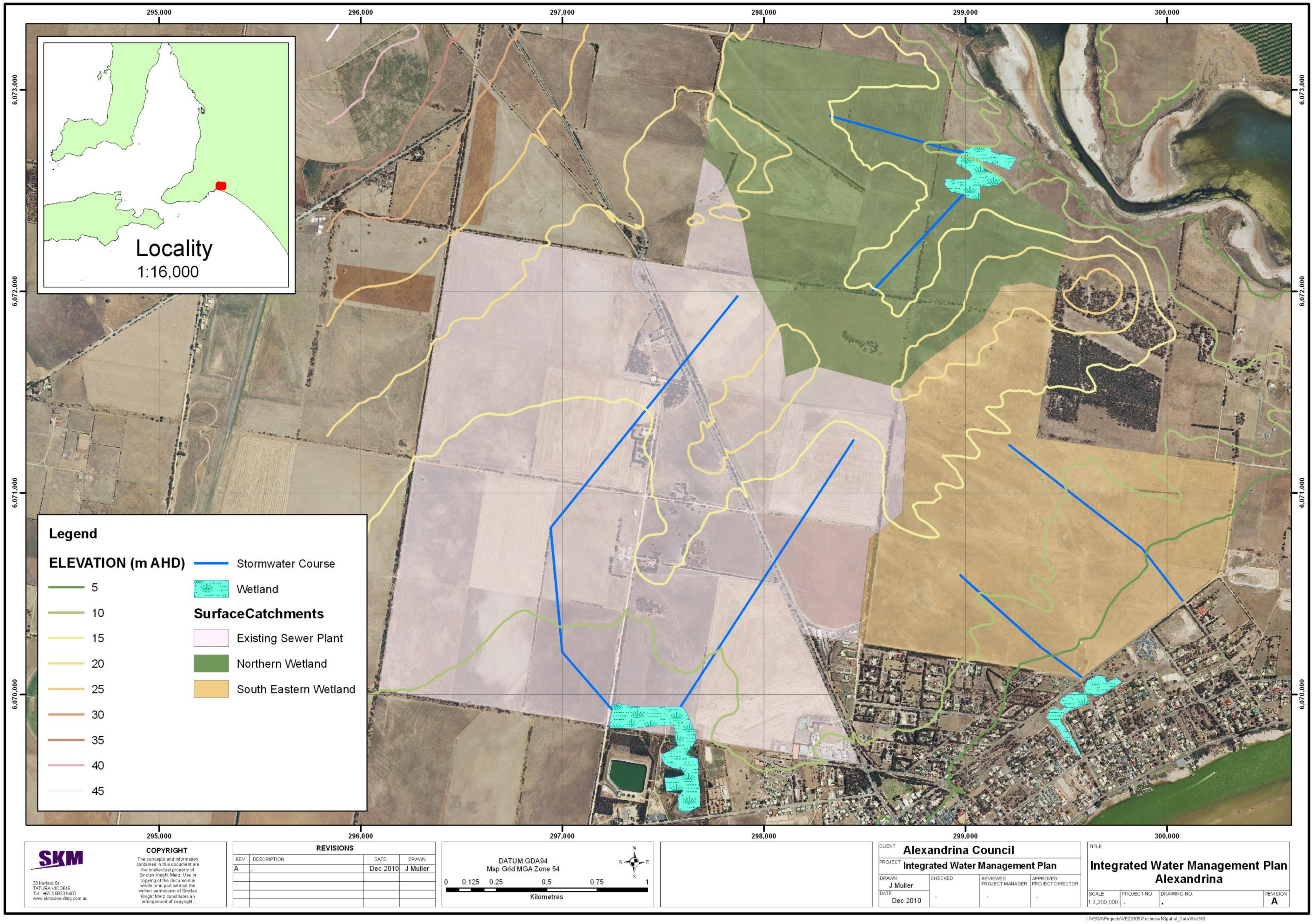
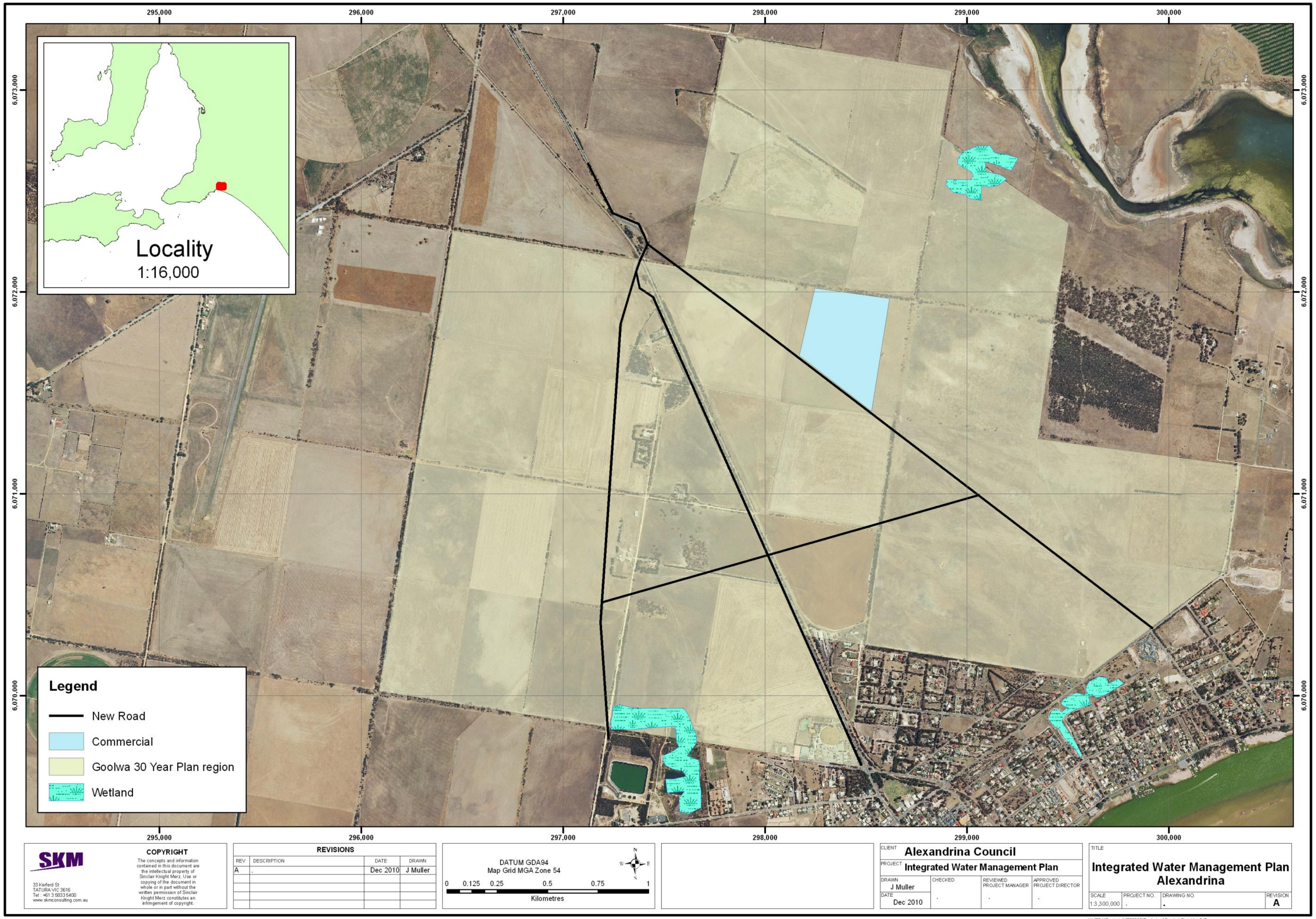
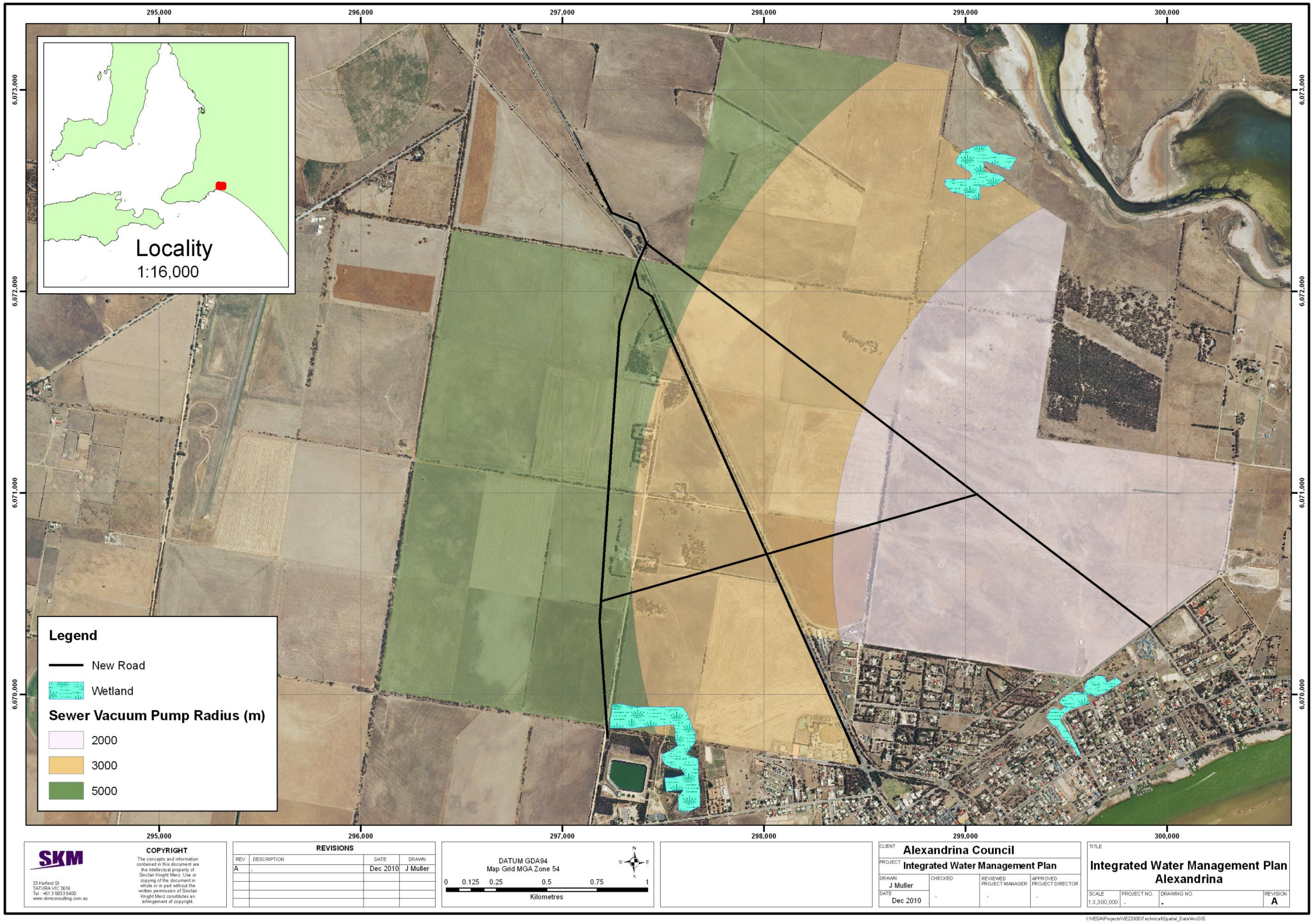


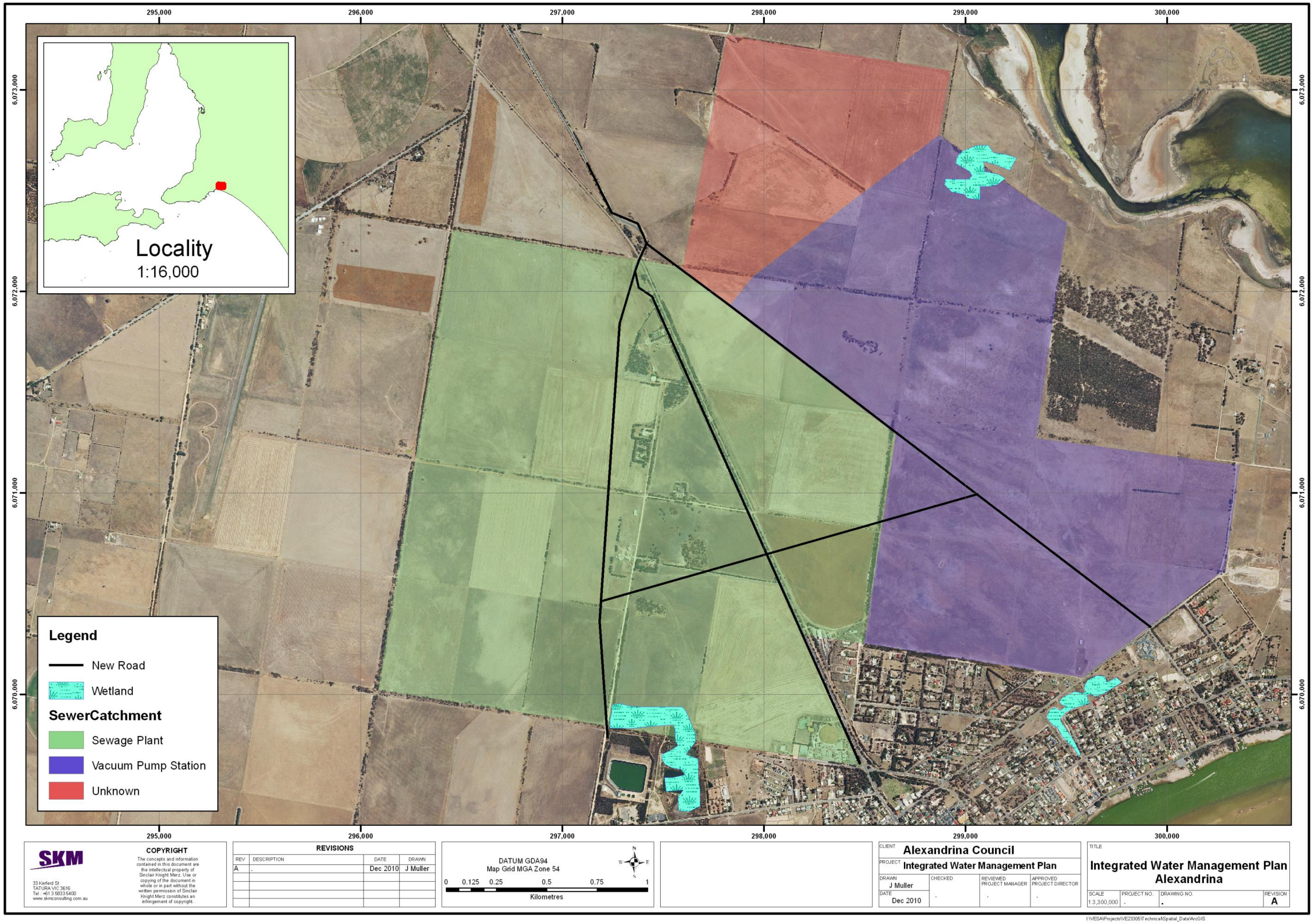
- **Figure 4-2: Surface water drainage**



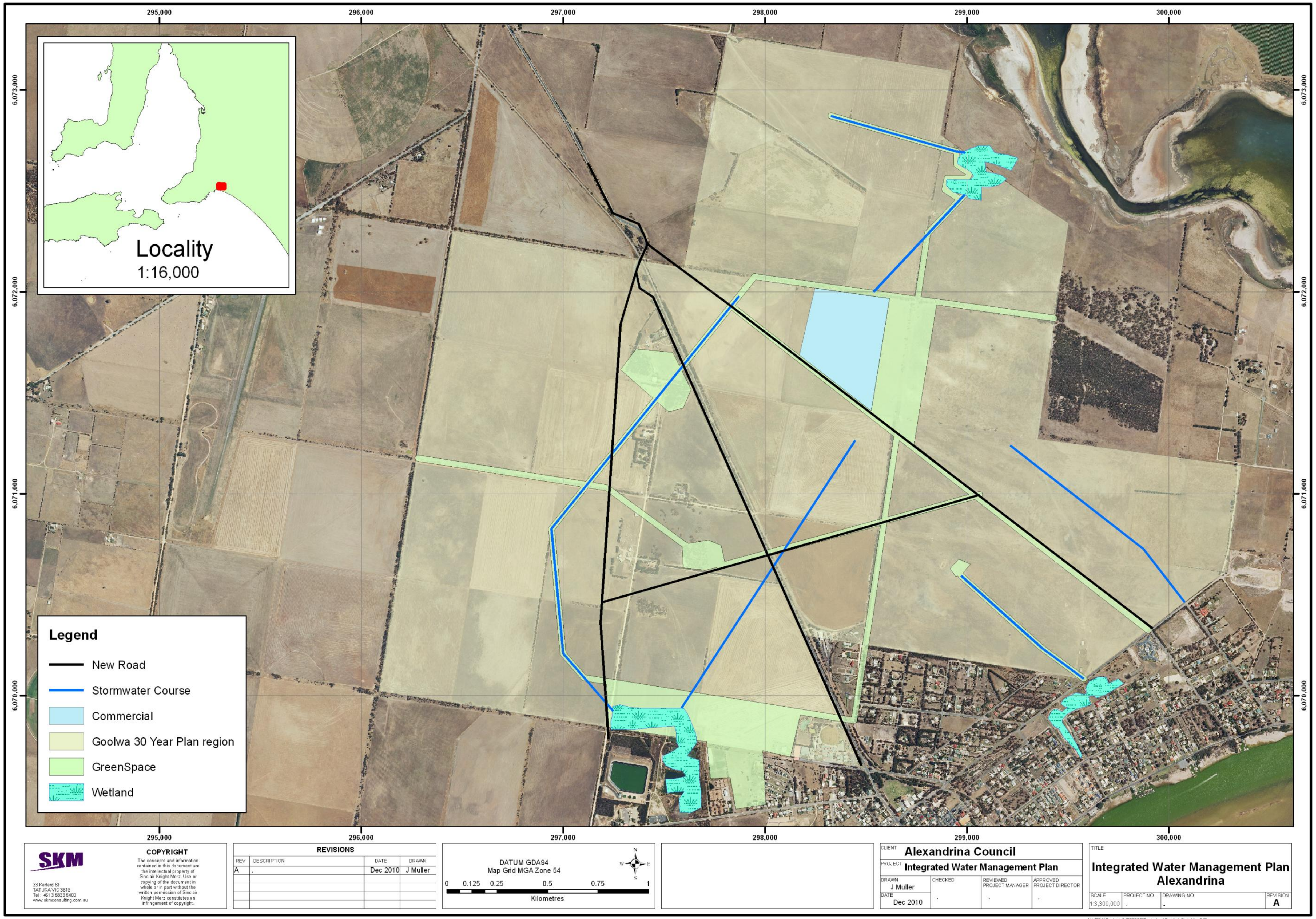
■ **Figure 4-3: Possible new road alignments, and new commercial hub**



- **Figure 4-4: Sewer Vacuum pump station radius**



- **Figure 4-5: Sewage catchments**



▪ **Figure 4-6: Possible green space and linking corridors**

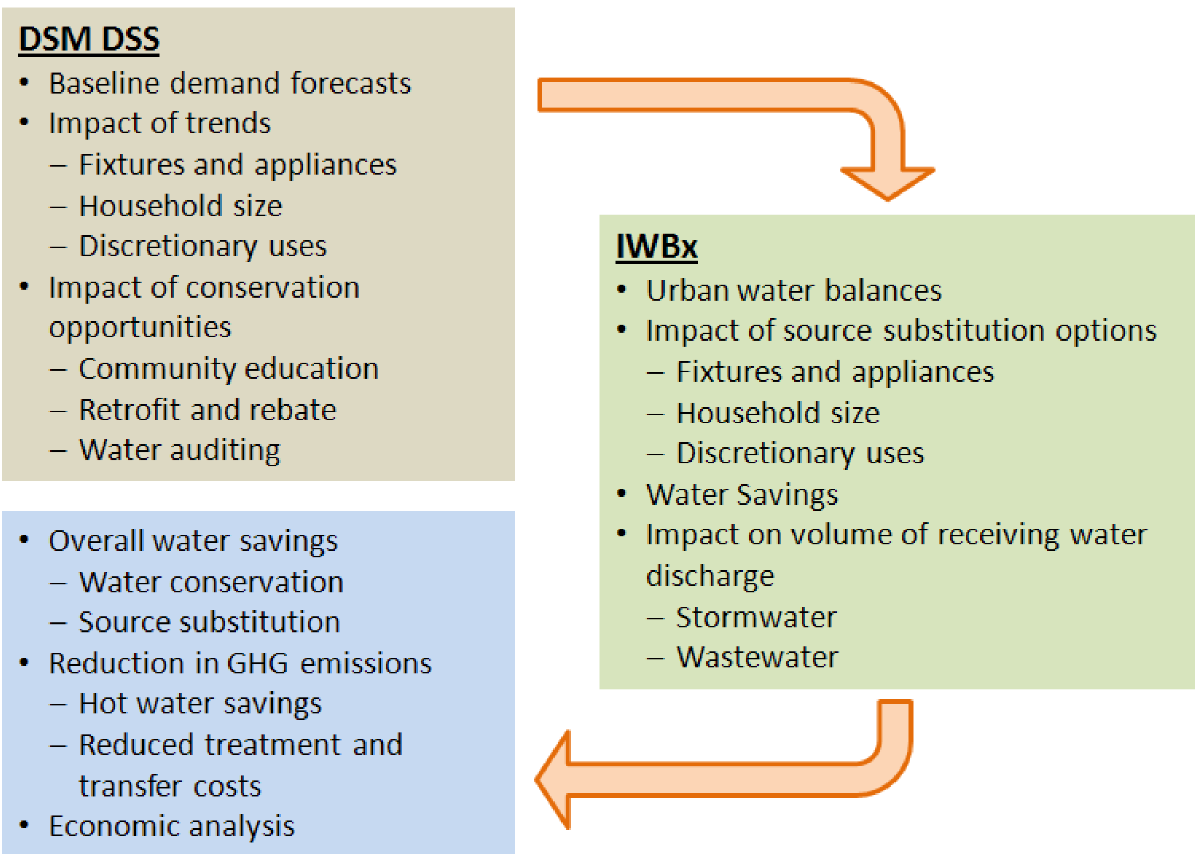
5. Water Balance and Options Modelling

5.1. Modelling Framework

The initial stages of the project have involved setting up the models within the water balance modelling framework. The assessment of opportunities for water conservation and recycling is undertaken using two models (Figure 5-1):

1) The Demand Side Management Decision Support System (DSM DSS) – which is used to both prepare forecasts of demand, assess the impact of water conservation options and to undertake the final analysis of water savings, greenhouse gas emissions and economics; and
2) The Integrated Urban Water Balance Simulation Model (IWBx) which utilises a unique whole of water cycle modelling approach to assess the impact of different water management strategies.

A detailed description of each of the models is provided below.



▪ **Figure 5-1: Integrated Water Balance and Decision Support Framework**

5.1.1. Demand Side Management Decision-Support System (DSM DSS)

The DSM DSS model is an "end-use" urban water decision support model designed for use in preparing forecasts of water demand and assessing the impact of demand management options. The model prepares baseline forecasts of water demand and wastewater generation taking account of trends in:

- The propagation of water efficient fixtures and appliances;
- Account formation and household size;
- Employment; and
- Discretionary water uses and the impact of income and lifestyle factors

The model has a full in-built benefit cost analysis capability that allows the user to examine the full suite of benefits (financial and other) accruing from demand management and recycling initiatives. These include:

- Reductions in water and wastewater treatment and transfer costs;
- Financial benefits accruing from the delay and/or downsizing of future capital infrastructure;
- Benefits to customers from reduced water heating costs; and
- Reductions in water utility operational and customer greenhouse gas emissions.

5.1.2. Integrated Urban Water Balance Simulation Model (IWBx)

The Integrated Urban Water Balance Simulation Model (IWBx) utilises a unique water balance modelling approach to explore the impact of different water cycle management options on water consumption and receiving water discharges. The conceptual layout of the model is shown in Figure 5-2. At the heart of the model is a Monte-Carlo simulation of customer water demands at the end use level. This simulation uses a stratified customer base that reflects the different water use characteristics of individual customers. This is coupled to a combined climate/randomised water demand and wastewater simulation that is aggregated to form the total water consumption and wastewater flow.

The model also simulates the generation of stormwater and the capture and treatment of both recycled wastewater and stormwater. As such it provides a complete simulation of the urban water cycle and allows the impact of different water cycle management options to be explored.

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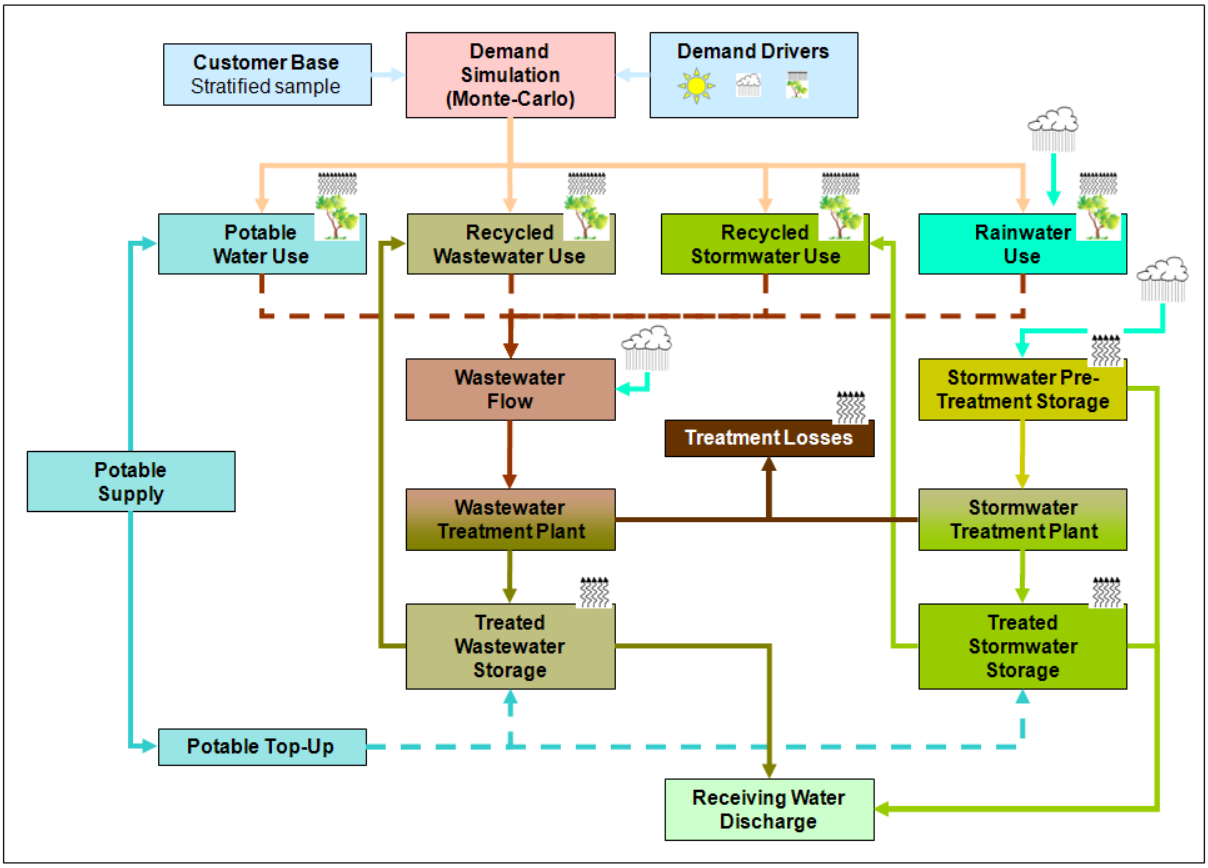
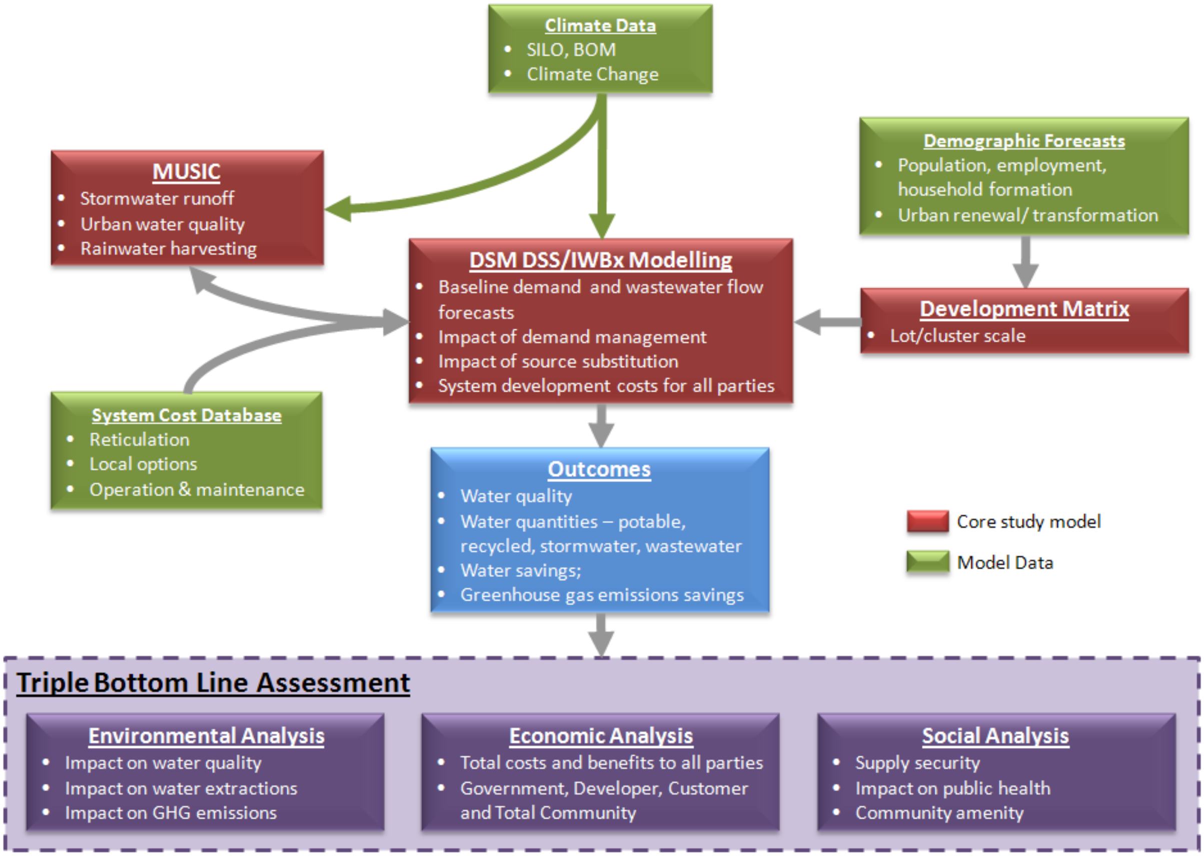


- **Figure 5-2: Conceptual Layout of IWBx Model**

Ultimately, the water balance modelling will incorporate the assessment of water quality impacts and will lead to an assessment of environmental, social and economic outcomes.



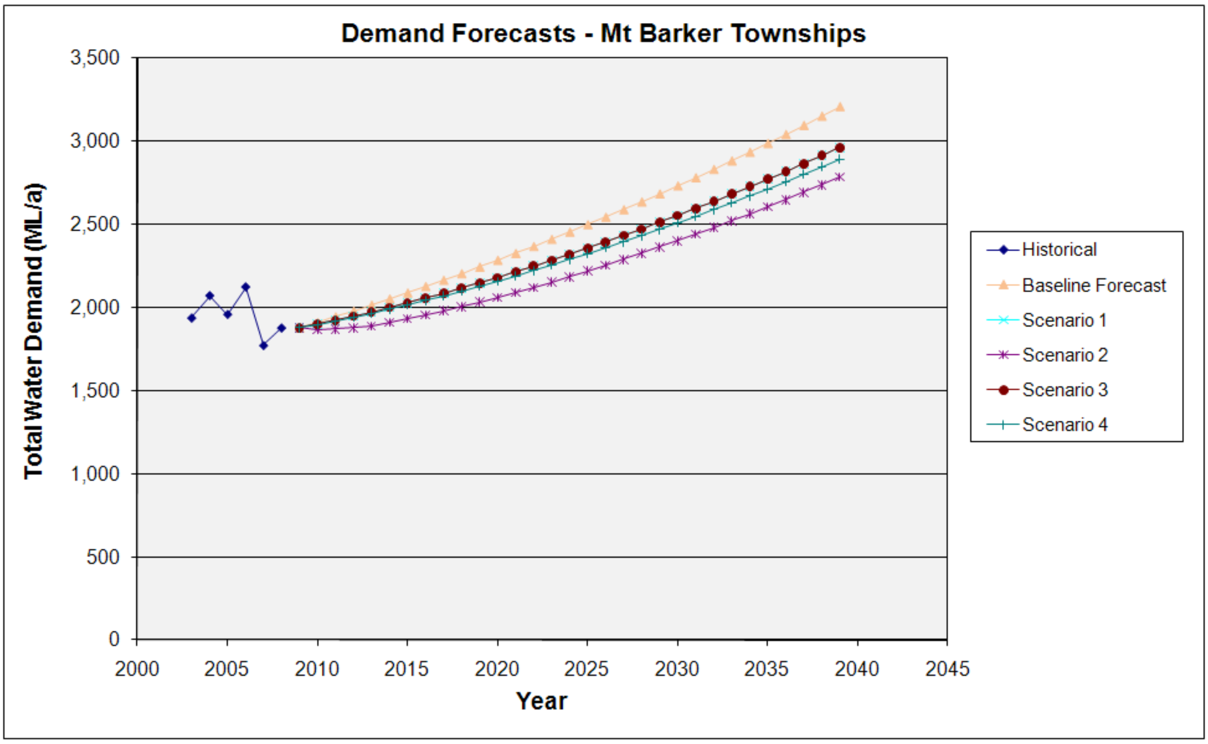
■ **Figure 5-3: Water Cycle Management and Water Balance Modelling**

5.2. Baseline Demand Forecasting and Impact of Conservation Options

The preparation of demand forecasts and the assessment of potential conservation options involve the application of a number of different options that are found to be cost-effective. These may include:

- Community education programs;
- Water pricing initiatives;
- System water loss management
- Residential showerhead retrofit and home tune-up programs;
- Residential washing machine rebates;
- Large non-residential customer water audit;
- Commercial toilet retrofit programs;
- Evaporative cooling unit and cooling tower audit programs;
- New development codes governing water use.

Of those programs, the water pricing and system water loss management are under the control of SA Water and are not considered in this study. Once assessed, the impact of water conservation and recycling initiatives can be forecast (Figure 5-4).



■ **Figure 5-4: Example Output - DSM DSS Model - Mt Barker Townships**

6. Project History

6.1. Alexandrina Council

The Alexandrina Council area covers approximately 1800km^2 to the south of Adelaide, and forms part of the Fleurieu Peninsula. Agriculture in the area includes irrigated horticulture and general farming, including viticulture, dairying and fruit production. Other industries within the area include tourism, manufacturing, engineering and boat building (Alexandrina Council, 2010).

A summary of the region's water resources and water supply and treatment is in preparation to inform the options assessment. This will be included in the final report.

6.2. Previous investigations and plans

A number of previous investigations and plans have been prepared that have guided the water saving and water reuse initiatives already been implemented within the region. The status of water management actions recommended in previous reports has been reviewed by Council. Where action is still required and continues to be a Council priority, these will be reviewed for inclusion in the IWMP.

Key documents include:

- The *Sustainable Alexandrina 2007-2010 Policy Direction and Action Plan* prepared for Alexandrina Council by South Australian Murray-Darling Basin Natural Resources Management Board describes actions for water management.
- Alexandrina Council's *Infrastructure and Asset Management Plan* (January 2009) provides direction for stormwater, water supply and wastewater management. It identifies future concentration on stormwater and wastewater reuse initiatives, a need to include WSUD principles in new development and future requirements to renew infrastructure in older land divisions and townships.

6.3. Policy Review

A Policy Review was prepared as part of this project, summarising the key strategic planning directions and statutory planning policy context for integrated water management relating to the Alexandrina Council. This review was submitted as the Milestone 1 report to meet requirements of the DEWHA funding arrangement.

This policy review includes a summary of the broader strategic planning context which Council planning processes sit within such as the South Australia's Strategic Plan and Water for Good as well as Council's Strategic Plan 2009-2018. Additionally, Council's Development Plan is assessed to identify strengths and weaknesses of existing planning policies in terms of integrated water management.

7. Stakeholder Consultation

7.1. Stakeholder Workshop (Goals, Issues and Options)

A workshop was held on Monday 9th August 2010 regarding the Integrated Water Management Plan for the Alexandrina Council. Representatives from a range of government departments and other stakeholder organisations attended the workshop. The aim of the workshop was to identify and articulate each organisation's goals, issues and opportunities for integrated water management in the identified townships and for particular growth areas that are the subject of the IWMP project. Appendix A contains a comprehensive summary of the findings of the workshop.

7.2. Developer Consultation

A number of interviews and meetings were undertaken with developers and land owners to:

- Understand developers, development program, including staging plans;
- Obtain developers feedback on a range of water related natural resources management policies and procedures.

The information gathered will be considered during the preparation of township structure plans and recommendations associated with the Integrated Water Management Plan.

The interview questions and a summary of responses are contained in Appendix B.

7.3. Elected Member Briefing

A briefing with elected members was held on Monday 18th October, 2010. An introduction to IWM was provided and the project objectives and outcomes described.

7.4. Community Consultation

A community workshop was held on the 2nd November, 2010. The objective of the workshop was to identify and articulate the community's goals, issues and opportunities for integrated water management in identified townships and for particular growth areas throughout the Council area. A summary of the minutes of the workshop are contained in Appendix C.

Appendix A - Summary of Goals, Issues and Opportunities Workshop for the Alexandrina Council

Introduction

This report summarises the workshop held on Monday 9 August 2010 regarding the Integrated Water Management Plan (IWMP) project being undertaken for Alexandrina Council, District Council of Mount Barker and the Rural City of Murray Bridge.

Three workshops were scheduled over the day, with one workshop focussing on each of the three Council areas. Representatives from a range of government departments and other stakeholder organisations attended one or all of the workshops.

The following organisations were represented at the workshops:

- District Council of Mount Barker
- Alexandrina Council
- The Rural City of Murray Bridge
- SA Water
- Department for Planning and Local Government
- Department of Health
- Department for Water
- South Australian Murray Darling Basin Natural Resources Management Board
- Adelaide and Mount Lofty Ranges Natural resources Management Board
- Environment Protection Agency

The aim of the workshop was to identify and articulate each organisation's goals, issues and opportunities for integrated water management in the identified townships and for particular growth areas that are the subject of the IWMP project.

Workshop Approach

Following an overview of the IWMP project and discussion about what integrated water management is, an affinity diagram process was used to identify the goals for each Council area's IWMP.

The affinity diagram is a tool that gathers large amounts of disparate information and organises it into groupings based on their natural relationships, or "affinity".

The affinity diagram provided a tool for organising the diverse range of issues to be addressed by the IWMPs identified at the workshop and helped order them into groups or themes from which Goals for each of the IWMPs were then developed. For each goal area, key questions were asked including:

- What outcomes are we looking to achieve?
- What would successful integrated water management look like if it was working well?

Once the goals were identified, workshop participants were asked to identify specific actions that could be undertaken in the townships and growth areas that would contribute to the achievement of the goals.

IWMP Goals, Issues and Opportunities

The following goals, issues and opportunities were identified for the Alexandrina Council area and the growth area identified as Goolwa North.

Goal 1: Minimise adverse impacts on the environment

A range of comments were identified relating to the need to ensure that any approach to integrated water management minimises adverse impacts on the environment. This includes recognising the environmental value of existing natural waterways such as Currency Creek and maintaining the water flows of the River Murray past Goolwa. It was also identified that development should provide infiltration to groundwater to maintain the natural water balance (base flows) of local streams.

Comments also identified the need to improve the quality of water when collecting and using it for recharge. For example, any water discharged into the River or into aquifers needs to be of a suitable quality.

It was considered that the community wants sustainable development and that this includes minimising impacts of urban development on the River Murray. It was also suggested that there needs to be carbon offsets for the provision of open space.

Goal 2: Use a Water Balance Approach to Match Fit for Use Water Supply

A wide range of comments were recorded regarding the need to ensure an ongoing supply of water to service a growing population, and that opportunities to capture and reuse stormwater and wastewater need to be maximised.

These opportunities include the need to integrate the capture and reuse of stormwater and wastewater into the overall design of development, and in particular in large scale greenfield development sites, such as that anticipated at Goolwa North. It was considered critical that integrated water management drive master planning for the development of such areas and thereby guide developers to deliver an integrated approach. It was considered that water treatment facilities not just be “holes in the ground” but are combined with open space opportunities. At the same time it was recognised that stormwater retention basins, wetlands and WSUD features can present maintenance liabilities for Council. It was also identified that it was important to be able to provide green public open space across existing and new development and therefore there is a need to identify a sustainable water supply for irrigation purposes.

The need to consider reuse options for treated wastewater was identified, particularly given the anticipated generation of wastewater as a result of the growing population at Goolwa North. Investigating opportunities to reuse this water for commercial applications, irrigation of open space and agriculture was suggested, while also acknowledging the need to consider the health risks associated with using recycled water and adherence to the national guidelines for water recycling.

It was also identified that when considering how to use wastewater that a range of opportunities are investigated and compared (ie urban versus open space and urban versus horticultural use) in order to match fit for purpose use. This was a recurring theme with a number of comments identifying the need to ensure the matching of fit for purpose water supply with its end use; that is, use high quality water for potable purposes, and use reduced quality for a suitable use (ie. to irrigate).

The need for residential development to capture and reuse stormwater was also identified as a key issue. The requirement for houses to not only capture stormwater but reuse it for household uses was considered an important direction. It was also identified that resolution is required between allotment sizes and rainwater harvesting by nominating a minimum rainwater tank size that can deliver measurable benefit.

Goal 3: Establish a Funding Model to Deliver the IWMP

The importance of ensuring that an appropriate funding model is in place to deliver on the directions proposed by the IWMP was considered a critical element to the IWMP's success.

It was considered that this funding model needs to be a partnership between the State government, developers and Council, rather than the current approach to infrastructure provision which is generally the responsibility of Council and developers.

Coupled with this funding model is the need to ensure that adequate personnel are allocated to support the implementation of the IWMP at the local level.

This funding model should explore mechanisms to require developer contributions for the provision of infrastructure that is external to the subject development site.

The funding model should recognise that more lead time is required for funding applications (not just current financial year) for water re-use schemes.

Goal 4: A Supportive Legislative Framework that delivers Integrated Water Management

For the IWMP to be successfully implemented it was considered that a supportive legislative framework needs to be in place. This issue was particularly raised in relation to the current approach to WSUD which will not become mandatory in new development until 2013. It was strongly considered that WSUD needs to be mandatory now, and that a legislative mechanism is required to support its implementation. In addition, the preparation of a Better Development Plan Module for WSUD "now" was called for. It was reiterated that any planning policy relating to water management needs to be easy to interpret and legally enforceable.

The application of the Residential Code to Goolwa North was identified as a possibility. Given that the Residential Code does not currently address WSUD or other water management issues it was considered important that the upcoming review of the Residential Code deliver the inclusion of requirements for new development assessed under the Code to address these issues.

It was identified that the timing / use of structure plans relative to land division requires better clarification in order to ensure the delivery of coordinated and integrated water management outcomes in new development.

It was also identified that new development must be responsive to changes in technology which deliver better integrated water management outcomes; however this needs to be coupled with a responsive legislative framework. In particular, Council's Development Plan needs to b able to respond to changes and continue to reflect new building / design techniques.

Goal 5: Strong Partnerships and a Commitment to Integrated Water Management

The successful implementation of the IWMP will also be dependent on a strong partnership approach and a sustained commitment to the overall vision and objectives of integrated water management. It was identified that one of the threats to the IWMP could be a shift in Council's priorities and therefore, there needed to be a strong commitment established across Council to the IWMP's overall vision.

Goal 6: An Integrated Water Management Structure Plan for Goolwa North

A goal which speaks directly to the need for the preparation of an integrated water management structure plan for Goolwa North was considered necessary in order to emphasise the importance of ensuring the area is designed and develops into the future with integrated water management as one of its central drivers. This approach recognises the uncertain water future and the need to secure water supplies for new (and existing) development that come from a range of sources, including stormwater capture and reuse and wastewater reuse.

Opportunities

The following opportunities were identified for integrated water management in the Alexandrina Council area:

- Reuse of wastewater from Goolwa and Hindmarsh Island (private) waste water treatment plants
- Harvest and reuse of stormwater runoff and wastewater generated by new development area
- Development of innovative policy relating to wastewater reuse and water harvesting for inclusion in Council's Development Plan
- Lobbying of government for funding support for the development of 30 Year Plan for Greater Adelaide growth areas
- Imbedding consideration of guidelines for water recycling early in development process
- Up skill and educate planners to implement water recycling guidelines
  - Water recycling needs to be reinforced and committed to by Council elected members and upper Council management
- Development of a structure plan for Goolwa North
  - Include open space / WSUD corridors
  - Link with reuse of water and strategically located, natural flow corridors
- Investigate purple pipes to Goolwa North
- Investigate new technology / innovation
- Mix stormwater with wastewater to improve quality
- Consider how to protect native vegetation and relationship of Goolwa North to the River
  - need for a localised environmental study relating to development of Goolwa North
- Require developer contributions for infrastructure provision (this will require legislative change)
- Prepare cost/benefit estimates regarding integrated water management infrastructure provision for Goolwa North (need to undertake consultation for whole area)
  - A well researched approach will assist in obtaining funding from Government
- Investigate aquifer recharge at Currency Creek and Finnis
- Keep pressure on State Government to implement policy changes
- Complete Better Development Plan conversion of Council's Development Plan
- Promote and support the preparation on a WSUD Better Development Plan Module
- Investigate opportunities to better use legislation (e.g. Local Government Act, Development Act) to achieve integrated water management outcomes such as via conditions of approval and infrastructure agreements
- Ensure review of Residential Code includes/addresses WSUD
- Identify appropriate rainwater tank sizes
- Allocate personnel / resources to 'rollout' 30 year plan at Council and State level
  - Need dedicated resource for the development of Goolwa North
  - Not only to address water supply but other infrastructure provision e.g. common sewer.

- Consider the implications of Goolwa North for Steam Ranger
    - Negotiate with different parties and investigate other infrastructure partnerships
- Bike paths / linkages throughout Goolwa North provide opportunities for open space

Appendix B – Developer Consultation

1.0. DEVELOPER / LANDOWNER INTERVIEWS

1.1. Objective

A number of interviews and meetings were undertaken with developers and land owners for the following reasons:

(a) To understand developers, development program, including staging plans;

(b) To obtain developers feedback on a range of water related natural resources management policies and procedures.

The interview questions are contained in Appendix A.

The information gathered has been considered during the preparation of township structure plans and recommendations associated with the Integrated Water Management Plan.

This information has been considered within the context of the "*Housing and Employment Land Supply Program (HELSP) Report 2010, Greater Adelaide*", prepared by the Department of Planning and Local Government (October 2010).

1.2. Interviewees

Participating Local Governments and the Natural Resources Management Board provided the consultant team with the following contacts. Representatives from these organisations were interviewed:

(a) Lanser Communities;

(b) Delfin Lend Lease;

(c) Walker Corporation;

(d) Burke Urban;

(e) Fairmont Homes;

(f) Ammo Pty Ltd;

(g) Mr Skewes.

The comments contained in this chapter represent the views of the consulted organisations and not necessarily those of the consultant team.

1.3. Study Area

The interviewed organisations had landholdings (including options) in the following locations:

(a) Goolwa and Strathalbyn within the Alexandrina Council;

(b) Mt Barker Township within the District Council of Mount Barker;

(c) Murray Bridge within the Rural City of Murray Bridge.

1.4. Results of Interviews

All developers were pleased to answer questions contained in Appendix A, however, in order to promote robust feedback, most developers preferred that their comments should be reported in general terms.

This section groups respondent feedback into the following categories:

(a) location of and staging of proposed development;

(b) approximate allotment sizes;

(c) purchaser preferences;

(d) stormwater management and drainage reserves;

(e) integration of targets in planning policy;

(f) Use of WSUD guidelines;

(g) Rainwater tanks;

(h) Areas for Improvement

1.4.1. Location and Staging

Land proposed to be developed in Goolwa and Strathalbyn is illustrated in Maps 3.37 and 3.40 contained within the HELSP Report. Subject to market supply and demand pressures, the developers anticipate releasing approximately 50 allotments per year.

Land proposed to be developed around the Mt Barker Township is illustrated in Map 3.32 of the HELSP Report. Discussions with developers have indicated that the demand for allotments in this locality is anticipated to be very high.

Information contained in the draft Ministerial Mt Barker Urban Growth DPA states:

> *"Typically the sale of allotments and construction of dwellings in large residential subdivisions is slower in the early stages of land release and gains momentum as the subdivision takes shape, giving buyers more certainty about the area they are buying in to.*
>
> *The proposed urban expansion is likely to result in multiple residential projects rather than a single developer project which may result in a different pattern of allotment sales and construction. It can be reasonably expected that multiple concurrent projects will increase the speed of construction, due to an increased capacity to create allotments (multiple developers / contractors involved) and an increased choice of land for buyers.*
>
> *Having regard to .... historical dwelling approvals in Mount Barker LGA, which peaked in 2003/04 at around 425 dwellings, it is considered that an average dwelling construction rate of 450 dwellings per annum is a suitable assumption for planning purposes."*

These allotment take-up rate assumptions appear to be reasonable.

Land proposed to be developed near the Murray Bridge Township is illustrated on Map 3.34 of the HELSP Report. Subject to demand and supply pressures, the developer anticipates to market approximately 50 allotments per year.

Developers noted that significant determinants to develop land include having the land rezoned for residential and the costs associated with infrastructure. For instance, a certain size land division may 'tip' the infrastructure costs (e.g. water and sewer) into a category where the development becomes unviable.

1.4.2. Allotment Sizes

Allotment sizes are typically influenced by:

(a) purchaser preferences;

(b) topography;

(c) planning policies: and

(d) adjacent land uses.

Most developers held the opinion that most purchasers desire allotments having an area of approximately 600 – 800 square metres, with smaller allotments (i.e. 350 square metres) near centres. There also appears to be demand for rural living allotments on sites with sloping ground levels or near non-residential land uses.

Having said that, one developer held the view that there is a significant lack of housing choice within the Mt Barker locality, for the singles, couples and housing affordability markets. There appears to be demand for smaller allotments (e.g. 200 square metres) in localities within walking distance to centres and public transport nodes.

With respect to density definitions, *The 30-Year Plan for Greater Adelaide* states "*the following density ranges apply to 'net' residential site density and define the housing densities referred to in the Plan. These definitions should be used in planning policy to guide individual developments:*

- *Low density = less than 35 dwelling units per hectare;*
- *Medium density = 35 - 70 dwelling units per hectare; and*
- *High density = more than 70 dwelling units per hectare.*

Net residential site density is calculated using the residential site area only and excludes all other land from consideration. Gross density is a different measurement that includes non-residential land uses. Given the variation in the amount of non-residential land uses and styles of development in different areas, consistent ranges for gross density cannot be calculated for planning policy".

Nevertheless, the DPLG "*Understanding Residential Densities: A Pictorial Handbook of Adelaide Examples*" (August 2006), provides an alternative view. The report seeks to define "*gross density as the total development site area and allows for roads (20%) and open space (12.5%), but does not include non-residential development such as schools and shops*". It is noted that this definition does not refer to potential drainage reserves required above the 12.5% open space requirement.

The Handbook notes that a land division having an average site area per dwelling of 618 square metres equates to a net density of 16.2 dwellings per hectare and a gross density of 10.9 dwellings per hectare.

1.4.3. *Purchasers Preferences*

Although many developers desire to incorporate good stormwater management and WSUD outcomes into their developments, these features are rarely associated with a purchaser's willingness to pay a higher allotment price (except for circumstances discussed in section1.4.4). Key purchaser decisions are typically based on the following criteria:

(a) affordability;

(b) proximity to goods and services (including schools);

(c) sense of 'community'; and

(d) views.

1.4.4. *Stormwater Management and Drainage Reserves*

This section discusses developer feedback regarding on-site detention and use of the 12.5% open space requirement.

Developers all agreed in-principle, that planning policies should seek to require on-site detention to ensure runoff from the development does not exceed pre-development rates. However, the implementation of such planning policy should allow for some level of flexibility to have regard to specific site conditions. For instance it may be appropriate to forward stormwater run-off (after it has been filtered through small scale wetlands) into an existing council stormwater drainage system that promotes capture and reuse. Alternatively, there may need to be some acknowledgement that this policy cannot always be implemented from a practical and / or viability perceptive on small scale developments (e.g. less than 20 allotments).

There was significant feedback regarding the common practice of councils' and developers' negotiations regarding what amount of the 12.5% open space requirement can also be used for drainage reserve, particularly when the drainage reserve is likely to be dry for most of the year.

Developers clearly stated that good design (including Water Sensitive Urban Design (WSUD)) is not fundamentally based on the amount of public open space allocated to a development. The integration and quality of the open space within the development (rather than the amount) is a key determinant to urban design outcomes.

For instance, large scale development that incorporates a combination of permanent water and dry drainage reserves well integrated with housing, does contribute to better design outcomes and higher allotment premiums for land fronting permanent well designed wetlands. Developers would expect to receive approximately 15% more in the sale price for those lots. This increased value is advantageous to a council's rate base. However, developers emphasised that these open space / drainage areas must be well designed, including the combination of hard and soft edges along wetlands, cycle and pedestrian paths and potential water features.

Developers argue that if they financially contribute to these capital urban design improvements and that the majority of the drainage reserve is usable for most of the year, there should be greater flexibility in the use of the 12.5% open space requirement for drainage reserve purposes.

1.4.5. *Introduction of Targets*

Developers were asked if they would support the introduction of specific water reduction and re-use targets into a council's Development Plan.

In principle the concept of targets was not opposed, subject to (i) the target being justified with the development industry and (ii) the targets are implemented with a reasonable level of flexibility, noting that they will not always be able to be met.

Several developers noted that it is often impractical to have these targets if there is no available water re-use systems in place.

1.4.6. <u>WSUD & District Council of Mt Barker Fact Sheet</u>

All developers were in-principle supportive of the States WSUD guidelines and Council's WSUD Fact Sheet. These guidelines are a positive step. One developer noted that they have been successfully implementing various aspects of WSUD since the 1980s.

Developers noted that the guidelines provide good examples of how high level Development Plan Objectives and Principles of Development Control are implemented. However, they emphasised that the implementation of those guidelines must acknowledge the different characteristics of each development site and its locality. For instance, the size of the development, existing topography and existing stormwater management systems need to be considered when seeking to implement these guidelines.

Developers did note that WSUD did come at a cost to them, purchasers and Councils (with respect to higher on-going maintenance).

1.4.7. <u>Rainwater Tanks</u>

Developers were asked about the concept of planning policies promoting larger rainwater tanks (in the order of 9,000 litres) on township allotments.

Although developers did not oppose the current rainwater tank policies, they generally disagreed with the concept of rainwater tanks on private property for the flowing reasons:

(a) can't effectively control how the water will be used (if at all);

(b) can't measure outcomes / benefits; and

(c) can't control their long term management / maintenance.

Developers would prefer a "Salisbury Council" approach that focuses on stormwater being forwarded to a single retention point. This concept is promoted because it:

(a) promotes significant biodiversity outcomes;

(b) results in a significant community asset that has recreation, community and environmental education benefits;

(c) provides long term engineering management benefits;

(d) is a more effective and efficient management / use of water;

(e) provides greater potential for larger scale reuse (e.g. nearby agricultural activities) and a highly controlled framework;

(f) potentially involves less use of energy (e.g. electric pumps and environmental costs involved in the manufacture of tanks).

Large 9,000 litre tanks in most new locations are not considered to be appropriate, certainly not viable / appropriate on smaller lots. Underground tanks are not viable for most people.

The relationship between rainwater tanks and the Development legislation is of relevance to this broader topic. The present 'requirement' for rain water tanks associated with new dwellings across the State is derived from the Building Code and not Council's Development Plans, (although it is acknowledged that some Development Plans do promote an independent water source for firefighting purposes).

It is understood that the Minister for Urban Development and Planning intends to increase the application of the Residential Code (refer in part to Schedule 4 of the Development Regulations). The code essentially results in dwellings and single storey additions being processed as "complying developments" (except in Flood Management, Hills Face and Historic Conservation Zones), if the development complies with pre-determined design criteria.

This would mean that Development Plan Objectives and Principles of Development Control (eg those existing or proposed policies that promote rainwater tanks) will by-passed. If an agency wanted to ensure that larger tanks were constructed with the majority of dwellings, the Development Regulations and/or Building Code would need to be amended. It is highly likely that the interviewed developers would not support this proposal for the reasons contained in this chapter.

It is noted that Schedule 1A of the Development Regulations lists certain types of rainwater tanks that do not require Development Plan Consent (i.e. planning approval), as opposed to being a 'requirement'. These include the following:

"<u>Water tanks (above ground)</u>

The construction or alteration of, or an addition to, a water tank (and any supporting structure), other than in a Historic Conservation Zone/Area, the Hills Face Zone, a Flood Management Zone/Area, or a River Murray Zone, if –

(a) the tank is part of a roof drainage system; and

(b) the tank has a total floor area not exceeding 15 square metres; and

(c) the tank is located wholly above ground; and

(d) no part of the tank is higher than 4 metres above the natural surface of the ground; and

(e) no part of the tank will be in front of any part of the building line of the building to which it is ancillary that faces the primary street; and

(f) in the case of a tank made of metal – the tank is pre-colour treated or painted in a non-reflective colour.

<u>Water tanks (underground)</u>

The construction of alteration of, or addition to, a water tank (and any associated pump) if –

(a) the tank is ancillary to a dwelling erected on the site; and

(b) the tank (and any associated pump) is located wholly below the level of the ground."

Furthermore, Schedule 4 of the Development Regulations list certain water tanks as "complying developments", including the following:

(e) a water tank (and any supporting structure) which –

(i) is part of a roof-drainage system; and

(ii) has a total floor area not exceeding 10 square metres; and

(iia) is located wholly above ground; and

(iii) has no part higher than 4 metres above the natural surface of the ground;"

<u>1.4.8 Areas of Improvement</u>

Based on their experiences with local governments and state agencies, developers made the following observations:

(a) The preparation of WSUD and land development guidelines are beneficial if they are prepared in consultation with stakeholders and are implemented as flexible guides having regard to local circumstances.

(b) Development Plan policy does and should continue to contain stormwater management and WSUD policies, however these policies should not be overly specific and must be implemented in a flexible manner having regard to local circumstances.

(c) Development Plan policy should allow greater flexibility in allotment sizes to facilitate greater housing choice and affordability, particularly close to centres and public transport nodes.

(d) Targets relating to reduced water use and greater use of 'purple pipe water' etc, are not opposed, subject to (i) targets being justified, (ii) the targets are implemented with a reasonable level of flexibility , noting that they will not always be met and (iii) there is an alternative water supply (if required).

(e) There should be greater flexibility in the use of the 12.5% open space required to accommodate drainage reserve purposes, particularly were significant capital is required to construct high quality and well integrated open space and wetlands that will benefit all parties, including landowners, Council and environmental agencies.

(f) Councils and State agencies should better acknowledge that in many instances the proposed development is significantly improving a degraded environment (i.e. caused by over-stocking, stock directly accessing watercourses and fertilizer spill into watercourses).

(g) There should be greater acknowledgment from Councils and State agencies that in some circumstances, different development sites will require different design solutions. Therefore, there are often several design solutions that can address a policy objective.

(h) The flexibility in implementing policy is a "double edged sword". For instance, the flexibility allows developers to implement site responsive solutions to particular sites, but it also doesn't encourage accountability from Councils and State agencies to clearly articulate what they will deem to be an acceptable development solution. That is, the “goal posts” continue to be changed.

(i) There is often conflicting advice received from Councils and State agencies (including NRM Boards). At times, this results in a Council’s (who is the key decision maker) lack of willingness to make a decision. These delays add considerable costs to the development. There must be greater coordination within government to provide the developer with a coordinated government position.

(j) There is concern in some sectors of the development industry, that a Council’s decision making responsibilities are being eroded by some environmental agencies. Councils are the appropriate decision making organisations for land development issues. Councils have the local knowledge and skills to make balanced decisions that consider a range of issues including social, economic and environmental.

(k) A better culture adopted by developers, Councils and Government agencies “working together” to achieve a balanced and successful outcome is desired. This often requires people from all parties to better communicate and negotiate their desired outcomes.

(l) At times there is an unwillingness for Councils to accept WSUD solutions because it can result in higher Council maintenance costs. However, these additional costs need to be considered in-line with potential increase in the capital values/rate base.

(m) Stormwater Management Plans as allowed by the Local Government Act (refer to Schedule 1A, Division 3) should be prepared by Councils. From a developer’s perspective, it is extremely difficult to provide a robust stormwater and WSUD management solution for a development site, if Council has limited understanding of its strategic and operational directions.

(n) There is concern regarding the reluctance of some agencies such as the EPA and SA Water to embrace and emerging technologies regarding recycled effluent.

(o) The time delays in obtaining a response from agencies can be problematic. An example was provided where it took eight weeks to obtain approval for a permit to remove reeds to enable the surveyors to peg a flood line.

(p) As a general principle, Council controlled district and/or regional wetlands (e.g. City of Salisbury and Playford examples quoted) are promoted to manage stormwater rather than site specific solutions for the reasons previously mentioned.

1.5 Conclusion

The feedback from the contacted developers and landowners has been considered in the preparation of the Integrated Water Management Plan. The feedback has implications for a range of governance, administrative, and policy decision makers.

ATTACHMENT A: INTERVIEW QUESTIONS

Introduction

SKM and URPS have been engaged by the SA Murray-Darling Basin Natural Resources Management Board in partnership with the DC of Mt Barker, Alexandrina Council and the Rural City of Murray Bridge to prepare Integrated Water Management Plans for their major townships.

These plans are being prepared to ensure that future growth of their major towns is sustainable in terms of water quality and quantity. A key objective of the Plans is to identify 'fit for purpose' water supplies that will meet the needs of Council, residents and industry now and into the future. The outcomes of these plans will seek to influence Development Plan policy, including land division policy.

I would appreciate your input from a land developer's perspective to ensure future planning policies have regard to your industry requirements.

1. Do you have any landholdings in any of the following locations:
    - Goolwa and Hindmarsh Island?
    - Mount Barker, Nairne, Littlehampton and/or Callington (Mt Barker DC)?
    - Murray Bridge, Callington, Jervois, Wellington and/or Mypolonga? (RC Murray Bridge)?
2. What land area do you own (approx) in each of these towns?
3. How many allotments are you proposing to bring onto the market within the next 5, 10, 15 plus years?
4. What would be the average proposed allotment area (gross density per hectare)?
5. Are there any general principles or initiatives you typically would like to see implemented in your development scheme relating to water (eg stormwater/waste water) quality and quantity?
6. What do you think are the market's (eg allotment purchasers) expectations regarding how water (eg stormwater/wastewater) quality and quantity should be managed.
7. Do you think that there is a premium paid by allotment purchasers for lots fronting drainage swales (with or without permanent water) / wetlands? If so, what proportion?
8. Are there any hurdles established by Council's/State Government that discourage developers promoting innovative water management schemes? If so, please explain?
9. What would you like Councils and/or the State to do differently to promote innovation in the management of water quality and quantity?

10. Do you have any opinions regarding the State's desire for water sensitive urban design outcomes?[1]

11. Have you seen and used the Mount Barker's Council's Water Sensitive Urban Design Fact Sheet (Number 3)?

12. Some Council's require on-site detention to ensure runoff from the development does not exceed pre-development rates. This is not only to ensure flooding is not exacerbated downstream, but also to maintain natural water regimes for valuable wetlands and creeks. This may require additional on-site storage of stormwater as well as flood conveyance and the application of other water sensitive planning and management practices. Have you had any experience with respect to these requirements? If so, what has been your experience?

13. Some Council's seek land developments to meet a range of targets relating to reducing mains water and improving stormwater quality such as:

    - Reduction of mains water use by 30% (eg use of purple pipes and rain water tanks)
    - Reduction of annual total suspended solids, phosphorus and nitrogen levels
    - What is your opinion on the concepts of these targets?

What is your opinion about promoting the concept of larger rainwater tanks on suburban allotments (say in the order of 9,000 litre tanks) [2]

Thank you for your time.

[1] The general objectives for WSUD are to (i) maintain the natural (i.e. pre-development) hydrologic regime, (ii) maintain and, where possible, enhance the water quality of surface and ground water, (iii) encourage water conservation, and (iv) maintain and enhance water-related environmental, recreational and cultural values and opportunities.

[2] Requires a diameter of about 2.350 metres

Appendix C – Community Workshop

Attendees:

Joe Southworth
John Brice
Tony Skewes
Frank Tuckwell
Keith Parkes
Alan Oliver
Tony Lucas
Anne Woolford
Paul Barnes (Alexandrina Council)
Neville Styan (Alexandrina Council)
Mellissa Bradley (SA MDB NRMB)
Anna Pannell (SKM)

Water Management Issues Facing Goolwa and Hindmarsh Island

- Loss of primary production / not desirable to convert rural living allotments
- No mains water to Hindmarsh Island
  - residents cart water 30-40 times per summer, some have stock and domestic allocation but prefer not to use
  - SA Water to consult on mains water extension
- Goolwa – reduce runoff by requiring rain-water tanks
- Existing Septic tanks and soakage trenches on Hindmarsh Island – impact on water quality
- Opportunities for joint ventures with Council and horticulture
- Prevent urban growth westward, potential loss of primary production
- Future Development
  - Proportion of non-residents (holiday homes etc) with impact on wastewater generation and treatment plan operation
  - Q. – Is there a demand for rural living?
  - Rural Living on outskirts of town doesn't provide the most attractive entrance to town
  - Q. – Is there demand for 'home industries'
- Currency Creek –AV Jennings River Breeze good example

Ideas for Water Management

- Green belt around town
- Q. - Will Council pursue purple pipe as option?
- Use of aquifers for storage
- Small urban forests – Native Cypress
- Create linkages between Rural Areas DPA with IWMP DPA/Plan where appropriate.
- Growth area – vision
- Large scale horticulture development north west of development area using treated wastewater
  - Add value to neighbouring properties
  - Economic return
  - Demonstrate wastewater use to other farmers

  Enhance Hills / view landscape

Less food miles for local production
Soil suitability for horticulture
Shallow rooted species may be suitable if high salinity
Crop selection – what is suitable and sustainable?

- Common / open space in middle of houses (no fences)
- Main road through middle – is this suitable? New road and rail route?
- Echo style of existing homes in Goolwa?
- Eg beyond development, could be a model for future development
- Could zone area for single storey development, higher density – control built form
- Opportunity to 'get it right'
- Incorporate vegetation remnants near western horticulture belt
- Landscaped area with walking trails
- Recycled water for additional schools
- Development area questions
  - % of affordable housing?

  What will socio-economic / demographic status of proposed development?
- Permanency of population? Holiday houses%?

  Impacts on wastewater generation and treatment plant
- Possibility of underground storage under roads? Eg Romans.
- Woodlot irrigated by recycled water.
- South Lakes Golf Course
  - Currently use 25ML stormwater

  Future demand 90 – 100ML

Community Goals

- Minimum carbon footprint
  - Carbon offsets – tree planting
- Community Awareness
- Demand management – permanent water restrictions
- Higher value open space
  - move away from pocket open space
  - centralised open space high value instead
  - optimal level of open space
- Integrate/shared bike/walking path with wetlands/biodiversity corridors

Appendix C: Demand Analysis

Greater Adelaide Integrated Water Management Planning

TECHNICAL MEMO - BASELINE POPULATION AND DEMAND FORECASTS – GOOLWA AND HINDMARSH ISLAND

- 11 August 2011

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1. Introduction

The purpose of this technical memorandum is to provide an outline of the expected baseline population and demand forecasts for the townships of Goolwa and Hindmarsh Island in the Alexandrina Local Government Area (LGA) that is likely to impact on future water security. The memo is intended to be a catalyst for discussions with Council staff about future population growth and the baseline demand forecast to ensure that the water security evaluation work to follow is based on robust data and analysis.

2. Baseline Population Forecast

2.1. Historical Population Growth

In 2006, the populations of Goolwa and Hindmarsh Island Urban Centres/Localities (UCL) were 5,882 and 534 respectively (ABS, 2006). The Alexandrina LGA experienced a fairly steady population growth from 1996 to 2006, with an average annual growth rate of about 2.7%. Population data of Alexandrina LGA, Goolwa UCL and Hindmarsh Island UCL are shown in Table 2.1.

Table 2.1 Alexandrina LGA population

Year	Population Alexandrina LGA	Average Annual Growth Rate (%)	Population Goolwa UCL	Population Hindmarsh Island UCL
1996	15,452	-	-	-
2001	17,496	2.5	4,327	-
2006	20,190	2.9	5,882	534

Between 1996 and 2006 the Alexandrina LGA experienced population growth rates higher than the overall growth rates of South Australia of 0.6% p.a. on average. The population growth rates for South Australia and Alexandrina LGA have both increased during the 2001-2006 period compared to the 1996-2001 period.

2.2. Review of Population Projections

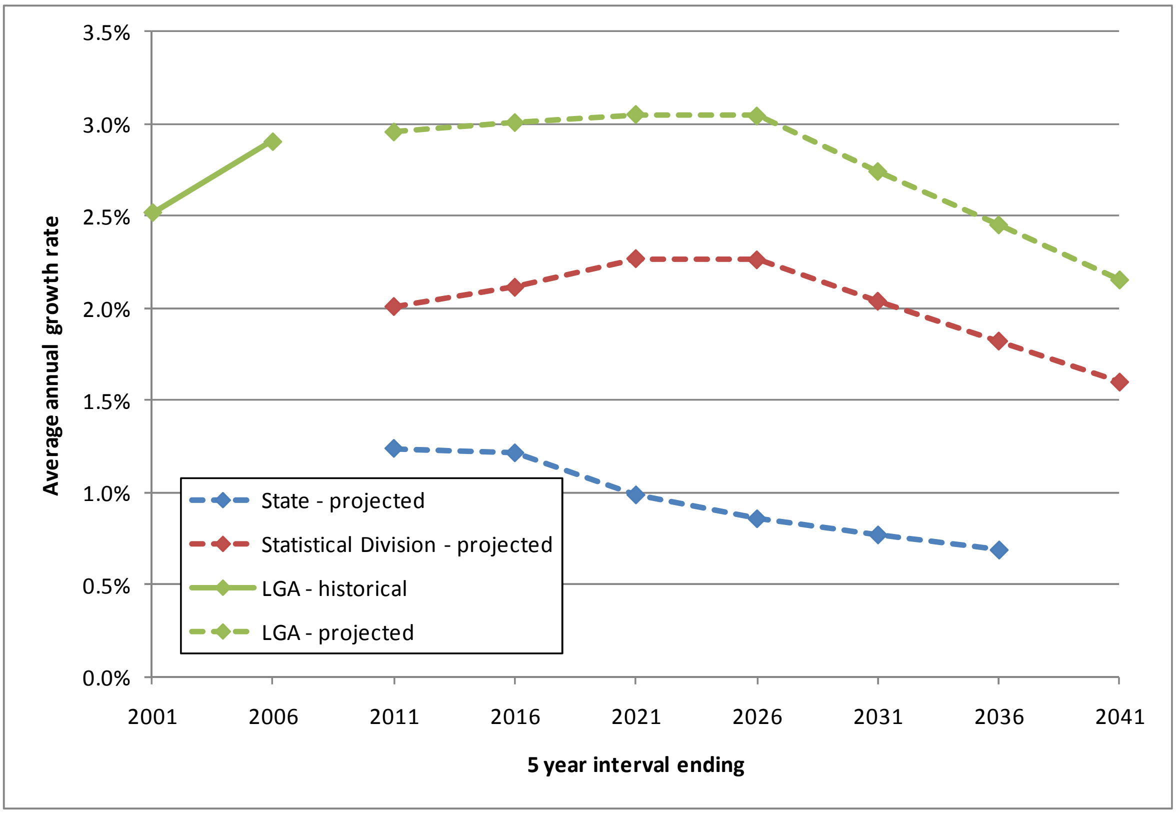
At five-yearly intervals that coincide with the ABS Census data collection years, the South Australian Department of Planning and Local Government (DPLG) prepares a set of population for the State and its seven Statistical Divisions. The latest set of population projections (Planning SA, 2010) is based on the 2006 Census of Population and Housing and developed in the context of the release of the 30-Year Plan for Greater Adelaide which identifies key areas for population growth. The population projection runs over a 30-year period from 2006 to 2036.

Three projection series, Low, Medium and High, were prepared for the State and each Statistical Division. Each series reflect alternative future trends in fertility, net overseas migration, net interstate migration, and in the case of the Statistical Division projections, net intrastate migration. The Medium series is towards the middle of the range and assumes that after several more years of historically high levels of population gains through net overseas migration, total net migration at the all-of-State level from both overseas and interstate will return to more moderate levels.

The population projections based on the 2006 Census have recently superseded the projections based on the 2001 Census. In the latest population projections (Planning SA, 2010), the annual growth rates for the State and the Statistical Divisions have increased in comparison to the previous projections (Planning SA, 2007). The DPLG website (http://www.planning.sa.gov.au/) also provides the Medium projection series for individual LGA, however these have not been updated yet with the 2006 Census, but run to the year 2021 based on the 2001 Census. Therefore the series for Alexandrina LGA had to be scaled up according to the 2001 and 2006 growth rates relative to the Outer Adelaide Statistical Division to which the LGA belongs. Beyond 2021 the series was extrapolated following the same trend as the Outer Adelaide projection. An anomalous growth rate was obtained for 2011, the value was unrealistically low with regards to the 2006 historical growth rate, and therefore an average value was inferred by averaging the 2006 and 2016 growth rates. The 2041 growth rates for both the Statistical Division and the LGA were extrapolated assuming the same trend as between 2031 and 2036.

Figure 2.1 presents the average annual growth rates relative to the Medium projection series for the state and the Outer Adelaide Statistical Division according to the South Australian DoP and the assumed average annual growth rates for Alexandrina LGA.

■ **Figure 2.1 Average annual growth rates at the state, statistical division and LGA levels**



2.3. Adopted Baseline Population Forecast

The assumed growth rates for Alexandrina LGA will be adopted for determining the baseline population forecasts of Goolwa and Hindmarsh Island as it is more representative of the localities than the state and statistical division projections. The initial point is the combined population of Goolwa and Hindmarsh Island UCL during the last census in 2006, this population was 6,416. The baseline population forecast was calculated at 5 year intervals from 2010 to 2040 as shown in Table 2.2.

This population forecast is in agreement with the Council's GO2030 plan which indicates that by 2021 there will be approximately 14,000 to 17,000 people living in Goolwa and nearby townships including Hindmarsh Island, Port Elliot and Middleton.

While the 2006 census indicates an average household size of 2.1 and 2.2 and a number of households of 2,290 and 222 for Goolwa and Hindmarsh Island respectively, the information is limited or non-existent in previous census, therefore household size relative to Alexandrina LGA was adopted as baseline forecast. On average household size decreased of 0.47% between 1996 and

2006 in the Alexandrina LGA, this constant rate was adopted for determining the baseline household size forecasts of Goolwa and Hindmarsh Island.

Table 2.2 Baseline population and household size forecast

Year	Goolwa and Hindmarsh Island combined population	Alexandrina LGA household size
1996	-	2.49
2001	-	2.43
2006	6,416	2.37
2010	7,209	2.33
2015	8,007	2.28
2020	9,302	2.22
2025	10,808	2.17
2030	12,409	2.12
2035	14,047	2.07
2040	15,671	2.03

3. Baseline Demand Forecast

3.1. Demand Side Management Decision Support System (DSM DSS)

The Demand Side Management Decision Support System (DSM DSS) is a model used for generating demand forecasts and assessing the impact of demand management and source substitution initiatives. The model was developed by the New South Wales Department of Energy, Utilities & Sustainability (DEUS) to enable NSW water utilities to improve the accuracy of their demand forecasts and obtain a better understanding how investment in water conservation can bring about net savings in capital and operating costs (DEUS, 2005).

The model was used to generate a baseline demand forecast for Goolwa and Hindmarsh Island from 2010 to 2040. The baseline forecast represents the demand that would occur in the event that there was no demand management or source substitution intervention. The baseline forecast will be a reference case for assessing the impact of various demand management and source substitution initiatives for Goolwa and Hindmarsh Island Integrated Water Management Plan.

3.2. DSM DSS Model Inputs

The DSM DSS baseline demand forecast is based on:

- Account type information provided by the Alexandrina Council. This information includes water usage in kL and the corresponding number of accounts for the water years 2004 to 2010 divided in three categories: residential, non residential and commercial. Non residential data was assigned to the “other” account type in the DSM DSS.
- Historical trends in household size from the ABS Census that indicates household size has decreased from 2.49 persons to 2.37 persons from 1996 to 2006 in the Alexandrina LGA. Falling household sizes will increase the residential dwelling formation rate above the population growth rate and will tend to put upward pressure on per capita water demands.
- The baseline population forecasts presented in Section 2.3 of this technical memorandum. The combined population of Goolwa and Hindmarsh Island is adopted for the demand baseline, assuming that the entire UCL populations are served with water and will continue to be in the future.

3.3. Actual water consumption

The water consumption information provided for Alexandrina by SA Water appeared to have an unrealistically low consumption per residential account. As a work-around, consumption per residential account was taken to be the average for the overall SA Water Supply area for 2005/06 (prior to the introduction of water restrictions) (WSAA 2009). The number of residential accounts was set equal to the number of households in Goolwa and Hindmarsh Island UCL at the 2006 census equal to 2,512. The same household growth rates as the original data was applied to populate all other years and the same proportionality between the different account categories was applied. Subsequently the consumption volumes for each year and each category were scaled up to correspond to 237 kL/household/annum. The original data is provided in Table 3.1 and the altered in Table 3.2.

Table 3.1 Original water consumption

Year	Residential use (kL)	Residential number of accounts	Non residential use (kL)	Non residential number of accounts	Commercial use (kL)	Commercial number of accounts
2009/2010	1,301,430	12068	181,256	233	70,817	302
2008/2009	1,622,172	11267	213,003	227	95,481	296
2007/2008	1,259,480	10927	154,458	223	69,231	283
2006/2007	1,583,722	10641	167,421	218	46,297	277
2005/2006	1,523,451	9864	170,365	214	45,763	275
2004/2005	1,497,672	9627	177,203	216	49,866	275
2003/2004	1,270,940	9670	151,900	205	40,732	257

Table 3.2 Altered water consumption

Year	Residential use (kL)	Residential number of accounts	Non residential use (kL)	Non residential number of accounts	Commercial use (kL)	Commercial number of accounts
2009/2010	728,204	3070	101,420	59	39,625	76
2008/2009	680,052	2867	89,296	57	40,028	75
2007/2008	659,653	2781	80,897	56	36,260	72
2006/2007	642,575	2709	67,929	55	18,784	70
2005/2006	595,846	2512	66,633	54	17,899	70
2004/2005	581,377	2451	68,788	54	19,357	70
2003/2004	583,749	2461	69,768	52	18,708	65

Input parameters into the DSM DSS model and the adopted values are shown in Table 3.3.

SINCLAIR KNIGHT MERZ
SKM

Table 3.3 Alexandrina DSM DSS model inputs

Parameter	2010 Input / Assumption
Population	7,209
Annual change in household size (%)	-0.47
Current volume of water supplied (ML/year)	966
Proportion of annual use attributed to losses (%)	10
Peak to Average Demand Ratio	3.0
Total number of accounts	3,205
Residential	3,070
Commercial	59
Industrial	0
Public	0
Parks and Open Spaces	0
Rural	0
Other	76
Unmetered	0

A modest increase in the baseline per capita water use was assumed to account for the impact of income and lifestyle factors (3% increase in total per capita over 30 years). Allowances were also made in the forecast for the expected impact of the propagation of more water efficient toilets, showers and washing machines in the residential sector.

3.4. Baseline Demand Forecast Results

The baseline demand forecast in the event of a traditional approach towards water efficiency is shown in Table 3.4. The forecasts of total per capita demand and total annual water demand are illustrated in Figure 3.1 and Figure 3.2 respectively.

Table 3.4 Baseline water demand forecast

Demand Parameter	2010	2015	2020	2025	2030	2035	2040
Per capita water demand (L/day)	366.8	368.6	370.5	372.3	374.1	376.0	377.8
Annual water demand (ML/year)	966	1,078	1,259	1,470	1,696	1,929	2,163
Peak day water demand (ML/day)	7.9	9.4	11.4	13.7	16.1	18.5	20.9

Figure 3.1 Per capita demand forecasts

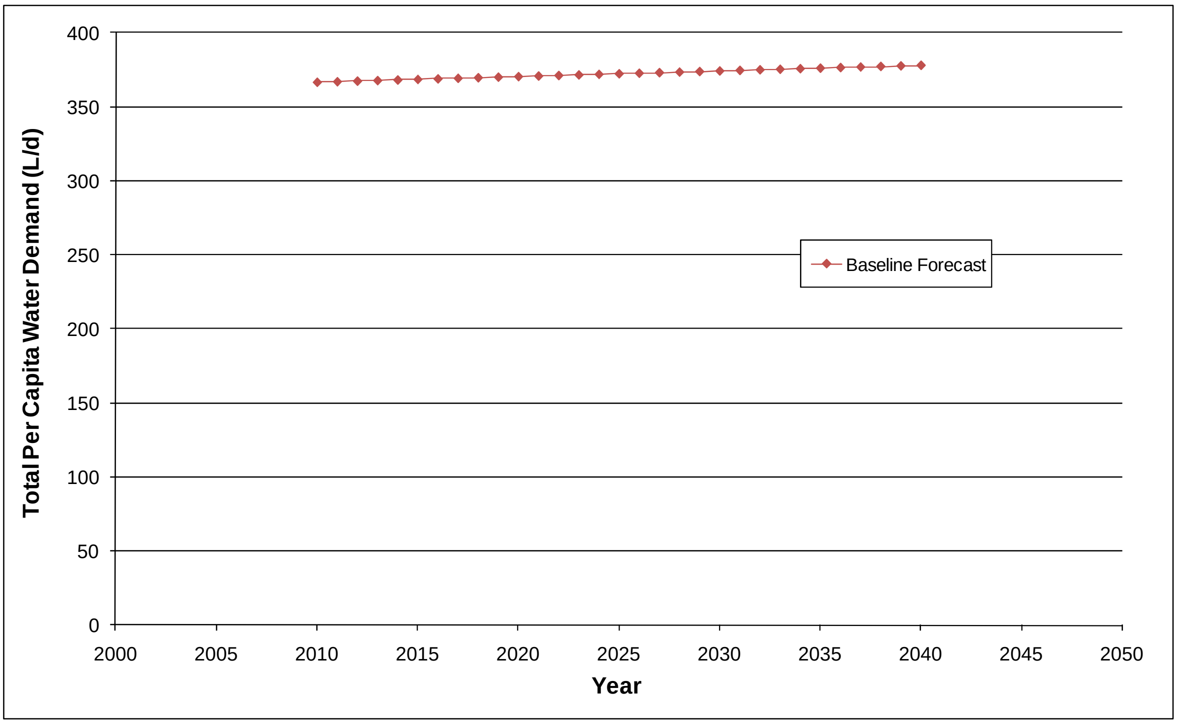
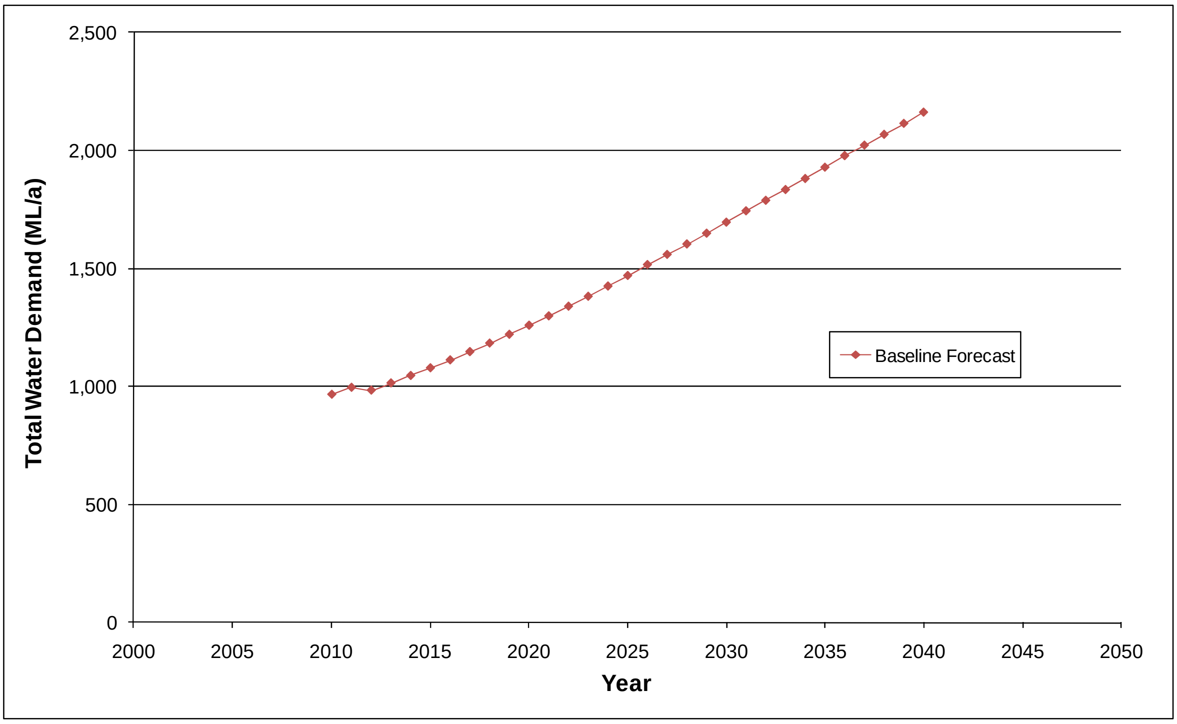


Figure 3.2 Annual water demand forecasts



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Planning SA, 2007, Population Projections for South Australia (2001-31) and the State's Statistical Divisions (2001-21)

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Water Services Association of Australia (WSAA) (2009), National Performance Report - Urban Water Utilities 2008/09.

Appendix D: Triple Bottom Line Assessment Outcomes Report

NOTE - The modelled results (water quality and quantity) described in this TBL report were updated during the preparation of the IWMP. Whilst they are still relevant for the comparative assessment undertaken they should not be used for any other purpose.

Integrated Water Management Plan

TRIPLE BOTTOM LINE ASSESSMENT

- Goolwa and Hindmarsh Island Outcomes
- 30 May 2011

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1. Introduction

1.1. Objectives

The Alexandrina Council is committed to the responsible stewardship of natural resources, ensuring that water resources are protected and restored. The development of an Integrated Water Management Plan (IWMP) will provide for the sustainable, resilient development of Hindmarsh Island and Goolwa through the identification of 'fit for purpose' water supplies for Council, residential, commercial, agricultural and industrial uses. The IWMP aims to maintain and enhance the valued amenity and open space features of these towns and protect and restore the local environment.

In consultation with the Council, Sinclair Knight Merz (SKM) developed a range of options for integrated water management in Hindmarsh Island and Goolwa. Some of these options relate to infrastructure provision or upgrade and some relate to policy and planning. The development of these options has required desktop studies, site visits, workshops and stakeholder meetings.

To optimise the selection of infrastructure options for integrated water management to meet the project's goals, four scenarios (groups of options) that represent different outcomes and levels of investment were generated. These scenarios were focussed on growth areas identified in the 30 Year Plan for Greater Adelaide (DPLG, 2010) in the Hindmarsh Island and Goolwa areas.

The objective of this assessment was to allow for a transparent high level comparison of the scenarios using a Triple Bottom Line (TBL) assessment. A workshop was held on March 21, 2011 at the Old Council Chambers at Goolwa. A summary of attendees is provided in Appendix A.

The assessment was conducted using a tool developed by SKM and based on the Melbourne Water Triple Bottom Line (TBL) Guidelines, Department of Treasury and Finance Gateway Lifecycle Guidance material and SKM's previous experience in undertaking TBL assessments. The criteria used included relevant financial, environmental and social factors and were developed using Council's Procurement Policy and Tender Evaluation Procedure.

1.2. Purpose of this document

This document provides a summary of the outcomes of the March 21 TBL workshop, and in particular a description of the scenarios considered for Hindmarsh Island and Goolwa, the scores applied by workshop participants, and discussion surrounding the preferred option with which to move forward.

A summary of the comments from the workshop are provided in Appendix A.

Preliminary scores were proposed by the workshop participants, however participants suggested that they would have preferred making decisions based on more detailed information, in particular a Net Present Value costing. Some of this detail is presented in this document, with suggestions as to possible influences on the scores chosen.

1.3. TBL Approach and Assessment Criteria

The TBL evaluation used a multi-criteria assessment (MCA). MCA is a management tool that enables monetary and non-monetary data of various options to be considered by assigning scores and weights. The weights express the importance of each of the TBL criteria to the decision making team.

In response to the discussions held at the TBL workshop 21/3/2011, SKM adopted the SA Water recommended approach to the preliminary scoring and weighting for TBL assessments, recommending equal weightings to financial, social and environmental themes.

SKM has adopted the Victorian Department of Treasury and Finance (DTF) recommended approach to scoring as follows. The **scoring scale** is (relative to the base case):

+4	*Very Much Better*
+3	*Much Better*
+2	*Moderately Better*
+1	*Little Better*
0	*No Change (same as the Base Case)*
-1	*Little Worse*
-2	*Moderately Worse*
-3	*Much Worse*
-4	*Very Much Worse*

Based on discussions at the Goolwa and Hindmarsh Island TBL workshop (21/03/2011), information provided for the desktop reviews, stakeholder consultation and financial estimates, the following criteria have been considered as part of the TBL assessment:

Financial

- ***Net Present Value:*** An estimate of the Net present value of each scenario, calculated over 30 years. It includes capital costs, annual maintenance costs, annual operating costs and revenue from sale of recycled water.

Environmental

- ***Volume of yearly stormwater reused/discharged.*** This considers the environmental benefits associated with increased stormwater reuse and decreased stormwater discharge associated with each scenario.
- ***Volume of yearly wastewater reused/discharged.*** This considers the environmental benefits associated with increased wastewater reuse and decreased wastewater discharge associated with each scenario.
- ***Reduction to household potable water demand.*** This considers how much of the household water demand is supplied from fit for purpose sources.
- ***Operational energy usage.*** This considers the relative energy consumption (hence greenhouse gas emissions) associated with each of the scenarios.
- ***Adaptability to climate change.*** This considers how well the scenario would be able to adapt to decreased total rainfall, increased evaporation and higher intensity storms.
- ***Quality of water discharged to receiving waters.*** This considers any impacts that the scenario will have on the quality of stormwater discharged to receiving waters.

Social

- ***Maintenance required by Community.*** This considers any household maintenance of the infrastructure
- ***Community ownership and acceptance.*** This considers whether the initiatives raise community awareness of water conservation, and whether the communitiy is likely to accept the iniatives.
- ***Creation of high quality green space.*** This considers the amount and value of open space that the initiative provides
- ***Flooding attenuation***. This considers the social benefits associated with a reduction to minor flooding from improved stormwater management.

1.4. Scenarios

1.4.1. Goolwa Scenarios

Four integrated water management infrastructure scenarios have been developed for Goolwa, and these were assessed during the TBL workshop. During the workshop a change was agreed to the Base Case Scenario, and this has been included in the scenario descriptions that follow. It was considered that the new wastewater storage lagoon to the west of Goolwa should be included in all scenarios, hence was added to the Base Case.

Other options relating to policy, planning, education and engagement were not been included in the TBL assessment as these do not generally have alternatives and will be recommended regardless of the scenario chosen. The scenarios (and component "Options" as shown in Figure 1-1) are:

Scenario 1: Base Case

- The current stormwater reuse initiatives would be continued, however the volumes of reuse would remain at the current levels.
- Provide a new wastewater storage lagoon near irrigated farmland to the west of Goolwa, and encourage an increase in irrigated horticulture to the area. (Option 3)
- The additional volumes of stormwater resulting from the urban growth would be discharged to the River.

Scenario 2 : Stormwater Reuse and WSUD

- Includes all of the infrastructure and policy options that would be required in the future in order to cater for increased development and population.
- Implement demand management measures such as efficient shower fittings and water restrictions
- Provide a new wastewater storage lagoon near irrigated farmland to the west of Goolwa, and encourage an increase in irrigated horticulture to the area. (Option 3)
- Expand the capacity of the stormwater lagoons at the WTP location and convert them into an amenity wetland, which will be linked to the stormwater reuse network. This will provide flood attenuation for up to the 100 year ARI. (Option 4)
- Provide two large wetlands in the Goolwa North area for storage of stormwater up to the 5 year ARI, with overflow for larger rainfall events. They will be linked to the stormwater reuse network. (Option 5)
- Extend stormwater reuse network to irrigate the council land on foreshore and the Golf course (Option 6)
- Implement roadside WSUD strategies to reduce runoff volumes. (Option 7)
- As part of this provide green bike path corridors linking green areas (these can be integrated with irrigation pipeline routes)

Scenario 3: Maximum Household Rainwater Tank Use

- Would include similar community infrastructure to Scenario 2 but would include maximum reuse of rainwater within individual houses.
- Mandate particular rainwater tank sizes and in house use (garden, toilet, hot water system) for all new developments.

Scenario 4: Purple Pipe to New Development Areas

- Would include similar community infrastructure to Scenario 2 but would include a 'purple' pipe to each new residence for domestic irrigation and toilet uses
- Provide purple pipe to supply mixed stormwater and wastewater for domestic use, irrigation of open space and irrigation of horticultural land.

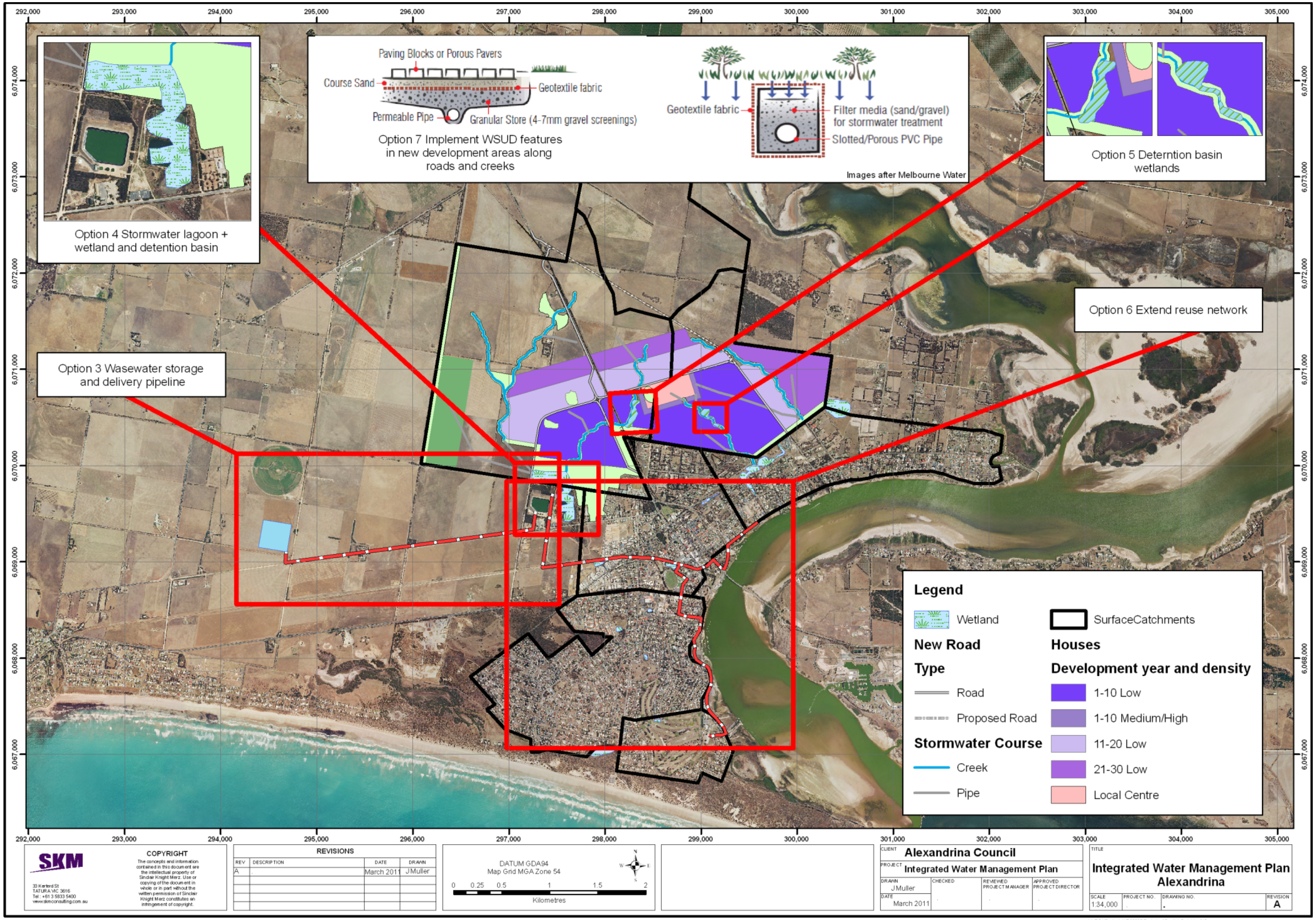


Figure 1-1: Map of Goolwa Showing Integrated Water Management Options

1.4.2. Hindmarsh Island Scenarios

Three integrated water management infrastructure scenarios have been developed for Hindmarsh Island, and these were assessed during the TBL workshop. During the workshop it was agreed that the wastewater management infrastructure would be required regardless of what Scenario is chosen, hence this was included in the Base Case. The scenarios are:

Scenario 1 (Base Case)

Wastewater management

- New development of approximately 300 allotments is expected on Hindmarsh Island, which is currently serviced by individual septic systems.
- The EPA has advised that there should be no on-site disposal of wastewater in the future.
- This option would provide a community wastewater management system and then pump the sewage through a pipeline to Goolwa, where it would be integrated with the Goolwa sewage and treated at the Goolwa wastewater treatment plant.

Scenario 2

Wastewater management and WSUD features

- This Scenario includes the wastewater management system proposed for the Base Case as well as construction of several bio-infiltration basins at locations where stormwater runoff naturally collects within the catchment.
- This would reduce the volume of water discharged to the Lower Lakes System, and decrease the risk of flooding to new development areas.

Scenario 3

Wastewater management, WSUD features and constructed wetland

- Includes the wastewater and WSUD features described for Scenario 2, as well as a constructed wetland, which would improve the quality of water discharged to Lower Lakes System.

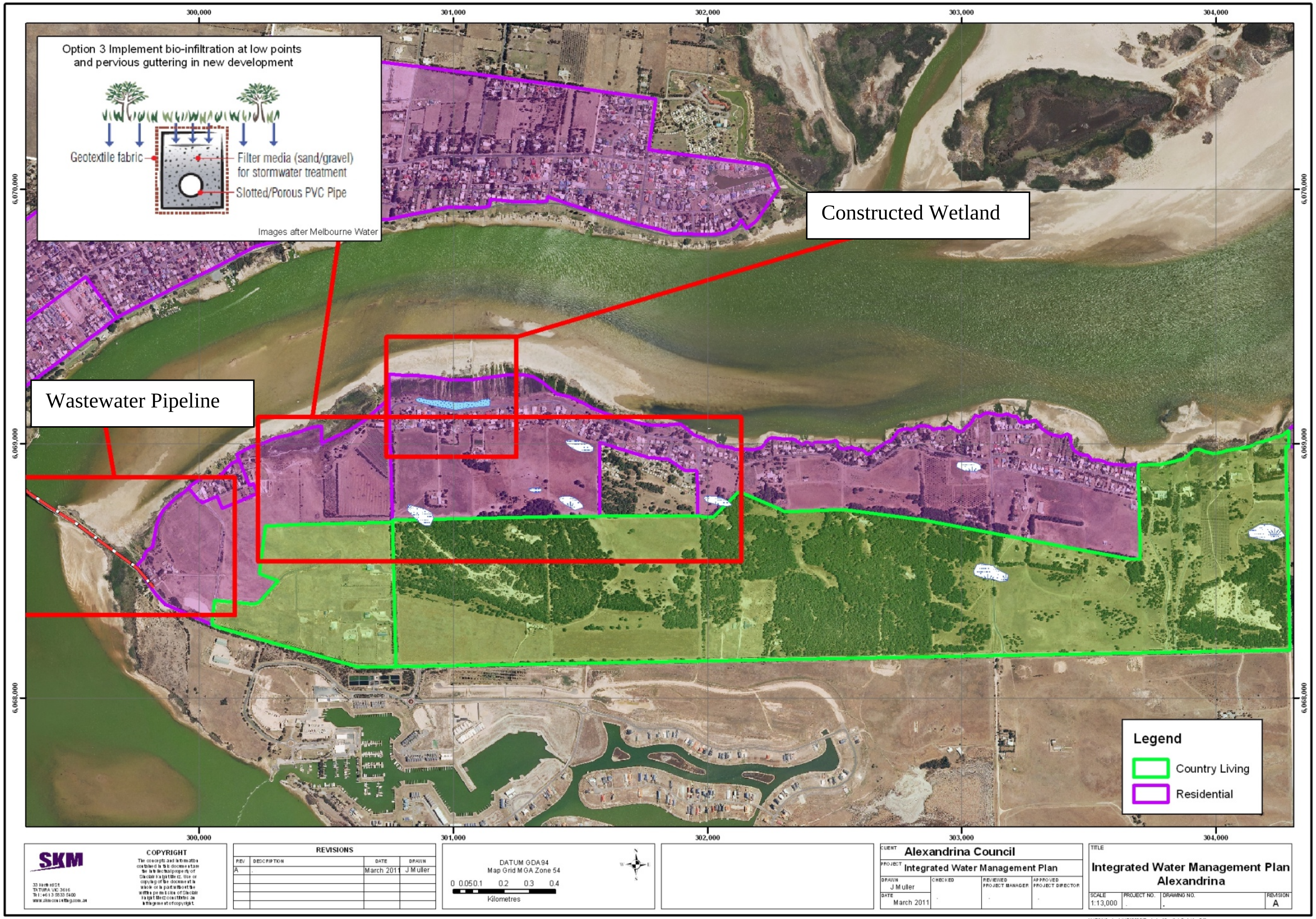


Figure 1-1: Map of Hindmarsh Island Showing Integrated Water Management Options

2. TBL Assessment

Notes summarising the key decisions from the TBL assessment workshop for Goolwa and Hindmarsh Island are included in Appendix A.

During the TBL assessment workshop, representatives from relevant stakeholders undertook the following:

- Confirm the weightings;
- Confirm the assessment criteria to check that the key issues are covered;
- Review the scoring of each scenario against the assessment criteria (note pre-scoring has been undertaken and is included in this document);
- Undertake a sensitivity analysis to check the impact of assumptions and weightings on the outcomes;
- Identify preferred scenarios to be included in the Integrated Water Management Plan for Goolwa and Hindmarsh Island.

2.1. Exclusions and Assumptions

- Details of the infrastructure included in each scenario is at a very high level, hence the information included is intended to be used for comparison of the scenarios only.
- All scenarios are assumed to adhere to all regulations and legal requirements, such as EPA discharge and water quality requirements, heritage requirements, native vegetation approvals and health and safety requirements. Hence these items have not been included in the assessment.
- Options relating to policy, planning, education and engagement have not been included in the TBL assessment as these do not generally have alternatives and will be recommended regardless of the Scenario that is chosen.
- A desktop investigation of the potential for Managed Aquifer Recharge (MAR) for storage of stormwater or wastewater within Goolwa has been conducted as part of the IWMP project. MAR has not been included in the TBL assessment due to the uncertainty associated with potential locations, yield and costs. Recommendations relating to further investigation into MAR will be included in the IWMP regardless of the results of the TBL assessment.

3. TBL Scoring - Goolwa

3.1. TBL criteria

3.2. Scoring criteria

Based on the data presented by SKM, and other data as understood by workshop participants through their own experience, the workshop group assigned a TBL score to each scenario against each criterion. These scores ranged from +4 to -4 as described in Section 1.3.

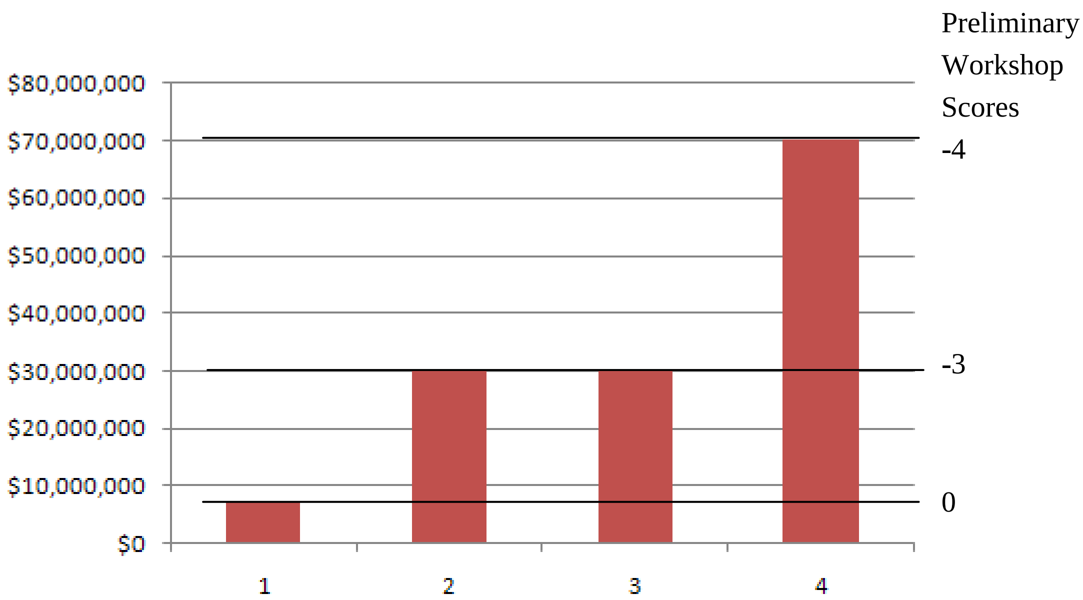
Preliminary scores were proposed by the workshop participants, however participants suggested that they would have preferred making decisions based on more detailed information, in particular a Net Present Value costing. Some of this detail is presented in this document, with suggestions as to possible influences on the scores chosen.

3.3. Financial

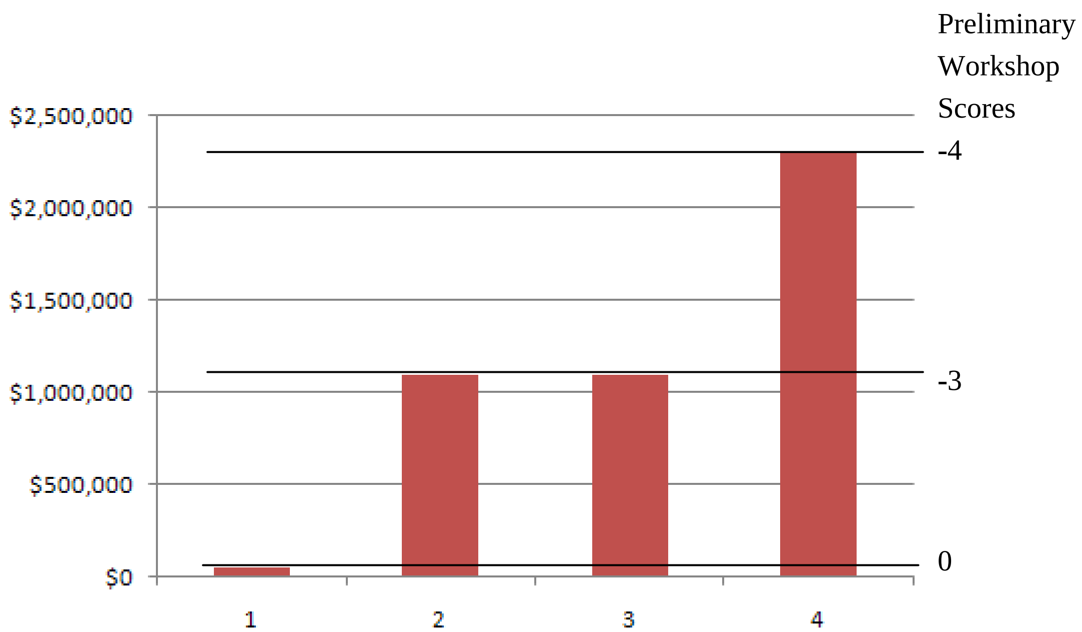
In the information presented to the workshop, the financial category consisted of:

- Capital cost to Council
- Maintenance cost to Council
- Impact on Council Revenue

Each of these elements was scored separately. However, workshop participants stated that they would prefer to view all financial costs rolled into a Net Present Value, and that only costs to Council should be included. The costs presented in the workshop and scores assigned for the capital and maintenance costs are shown in Figure 3-1 and Figure 3-2. The impact to Council revenue was scored qualitatively as described in Table 3-1.



▪ **Figure 3-1: Capital cost to Council**



▪ **Figure 3-2: Annual Maintenance cost to Council**

Table 3-1 Impact on Council Revenue

Scenario	TBL workshop score	Description
Scenario 1 (Base Case)	0	Revenue from sale of recycled wastewater to local irrigators
Scenario 2 (Stormwater and WSUD)	1	Revenue from sale of recycled wastewater, plus cost saving due to use of recycled stormwater for irrigation of open space
Scenario 3 (Maximum Household Rainwater Tank Use)	1	Same as for Scenario 2 (no additional revenue to Council associated with rainwater tanks)
Scenario 4 (Purple pipe to new development areas)	2	Additional revenue due to potential for higher value recycled water sale in purple pipe.

In the workshop, Capital Cost was given a higher weighing than the Maintenance and Revenue criteria, as shown in Figure 3-4. Multiplying the workshop scores with their weightings, scores for the financial category at the completion of the workshop were as shown in Table 3-2.

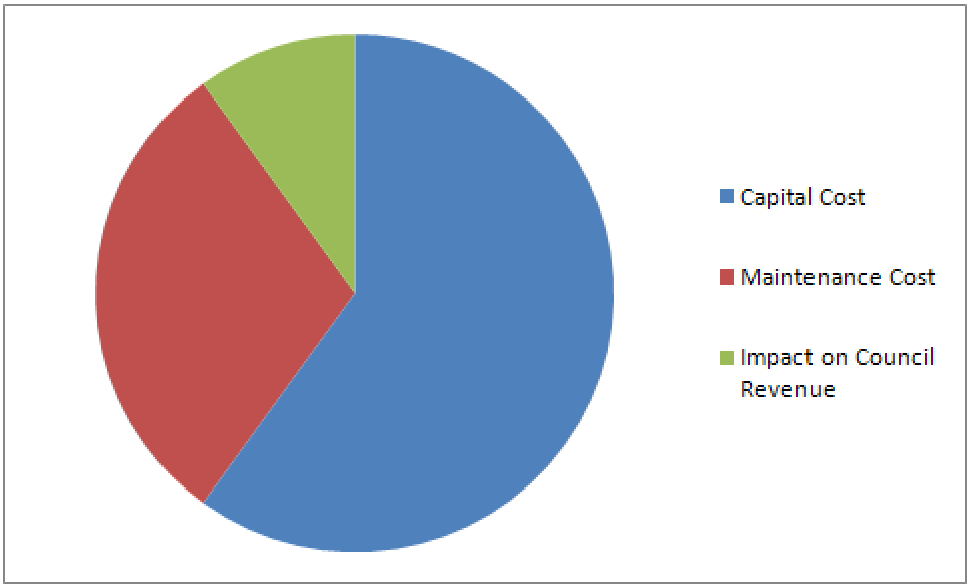


Figure 3-3: Financial Criteria weightings agreed in workshop

Table 3-2: Workshop scoring

		Scenarios			
	Weight	1	2	3	4
Capital	60%	0	-3	-3	-4
Maintenance	30%	0	-3	-3	-4
Revenue	10%	0	1	1	2
Overall Score	100%	**0**	**-2.43**	**-2.43**	**-3.28**

After the workshop an NPV was created based on the costs already calculated plus feedback given by workshop participants. During the workshop, it was agreed that the NPV should include only the costs to Council; hence assumptions have been made as to which costs Council would be likely to pay and which would be the responsibility of the community or developers. It is acknowledged that there are a range of alternative funding options for the infrastructure, which may divert unascertained costs away from the Council however it would be premature to speculate on these arrangements at this early stage of the infrastructure planning.

A summary of the NPV is given in Table 3-3 and plotted in Figure 3-4, with a proposed scoring scale. It is proposed that the following scores be assigned:

- Scenario 1: **0**
- Scenario 2: **-2**
- Scenario 3: **-2**
- Scenario 4: **-4**

These proposed score changes would have the effect of giving Scenarios 2 and 3 slightly more positive scores than previously awarded and Scenario 4 a slightly more negative score than previously awarded, as shown in Figure 3-5.

Figure 3-6 shows the NPV result if the complete cost, rather than just the cost to Council was included in the NPV. It shows that the TBL criteria score would remain the same if this version of the NPV was used.

- **Table 3-3: NPV Summary (Councils costs only)**

Scenario 1

Infrastructure	NPV
Wastewater Storage Lagoon to West of Goolwa (capital, maintenance , operation costs and revenue from water sale all assumed to Council)	40,793
Minimum household rainwater tanks (all costs assumed to be covered by community/developers)	0
Total	40,793

Scenario 2

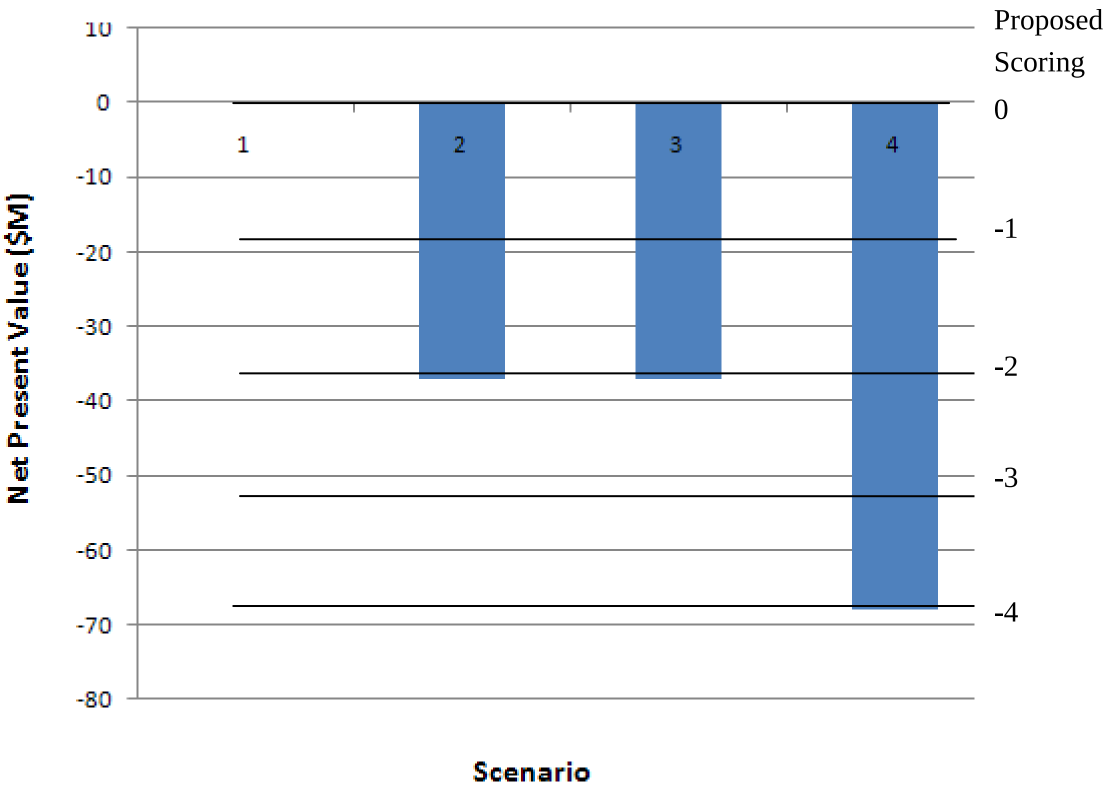
Infrastructure	NPV
Wastewater Storage Lagoon to West of Goolwa (capital, maintenance, operation costs and revenue from water sale all assumed to Council)	40,793
Minimum household rainwater tanks (all costs assumed to be covered by community/developers)	0
Stormwater Wetland Adjacent to WWTP (capital, maintenance , operation costs and revenue from water sale all assumed to Council)	-20,564,958
Wetland Basins to Goolwa North (capital costs assumed to developers, maintenance costs assumed to Council)	-1,373,914
Extend stormwater reuse network (capital, maintenance , operation costs and revenue from water sale all assumed to Council)	-1,701,144
WSUD to new development areas (capital costs assumed to developers, maintenance costs assumed to Council)	-12,480,672
Total	-37,000,000

Scenario 3

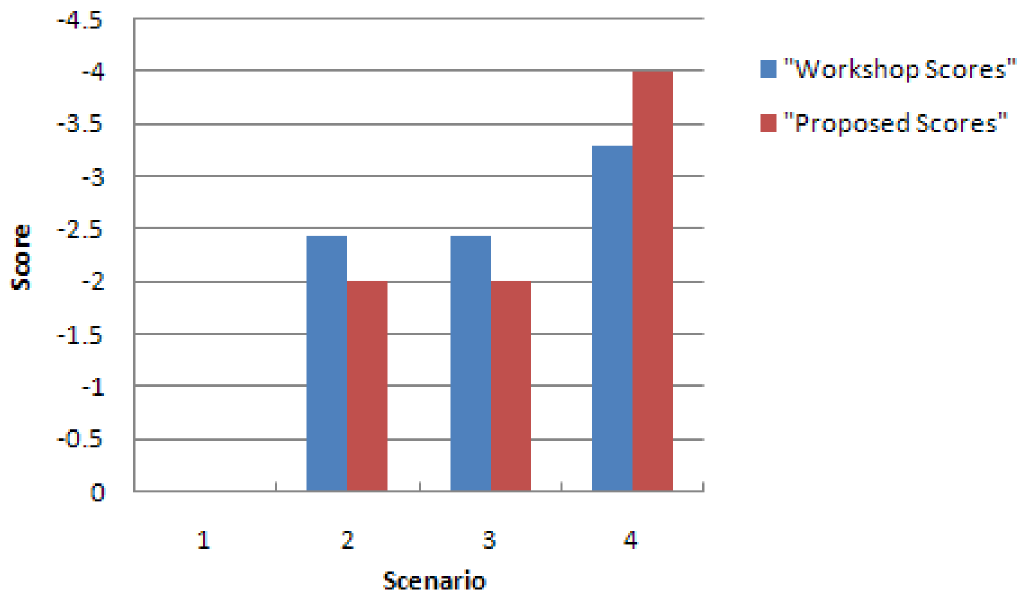
Infrastructure	NPV
Wastewater Storage Lagoon to West of Goolwa (capital, maintenance , operation costs and revenue from water sale all assumed to Council)	40,793
Stormwater Wetland Adjacent to WWTP (capital, maintenance , operation costs and revenue from water sale all assumed to Council)	-20,564,958
Wetland Basins to Goolwa North (capital costs assumed to developers, maintenance costs assumed to Council)	-1,373,914
Extend stormwater reuse network (capital, maintenance , operation costs and revenue from water sale all assumed to Council)	-1,701,144
WSUD to new development areas (capital costs assumed to developers, maintenance costs assumed to Council)	-12,480,672
Maximum Household Rainwater Tank Use (all costs assumed to be covered by community/developers)	0
Total	-37,000,000

Scenario 4

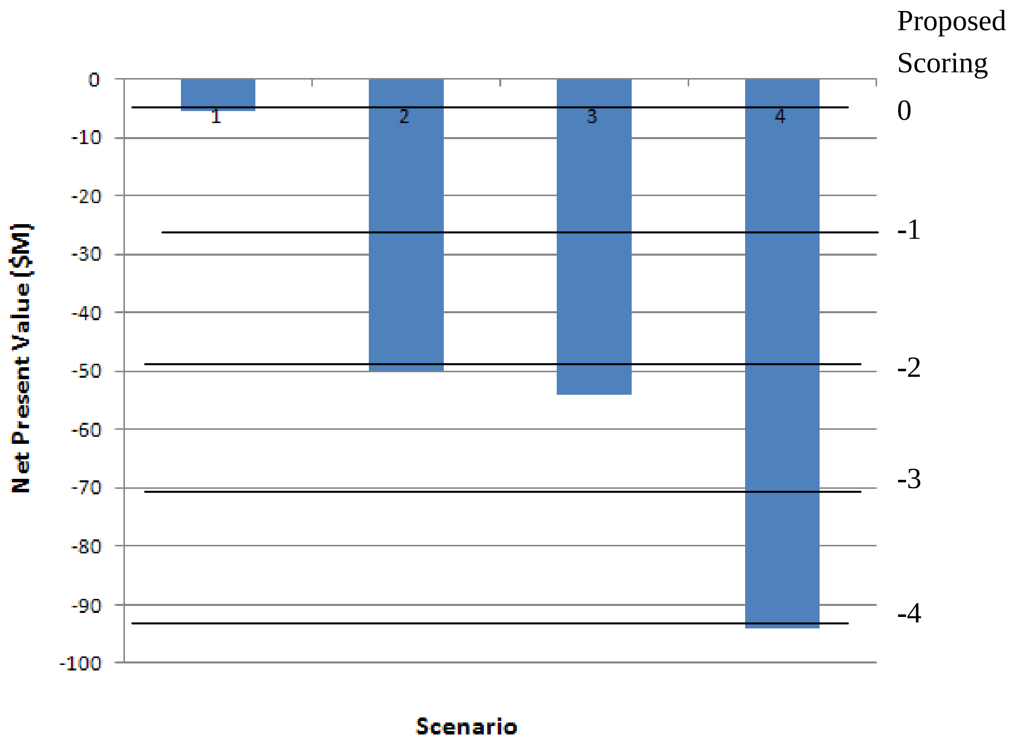
Infrastructure	NPV
Wastewater Storage Lagoon to West of Goolwa (capital, maintenance, operation costs and revenue from water sale all assumed to Council). For Scenario 4 there is less sale of wastewater to irrigators due to the volume used in the purple pipe)	-3,822,555
Minimum household rainwater tanks (all costs assumed to be covered by community/developers)	0
Stormwater Wetland Adjacent to WWTP (capital, maintenance , operation costs and revenue from water sale all assumed to Council)	-20,564,958
Wetland Basins to Goolwa North (capital costs assumed to developers, maintenance costs assumed to Council)	-1,373,914
Extend stormwater reuse network (capital, maintenance , operation costs and revenue from water sale all assumed to Council)	-1,701,144
WSUD to new development areas (capital costs assumed to developers, maintenance costs assumed to Council)	-12,480,672
Purple Pipe to New Development Areas (capital, maintenance, operation costs and revenue from water sale all assumed to Council)	-27,667,224
Total	-68,000,000



■ **Figure 3-4: Net Present Value for each Scenario – Only costs to Council included**



■ **Figure 3-5: Financial scores**



▪ **Figure 3-6: Net Present Value for each Scenario – All costs included**

3.4. Environmental

3.4.1. Stormwater

Figure 3-7 shows the average yearly volume of stormwater reused in each scenario. It can be seen that Scenarios 2- 4 generate more reuse than the Base Case and Scenario 3 generates the most reuse. Implementation of stormwater wetlands and WSUD in the new development areas will increase the volume of infiltration and evaporation. Figure 3-7 also shows that these effects will reduce runoff by approximately 400 ML/yr. Note that the effectiveness of WSUD depends on what is constructed and how much of it there is.

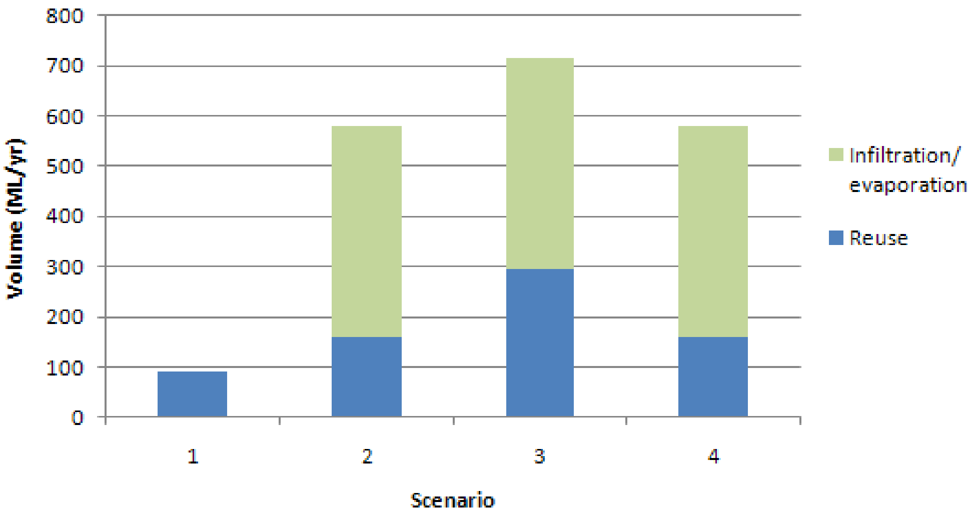
During the workshop, scores of 1, 2 and 2 were assigned to Scenarios 2, 3, and 4 respectively. However, after examination of Figure 3-8 it is suggested that a +4 score may be achieved by halving the total future stormwater discharge, and that other scores may be distributed linearly.

The MUSIC model was used to estimate the volume of stormwater runoff for the current township, giving a volume of around 550ML/year. This indicates that the infrastructure proposed for Scenario

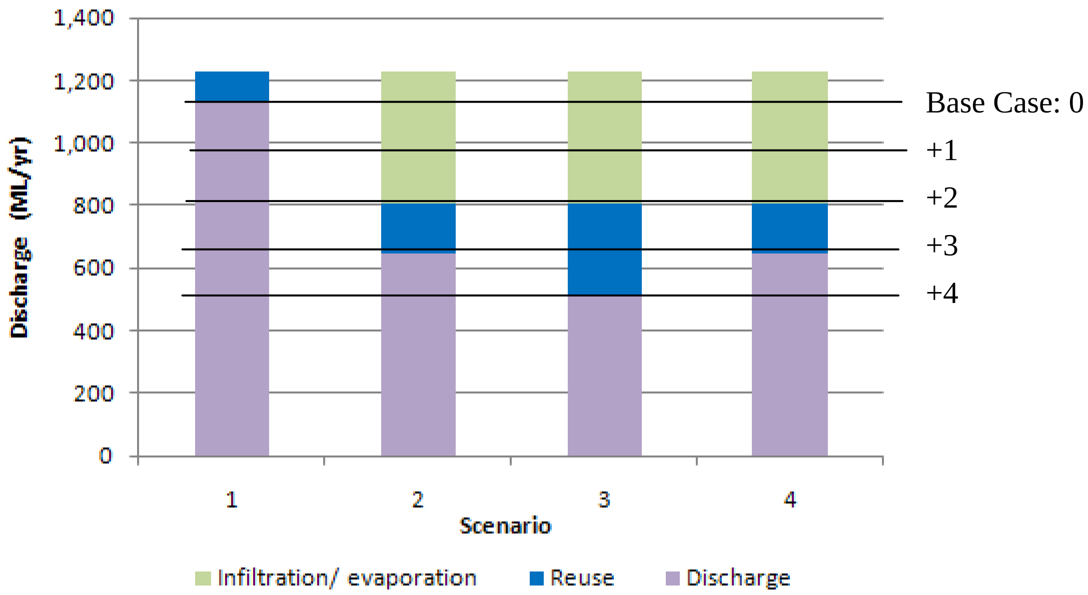
3 would result in similar stormwater discharge to the current town and further justifies the +4 score for the Scenario.

Due to the impact on total stormwater runoff from the town, it is suggested that the following scores be applied:

- Scenario 1: **0**
- Scenario 2: **+3**
- Scenario 3: **+4**
- Scenario 4: **+3**



- **Figure 3-7: Stormwater reuse and infiltration for each scenario**



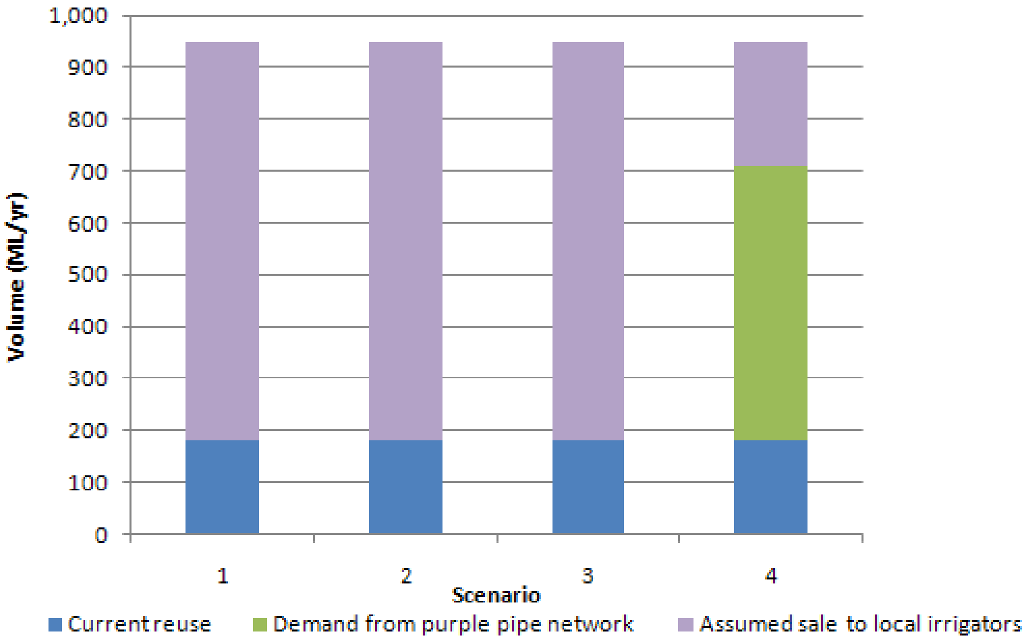
- **Figure 3-8: Stormwater discharge for each scenario**

3.4.2. Wastewater

Wastewater from Goolwa is currently treated at a Council-owned wastewater treatment plant and approximately 180ML/year is reused for irrigation of a local turf pivot.

Figure 3-9 shows the wastewater reuse estimated for each Scenario, for increased population in Goolwa. Scenarios 1, 2, and 3 assume that all of the wastewater (estimated volume of 950ML/year) will be reused through sale to local irrigators. There is uncertainty as to the pattern and total amount of irrigation demand that will exist for the wastewater in the future. Scenario 4 assumes that around 530ML/year will be reused in the purple pipe network and the remainder (420ML) will be sold to local irrigators. The consistent demand for wastewater for the purple pipe removes some of the uncertainty associated with the other Scenarios.

In the workshop all scenarios were scored **0** except Scenario 4, which was scored **+2**, based on the increased demand for wastewater from the purple pipe network, and reduced uncertainty as to whether the wastewater can be sold. It is proposed that this score remains as determined in the workshop.



- **Figure 3-9: Wastewater reuse for each scenario**

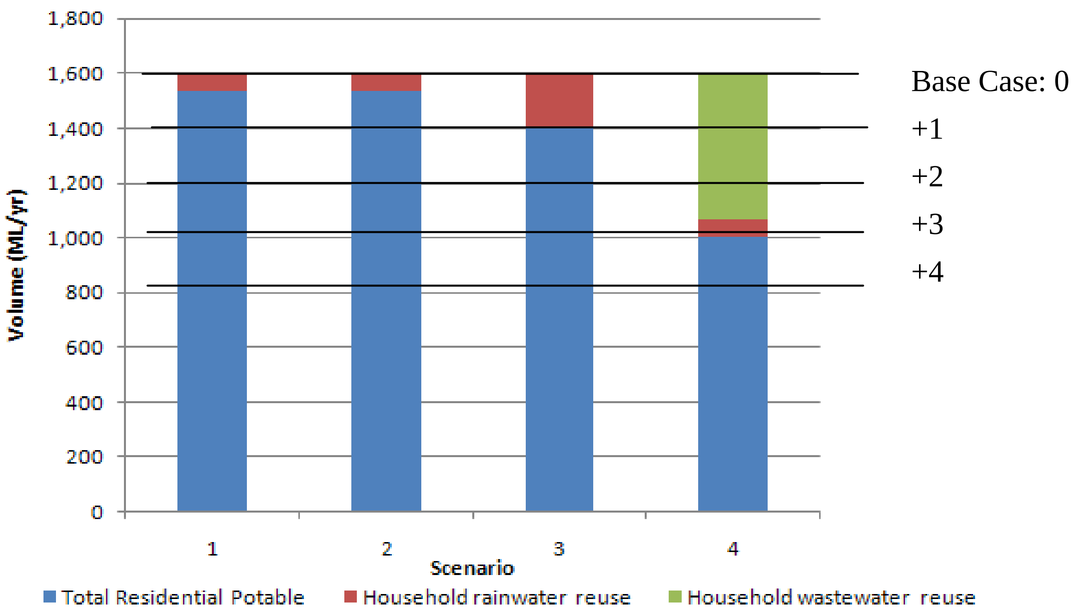
3.4.3. Reduction to Residential Potable Water Demand

Figure 3-9 shows the estimated breakdown of residential water demand and sources utilised for each of the Scenarios. For the Base Case and Scenario 2, there is only a small volume of household water sourced from rainwater (assuming new houses comply with the minimum SA Water guidelines for rainwater tanks of 1kL). For Scenario 3, the volume of rainwater use is increased to around 200ML/year due to the introduction of 5kL rainwater tanks for outdoor, toilet and laundry uses. For Scenario 4, there is a significant additional volume of household water supplied by the purple pipe network to the new development areas.

During the TBL workshop, the following scores were assigned for this criterion:

- Scenario 1: **0**
- Scenario 2: **0**
- Scenario 3: **+1**
- Scenario 4: **+3**

If a score of +4 is awarded for replacement of around half of the household demand with fit for purpose sources, and the remaining scores are distributed linearly then Figure 3-10 supports the scores that were assigned.



▪ **Figure 3-10: Household water use for each Scenario**

3.4.4. Energy

The total energy used in each scenario is presented in Figure 3-11. It can be seen that Scenario 2 and 4 use a similar amount of energy, and Scenario 3 uses considerably more. This is because in Scenario 3 there is a larger volume of water being reused due to the increased size of rainwater tanks.

Figure 3-12 shows the energy use per ML reused. It can be seen that the maximum reuse of rainwater results in a slightly more energy efficient result, however the difference between all of the scenarios is not significant.

Scoring the energy use criterion is difficult as there are uncertainties around which energy source might be used, and design decisions will make a large difference to energy use. As this study has not completed design work for any of the infrastructure options, these energy calculations are very rough, and small differences between scenarios should be ignored. It should also be acknowledged that the energy used to treat and distribute potable water has not been included in this analysis.

During the workshop it was suggested that the scenarios be scored:

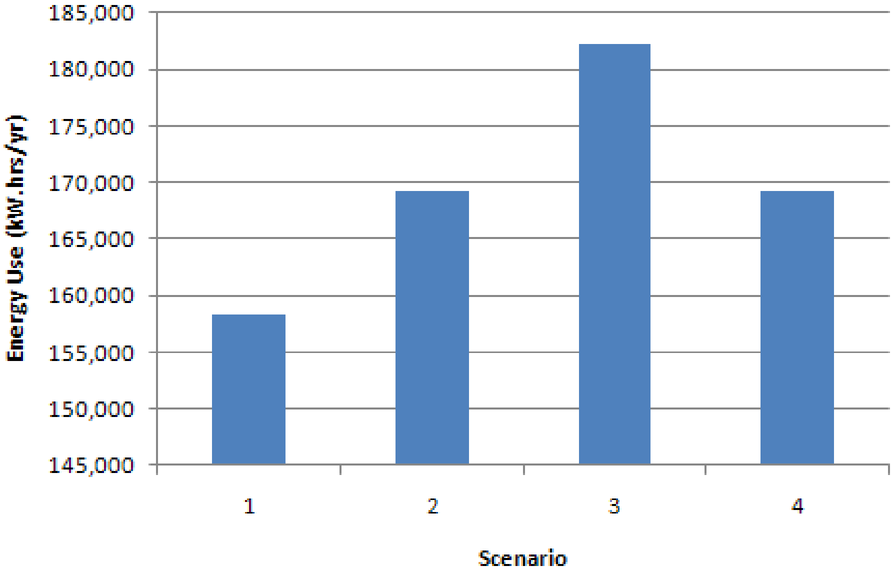
- Scenario 1: 0
- Scenario 2: -1
- Scenario 3: -2

- Scenario 4: -4

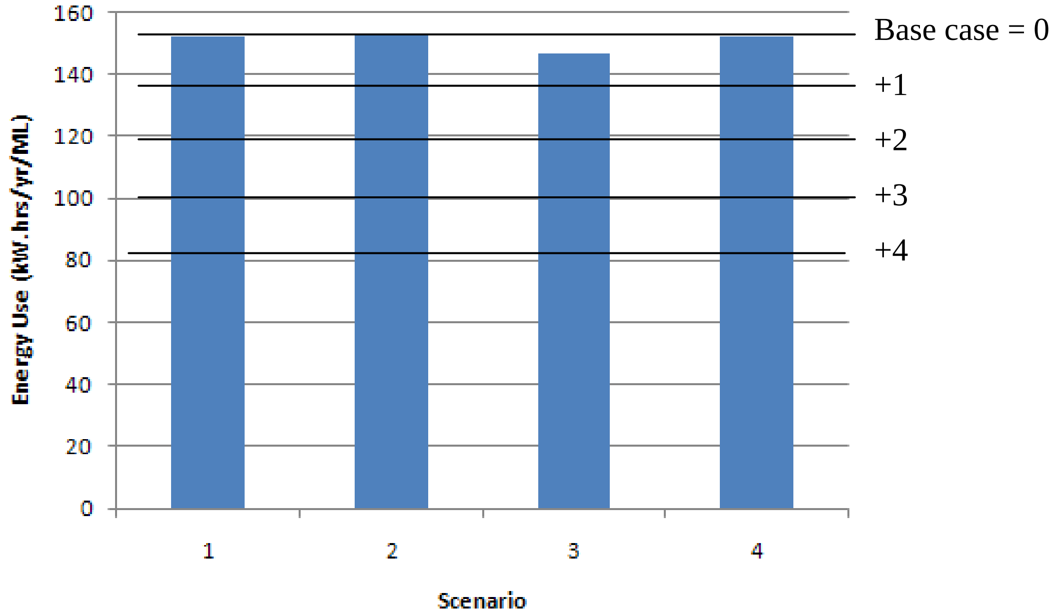
However, if the Base Case is awarded a score of zero and approximately doubling the energy efficiency is considered to achieve a score of +4, then the following scores are obtained based on Figure 3-12:

- Scenario 1: **0**
- Scenario 2: **0**
- Scenario 3: **+0.5**
- Scenario 4: **0**

This is considered to more accurately reflect the small difference in the estimated energy efficiency between the scenarios.



- **Figure 3-11: Total pumping energy used for each scenario**



▪ **Figure 3-12: Pumping energy used for each scenario per ML of water reused**

3.4.5. Climate Change Adaptability

Climate change adaptability cannot be presented in a quantitative form. Greater diversity in water sources, lower water intensity land use options, and policies encouraging water recycling will increase adaptability. Table 3-4 shows the key elements of each scenario, and the climate change adaptability scores assigned during the workshop. During the workshop, the discussion points were not collated as shown in the Table. The scores previously assigned were:

- Scenario 1: **0**
- Scenario 2: **+1**
- Scenario 3: **+2**
- Scenario 4: **+3**

It is suggested that the scores be changed based on Table 3-4 to be:

- Scenario 1: **0**
- Scenario 2: **+2**
- Scenario 3: **+3**
- Scenario 4: **+3**

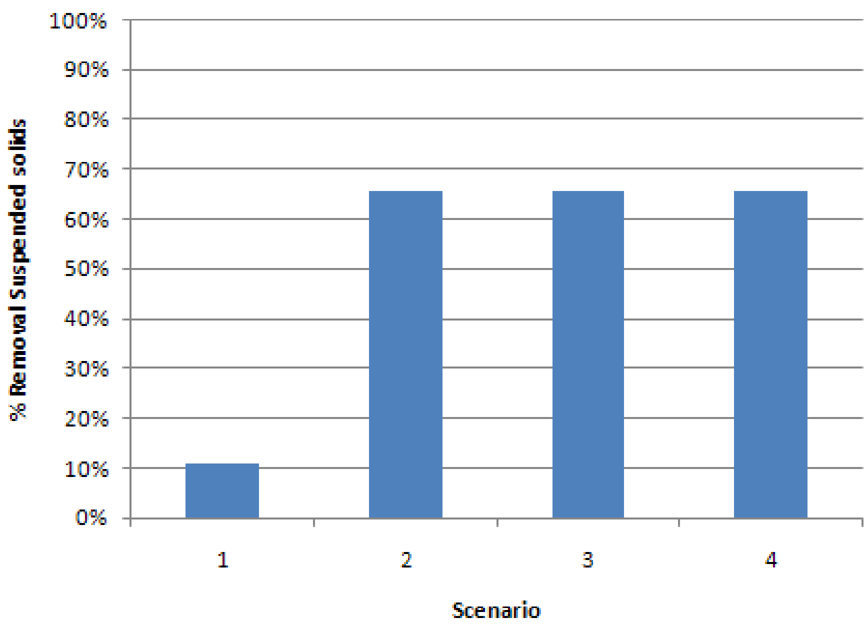
▪ Table 3-4: Climate change adaptability

Base Case	Scenario 2	Scenario 3	Scenario 4	Score
		In a drier climate WSUD features may dry out and require more maintenance.	In a drier climate WSUD features may dry out and require more maintenance.	+4
	In a drier climate WSUD features may dry out and require more maintenance.	The increased volume of household reuse of rainwater will reduce reliance on potable water. Additional sources increases reliability.	The purple pipe will provide a climate independent water source to households, which will reduce reliance on potable water. Additional sources increases reliability.	+3
	Stormwater will be available to water Council green spaces, reducing reliance on other sources. Additional sources increases reliability.	Stormwater will be available to water Council green spaces, reducing reliance on other sources. Additional sources increases reliability.	Stormwater will be available to water Council green spaces, reducing reliance on other sources. Additional sources increases reliability.	+2
Higher intensity storms may cause more frequent flooding of the town.	WSUD will help reduce flash flooding through onsite retention and increased infiltration	WSUD will help reduce flash flooding through onsite retention and increased infiltration	WSUD will help reduce flash flooding through onsite retention and increased infiltration	+1
Wastewater storage and reuse will provide a climate independent water source to irrigators.	Wastewater storage and reuse will provide a climate independent water source to irrigators.	Wastewater storage and reuse will provide a climate independent water source to irrigators.	Wastewater storage and reuse will provide a climate independent water source to irrigators.	0

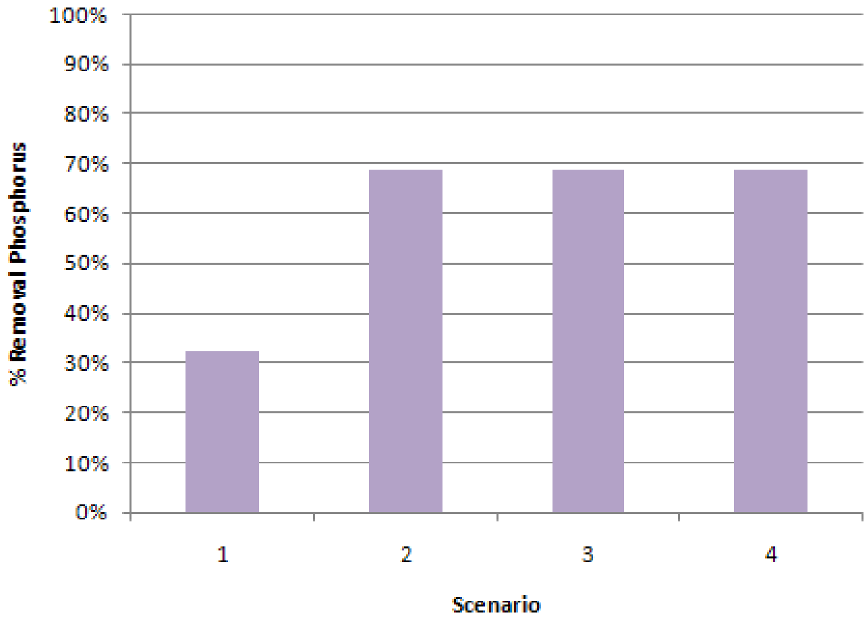
3.4.6. Water Quality

The concentrations of suspended solids, nitrogen and phosphorus in the excess stormwater from the Goolwa catchments were estimated using the MUSIC model. Figure 3-13, Figure 3-14 and Figure 3-15 show the percentage removal of pollutants for each of the scenarios. The Figures show that the stormwater wetlands and WSUD features proposed for Scenarios 2, 3 and 4 result in a significant increase in removal of pollutants. Hence they support the scores that were agreed upon during the TBL workshop:

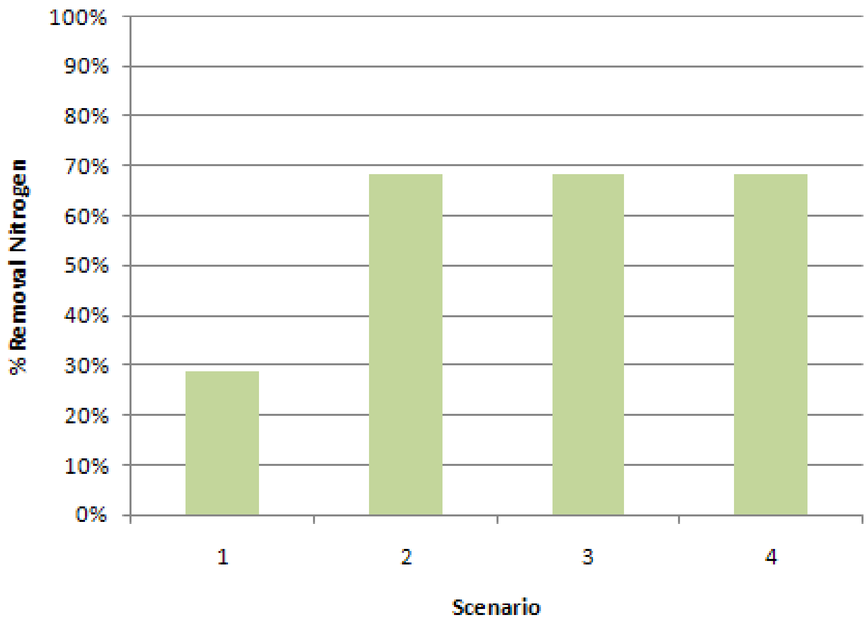
- Scenario 1: **0**
- Scenario 2: **+3**
- Scenario 3: **+3**
- Scenario 4: **+3**



- **Figure 3-13: Percentage Removal of Suspended Solids**



▪ **Figure 3-14: Percentage Removal of Phosphorus**



▪ **Figure 3-15: Percentage Removal of Nitrogen**

3.5. Social

3.5.1. Maintenance required by Community

The amount of maintenance required by the community was considered as part of this criterion, as it was excluded from the Net Present Value calculations. The criterion was considered qualitatively, as shown in Table 3-5. The implementation of maximum reuse of rainwater for Scenario 3 was considered to have a relatively significant maintenance requirement, due to the requirement for pumps, connections to household uses and regular checks that would be required by householders. It was considered that there would be a relatively minor component of maintenance required by the community for the purple pipe network in Scenario 4. This would consist of checks and awareness of how the scheme was working in order to identify any problems.

The following scores were derived during the workshop:

- Scenario 1: **0**
- Scenario 2: **0**
- Scenario 3: **-2**
- Scenario 4: **-1**

3.5.2. Community ownership and acceptance

Community ownership and acceptance cannot be presented in a quantitative form. The community is more likely to accept water infrastructure and the project will be seen as a success by the community when the community is both aware of what is happening and involved. Appropriate signage and taking advantage of community education opportunities is also likely to increase acceptance.

Table 3-6 presents the agreed scores and the main points of the discussion during the workshop. The scores are:

- Scenario 1: **0**
- Scenario 2: **+2**
- Scenario 3: **+3**
- Scenario 4: **+4**

3.5.3. Creation of high quality green space

The high quality open space would be created through wetlands constructed with community use in mind, and possible irrigation using stormwater. These are included in Scenarios 2-4, and so the following scores were agreed by workshop participants:

- Scenario 1: **0**
- Scenario 2: **+4**
- Scenario 3: **+4**
- Scenario 4: **+4**

Table 3-5: Maintenance Required by Community

	Base Case	Scenario 2	Scenario 3	Scenario 4
2				
1			Additional maintenance to householders associated with maximum use of rainwater tanks, incuding pump maintenance and connections to indoor uses.	Minor maintenance to householders associated with purple pipe network (mostly covered by Council)
0	Small amount of maintenance from community for minimal outdoor	Small amount of maintenance from community for minimal outdoor		Small amount of maintenance from community for minimal outdoor

Table 3-6: Community Ownership and Acceptance

	Base Case	Scenario 2	Scenario 3	Scenario 4
				Wider community likely to be unaware of the sale of wastewater to local irrigators
+4			Wider community likely to be unaware of the sale of wastewater to local irrigators	Purple pipe network likely to be widely accepted and appreciated, and may encourage some residents to move to the area.
+3		Wider community likely to be unaware of the sale of wastewater to local irrigators	Increase in water awareness throguh provision of tanks in new residences	
+2		Recycled stormwater for community irrigation likely to be accepted and appreciated	Recycled stormwater for community irrigation likely to be accepted and appreciated	Recycled stormwater for community irrigation likely to be accepted and appreciated
+1	Wider community likely to be unaware of the sale of wastewater to local irrigators	WSUD and wetlands likely to be accepted and appreciated by local residents as a visual and obvious water saving approach	WSUD likely to be accepted and appreciated by local residents as a visual and obvious water saving approach	WSUD likely to be accepted and appreciated by local residents as a visual and obvious water saving approach
0				

3.5.4. Flooding Attenuation

During the workshop the intent of the flooding attenuation criteria was discussed, and workshop participants agreed that it should be a key consideration. It was agreed that it would be included as part of the social theme to take into account the social impacts of minor flooding close to houses and along roadways. It was considered that all Scenarios would achieve basic flood safety requirements, so these were not included in the assessment.

Scenarios 2, 3 and 4 were all considered to provide similar flooding attenuation benefits, through the stormwater wetlands and WSUD features proposed. Hence the following scores were agreed upon:

- Scenario 1: **0**
- Scenario 2: **+3**
- Scenario 3: **+3**
- Scenario 4: **+3**

3.6. TBL Scoring

3.6.1. Proposed scores

The TBL scores for each of the criteria suggested in this document are summarised in Table 3-7 along with the SA Water recommended criteria weightings (equal weightings for financial, environmental and social themes). Figure 3-16 illustrates the final scores, in which it can be seen that Scenario 3 has scored the highest.

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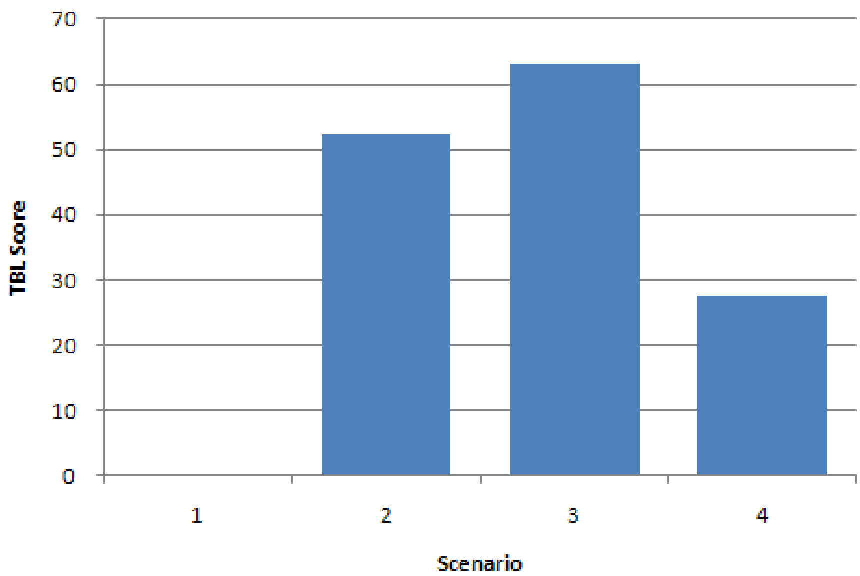
- **Table 3-7: Overall TBL scores using equal weightings for financial, environmental and social themes**

Criteria Scoring Definition	Overall Theme Weighting	Criteria Weighting (%)	Overall Weighting (%)	Base Case	Scenario 2	Scenario 3	Scenario 4
Economic	**33%**			**0**	**-66**	**-66**	**-132**
Net Present Value		100	33	0	-2	-2	-4
Environment	**33%**			**0**	**44**	**63**	**77**
Volume of yearly stormwater reused/discharged		17	6	0	3	4	3
Volume of yearly wastewater reused/discharged		17	6	0	0	0	2
Reduction to Potable water use		17	6	0	0	1	3
Operational energy usage		17	6	0	0	0.5	0
Adaptability to climate change		17	6	0	2	3	3
Quality of water discharged to receiving waters		17	6	0	3	3	3
Social	**33%**			**0**	**74**	**66**	**83**
Maintenance required by Community		25	8	0	0	-2	-1
Community ownership and acceptance		25	8	0	2	3	4
Creation of high quality green space		25	8	0	4	4	4
Flooding attenuation		25	8	0	3	3	3
Total TBL Score				**0**	**52**	**63**	**28**



▪ **Figure 3-16: Comparison of overall TBL scores for each scenario**

3.6.2. Sensitivity analysis – 50% financial

If financial were weighted more strongly, then the TBL score for each of the Scenarios has a negative result, which indicates that they are less desirable than the Base Case. However, Scenario 3 still comes out as preferable to Scenarios 2 and 4. This weighting was used during the workshop, but is more applicable to water recycling schemes that have the potential to sell water and generate revenue, which is only one of many considerations for the overall water future for Goolwa. As such it is not recommended that this weighting be used for final decision making.

- **Table 3-8: Overall TBL scores using 50% weighting for financial**

Criteria Scoring Definition	Overall Theme Weighting	Criteria Weighting (%)	Overall Weighting (%)	Base Case	Scenario 2	Scenario 3	Scenario 4
Economic	**50%**			**0**	**-100**	**-100**	**-200**
Net Present Value		100	50	0	-2	-2	-4
Environment	**25%**			**0**	**33**	**48**	**58**
Volume of yearly stormwater reused/discharged		17	4	0	3	4	3
Volume of yearly wastewater reused/discharged		17	4	0	0	0	2
Reduction to Potable water use		17	4	0	0	1	3
Operational energy usage		17	4	0	0	0.5	0
Adaptability to climate change		17	4	0	2	3	3
Quality of water discharged to receiving waters		17	4	0	3	3	3
Social	**25%**			**0**	**56**	**50**	**63**
Maintenance required by Community		25	6	0	0	-2	-1
Community ownership and acceptance		25	6	0	2	3	4
Creation of high quality green space		25	6	0	4	4	4
Flooding attenuation		25	6	0	3	3	3
Total TBL Score				**0**	**-10**	**-2**	**-79**

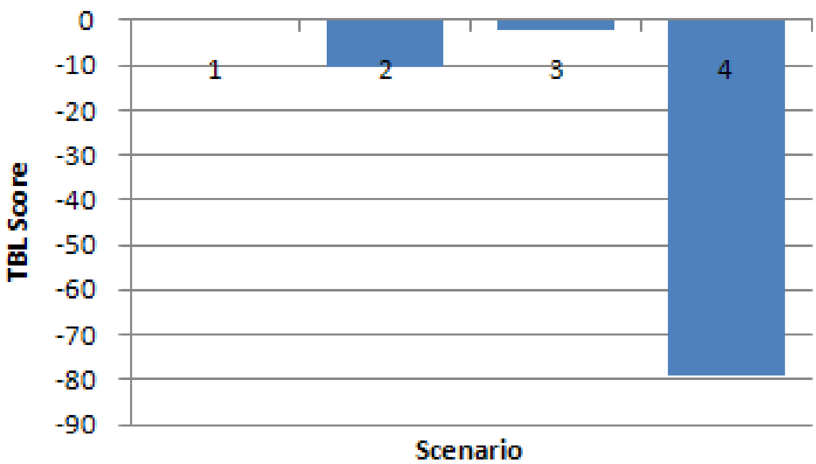
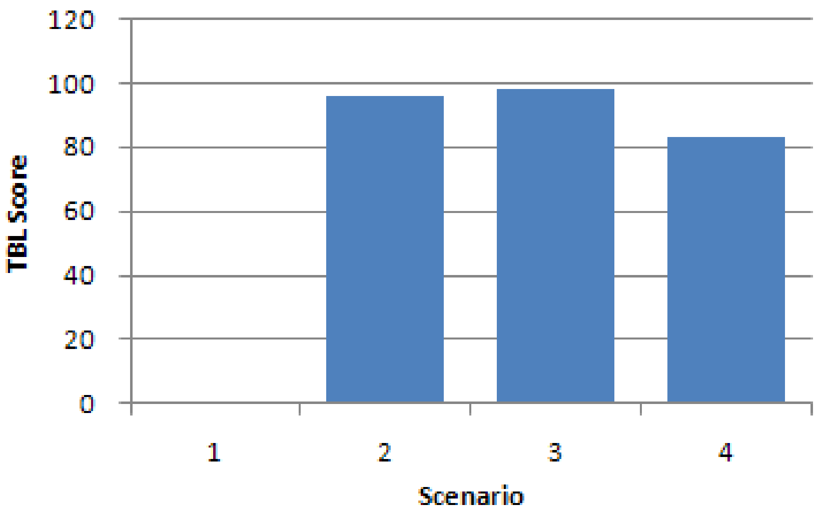


Figure 3-17: Comparison of overall TBL scores for each scenario

3.6.3. Sensitivity analysis – Increased weighting on community/social criteria

During the workshop it was requested that a sensitivity analysis which increased the weighting of the social theme be investigated. To do this, the social theme has been increased to 50% of the total score, with the financial and environmental themes each given a total weighting of 25%. As shown in Figure 3-18, Scenario 2 and Scenario 3 both have very similar scores for this analysis.

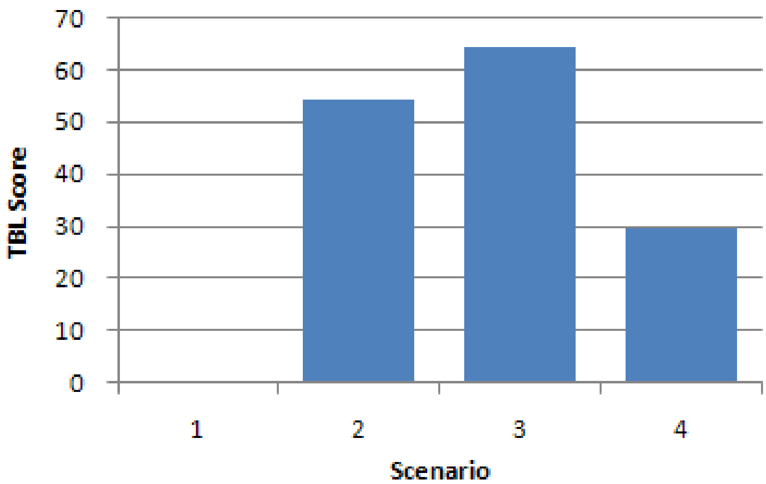


- **Figure 3-18: Comparison of overall TBL scores for each scenario**

3.6.4. Sensitivity analysis – Increased weighting on stormwater and wastewater reuse/discharge

Discharge of stormwater and wastewater to the environment were seen by workshop participants as the most important environmental parameters, so a sensitivity analysis was run to see the impact of increasing the weight of the two discharge criteria within the environmental category.

As shown in Figure 3-19, Scenario 3 obtains the highest score for this analysis.



- **Figure 3-19: Comparison of overall TBL scores for each scenario**

4. TBL Scoring – Hindmarsh Island

4.1. TBL criteria

4.2. Scoring criteria

Based on the data presented by SKM, and other data as understood by workshop participants through their own experience, the workshop group assigned a TBL score to each scenario against each criterion. These scores ranged from +4 to -4 as described in Section 1.3.

Preliminary scores were proposed by the workshop participants, however participants suggested that they would have preferred making decisions based on more detailed information, in particular a Net Present Value costing. Some of this detail is presented in this document, with suggestions as to possible influences on the scores chosen.

4.3. Financial

In the information presented to the workshop, the financial category consisted of:

- Capital cost to Council
- Maintenance cost to Council
- Impact on Council Revenue

Each of these elements was scored separately. However, workshop participants stated that they would prefer to view all financial costs rolled into a Net Present Value, and that only costs to Council should be included. The scores assigned for these criteria during the workshop, and the overall score for the combined criteria are shown in Table 4-1.

- **Table 4-1: Workshop scoring**

		Scenarios		
	Weight	1	2	3
Capital	60%	0	-2	-4
Maintenance	30%	0	-1	-1
Revenue	10%	0	0	0
Overall Score	100%	**0**	**-1.6**	**-3.2**

After the workshop an NPV was created based on the costs already calculated plus feedback given by workshop participants. During the workshop, it was agreed that the NPV should include only the costs to Council; hence assumptions have been made as to which costs Council would be likely to pay and which would be the responsibility of the community or developers. It is acknowledged that there are a range of alternative funding options for the infrastructure, which may divert unascertained costs away from the Council however it would be premature to speculate on these arrangements at this early stage of the infrastructure planning.

A summary of the NPV is given in Table 4-2 and plotted in Figure 4-1, with a proposed scoring scale. It is proposed that the following scores be assigned:

- Scenario 1: **0**
- Scenario 2: **-2**
- Scenario 3: **-4**

These proposed score changes would have the effect of giving both Scenarios 2 and 3 slightly more negative scores than previously awarded, as shown in Figure 4-2.

Table 4-2: NPV Summary

Scenario 1

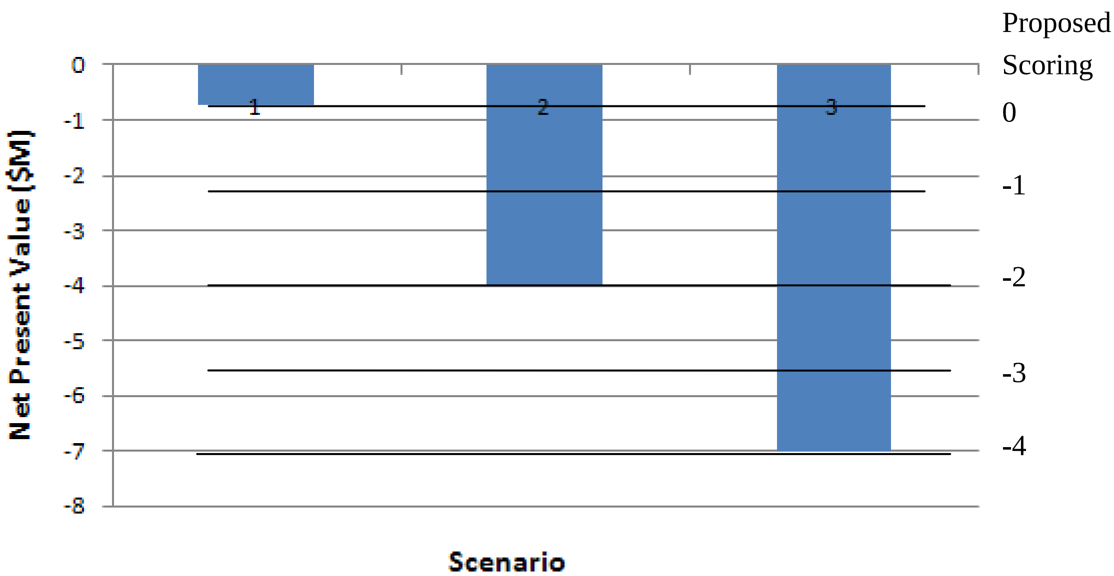
Infrastructure	**NPV**
Wastewater to Goolwa	-734,880
Total	-734,880

Scenario 2

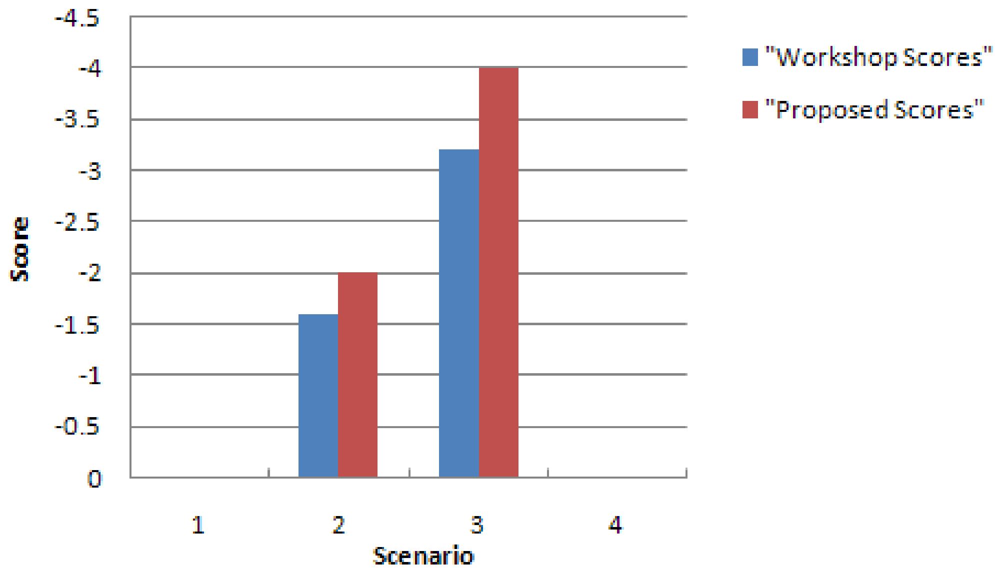
Infrastructure	**NPV**
Wastewater to Goolwa	-734,880
Biofiltration Basins	-2,721,812
Total	-4,000,000

Scenario 3

Infrastructure	**NPV**
Wastewater to Goolwa	-734,880
Biofiltration Basins	-2,721,812
Stormwater wetland	-2,990,034
Total	-7,000,000



▪ **Figure 4-1: Net Present Value for each Scenario – Only costs to Council included**



▪ **Figure 4-2: Financial scores**

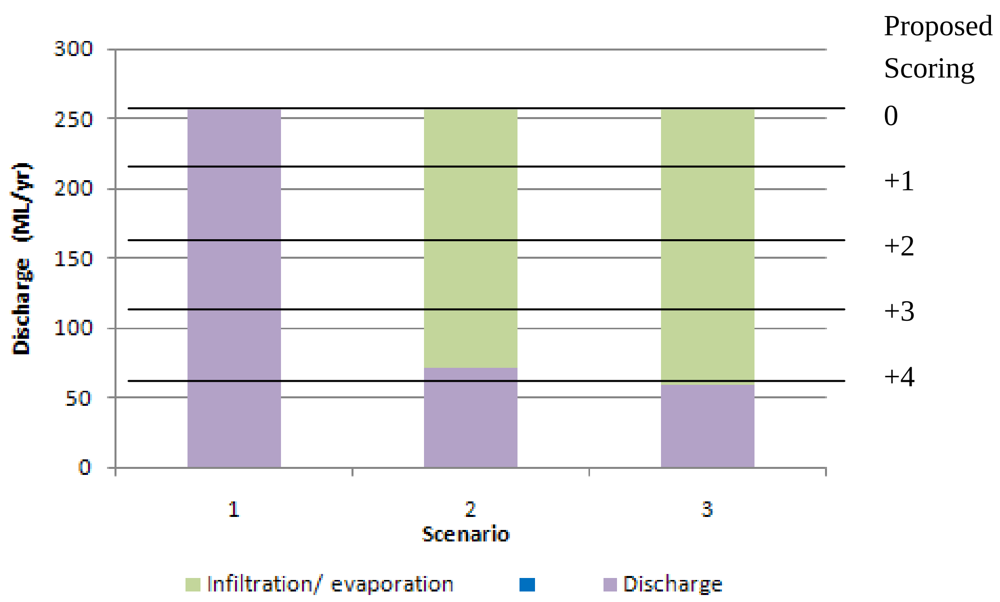
4.4. Environmental

4.4.1. Volume of Stormwater Reuse/Discharge

The volume of stormwater discharge was estimated using a MUSIC model of Hindmarsh Island. For the Scenario 1, all stormwater runoff is discharged to the Lower Lakes, while for Scenario 2 there is increased infiltration from the bio-infiltration basins which results in a decreased discharge. For Scenario 3, there is a further decrease to discharge due to the proposed stormwater wetland. During the TBL workshop, Scenario 1 was given a score of 0, Scenario 2 was given a score of +3 and Scenario 4 was given a score of +4.

Figure 4-3 shows the volumes of stormwater discharge and infiltration estimated from MUSIC modelling of the scenarios. Based on the figure it is suggested that the scores be altered to:

- Scenario 1: **0**
- Scenario 2: +**4**
- Scenario 3: +**4**



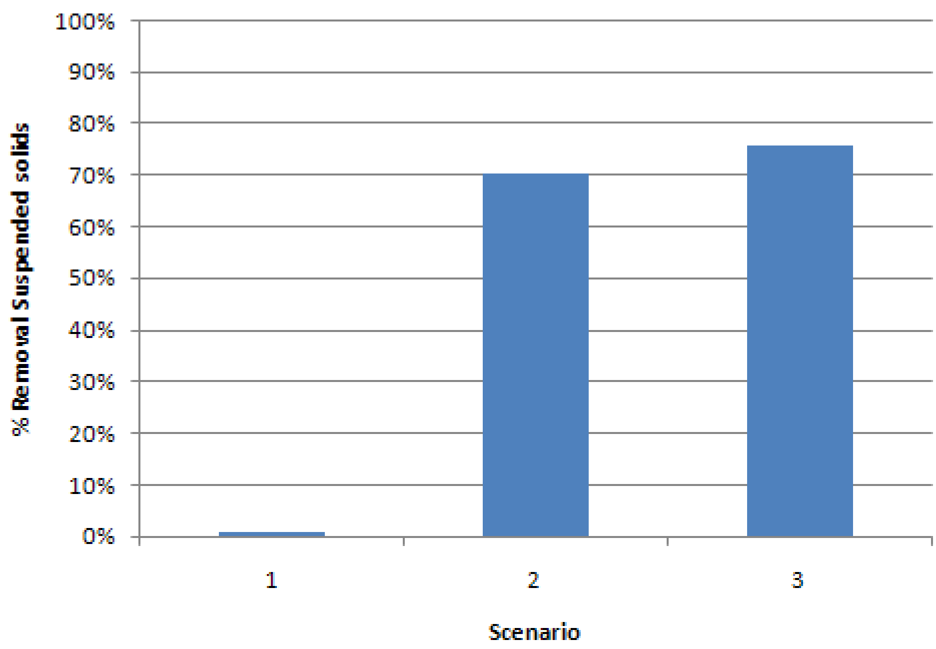
- **Figure 4-3: Stormwater discharge and infiltration**

4.4.2. Other Environmental Criteria

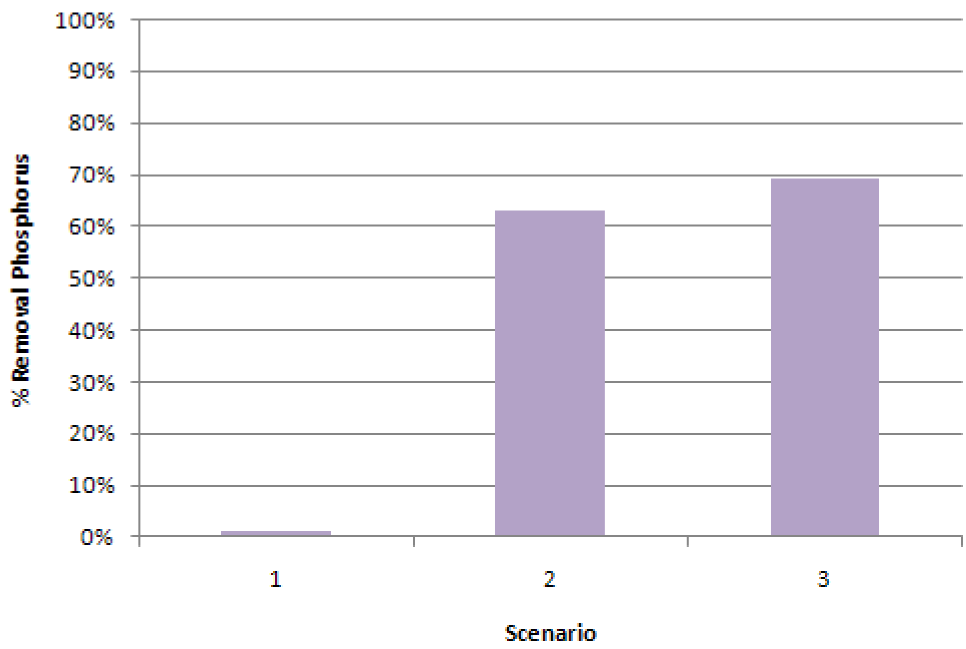
No changes are proposed to the other environmental criteria that were determined during the workshop. A summary of the other environmental scores and rationale behind the scoring selection is provided in Table 4-3.

Table 4-3: Summary of Environmental Criteria

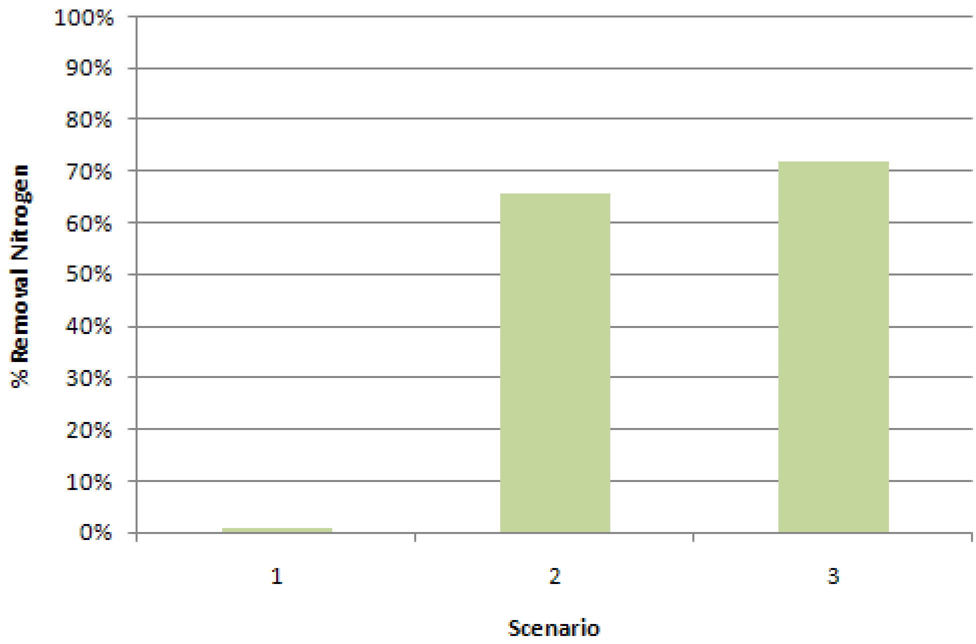
Environmental Criteria	Scenario Scores			Scoring Rationale
	1	2	3	
Volume of yearly wastewater reused/discharged	0	0	0	Remove from assessment since transfer of wastewater to Goolwa proposed for all scenarios, so discharge is eliminated for all cases.
Reduction to Potable water use	0	1	2	A score of +1 was assigned to Scenario 2 since the bio-infiltration systems would be expected to result in a small reduction to irrigation requirements in adjacent locations. Scenario 2 was given a score of +2 since the wetland would be expected to have minor irrigation potential for public open space adjacent to wetland.
Operational energy usage	0	0	0.5	The wastewater transfer pipeline to Goolwa would require energy for pumping, but it is common for all Scenarios. Scenario 3 was given a score of +0.5 as there would be a small amount of energy required for irrigation of public open space adjacent to the wetland.
Adaptability to climate change	0	2	3	It was considered that the bio-infiltration basins (included in Scenarios 2 and 3) would provide a moderate benefit to climate change adaptability through retention and infiltration of stormwater within the Hindmarsh Island catchments rather than discharging to the Lower Lakes. The stormwater wetland in Scenario 3 would provide additional benefit through additional stormwater harvesting and reuse potential. Hence Scenario 2 was given a score of +2 and Scenario 3 was given a score of +3.
Quality of water discharged to receiving waters	0	3	3	The quality of stormwater discharge was investigated using MUSIC modelling of the catchment for each Scenario. Figure 4-4, Figure 4-5, and Figure 4-6 show the percentage of load reduction for each scenario for suspended solids, nitrogen and phosphorus. The figures support the scores that were determined in the workshop.



- **Figure 4-4: Percentage Removal of Suspended Solids**



- **Figure 4-5: Percentage Removal of Phosphorus**



- **Figure 4-6: Percentage Removal of Nitrogen**

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4.5. Social

No changes are proposed to the social criteria that were determined during the workshop. A summary of the social criteria scores and rationale behind the scoring selection is provided in Table 4-4.

Table 4-4: Summary of Social Criteria

Environmental Criteria	Scenario Scores			Scoring Rationale
	1	2	3	
Maintenance required by Community	0	0	0	This criterion was removed from the assessment because none of the scenarios were considered to require maintenance by the community.
Community ownership and acceptance	0	4	4	Scenarios 2 and 3 were both considered to have high community ownership and acceptance, as they involve highly visible, public stormwater management options. They were both given a score of +4, as it was considered that the additional benefit of the stormwater wetland (Scenario 3) would be minor compared with the several bio-infiltration basins proposed for Scenario 2.
Creation of high quality green space	0	3	4	Scenario 2 was given a score of +3 due to the green open spaces created for the bio-infiltration basins throughout the township. Scenario 3 was given a score of +4 due to the additional benefit of the stormwater wetland, which would create another open space area, with the potential to integrate with a high-value community park area.
Flooding attenuation	0	4	4	Scenario 2 and 3 were both considered to provide attenuation to minor flooding through infiltration and capture of stormwater throughout the Hindmarsh Island catchments.

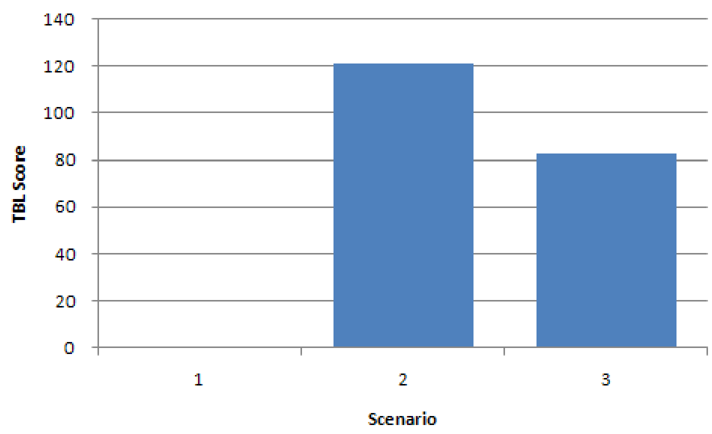
4.6. TBL Scoring

4.6.1. Proposed scores

The TBL scores for each of the criteria suggested in this document are summarised in Table 4-5 along with the SA Water recommended criteria weightings (equal weightings for financial, environmental and social themes). Figure 4-7 illustrates the final scores, in which it can be seen that Scenario 3 has scored the highest.

- **Table 4-5: Overall TBL scores using equal weightings for financial, environmental and social themes**

Criteria Scoring Definition	Overall Theme Weighting	Criteria Weighting (%)	Overall Weighting (%)	Base Case	Scenario 2	Scenario 3
Economic	**33%**			**0**	**-66**	**-132**
Net Present Value		100	33	0	-2	-4
Environment	**33%**			**0**	**66**	**83**
Volume of yearly stormwater reused/discharged		20	7	0	4	4
Reduction to Potable water use		20	7	0	1	2
Operational energy usage		20	7	0	0	0.5
Adaptability to climate change		20	7	0	2	3
Quality of water discharged to receiving waters		20	7	0	3	3
Social	**33%**			**0**	**121**	**132**
Community ownership and acceptance		33	11	0	4	4
Creation of high quality green space		33	11	0	3	4
Flooding attenuation		33	11	0	4	4
Total TBL Score				**0**	**121**	**83**



- **Figure 4-7: Comparison of overall TBL scores for each scenario**

4.6.2. Sensitivity analysis – 50% financial

Table 4-6 shows the result of the assessment if the financial theme was weighted more strongly. It shows that Scenario 2 is still preferable for this analysis, and the overall score for Scenario 3 becomes negative, which indicates that it is less desirable than the base case.

- **Table 4-6: Overall TBL scores using 50% weighting for financial**

Criteria Scoring Definition	Overall Theme Weighting	Criteria Weighting (%)	Overall Weighting (%)	Base Case	Scenario 2	Scenario 3
Economic	**50%**			**0**	**-100**	**-200**
Net Present Value		100	50	0	-2	-4
Environment	**25%**			**0**	**50**	**63**
Volume of yearly stormwater reused/discharged		20	5	0	4	4
Reduction to Potable water use		20	5	0	1	2
Operational energy usage		20	5	0	0	0.5
Adaptability to climate change		20	5	0	2	3
Quality of water discharged to receiving waters		20	5	0	3	3
Social	**25%**			**0**	**92**	**100**
Community ownership and acceptance		33	8	0	4	4
Creation of high quality green space		33	8	0	3	4
Flooding attenuation		33	8	0	4	4
Total TBL Score				**0**	**42**	**-38**

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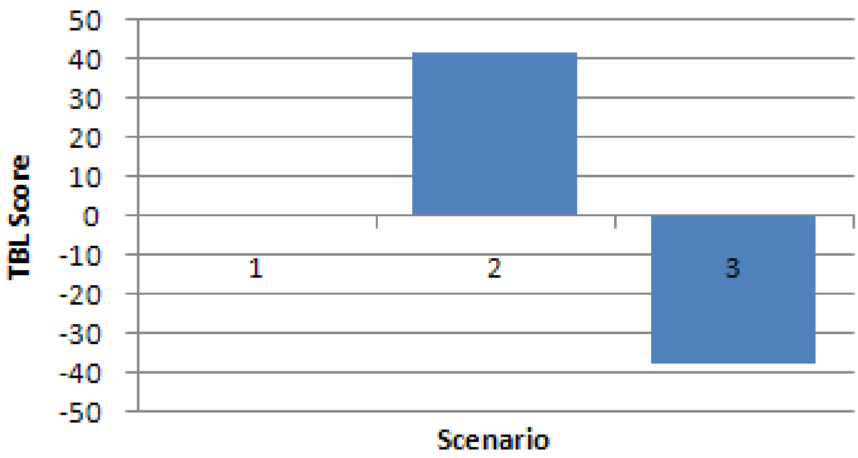
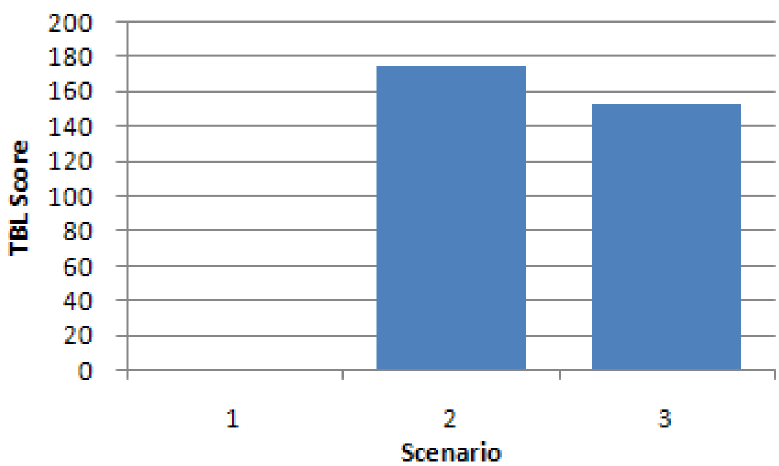


Figure 3-8: Comparison of overall TBL scores for each scenario

4.6.3. Sensitivity analysis – Increased weighting on community/social criteria

During the workshop it was requested that a sensitivity analysis which increased the weighting of the social theme be investigated. To do this, the social theme has been increased to 50% of the total score, with the financial and environmental themes each given a total weighting of 25%. As shown in Figure 4-9, Scenario 2 again achieves the higher score.

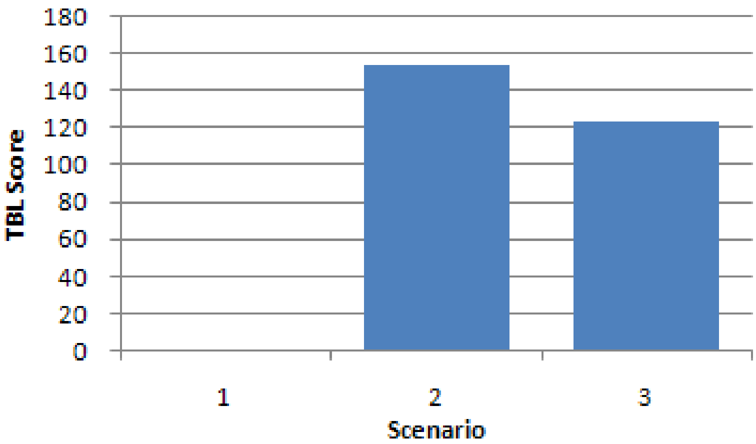


- **Figure 4-9: Comparison of overall TBL scores for each scenario**

4.6.4. Sensitivity analysis – Increased weighting on stormwater and wastewater reuse/discharge

Discharge of stormwater and wastewater to the environment were seen by workshop participants as the most important environmental parameters, so a sensitivity analysis was run to see the impact of increasing the weight of the two discharge criteria within the environmental category.

As shown in Figure 4-10, Scenario 2 obtains the highest score for this analysis.



- Figure 4-10: Comparison of overall TBL scores for each scenario

5. Conclusion

Based on the scores agreed by workshop participants, and the sensitivity analyses applied, it is recommended that Scenario 3 be adopted for Goolwa and Scenario 2 be adopted for Hindmarsh Island.

Appendix A TBL Workshop Minutes

Meeting Notes

Purpose of Meeting	**Triple Bottom Line Assessment**		
Project	Alexandrina IWMP	Project No	VE23421
Prepared By	Anna Pannell	Phone No	8424 3847
Place of Meeting	Alexandrina Council, Goolwa	Date	21 March 2011
Present	Neville Styan Sally Roberts Stewart Ratcliff	Mellissa Bradley (SA MDB NRMB) Christina Son (DfW) Peter Scott (EPA) Marta Vergara-Godoy; (SA Water)	
SKM	Anna Pannell Brittany Coff	Peta Maddy Jarrah Muller	
Distribution	[Name]	[Name]	

Discussion Points

1) Language and terminology

Use "wetland" rather than "basin" – ensure developers don't think its just a hole in the ground. Wetlands imply multiple functions of water treatment, storage and amenity.

Rather not suggest "rain gardens". "Bioinfiltration system" preferred.

2) Assumptions and Comments for Hindmarsh Island (to inform policy recommendations)

- All development will require provision of rainwater tanks to service household use. (Size calculations will be provided)
- Discourage pumping from Goolwa Channel (Lower Lakes) and encourage self-sufficiency
- Detain up to 1 in 5 ARI flood event
- Wouldn't pick options that result in danger to residents (eg flooding) or not meeting legislative or policy options
- Bioinfiltration systems to be planted with appropriate species as noted in updated WSUD guidelines, noting requirements for inundation, artificial substrates etc.
- Council responsible for maintenance of bioinfiltration and wetland
- Bioinfiltration systems expected to have small reduction in irrigation requirements in adjacent locations
- Wetlands expected to have minor irrigation potential for public open space adjacent to wetland

3) Option 4 – approximate location of wetland only - note difficulty in locating wetland between residential area and Lake

4) CRITERIA – discussed and altered for base assessment (altered for sensitivity analysis)

Discussion Points

<u>Financial Criteria:</u>

Include 5% Annual renewal costs – couldn't include at TBL workshop

30% capital costs

10% maintenance costs (15% used for workshop)

5% impact on Council revenue

<u>Environmental Criteria:</u>

5% Stormwater reuse

10% wastewater reuse

2.5% each for energy, climate change, water quality and reduction to potable demand

<u>Social Criteria</u>*:*

Discussion on flooding as key criteria, social impact of flood water on road, near houses etc

Noted that community acceptance (included in ownership) critical to success

Agreed to start with equal weighting for community maintenance, community ownership, open space creation and flood attenuation

Questions if heritage would be included – Council noted that no European heritage in growth area, possible Aboriginal heritage. Any development would need to undertake site survey.

Noted that SA Water used equal split between environmental, financial and social

5) Hindmarsh Island Options (renumbered)

Base Case – do need to take wastewater away so Option 2 is required for base case. This also includes discharge of stormwater to Lakes.

Option 1 – wastewater to WTP and stormwater treated in bio-infiltration systems

Option 2 – wastewater to TWP and stormwater treated in wetland

6) DfW representative noted that would like Martin Allen to look at stormwater volumes calculated by MUSIC modelling – to be discussed with Council and NRM Board

7) <u>Sensitivity analyses</u>

1- Used SA Water equal split (33.3% each) with same proportions as first run
2- More weighting on flooding
3- More weighting on community / social

8) Outcome – Option 1 – biofiltration scored above wetland, which "felt" right to most participants.

Discussion Points

9) Need to check details on costs of maintenance for bio-infiltration basins.

10) Assumptions and Comments for Goolwa:
   - Capital costs – only include Council costs (community (maintenance costs to be considered in social criteria
   - Ensure 10% runoff to meet NRM Policy
   - Climate change criteria – how well the infrastructure would adapt to decreased average rainfall, increased evaporation, increased flashy events
   - Treatment and pumping energy requirements higher to treat wastewater to level suitable for third pipe reticulation
   - Rainwater tanks plumbed to houses would be used for xx
   - Timing of discharge of stormwater to Lower Lakes also important to consider when looking at quality of discharge / load reductions

11) Weaknesses in data to date include detailed and lifecycle costs – to be considered in next stage of reporting

    Need to clearly define generation, reuse and excess (discharge) for wastewater and stormwater

12) Changes to Scenarios for Goolwa

    Base case – need to upgrade storage of wastewater, so include Option 3 in base case

13) Next steps

    Further investigate costs of third (purple) pipe connection and associated water treatment. Look at costs against volumes of potable water saved and volume of wastewater reused.

Appendix E: Climate Change Inputs

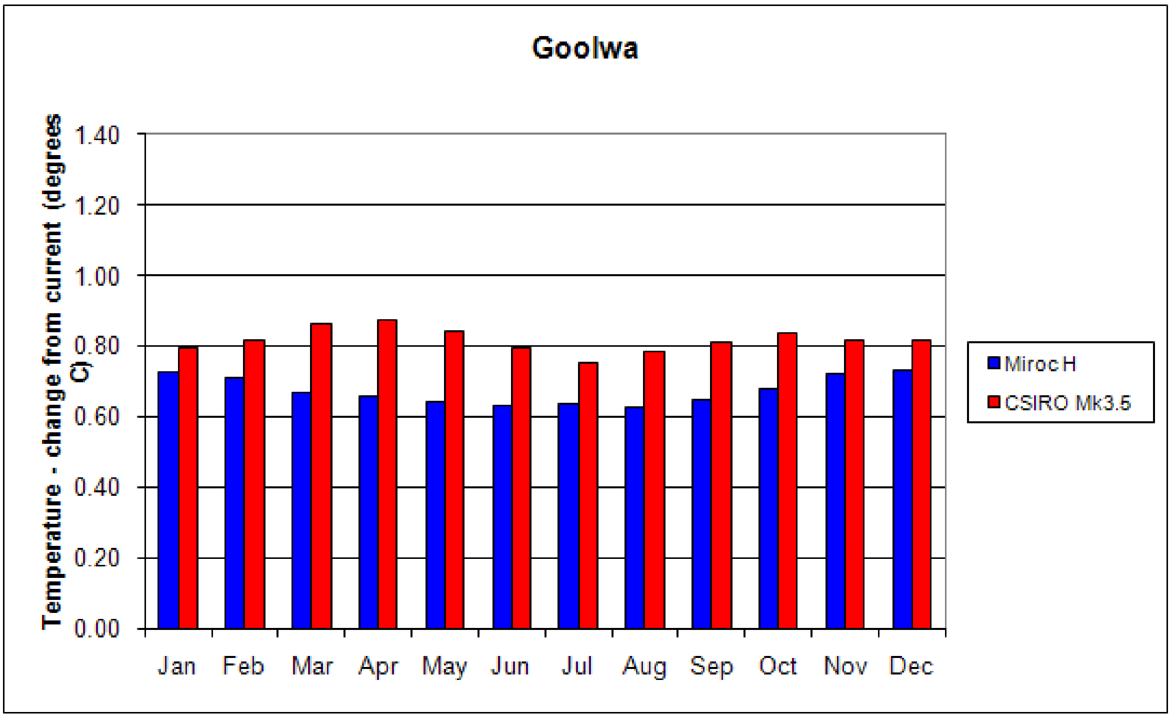
Climate Change Inputs

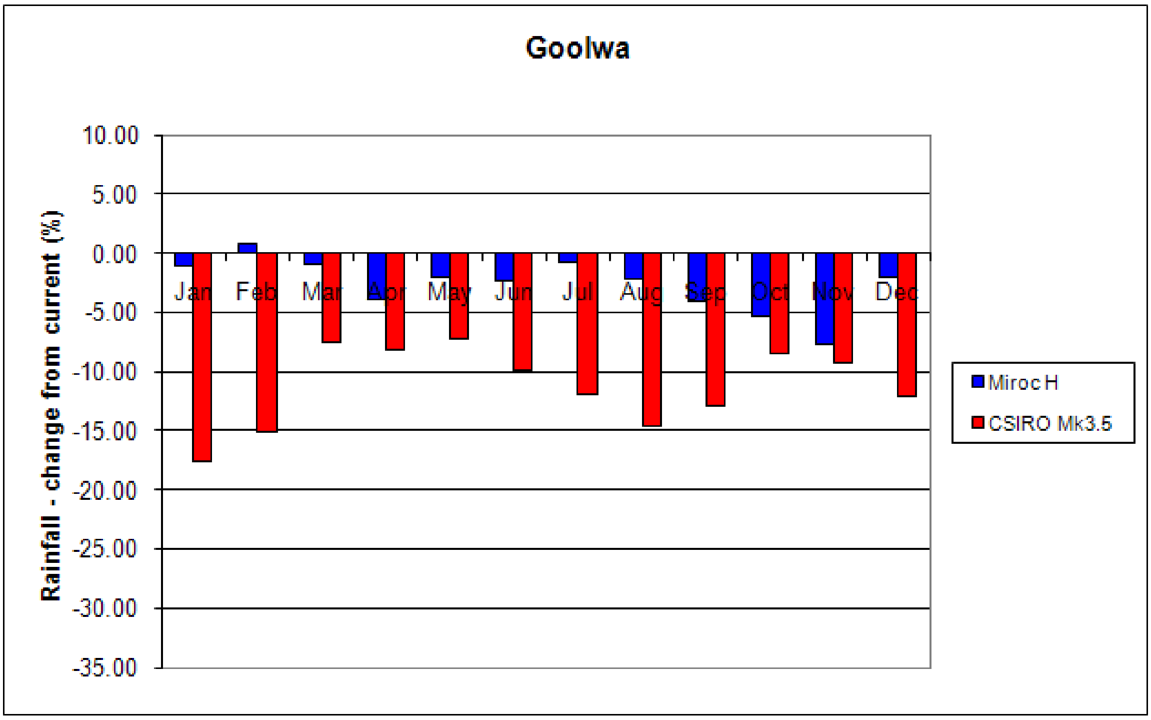
This section describes the climate change information provided by the Climate Change Adaptation Project (Hayman et al, 2011)

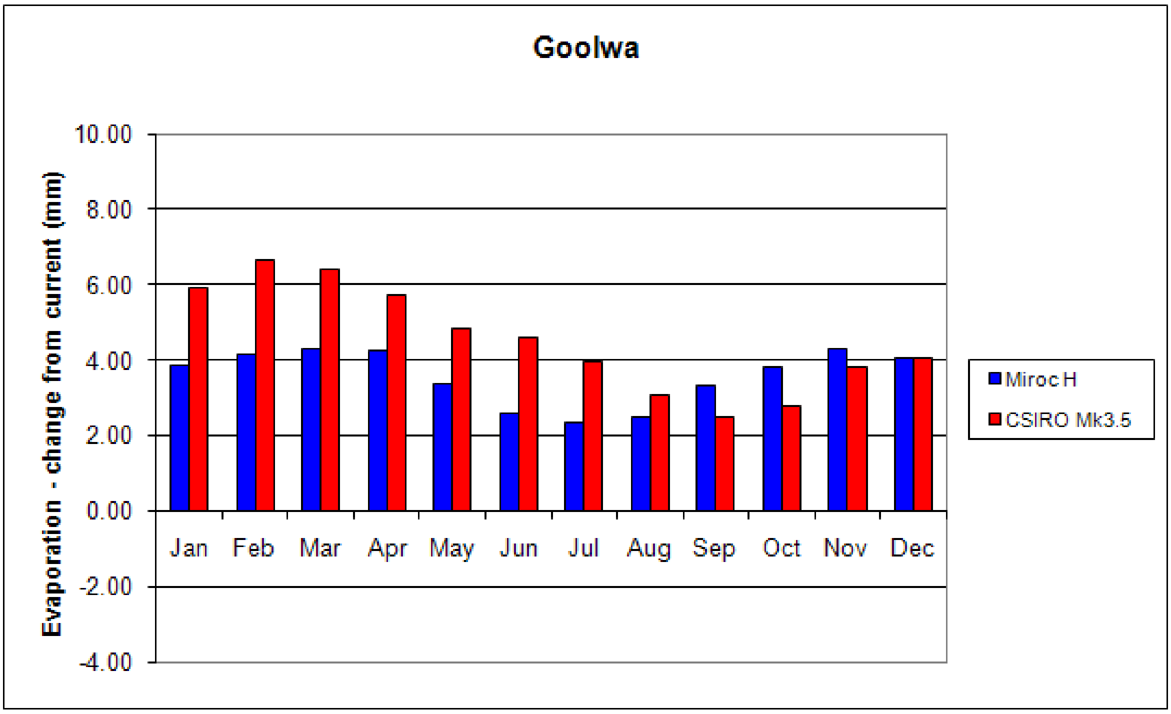
IWMP Climate Change information 17 Sept 2010

The purpose of this spreadsheet is to provide changes in mean temperature (degrees C), rainfall (%) and evaporation (mm) for 2 models Miroc H (mild drying) and CSIRO Mk 3.5 (more severe drying) for a range of towns in the study region.

NOTE – The Miroc H (mild drying) scenario was chosen for use by the SBC project.




Goolwa
Rainfall - change from current (%)
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
-25.00
-30.00
-35.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Miroc H
CSIRO Mk3.5


Goolwa
Evaporation - change from current (mm)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
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Appendix F: Cost Estimates

1. Net Present Value Calculations

An estimate of the Net Present Value (NPV) was made for each Scenario. The NPV was calculated for duration of 30 years and included the following costs:

- Capital costs
- Annual maintenance costs
- Annual operating costs
- Revenue from sale of recycled water

A discount rate of 6% and an escalation rate of 3.5% were applied, which are both consistent with the rates used by SA Water for infrastructure projects.

At the request of project stakeholders, the NPV was created to include only the costs to Council; hence assumptions have been made as to which costs Council would be likely to pay and which would be the responsibility of the community or developers. It is acknowledged that there are a range of alternative funding options for the infrastructure, which may divert unascertained costs away from the Council however it would be premature to speculate on these arrangements at this early stage of the infrastructure planning.

Due to the high level nature of this study, a range of assumptions were made as part of the estimation of costs and revenue for each scenario. The intent of the NPV calculations is to enable comparison of the economic value of each of the scenarios, and should not be used for any other purpose. The following subsections describe the methods and assumptions that have been used for estimation of the costs and revenue for each infrastructure option.

1.1. Capital Costs

The capital costs have been estimated for all of the infrastructure options that are proposed within the four scenarios, and these were put into the NPV calculation. Table 5-1 describes the information that was used to estimate each of the capital costs. Further details of the cost estimates for each infrastructure option are included in Appendix C.

Table 5-1: Description of Capital Cost Calculations

Infrastructure	Information and Assumptions	Estimated Cost
Wastewater Storage Lagoon to West of Goolwa (included in all scenarios)	- Capital cost assumed to Council. - For Scenario 4 there is less sale of wastewater to irrigators due to the volume used in the purple pipe network. - Cost was based on 92ML storage, with surface area of 4Ha. - Additional costs were added for preliminaries (establishment, environmental management and	$6.85M

Infrastructure	Information and Assumptions	Estimated Cost
	contractor's margin), non construction intangibles (survey, design, project management) and 30% contingency.	
Household rainwater tanks (included for all scenarios, but size of tanks modified for Scenario 3)	- All costs assumed to be covered by community/developers - Minimum required tanks of 1kL assumed for Scenarios 1, 2 and 4. - Maximum household reuse and 5kL tanks implemented for Scenario 3.	$0
Stormwater Wetland Adjacent to WWTP (included in Scenarios 2, 3, 4)	- Capital costs assumed to Council. - Cost based on a wetland of area around 8.8 hectares. Cost items include site clearance, earthworks, GPT, liner and planting to wetland basin, inlet and outlet structures, erosion protection, landscaping. - Construction costs based on the items and rates from recent wetland detailed design projects in Adelaide. - Additional costs were added for preliminaries (establishment, environmental management and contractors margin), non construction intangibles (survey, design, project management) and 30% contingency.	$16.8M
Wetland Basins to Goolwa North (included in Scenarios 2, 3, 4)	- Capital costs assumed to developers	$0
Extend stormwater reuse network (included in Scenarios 2, 3, 4)	- Capital costs assumed to Council. - Cost based on approximately 3.3km of pipe required, and submersible pump station. - Rates for the pipes and pumps were sourced from Rawlinson's construction handbook (2010) and from cost estimates from recent detailed design projects in Adelaide. - Additional costs were added for preliminaries (establishment, environmental management and contractor's margin), non construction intangibles (survey, design, project management) and 30% contingency.	$2.1M
WSUD to new development areas (included in Scenarios 2, 3, 4)	- Capital costs assumed to developers - The cost estimate is based on the construction of swales of total area equal to 4% of the area of new urban development. (A total length of 8km of 20m wide swales).	$0
Purple Pipe to New Development Areas (included in Scenario 4 only)	- Capital costs assumed to Council. - The cost estimate is based on an assumption of 150m of pipe work per hectare of urban development in Goolwa North. - The cost for connections to each household was included, using an estimate of the total number of new houses in the development. - Rates for the pipes and pumps were sourced from	$28.8M

Infrastructure	Information and Assumptions	Estimated Cost
	Rawlinson's construction handbook (2010) and from cost estimates from recent detailed design projects in Adelaide. - Additional costs were added for preliminaries (establishment, environmental management and contractors margin), non construction intangibles (survey, design, project management) and 30% contingency.	

1.2. Maintenance Costs

The maintenance costs for each infrastructure option were estimated for inclusion in the NPV calculation, as described in Table 5-2. Further details of the maintenance cost calculations are provided in Appendix C.

- **Table 5-2: Description of Maintenance Cost Calculations**

Infrastructure	Information and Assumptions	Estimated Cost/yr
Wastewater Storage Lagoon to West of Goolwa (included in all scenarios)	- Maintenance cost assumed to Council. - Yearly maintenance assumed to be 1% of capital cost.	$55,000
Household rainwater tanks (included for all scenarios, but size of tanks modified for Scenario 3)	- Maintenance cost assumed to home owners	$0
Stormwater Wetland Adjacent to WWTP (included in Scenarios 2, 3, 4)	- Capital costs assumed to Council. - Yearly maintenance assumed to be 2% of capital cost.	$220,000
Wetland Basins to Goolwa North (included in Scenarios 2, 3, 4)	- Maintenance cost assumed to Council. - Cost based on maintenance of two wetlands of surface area of 1.7Ha and 1Ha respectively, assuming yearly maintenance is equal to 2% of capital cost.	$85,000
Extend stormwater reuse network (included in Scenarios 2, 3, 4)	- Yearly maintenance assumed to be 1% of capital cost.	$20,000
WSUD to new development areas (included in Scenarios 2, 3, 4)	- Maintenance costs were sourced from the WSUD Technical Manual for Greater Adelaide. - Maintenance activities include grass care, litter removal, re-seeding, fertilising, general inspection and administration.	$730,000
Purple Pipe to New Development Areas (included in Scenario 4 only)	- Yearly maintenance assumed to be 3% of capital cost.	$1.2M

1.3. Operational Costs

The operational cost for each of the infrastructure options were estimated for inclusion in the NPV calculation. The estimates of yearly energy use described in Section 6 were used, with an assumed cost per kWh of 30c (based on AGL 16/12/2010 gazetted 2011 standing contract prices). Table 5-3 shows the estimates of operational cost for each of the options.

- **Table 5-3: Description of Operational Cost Calculations**

Infrastructure	Estimated yearly energy use (kWh)	Estimated Cost/yr
Wastewater Storage Lagoon to West of Goolwa (included in all scenarios)	148,000	$44,400
Household rainwater tanks (included for all scenarios, but size of tanks modified for Scenario 3)	Operational cost assumed to home owners	$0
Stormwater Wetland Adjacent to WWTP (included in Scenarios 2, 3, 4)	No operational energy associated	$0
Wetland Basins to Goolwa North (included in Scenarios 2, 3, 4)	No operational energy associated	$0
Extend stormwater reuse network (included in Scenarios 2, 3, 4)	14,800	$4,440
WSUD to new development areas (included in Scenarios 2, 3, 4)	No operational energy associated	$0
Purple Pipe to New Development Areas (included in Scenario 4 only)	148,000	$44,400

1.4. Revenue from the sale of recycled water

Estimates of the volumes of stormwater and wastewater available to be sold to recycled water users were made in Sections 2 and 4.

It is proposed that recycled water would be sold to local irrigators surrounding Goolwa, and also used for irrigation of green open space areas within Goolwa. Water used for irrigation of open spaces would most likely be used by the Council, so there may not be explicit revenue generated from this. However, it is likely that the reuse water would replace an alternative water use (such as bore water), which the Council would otherwise have to pay for. Hence an economic benefit has been included in the NPV for this use of water. For the purpose of the NPV, it has been assumed that both uses of the water (sale to irrigators and use by Council) would generate the same revenue per kL. The District Council of Mount Barker *Treated Wastewater Pricing Framework* states that $1.22/kL will be the Base Price, but that rebates of up to 80% will be available dependent on contribution to infrastructure, nature of the customer, and benefit to the Mount Barker community. The Council suggested at the Hahndorf TBL workshop that a price of **50c/kL** would be appropriate for TBL decisions. The same reuse water price has been assumed for the Goolwa TBL workshop.

Infrastructure	Estimated yearly water sale (ML)	Estimated Annual Revenue
Wastewater Storage Lagoon to West of Goolwa (included in all scenarios)	950	$475,000
Household rainwater tanks (included for all scenarios, but size of tanks modified for Scenario 3)	No revenue to Council	$0
Stormwater Wetland Adjacent to WWTP (included in Scenarios 2, 3, 4)	None	$0
Wetland Basins to Goolwa North (included in Scenarios 2, 3, 4)	None	$0
Extend stormwater reuse network (included in Scenarios 2, 3, 4)	95	$47,500
WSUD to new development areas (included in Scenarios 2, 3, 4)	None	$0
Purple Pipe to New Development Areas (included in Scenario 4 only)	530	$1,314,400

1.5. Net Present Value Results

Table 5-4 to Table 5-7 show the results of the net present value calculations for each Scenario. Further details of the NPV calculations are provided in Appendix D.

- **Table 5-4: NPV results for Scenario 1**

Infrastructure	NPV
Wastewater Storage Lagoon to West of Goolwa	40,800
Minimum household rainwater tanks	0
Total	40,800

- **Table 5-5: NPV results for Scenario 2**

Infrastructure	NPV
Wastewater Storage Lagoon to West of Goolwa	40,800
Minimum household rainwater tanks	0
Stormwater Wetland Adjacent to WWTP	-20,570,000
Wetland Basins to Goolwa North	-1,370,000
Extend stormwater reuse network	-1,700,000
WSUD to new development areas	-12,480,000
Total	-37,000,000

▪ **Table 5-6: NPV results for Scenario 3**

Infrastructure	NPV
Wastewater Storage Lagoon to West of Goolwa	40,800
Stormwater Wetland Adjacent to WWTP	-20,570,000
Wetland Basins to Goolwa North	-1,370,000
Extend stormwater reuse network	-1,700,000
WSUD to new development areas	-12,480,000
Maximum Household Rainwater Tank Use	0
Total	-37,000,000

▪ **Table 5-7: NPV results for Scenario 4**

Infrastructure	NPV
Wastewater Storage Lagoon to West of Goolwa	-3,820,000
Minimum household rainwater tanks	0
Stormwater Wetland Adjacent to WWTP	-20,570,000
Wetland Basins to Goolwa North	-1,370,000
Extend stormwater reuse network	-1,700,000
WSUD to new development areas	-12,480,000
Purple Pipe to New Development Areas	-27,670,000
Total	-68,000,000

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Integrated Water Management Options for Goolwa
Cost Estimate for Wastewater storage basin to the west of Goolwa

Project:	VE23421
By:	BC
Date:	1-Aug-11

Rates are based on a detailed design cost estimate for a wetland in Adelaide in 2010

Wastewater storage basin design criteria

Volume (ML)	92
Surface area (m2)	40,000
Depth	2
Perimeter (assuming square)	200
length of pipe from WWTP to storage	2,750
Length of pipe from storage to irrigators	1,000

Item No	Description	Units	Qty	Rate ($)	Amount	Sub Total	Sub Total
1	**SITE CLEARANCE**						
	Medium Vegetation removal	m2	40,000	2	$ 80,000		
	SITE CLEARANCE - total					$ 80,000	
2	**EARTHWORKS**						
	Strip topsoil and retain for reuse	m2	40,000	2	$ 80,000		
	Excavate storage area	m3	92,000	22	$ 2,024,000		
						$ 2,104,000	
3	**Detention Basin**						
	Diffuser headwall outlet from creek	no.	1	2,500	$ 2,500		
	Outlet drain/manhole sump for overflow	no.	1	10,000	$ 10,000		
	Clay or synthetic liner to detention basin	m2	40,000	27	$ 1,080,000		
	200mm thick imported silty topsoil to Macrophyte zone basin	m3	8,000	60	$ 480,000		
						$ 1,572,500	
4	**LANDSCAPING**						
	Preparation of soil to planted areas	m2	2,000	16	$ 32,000		
	Supply trees and sedge planting	m2	2,000	16	$ 32,000		
	Gravel path (100mm thick, 1.2m wide)	m	200	20	$ 4,000		
						$ 68,000	
5	**Water Distribution**						
	Trench excavation and backfilling with excavated material - assuming up to 2m deep, clay soil, 1m wide	m3	7,500	70	$ 525,000		
	Pipework from WWTP to storage and from storage to irrigators (assume concrete or HDPE of D = 450mm)	m	3,750	175	$ 656,000		
	Disposal of surplus material (assuming uncontaminated clean fill, and 1/3 of what is excavated is disposed of)	t	1,875	5.5	$ 10,300		
	Pump system (including power, signals, pump inlet structure and pump offtake connection)	item	1	100,000	$ 100,000	$ 1,291,300	
	STRUCTURES PRIME COST (PC1)						$ 3,756,500
6	**PRELIMINARIES & DIVERSION**						
	Establishment/Disestablish. (10% of PC1)	Item	1	$376,000	$ 376,000		
	Environmental Mgt. (4% of PC1)	Item	1	$150,000	$ 150,000		
	Contractors Margin (7% of PC1)	Item	1	$263,000	$ 263,000		$ 789,000
	TOTAL PRIME COST (PC)						**$ 4,546,000**
7	NON-CONSTRUCTION INTANGIBLES (NCI)	%PC	20%				$ 909,000
	(Survey, Invest/Design, Proj.Mgt/Supervis'n, Owner Costs)						
	TOTAL COST (PC + NCI) TC	TC					$ 5,455,000
8	**TOTAL ESTIMATED PROJECT COST (INDICATIVE ONLY)**						**$ 5,455,000**
9	**CONTINGENCY (DESIGN & CONSTRUCTION) - Say 30%**						**$ 1,637,000**
10	**TOTAL ESTIMATED PROJECT COST (INDICATIVE ONLY)**						**$ 7,092,000**

11	Total Estimated Maintenance Cost	1% of total construction cost	$ 54,600

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Integrated Water Management Options for Goolwa
Cost Estimate for Stormwater Wetland at WWTP location

Project:	VE23421
By:	BC
Date:	15-Mar-11

WWTP Wetland design criteria

Surface Area	88000	m^2
Extended detention depth	0.5	m
Depth of permanent pool	0.5	m
Total excavated depth	1	m
Permanent pool volume	44000	m^3
Total full volume	88000	m^3
Notional detention time	72.4	hrs
High Flow bypass	2	m^3/s
Perimeter (assuming square wetland)	297	m

Rates are based on a detailed design cost estimate for a wetland in Adelaide in 2010

Item No	Description	Units	Qty	Rate ($)	Amount	Sub Total	Sub Total
1	**SITE CLEARANCE**						
	Medium Vegetation removal	m^2	88000	2	$ 176,000		
	SITE CLEARANCE - total					$ 176,000	
2	**EARTHWORKS**						
	Strip topsoil and retain for reuse	m^2	88000	2	$ 176,000		
	Excavate wetland area	m^3	88000	22	$ 1,936,000		
	Batters to pond perimeter, down to the water surface	m^2	889.9438	5	$ 4,450		
						$ 2,116,450	
3	**WETLAND BASIN**						
	Diffuser headwall outlet from creek	no.	1	2,500	$ 2,500		
	Outlet drain/manhole sump for overflow	no.	1	10,000	$ 10,000		
	Clay or synthetic liner to wetland basin	m^2	88,000	27	$ 2,376,000		
	200mm thick imported silty topsoil to Macrophyte zone basin	m^3	17,600	60	$ 1,056,000		
	Reeds and water grasses to macrophtye zone (assume 60% planting)	m^2	52,800	16	$ 844,800		
	Erosion protection rock beaching	m^2	8,800	100	$ 880,000		
						$ 5,169,300	
4	**LANDSCAPING**						
	Preparation of soil to planted areas	m^2	22,000	16	$ 352,000		
	Supply trees and sedge planting	m^2	22,000	16	$ 352,000		
	Irrigation to planted landscaping	m^2	22,000	7	$ 154,000		
	Gravel path (100mm thick, 1.2m wide)	m	590	20	$ 11,800		
						$ 869,800	
	STRUCTURES PRIME COST (PC1)						$ 7,462,000
5	**PRELIMINARIES & DIVERSION**						
	Establishment/Disestablish. (10% of PC1; max. of $100,000)	Item	1	$ 746,200	$ 746,200		
	Environmental Mgt. (4% of PC1; maximum of $,100,000)	Item	1	$ 298,500	$ 298,500		
	Contractors Margin (7% of PC1)	Item	1	$ 522,300	$ 522,300		
							$ 1,567,000
	TOTAL PRIME COST (PC)						**$ 9,029,000**
6	NON-CONSTRUCTION INTANGIBLES (NCI)	%PC	20%				$ 1,806,000
	(Survey, Invest/Design, Proj.Mgt/Supervis'n, Owner Costs)						
	TOTAL COST (PC + NCI) TC	TC					$ 10,835,000
7	**TOTAL ESTIMATED PROJECT COST**						**$ 10,835,000**
	CONTINGENCY (DESIGN & CONSTRUCTION) - Say 30%						**$ 3,250,500**
8	**TOTAL ESTIMATED PROJECT COST (INDICATIVE ONLY)**						**$ 14,085,500**

9	Total Estimated Maintenance Cost	2% of total construction cost				$216,700

Annual maintenance costs have been reported to be approximately 2% of construction costs in the WSUD Technical Manual for Greater Adelaide

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Integrated Water Management Options for Goolwa
Cost Estimate for two Stormwater Wetlands Located in new development areas of Goolwa North

Project: VE23421
By: BC
Date: 15-Mar-11

Detention Basins at Goolwa North Design Criteria	Basin 1	Basin 2	Units
Surface Area	17,000	10,000	m^2
Extended detention depth	0.5	0.5	m
Depth of permanent pool	0.5	0.5	m
Total excavated depth	1.0	1.0	m
Permanent pool volume	8,500	5,000	m^3
Total full volume	17,000	10,000	m^3
Notional detention time	73	77	hrs
High flow bypass	2.0	2.0	m^3/s
Perimeter (assuming square wetland)	130	100	m

Rates are based on a detailed design cost estimate for a wetland in Adelaide in 2010

Item No	Description	Units	Qty (Basin 1)	Qty (Basin 2)	Rate ($)	Amount	Sub Total	Sub Total
1	**SITE CLEARANCE**							
	Medium Vegetation removal	m^2	17000	10,000	$2	$54,000		
	SITE CLEARANCE - total						$ 54,000	
2	**EARTHWORKS**							
	Strip topsoil and retain for reuse	m^2	17000	10,000	$2	$54,000		
	Excavate wetland area	m^3	17000	10,000	$22	$594,000		
	Batters to pond perimeter, down to the water surface	m^2	391	300	$5	$3,500		
							$ 651,500	
3	**WETLAND BASIN**							
	Diffuser headwall outlet from creek	no.	1	1	$2,500	$5,000		
	Outlet drain/manhole sump for overflow	no.	1	1	$10,000	$20,000		
	Clay or synthetic liner to wetland basin	m^2	17000	10,000	$27	$729,000		
	200mm thick imported silty topsoil to Macrophyte zone basin	m^3	3400	2,000	$60	$324,000		
	Reeds and water grasses to macrophtye zone (assuming 60% planted)	m^2	10200	6,000	$16	$259,200		
	Erosion protection rock beaching	m^2	1700	1,000	$100	$270,000		
							$1,607,200	
4	**LANDSCAPING**							
	Preparation of soil to planted areas (assuming a 15m wide band around	m^2	1956	1,500	$16	$55,300		
	Supply trees and sedge planting (assuming a 15m wide band around wetland	m^2	1956	1,500	$16	$55,300		
	Irrigation to planted landscaping (assuming a 15m wide band around wetland	m^2	1956	1,500	$7	$24,200		
	Gravel path (100mm thick, 1.2m wide)	m	130	100	$20	$4,600		
							$ 139,400	
	STRUCTURES PRIME COST (PC1)							$ 2,312,700
5	**PRELIMINARIES & DIVERSION**							
	Establishment/Disestablish. (10% of PC1; max. of $100,000)	Item		1	$100,000	$100,000		
	Environmental Mgt. (4% of PC1; maximum of $,100,000)	Item		1	$92,508	$92,500		
	Contractors Margin (7% of PC1)	Item		1	$161,889	$161,900		$ 354,400
	TOTAL PRIME COST (PC)							**$ 2,667,100**
6	NON-CONSTRUCTION INTANGIBLES (NCI)	%PC		20%				$ 533,400
	(Survey, Invest/Design, Proj.Mgt/Supervis'n, Owner Costs)							
	TOTAL COST (PC + NCI) TC	TC						$ 3,200,500
7	**TOTAL ESTIMATED PROJECT COST**							**$ 3,200,500**
8	**CONTINGENCY (DESIGN & CONSTRUCTION) - Say 30%**							**$ 960,200**
9	**TOTAL ESTIMATED PROJECT COST (INDICATIVE ONLY)**							**$ 4,160,700**

10	Total Estimated Maintenance Cost	2% of total construction cost	$ 83,200.00

Integrated Water Management Options for Goolwa
Cost Estimate for extension of stormwater reuse network

Project: VE23421
By: BC
Date: 15-Mar-11

Design Criteria for extension of stormwater reuse network

Length of pipe required	3.3	km
Flowrate for pumping (from Sydney model)	0.5	ML/day
Required flowrate for pumping	6	L/s

Cost information comes from Rawlinsons construction handbook (2010) and cost estimate for recent detailed design of a wetland in Adelaide

Item No	Description	Units	Qty	Rate ($)	Amount	Sub Total	Sub Total
1	**Pipework**						
	Trench excavation and backfilling with excavated material - assuming up to 2m deep, clay soil, 1m wide	m^3	6,600	70	$462,000		
	Pipework (assume concrete or HDPE of D = 450mm)	m	3,300	175	$577,500		
	Disposal of surplus material (assuming uncontaminated clean fill)	t	1,650	6	$9,100		
	Reinstating disturbed surfaces					$ 1,048,600	
2	**Pumps**						
	Submersible pump station package	Item	1	100,000	$100,000	$ 100,000	
	STRUCTURES PRIME COST (PC1)						$ 1,148,600
3	**PRELIMINARIES & DIVERSION**						
	Establishment/Disestablish. (10% of PC1; max. of $100,000)	Item	1	$114,900	$114,900		
	Environmental Mgt. (4% of PC1; maximum of $,100,000)	Item	1	$45,900	$45,900		
	Contractors Margin (7% of PC1)	Item	1	$80,400	$80,400		$ 241,200
	TOTAL PRIME COST (PC)						**$ 1,389,800**
4	NON-CONSTRUCTION INTANGIBLES (NCI)	%PC	20%				$ 278,000
	(Survey, Invest/Design, Proj.Mgt/Supervis'n, Owner Costs)						
	TOTAL COST (PC + NCI) TC	TC					$ 1,667,800
5	**TOTAL ESTIMATED PROJECT COST**						**$ 1,667,800**
6	**CONTINGENCY (DESIGN & CONSTRUCTION) - Say 30%**						**$ 500,300**
7	**TOTAL ESTIMATED PROJECT COST (INDICATIVE ONLY)**						**$ 2,168,100**

10	Total Estimated Maintenance Cost	Yearly maintenance assumed to be 1% of capital cost	$21,700

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SKM

Integrated Water Management Options for Goolwa
Cost Estimate for WSUD measures throughout the new development area

BPI	
Mar-04	131
Dec-09	185.79
% difference	42
BPI factor	**1.42**

Design criteria for Swales

Base width	6	m
Top width	20	m
Total length	8,250	m
Assumed slope	3	%
Depth	0.6	m
Total surface area	165,000	m^2

Approximate Costing for Swales
Costing information sourced from the WSUD Design Technical Manual for Greater Adelaide

Capital Cost Estimate	**Units**	**Qty**	Rate ($) - based on 2004 study	**Revised rate for 2009 BPI**	**Amount (/m)**	**Sub Total**
Excavate and profiling of swale channel	m^2	165,000	2	3	$495,000	
Supply and place topsoil layer	m^2	165,000	7	10	$1,650,000	
Supply and appy grass seed, fertiliser and watering	m^2	165,000	1	2	$330,000	
						$2,475,000
PRELIMINARIES & DIVERSION						
Establishment/Disestablish. (10% of PC1; max. of $100,000)	Item	1		$247,500		
Environmental Mgt. (4% of PC1; maximum of $,100,000)	Item	1		$99,000		
Contractors Margin (7% of PC1)	Item	1		$173,300		$ 519,800
TOTAL PRIME COST (PC)						**$ 2,994,800**
NON-CONSTRUCTION INTANGIBLES (NCI) (Survey, Invest/Design, Proj.Mgt/Supervis'n, Owner Costs)	%PC	20%				$ 599,000
TOTAL COST (PC + NCI) TC	TC					$ 3,593,800
TOTAL ESTIMATED PROJECT COST						**$ 3,593,800**
CONTINGENCY (DESIGN & CONSTRUCTION) - Say 30%						**$ 1,078,100**
TOTAL ESTIMATED PROJECT COST (INDICATIVE ONLY)						**$ 4,671,900**

Maintenance Cost Estimate (Cost per year)	**Units**	**Qty**	Rate ($) - based on 2004 study	**Revised rate for 2009 BPI**	**Amount**	**Sub Total**
Mowing	$/100m^2$	1,650	1.62	2.30	$3,800	
General Grass Care	$/100m^2$	1,650	16.2	22.98	$37,900	
Debris/litter removal	m^2	165,000	0.95	1.35	$222,300	
Reseeding/fertilisation	m^2	165,000	0.65	0.92	$152,100	
Inspection and general administration	m^2	165,000	1.35	1.91	$315,900	
Total	m^2	165,000	3.13	4.44	$732,500	$732,500

Integrated Water Management Options for Goolwa
Cost Estimate for purple pipe network to new development areas

Project: VE23421
By: BC
Date: 15-Mar-11

Purple pipe network design criteria

Length of pipe per hectare of development	146	m
Total area of new development	375	ha
Total length of pipeline	54750	m
Number of new households to be connected	4509	item

Cost information was sourced from Rawlinsons Australian Construction Handbook 2010

Item No	Description	Units	Qty	Rate ($)	Amount	Sub Total	Sub Total
1	**Pipework**						
	Trench excavation and backfilling with excavated material - assuming up to 2m deep, clay soil, 1m wide	m^3	109,500	$70	$ 7,665,000		
	Pipework (assume concrete or HDPE of D = 450mm)	m	54,750	$175	$ 9,581,250		
	Disposal of surplus material (assuming uncontaminated clean fill, 1/3 of excavated material to be disposed of, 0.75 conversion factor for m3 to tonnes)	t	27,375	$6	$ 150,600		
						$17,396,900	
2	**Pumps**						
	3 pumps (2 duty, 1 standby) each with flowrate 40L/s, 40m pressure (including mounting, power, pump inlet structure, pump offtake connection)	item	3	$100,000	$ 300,000	$ 300,000	
	Connections per household	item	4,509	$800	$ 3,607,200	$ 3,607,200	
	STRUCTURES PRIME COST (PC1)						$ 21,304,000
3	**PRELIMINARIES & DIVERSION**						
	$100,000)	Item	1	$2,130,400	$ 2,130,400		
	Environmental Mgt. (4% of PC1; maximum of $,100,000)	Item	1	$852,200	$ 852,200		
	Contractors Margin (7% of PC1)	Item	1	$1,491,300	$ 1,491,300		$ 4,473,900
	TOTAL PRIME COST (PC)						**$ 25,780,000**
4	**NON-CONSTRUCTION INTANGIBLES (NCI)**	%PC	20%				$ 5,160,000
	(Survey, Invest/Design, Proj.Mgt/Supervis'n, Owner Costs						
	TOTAL COST (PC + NCI) TC	TC					$ 30,940,000
5	**TOTAL ESTIMATED PROJECT COST**						**$ 30,940,000**
6	**CONTINGENCY (DESIGN & CONSTRUCTION) - Say 30%**						**$ 9,280,000**
7	**TOTAL ESTIMATED PROJECT COST (INDICATIVE ONLY)**						**$ 40,220,000**

8	**Total Estimated Maintenance Cost**	Assume maintenance cost equal to 3% of capital cost	$ 1,207,000

Disclaimer Regarding Cost Estimation:

The cost information provided in this report provides an indicative assessment of values based on a number of broad assumptions, some of which are in accordance with the customer's specific instructions. SKM advise that the cost information is strictly indicative only.

SKM advises that the cost information will definitely change as additional information is developed, assessed, processed and the necessary adjustments made to the assessment of the quantities, rates and costs. It does not constitute a final cost assessment.

The SKM assessments are based on various calculations as well as our best professional judgement of current prices and taking into account the assumptions stated in the document.

SKM note the estimation of construction costs is a very problematic exercise which at best should be regarded as an indicative assessment of possibilities rather than absolute certainties. The process of making projections of cost involves a considerable number of variables which are acutely sensitive to changing conditions, variation in which may significantly affect the conclusions of the SKM assessments.

This report is confidential to South Australian Murray Darling Basin Natural Resources Management Board, District Council of Mount Barker and other invited workshop participants for the specific purpose to which it refers. No responsibility is accepted to any third party for the whole or any part of its contents. Neither the whole of the report nor any part or reference thereto may be published in any document, statement or circular or in any communications with third parties without prior written approval of SKM.

SINCLAIR KNIGHT MERZ SKM

Project Title	**IWMP for Murray Bridge: TBL Workshop**
Project Number	**VE23421**

INPUTS

WACC (Real, pre interest and tax)	**6.00%**	Asset life of major component	**25**
Years in Study Period	**30**	Asset Commissioned in Yr	**4**
Reference Year	**2011**	Sunk costs	**0**
		Escalation	**3.5%**

Financial Evaluation

IWMP for Mount Barker: TBL Workshop

FINANCIAL YEAR (June ending)	Present Value 6%	Total Over Project
Wastewater Storage Lagoon to West of Goolwa		
Capital Costs	7,092,000	7,092,000
Escalation	-	382,000
Total Capital Costs	**6,846,000**	**7,474,000**
Annual Maintenance Costs	55,000	1,475,000
Annual Operational Costs	44,400	977,000
Escalation	-	2,299,000
Total Annual Costs	**1,559,000**	**3,673,000**
Total Costs	**8,658,000**	**11,146,000**
Benefits (revenue/cost savings from water reuse)	475,000	12,825,000
Total Benefits	**7,478,000**	**17,622,000**
NET PRESENT VALUE	**39,000**	

FINANCIAL YEAR (June ending)	Present Value 6%	Total Over Project
Purple Pipe to New Development Areas		
Capital Costs	40,220,000	40,220,000
Escalation	-	30,398,000
Total Capital Costs	**28,762,000**	**70,618,000**
Annual Maintenance Costs	1,207,000	19,312,000
Annual Operational Costs	0	0
Escalation	-	20,321,000
Total Annual Costs	**12,177,000**	**38,992,000**
Total Costs	**40,939,000**	**109,610,000**
Benefits (revenue/cost savings from water reuse)	1,314,400	0
Escalation	0	22,128,566
Total Benefits	**13,260,374**	**43,158,966**
NET PRESENT VALUE	**(27,678,000)**	

Wetland Basins to Goolwa North		
Capital Costs	0	0
Escalation	-	0
Total Capital Costs	**0**	**0**
Annual Maintenance Costs	84,000	2,080,000
Annual Operational Costs	0	0
Escalation	-	1,904,000
Total Annual Costs	**1,374,000**	**3,984,000**
Total Costs	**1,374,000**	**3,984,000**
Benefits (revenue/cost savings from water reuse)	0	0
Total Benefits	**0**	**0**
NET PRESENT VALUE	**(1,374,000)**	

Stormwater Wetland Adjacent to WWTP		
Capital Costs	14,086,000	17,607,000
Escalation	-	1,277,000
Total Capital Costs	**16,796,000**	**18,884,000**
Annual Maintenance Costs	217,000	5,635,000
Annual Operational Costs	0	0
Escalation	-	4,999,000
Total Annual Costs	**3,215,000**	**10,633,000**
Total Costs	**20,566,000**	**29,517,000**
Benefits (revenue/cost savings from water reuse)	0	0
Escalation	0	0
Total Benefits	**0**	**0**
NET PRESENT VALUE	**(20,566,000)**	

WSUD to new development areas		
Capital Costs	0	0
Escalation	-	0
Total Capital Costs	**0**	**0**
Annual Maintenance Costs	733,000	18,679,000
Annual Operational Costs	0	0
Escalation	-	16,708,000
Total Annual Costs	**12,482,000**	**34,575,000**
Total Costs	**12,482,000**	**34,575,000**
Benefits (revenue/cost savings from water reuse)	0	0
Escalation	0	0
Total Benefits	**0**	**0**
NET PRESENT VALUE	**(12,482,000)**	

Extend stormwater reuse network		
Capital Costs	2,169,000	2,169,000
Escalation	-	117,000
Total Capital Costs	**2,093,000**	**2,285,000**
Annual Maintenance Costs	22,000	586,000
Annual Operational Costs	4,440	119,880
Escalation	-	607,000
Total Annual Costs	**479,000**	**1,283,000**
Total Costs	**2,572,000**	**3,568,000**
Benefits (revenue/cost savings from water reuse)	47,500	1,282,500
Escalation	-	1,103,000
Total Benefits	**870,000**	**2,386,000**
NET PRESENT VALUE	**(1,702,000)**	

Appendix G: MUSIC Modelling Outputs

Goolwa MUSIC model - Scenario 2 - daily data for the 50th percentile

East Goolwa Catchment

Area (Ha)	182
% impervious	30%
Flow (ML/yr)	199
Peak Flow (m3/s)	3.72E-01
Total Suspended Solids (kg/yr)	5.03E+04
Total Phosphorus (kg/yr)	75.5
Total Nitrogen (kg/yr)	5.97E+02
Gross Pollutants (kg/yr)	8.35E+03

Swale 1

Length (m)	2500		
	inflow	outflow	reduction
Flow (ML/yr)	190	100	47.2
Peak Flow (m3/s)	2.37E-01	2.28E-01	3.6
Total Suspended Solids (kg/yr)	2.78E+04	1.40E+03	95
Total Phosphorus (kg/yr)	38.6	13	66.3
Total Nitrogen (kg/yr)	492	147	70
Gross Pollutants (kg/yr)	0	0	0

NW Goolwa

Area (Ha)	165
% impervious	41%
Flow (ML/yr)	236
Peak Flow (m3/s)	4.16E-01
Total Suspended Solids (kg/yr)	5.62E+04
Total Phosphorus (kg/yr)	81.7
Total Nitrogen (kg/yr)	7.70E+02
Gross Pollutants (kg/yr)	9.89E+03

Swale 2

Length (m)	5000		
	inflow	outflow	reduction
Flow (ML/yr)	202	65.1	67.8
Peak Flow (m3/s)	2.92E-01	2.71E-01	7.1
Total Suspended Solids (kg/yr)	1.14E+04	9.12E+02	92
Total Phosphorus (kg/yr)	47.8	8.47E+00	82.3
Total Nitrogen (kg/yr)	4.01E+02	91.5	77.2
Gross Pollutants (kg/yr)	0	0	0

NE Goolwa

Area (Ha)	200
% impervious	41%
Flow (ML/yr)	286
Peak Flow (m3/s)	5.05E-01
Total Suspended Solids (kg/yr)	4.39E+04
Total Phosphorus (kg/yr)	127
Total Nitrogen (kg/yr)	8.67E+02
Gross Pollutants (kg/yr)	1.20E+04

Golf Course Catchment

Area (Ha)	71
% impervious	15%
Flow (ML/yr)	44.7
Peak Flow (m3/s)	9.87E-02
Total Suspended Solids (kg/yr)	8.10E+03
Total Phosphorus (kg/yr)	16.1
Total Nitrogen (kg/yr)	1.04E+02
Gross Pollutants (kg/yr)	1.64E+03

Receiving Node

Flow (ML/yr)	685
Peak Flow (m3/s)	1
Total Suspended Solids (kg/yr)	116000
Total Phosphorus (kg/yr)	236
Total Nitrogen (kg/yr)	1980
Gross Pollutants (kg/yr)	24000

South Goolwa Catchment

Area (Ha)	273
% impervious	34%
Flow (ML/yr)	332
Peak Flow (m3/s)	6.06E-01
Total Suspended Solids (kg/yr)	5.68E+04
Total Phosphorus (kg/yr)	137
Total Nitrogen (kg/yr)	1.17E+03
Gross Pollutants (kg/yr)	1.41E+04

Murray Smith Reserve Catchment

Area (Ha)	
% impervious	
Flow (ML/yr)	232
Peak Flow (m3/s)	4.24E-01
Total Suspended Solids (kg/yr)	5.30E+04
Total Phosphorus (kg/yr)	137
Total Nitrogen (kg/yr)	6.47E+02
Gross Pollutants (kg/yr)	9.83E+03

Total infiltration/evaporation	644.2
from swales only	226.9
wetlands only	417.3
reuse	268.95

Wetland 1 (NW Goolwa)

Surface area (Ha) 1

	Flow	TSS	TP	TN	GP
Flow In	236.17	56192.8	81.69	769.92	9890.83
ET Loss	18.58	0	0	0	0
Infiltration Loss	31.38	194.19	1.93	36.39	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	79.31	514.83	4.98	107.7	0
Weir Out	110.4	27298.57	33.63	384.48	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	19.67	50.5	52.74	36.07	100

Wetland 1 (Goolwa North) - Mean annual loads

	inflow	outflow	reduction (%)
Flow (ML/yr)	236	190	19.7
Peak Flow (m3/s)	4.16E-01	2.37E-01	43.1
Total Suspended Solids (kg/yr)	5.62E+04	2.78E+04	50.5
Total Phosphorus (kg/yr)	81.7	38.6	52.7
Total Nitrogen (kg/yr)	7.70E+02	492	36.1
Gross Pollutants (kg/yr)	9.89E+03	0	100

East Goolwa Wetland

Surface area (Ha) 3.1

	Flow	TSS	TP	TN	GP
Flow In	100.22	1403.02	13.03	147.41	0
ET Loss	19.68	0	0	0	0
Infiltration Loss	44.05	277.03	2.77	46.67	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	36.95	222.49	2.23	38.82	0
Weir Out	1.3	18.15	0.17	2.12	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	61.84	82.85	81.61	72.23	0

East Goolwa Wetland - Mean annual loads 61.8

	inflow	outflow	reduction (%)
Flow (ML/yr)	100	38.2	61.8
Peak Flow (m3/s)	2.28E-01	6.94E-02	69.6
Total Suspended Solids (kg/yr)	1.40E+03	2.41E+02	82.8
Total Phosphorus (kg/yr)	13	2.4	81.6
Total Nitrogen (kg/yr)	147	40.9	72.2
Gross Pollutants (kg/yr)	0	0	0

Wetland 2 (NE Goolwa)

Surface area (Ha) 1.7

	Flow	TSS	TP	TN	GP
Flow In	286.27	43865.71	126.9	867.27	11988.88
ET Loss	31.45	0	0	0	0
Infiltration Loss	52.96	323.92	3.25	59.72	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	115.26	713.95	7.18	145.89	0
Weir Out	87.11	10685.54	40.66	254.99	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	29.31	74.01	62.3	53.78	100

Wetland 2 (Goolwa North) - Mean annual loads

	inflow	outflow	reduction (%)
Flow (ML/yr)	286	202	29.3
Peak Flow (m3/s)	5.05E-01	2.92E-01	42.2
Total Suspended Solids (kg/yr)	4.39E+04	1.14E+04	74
Total Phosphorus (kg/yr)	127	47.8	62.3
Total Nitrogen (kg/yr)	8.67E+02	4.01E+02	53.8
Gross Pollutants (kg/yr)	1.20E+04	0	100

WWTP Wetland - Node Water Balance

Surface area (Ha) 8.8

	Flow	TSS	TP	TN	GP
Flow In	226.77	2708.71	25.12	367.07	0
ET Loss	50.68	0	0	0	0
Infiltration Loss	129.74	1080.11	10.8	181.23	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0	0	0	0	0
Orifice / Filter Out	71.54	430.9	4.31	75.34	0
Weir Out	0	0	0	0	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	0	0	0	0	0
Reuse Requested	0	0	0	0	0
% Reuse Demand Met	0	0	0	0	0
% Load Reduction	68.45	84.09	82.84	79.48	0

WWTP Wetland - Mean annual loads

	inflow	outflow	reduction (%)
Flow (ML/yr)	227	71.5	68.5
Peak Flow (m3/s)	4.99E-01	1.21E-01	75.8
Total Suspended Solids (kg/yr)	2.71E+03	4.31E+02	84.1
Total Phosphorus (kg/yr)	25.1	4.31	82.8
Total Nitrogen (kg/yr)	3.67E+02	75.3	79.5
Gross Pollutants (kg/yr)	0	0	0

Murray Smith Reserve Wetland - Node Water Balance

Surface area (Ha) 0.8

	Flow	TSS	TP	TN	GP
Flow In	232.16	52985.67	136.88	647.02	9830.2
ET Loss	1.23E+01	0.00E+00	0	0	0
Infiltration Loss	21.34	145.05	1.45	26.23	0
Low Flow Bypass Out	0	0	0	0	0
High Flow Bypass Out	0.00E+00	0.00E+00	0	0	0
Orifice / Filter Out	158.5	1509.24	14.69	265.82	0
Weir Out	3.12	287.41	1.96	9.75	0
Transfer Function Out	0	0	0	0	0
Reuse Supplied	38.91	265.01	2.66	47.93	0
Reuse Requested	49.95	0	0	0	0
% Reuse Demand Met	77.88	0	0	0	0
% Load Reduction	30.38	96.61	87.83	57.41	100

Murray Smith Reserve Wetland - Mean annual loads

	inflow	outflow	reduction (%)
Flow (ML/yr)	232	162	30.4
Peak Flow (m3/s)	4.24E-01	2.27E-01	46.3
Total Suspended Solids (kg/yr)	5.30E+04	1.80E+03	96.6
Total Phosphorus (kg/yr)	137	16.7	87.8
Total Nitrogen (kg/yr)	6.47E+02	2.76E+02	57.4
Gross Pollutants (kg/yr)	9.83E+03	0	100

Appendix H: Groundwater Report

Contents

1. Conceptual Model

1.1. Regional

Geology

The Eastern Mount Lofty Ranges (EMLR) is topographically separated into a highland (Hills) zone and lowland (Plains) zone (CSIRO, 2007). The Hills region of the EMLR forms part of the larger Adelaide Geosyncline and is coincident with the fractured rock basement aquifers. The Plains zone consists of sedimentary aquifers of the Murray Basin. The regional conceptual model is shown in Figure 1.1.

The basement rocks in this region comprise the Barossa Complex, the Adelaidean sediments, Normanville Group and Kanmantoo Group. The Barossa Complex is the oldest formation in the EMLR. The Adelaidean sedimentary rocks are present along the western ridge of the EMLR and consist of the Burra Group, Umberatana Group and Wilpena Group formations. These units consist mainly of siltstone, shale and slate (DWLBC, 2003). The Kanmantoo Group forms the eastern portion of the Mount Lofty Ranges.

A north-east to south-west trending fault line separates the hills region from the plains (DWLBC, 2010).

The sedimentary formations in the EMLR include the Permian Sands, Murray Group Limestone and other unconsolidated Quaternary and Tertiary sediments. The Permian Sand Formation consists of unconsolidated sands, silts and clays and is also referred to as the Cape Jervis Formation. The Murray Group Limestone consists predominantly of shallow fossiliferous limestone and underlies much of the Plains region. Quaternary sediments form much of the surface geology across the Plains region; in particular drainage lines where alluvial material has been deposited (DWLBC, 2003).

Hydrogeology

Groundwater in the catchments of the EMLR is sourced from two types of aquifers. Fractured Rock Aquifers occur in the Hills region and sedimentary aquifers are found in the valleys and across the Plains region. The Fractured Rock Aquifers in the EMLR include the Barossa Complex, Adelaidean sediments, Normanville Group and Kanmantoo Group.

The Barossa Complex is generally considered to be a poor aquifer as is generally tight and impermeable in nature and has few open fractures to transport groundwater (DWLBC, 2003). The Adelaidean sediments have good aquifer characteristics and are highly permeable resulting in relatively high yields. These sediments outcrop along the top of the Ranges, where rainfall is higher and ultimately allows greater recharge lower salinities (DWLBC, 2003). The Normanville Group aquifer outcrops in some locations through the Hills. This unit has developed secondary porosity which allows greater yields, greater recharge and lower salinities (DWLBC, 2003). The fractured rocks of the Kanmantoo Group are generally poor aquifers being tight and impermeable with few open fractures (DWLBC, 2003). Yields tend to be quite low (< 3 L/s) and salinity is generally high as there is little rainfall recharge to this formation (DWLBC, 2003).

The sedimentary aquifers of this region comprise the Permian Sands aquifer, the Murray Group Limestone and undifferentiated Quaternary and Tertiary sediments.

The Permian Sands aquifer is widely developed for irrigation and town water supply in some parts of the EMLR. This formation varies in productivity due to changes in the sedimentary deposition resulting in higher clay contents in some areas leading to low yields and high salinity (DWLBC, 2003). The Murray Group Limestone aquifer is an important source of water where it contains good quality groundwater. Reported yields vary from 5-15 L/s and salinity ranges from 1,500 to 3,000 mg/L (DWLBC, 2007). The main source of recharge to the Murray Group Limestone is believed to be via lateral recharge (DWLBC, 2007). Some recharge occurs by vertical leakage from overlying Quaternary aquifer. The Quaternary aquifer is generally highly saline with low yields and inevitably limited use

1.2. Local scale

Goolwa is situated on the flat undulating plains of the EMLR, bordering on Lake Alexandrina. Barnett (2008) carried out an investigation into groundwater resources within the Currency Limestone Groundwater Management Area (CL GMA) which is located approximately 6 km north of Goolwa.

The Murray Group Limestone is the only source of irrigation supplies in the CL GMA and has reported salinities ranging from 600 mg/L in the west to 4,000 mg/L in the east toward Lake Alexandrina (Barnett, 2007). The main source of recharge to the Murray Group Limestone is via lateral recharge from the Permian Sands Formation.

The unconfined Quaternary aquifer system comprises a 10-20 m thick sequence of sediments consisting of clays, silt, sand and occasional gravels (Barnett, 2007). Clayey members of the Quaternary sediments act as the confining layer to the Murray Group Limestone aquifer (Barnett, 2007).

These sedimentary aquifers underlie the area around Goolwa and groundwater is very minimally accessed for stock and domestic purposes.

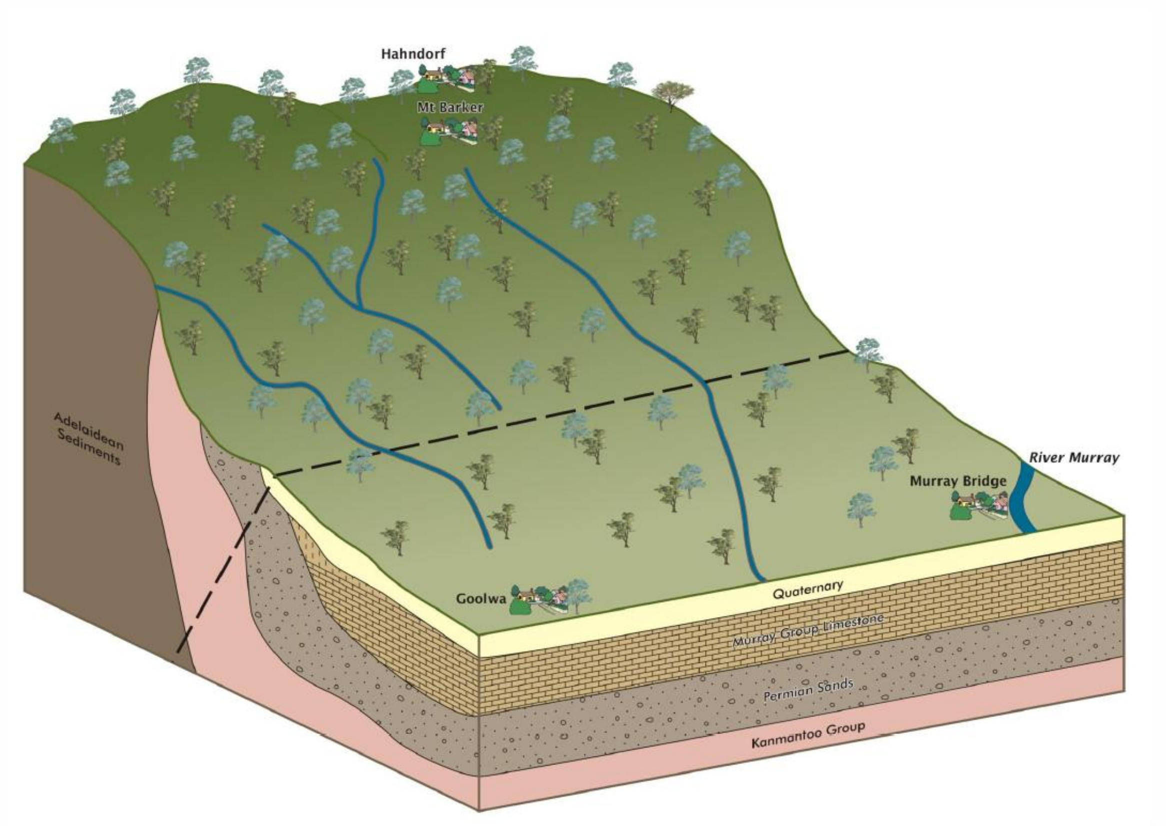


Figure 1.1: Regional conceptual model

2. Current Extraction

The prescription of the water resources of the EMLR was announced in September 2005. Currently, metered extraction within the project extent is minor with six metered wells located in the northern portion of the project extent within the CL GMA (Figure 2.1).

A licence to extract groundwater is not currently required for stock and domestic purposes. It is therefore difficult to report such volumes and so only an estimate can be attained for stock and domestic use. Around Goolwa, stock and domestic extraction (from the Murray Group Limestone aquifer) is estimated at less than 1 ML/yr (SA MDB NRMB, 2008).

There are five currently operational monitoring wells within the project extent as per the DFW, Obswell database with numerous other observation wells located in the CL GMA (Figure 2.1).

All currently operational wells within the study area and their classified purpose as obtained via the Department for Water's Drillhole Enquiry System (DES) are presented in Figure 2.2.

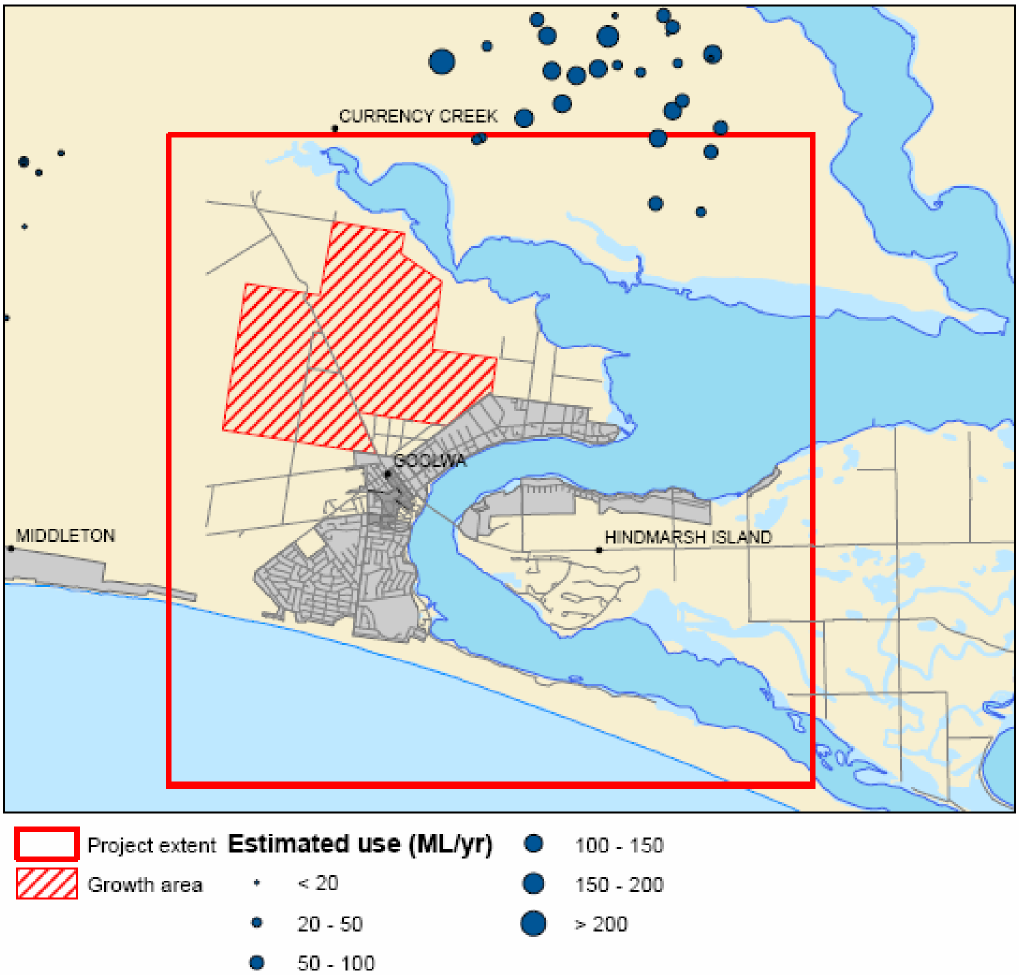


Figure 2.1: Estimated use from prescribed wells

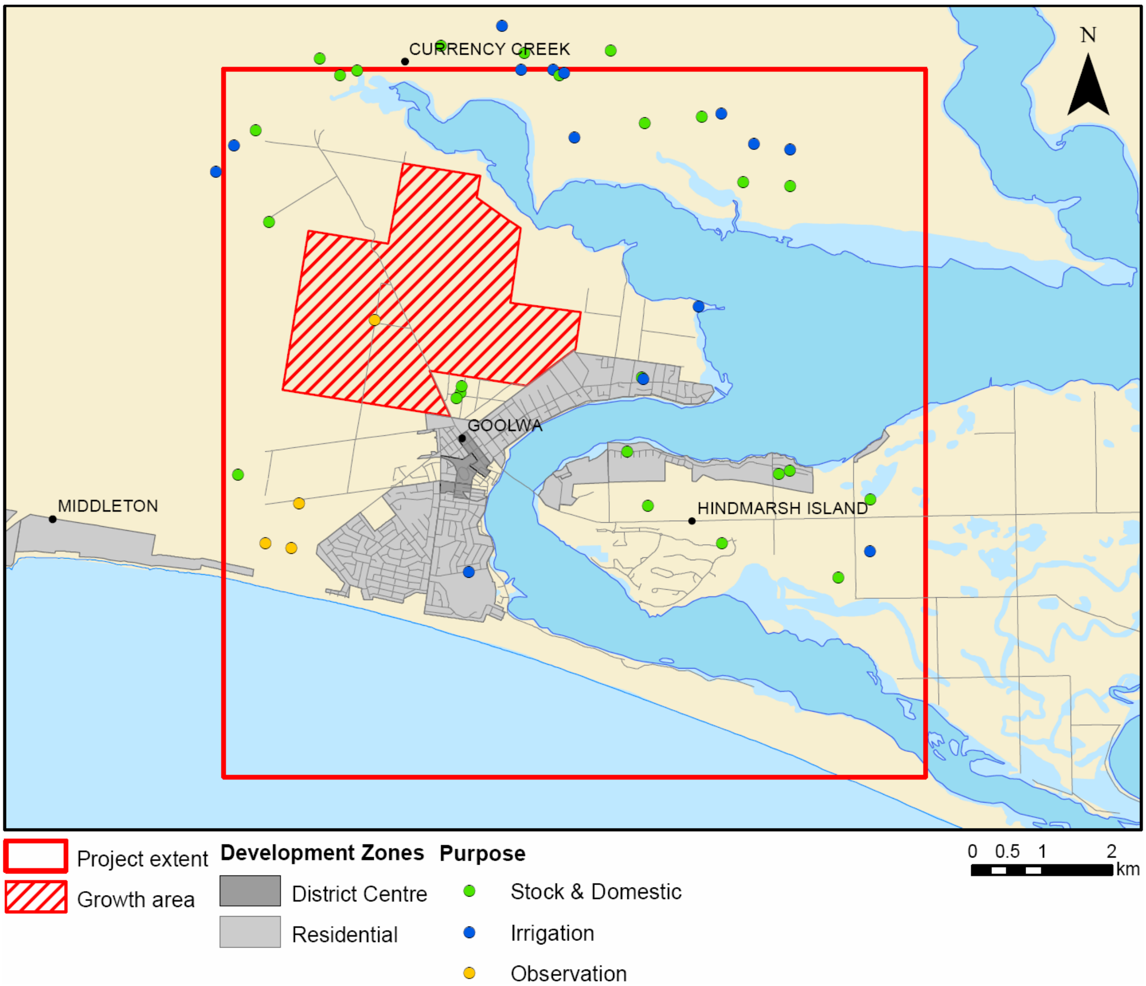


Figure 2.2: Purpose of wells around Goolwa

3. Groundwater levels

The height of groundwater levels below ground can impact on intended water storage and reuse operations. High groundwater levels have the potential to impact on surface water storage facilities with ingress of saline groundwater adversely affecting water quality and storage volume and leakage to the groundwater system acting as localised recharge and possibly causing adjacent waterlogging. For managed aquifer recharge purposes, shallow groundwater levels in the target aquifer increase the potential of inducing artesian conditions in the surrounding area interfering with the wells of adjacent groundwater users and limiting the aquifer's ability to store water.

Figure 3.1 shows the standing water level in meters below ground level (m bgl) recorded since 1980 for wells completed at a depth of less than 20 m. These water levels may not be representative of the watertable but do give an indication of areas where there may be higher risk for water storage and reuse operations.

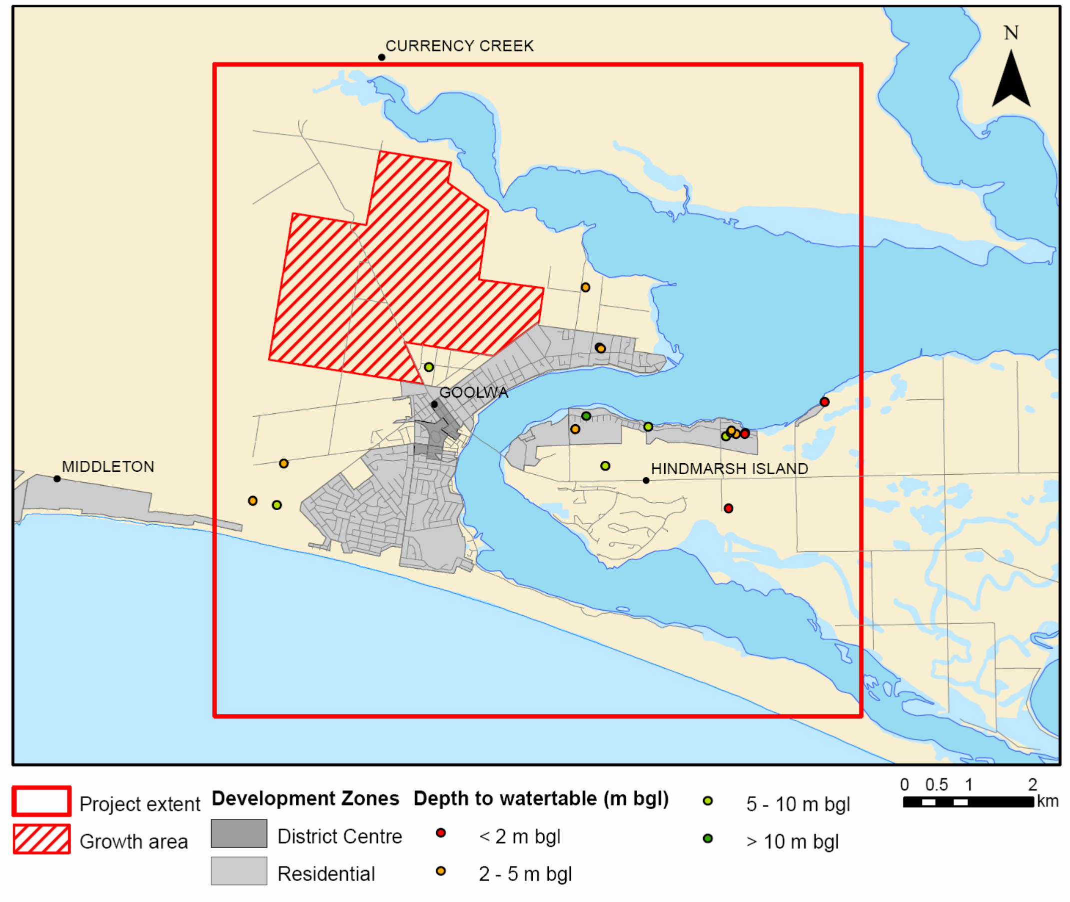


Figure 3.1: Depth to water in wells less than 20 m depth recorded since 1980

4. Groundwater salinity and yield

Barnett (2007) mapped the extent of fresh groundwater (<1,500 mg/L) in the CL GMA based on 1990 and 2007 data. A dramatic reduction in the area of fresh groundwater was observed. This raises doubts about the long term sustainability of the groundwater resource at the current extraction rate (Barnett, 2007). It is believed that downward leakage from the overlying high salinity Quaternary aquifer appears to be the dominant cause of salinity increase (Barnett, 2007). It is likely that similar trends are experienced around Goolwa and Hindmarsh Island.

Groundwater salinity and well yields recorded in wells since 1990 is shown on Figure 4.1 and Figure 4.2 respectively. Whilst there are relatively few wells in the area, in general high salinity corresponds with low well yields reflecting the lack of flushing that occurs in less permeable aquifers.

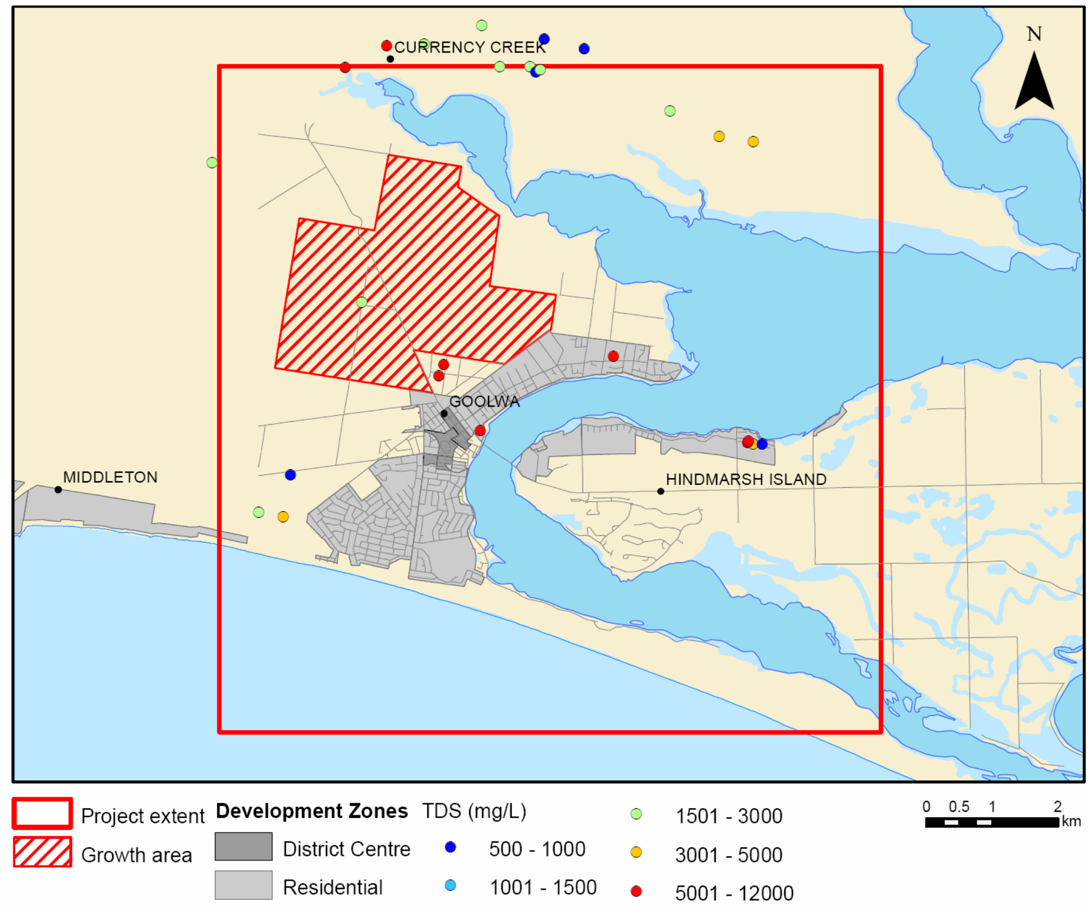
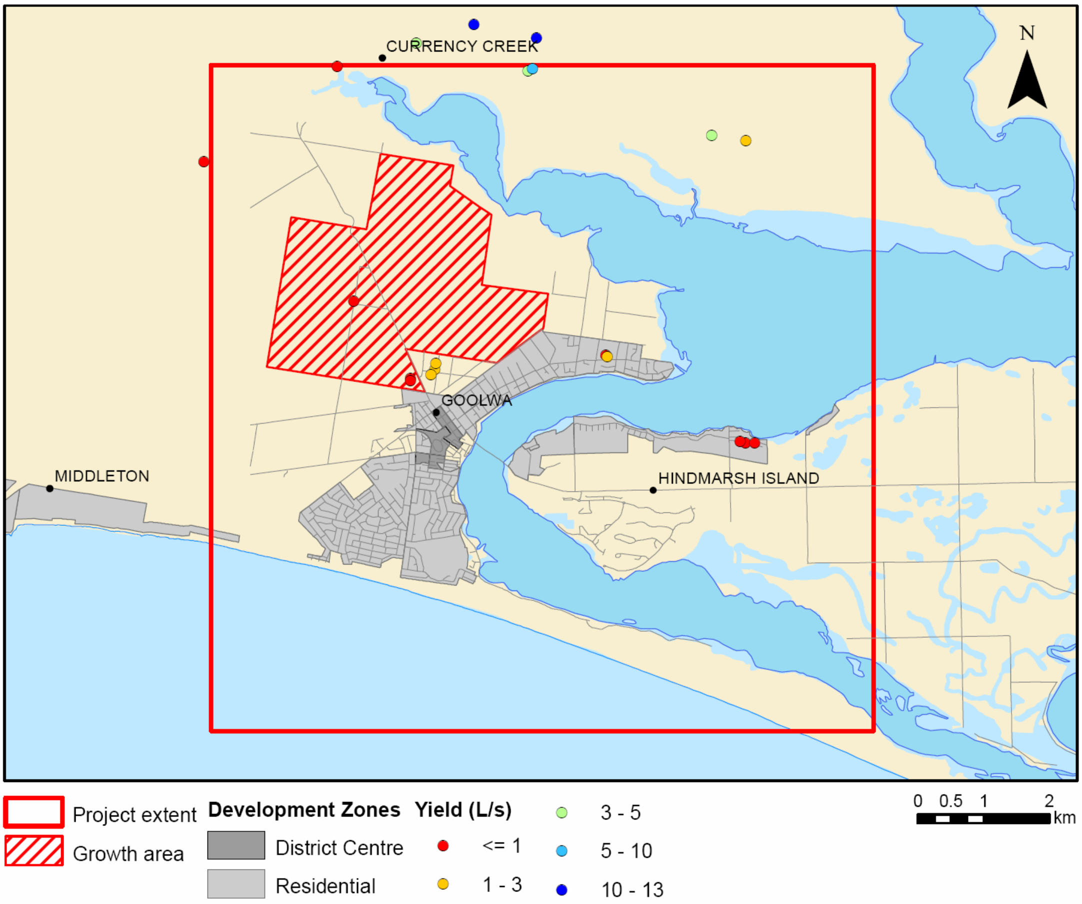


Figure 4.1: Groundwater salinity recorded since 1990



■ **Figure 4.2 Well yields recorded since 1990**

5. Surface water – Groundwater interactions

In the Hills region, groundwater moves from the higher points in the landscape to the lowest where discharge occurs along streams, providing baseflow and feeding permanent pools (CSIRO, 2007). Where the streams flow out of the Hills and across the Plains region, streams generally change from gaining to losing and recharges the underlying sedimentary aquifers (CSIRO, 2007).

DWLBC (2008) carried out an investigation into the interactions between groundwater and surface water systems in the EMLR. An understanding of such interactions and the presence of groundwater dependent ecosystems (GDEs) was essential in the development of the EMLR water allocation plan (WAP) and in general groundwater discharge occurs in the upper reaches of the catchments (in the Hills zone) providing for baseflow to streams and permanent pools.

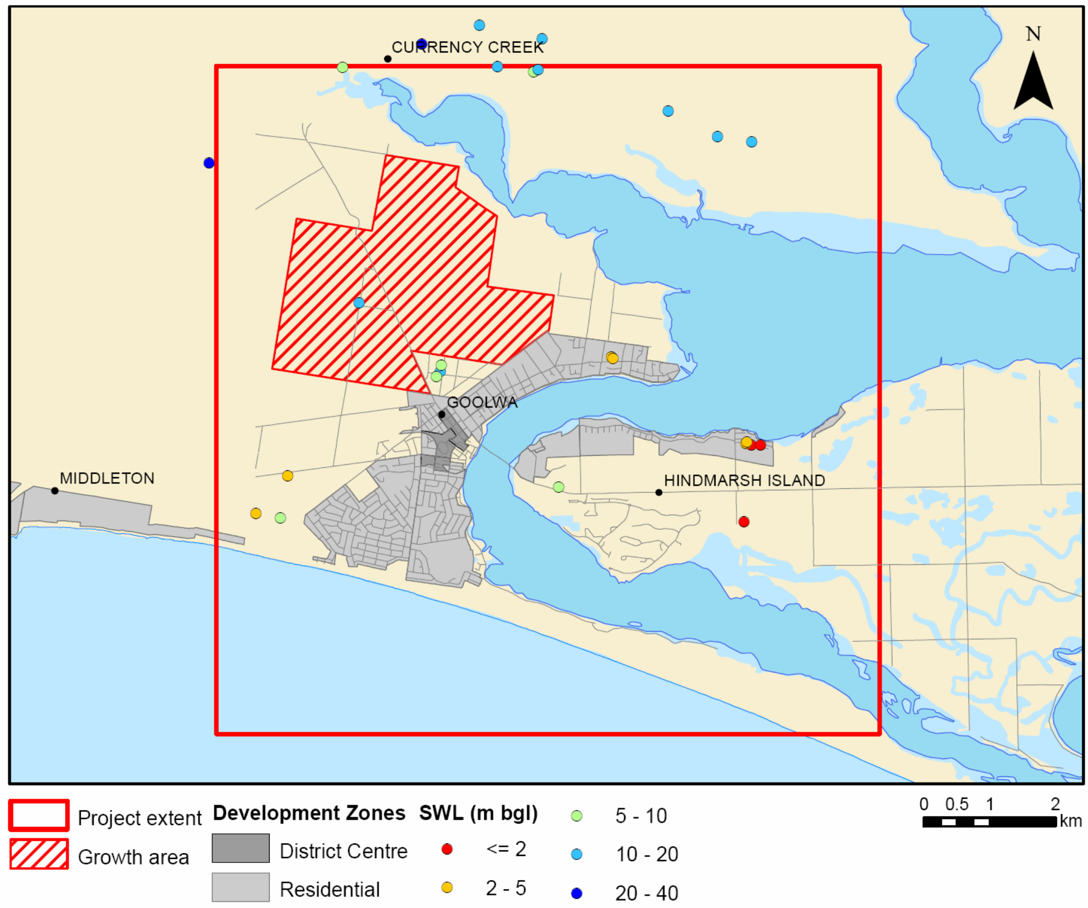
Groundwater – surface water interactions are an important component of catchment-scale water balances in the Mount Lofty Ranges and must be evaluated to provide for both the sustainable development of water resources and future maintenance of groundwater dependent ecosystems (DWLBC, 2004).

The Goolwa Channel, Currency Creek and Finniss River are part of the nationally important Ramsar Wetlands and support diverse range of plants, animals and ecosystems (DWLBC, 2003).

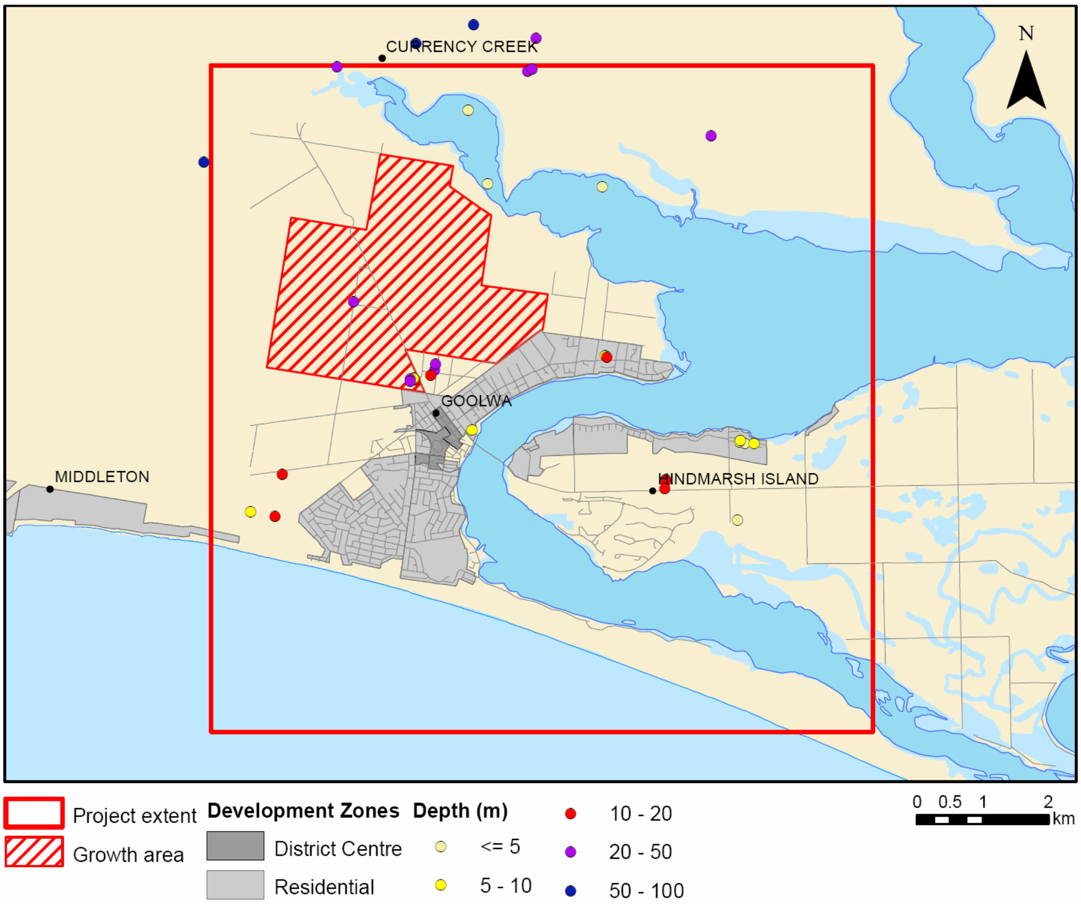
6. MAR Potential

The potential for managed aquifer recharge (MAR) in the Goolwa vicinity is uncertain due the lack of groundwater data for the immediate area. With groundwater not largely accessed for any purpose the characteristics of the underlying limestone formation even in terms of salinity and yields cannot be qualified. There are not a lot of deeper wells constructed in the vicinity of Goolwa. The area is however underlain by the Tertiary Murray Group Limestone which does provide good supplies of groundwater to the northwest in the Currency Creek area and further north in the Angas Bremer Prescribed Wells Area. This aquifer may be prospective for MAR dependent on the salinity which is known to be very high in other areas.

Standing water levels and well depths recorded since 1990 are shown on Figure 6.1 and Figure 6.2 respectively whilst Figure 6.3 overlays recorded yield on standing water levels. This data indicates that MAR may be prospective but it must be noted that this is a generalisation based on the availability of storage space as indicated by standing water level and well depth coincident with reasonable yields required for MAR.



- **Figure 6.1 Standing water levels recorded since 1990**



▪ **Figure 6.2 Depth of wells constructed since 1990**

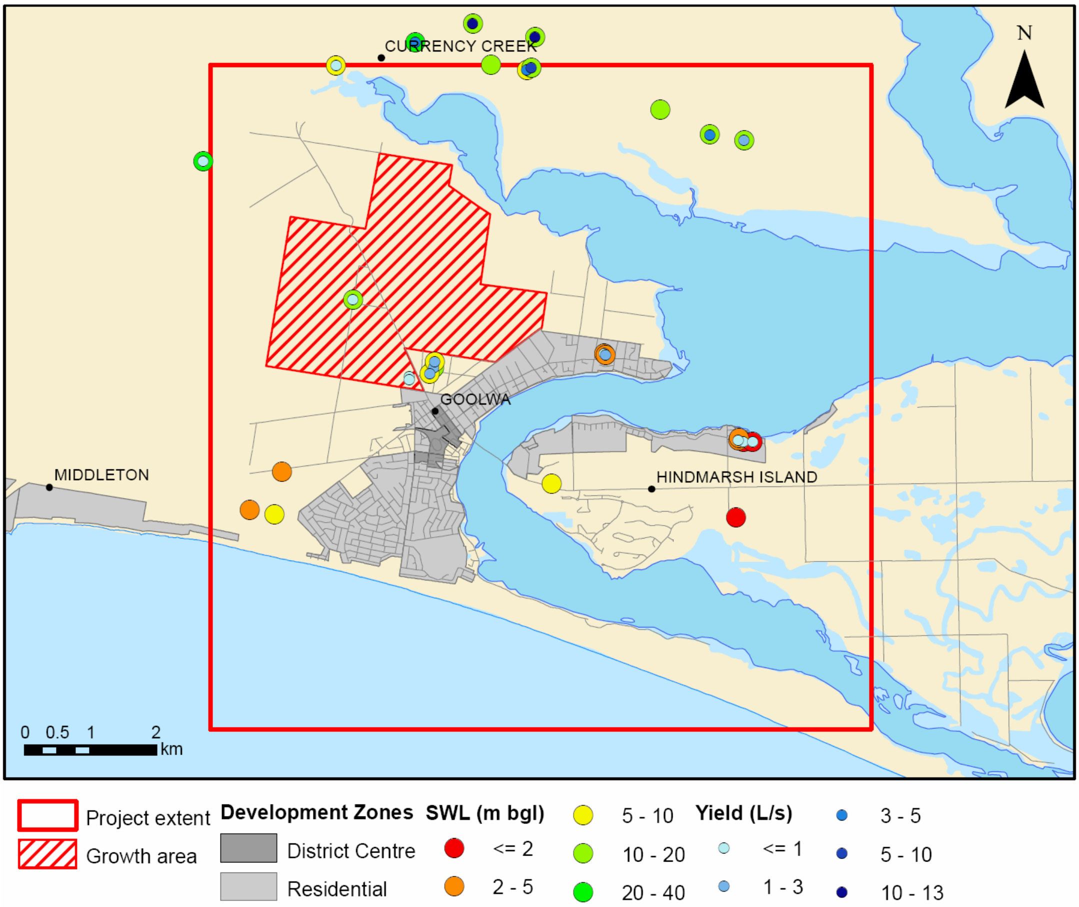


Figure 6.3 Standing water levels and yields recorded since 1990

7. References

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