Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

PARKS AND WILDLIFE SERVICE

Bull Creek Catchment Local Water Quality Improvement Plan Review Summary

December 2019

Acknowledgements
Thank you to the City of Melville, the City of Canning, Water Corporation and the South East Regional Centre for Urban Landcare (SERCUL) for their contributions to the review of the Bull Creek Catchment Water Quality Improvement Plan (WQIP).

Purpose and use of this document
The Department of Biodiversity, Conservation and Attractions (DBCA) Parks and Wildlife Service, with the support of the organisations noted above, has reviewed the implementation of the Bull Creek Catchment WQIP. The purpose of this document is to summarise that review and inform future updates of the Bull Creek Catchment WQIP. The Swan Canning Water Quality Improvement Plan is proposed to be reviewed by 2021 and the updated catchment modelling will be used to inform updates of the local WQIPs. It is intended that these documents will be used by partner organisations that will continue to have a role in implementing the WQIPs.

Front cover photo: Brentwood Living Stream. Photo – SERCUL.

Local Water Quality Improvement Plans (WQIPs)

The Department of Biodiversity, Conservation and Attractions (DBCA) Parks and Wildlife Service works to reduce nutrients and other contaminants entering the Swan and Canning rivers.

DBCA (previously the Swan River Trust) developed and invested in the implementation of local WQIPs. The WQIPs were designed to provide stakeholders with a mechanism to prioritise recommendations and resources and seek funding to improve water quality in catchments contributing the greatest amount of nutrients and contaminants.

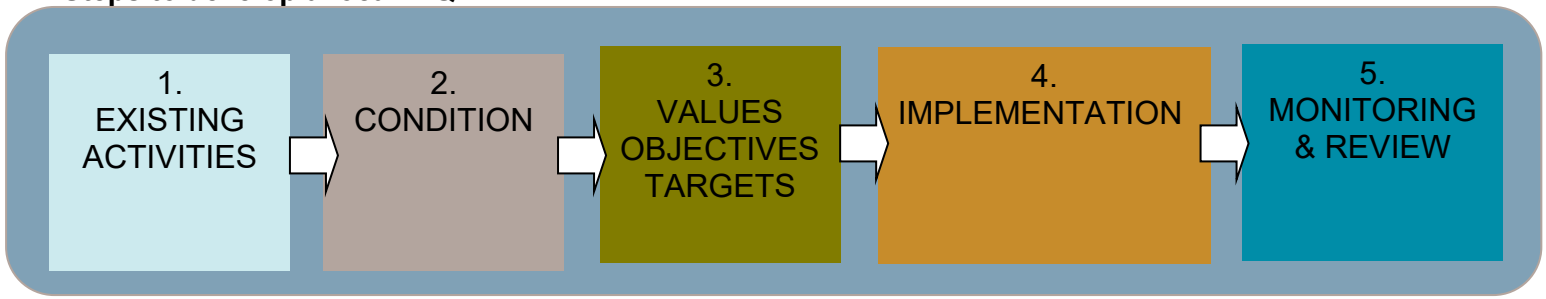
WQIP implementation adopts a treatment train approach with actions categorised by the following stages in the pathway of nutrients and non-nutrients from the source to the discharge point:

1. Prevention (Land use planning)
2. Minimisation (Ecoefficiency)
3. Reduction (Source control)
4. Amelioration (Conveyance and transmission)
5. Treatment – Reuse – Disposal

Water Quality Improvement Plans:

- identify water quality issues and hot spots;
- identify environmental values of water bodies and water quality objectives required to protect the values; and
- identify and commit to a set of cost-effective management measures to achieve and maintain those values and objectives.

Steps to develop a local WQIP



Local WQIP Review

Ten local WQIPs were developed between 2008 and 2012 with strong involvement from key stakeholders. Implementation of the WQIPs is ongoing, however, many of the actions are complete or require review. There are also actions that are still underway and others that will require an ongoing commitment and additional resources to maintain and improve water quality. This review of the Bull Creek Catchment WQIP is based on achievements and stakeholder participation.

There has been significant investment allocated to on-ground nutrient interventions in the Bull Creek Catchment through the Brentwood Living Stream and Bull Creek restoration projects. The monitoring associated with specific on-ground projects provides evidence that they are improving water quality in this catchment. Monitoring the effects of non-structural WQIP actions, such as community education and behaviour change programs, and changes to local government policies and procedures, on catchment water quality is more complicated. Therefore, statistically linking WQIP actions to changes in overall catchment water quality is not attempted at this stage. Variations in annual flow, changes in catchment land uses, and the long timeframes required for some catchment management practices affecting water quality at the catchment discharge point are other factors that can contribute to discharge water quality.

The Swan Canning River Protection Strategy supports the development and implementation of the Swan Canning and local WQIPs as an action to achieve nutrient load reduction targets and provides the framework for DBCA to update local WQIPs. This review will determine the local WQIPs to be updated based on the level of support from key stakeholders and the need for further water quality improvement. Modelling of water quality improvement targets is proposed as part of an update of the Swan Canning WQIP by 2021.


November 2012

Local Water Quality Improvement Plan

Bull Creek Catchment

GOVERNMENT OF WESTERN AUSTRALIA

SWAN RIVER TRUST

CITY OF CANNING

City of Melville

Background

The Swan River Trust (Trust) and partners work to reduce nutrients and other contaminants entering the Swan and Canning rivers.

The Trust has developed and is investing in local **Water Quality Improvement Plans** (WQIPs). These plans provide local government authorities and communities with a mechanism to prioritise recommendations and resources and seek funding to improve water quality in catchments contributing the greatest amount of nutrients. These plans should be reviewed annually and assessed after five years. Actions within WQIPs address nutrient and pollutant pathways through catchments from their source to the discharge point.

Analysis of recent data, modelling and other factors determined that Bull Creek Catchment is a priority catchment for WQIP development.

Outcomes

The Water Quality Improvement Plan will:

- identify water quality issues and hot spots;
- identify environmental values of water bodies and water quality objectives required to protect the values; and
- identify and commit to a set of cost-effective management measures to achieve and maintain those values and objectives.

Bull Creek Catchment Water Quality Improvement Plan

The Bull Creek Catchment is approximately 43.5 square kilometres and is located mostly within the cities of Canning and Melville. It is highly modified and converted to a largely piped drainage network with some intact natural wetlands and foreshore areas. The modified Bull Creek winds its way through a series of parks in the lower catchment before it discharges into the Canning River. The catchment has six other major outfalls discharging directly into the Canning River making water quality monitoring challenging. The drainage network receives water from stormwater runoff and groundwater, with Bull Creek at the lower end of the catchment flowing year round.

Most of the catchment has been cleared for urban residential, recreation, major roads with some business and light industry. There is remnant vegetation in the Bull Creek Reserve and key wetland sites such as Booragoon Lake, Blue Gum Lake and Piney Lakes. The foreshore length of over 10km provides a valuable asset and attracts many visitors to the Bull Creek Catchment.

One of the major issues in the catchment is nutrient inputs. Non-nutrient contaminants (e.g. hydrocarbons and heavy metals) in both the sediment and water within the catchment are also of concern. Specific issues include fertiliser use, lack of use of water sensitive urban design best practice, the impact from previous land uses including contaminated sites and farming, impact of light industry and septic tanks.

1. EXISTING ACTIVITIES → 2. CONDITION → 3. VALUES, OBJECTIVES, TARGETS → 4. IMPLEMENTATION → 5. MONITORING & REVIEW

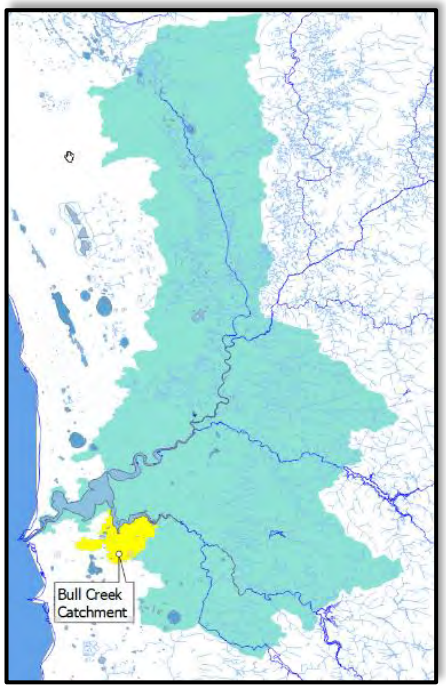
Steps to develop a local WQIP

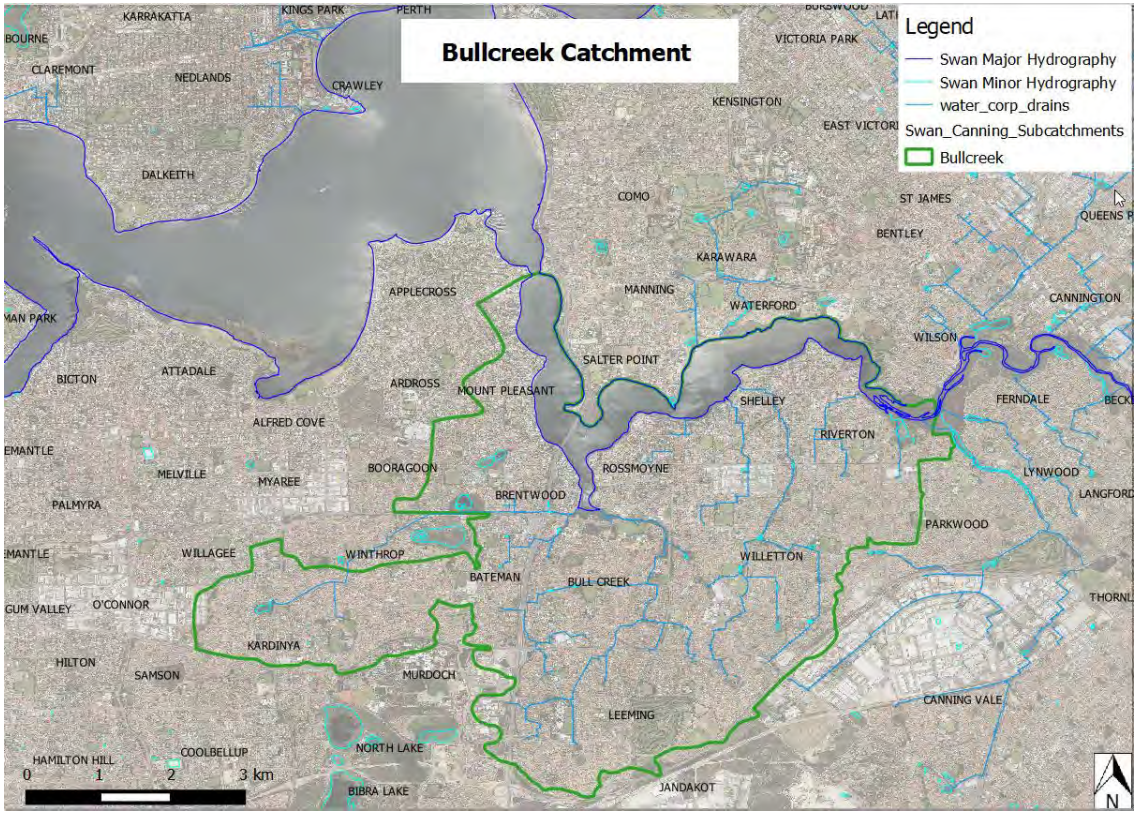
Local WQIP front cover for illustration purposes only

Bull Creek Catchment

The Bull Creek Catchment is an urban catchment covering approximately 43-square kilometres with most of the area cleared for urban residential, recreation, commercial and light industrial areas across Brentwood, Booragoon, Winthrop, Bateman, Bull Creek, Willetton, Leeming, Murdoch and Kardinya. The catchment is highly modified and converted to a largely piped network with some natural wetlands and foreshore. The downstream sections of Bull Creek flow through a natural park before discharging into the Canning River. The catchment incorporates six other outfalls that discharge directly into the Canning River making water quality monitoring challenging. The drainage networks that extend from these outfalls included the areas of Rossmoyne, Shelley and Riverton.

The drainage network receives water from surface run off via stormwater and groundwater with Bull Creek at the lower end of the catchment flowing all year round. Within this network there is remnant vegetation in Bull Creek Reserve, Booragoon Lake, Blue Gum Lake and Piney Lakes. The soil systems in the catchment are predominately Bassendean, with Spearwood to the west and smaller areas of Pinjarra Plain scattered throughout.





Bull Creek WQIP Review Summary

The Bull Creek WQIP has a total of 32 actions; 100 percent of those have been addressed: including 26 that have been completed or are on track to completion, and 6 that are implemented but will require ongoing commitment or further investment for catchment-wide implementation (see Appendix 1 for details).

Major projects:

- Brentwood Living Stream (DBCA, Water Corporation, SERCUL, Main Roads WA and the City of Melville).
- Bull Creek restoration (Australian Government through Perth NRM, Friends of Bull Creek, SERCUL and the City of Melville).
- Booragoon Lake restoration (Friends of Booragoon and Blue Gum Lakes, SERCUL and the City of Melville).
- Blue Gum Lake restoration (Friends of Booragoon and Blue Gum Lakes, SERCUL and the City of Melville).
- Restoration of the Shelley Foreshore (CRREPA, DBCA and the City of Canning)

Considerable progress in improved catchment management has occurred in the Bull Creek Catchment since the development of the WQIP. Multiple on-ground projects to improve drainage assets within the catchment have been undertaken. Extensive restoration has been undertaken at Brentwood Main Drain, Bull Creek Reserve, Blue Gum Lake, Booragoon Lake, Quenda Lake, Trevor Gribble Park, Brolga Lake, Yagan Reserve, Frederick Baldwin Park and along the Shelley Foreshore.

The Cities of Melville and Canning have altered their management process for public open spaces incorporating a fertilise wise and water wise approach to minimising the amount of fertiliser and water used on active open spaces.

The City of Melville (CoM) council endorsed the Bull Creek WQIP to enable a progression of actions towards this WQIP. The City of Caning (CoC) has conducted the Light Industry Audits program within the Willetton Industrial area with an officer engaged permanently to continue the program. Both of the cities continue to provide support to several community groups working within the sub-catchment. The community groups themselves have attracted significant funding to undertake on-ground works with large volunteer contributions to weed management and restoration of the sites.

Extensive restoration of the Shelley foreshore has been led by the Canning River Residents Environmental Protection Association (CRREPA). The Friends of Brolga Lake is a new group established within the sub catchment. The Friends of Booragoon and Blue Gum Lakes have achieved significant transformations of their sites with assistance from the South East Regional Centre for Urban Landcare (SERCUL). The restoration of Bull Creek Reserve has been a large program involving significant blackberry control along with other aggressive weed species. SERCUL and the Friends of Bull Creek have transformed the top half of the reserve with works now progressing into the lower half of the reserve.

The Brentwood Living Stream (Dragonfly Dreaming) project was a significant collaborative effort that saw the removal of old drainage infrastructure and the establishment of a living stream with public access through an interpretive node. The site highlights what can be achieved through state agency, local government and community organisations working collaboratively to optimise the outcomes of a project. Dragonfly Dreaming is a project that has restored life into an area that experienced significant environmental, amenity and access challenges. The outcome of this effort is a fabulous asset that achieves both environmental and social interaction benefits.

WQIP Review Summary						
WQIP catchment	Release date	Total number of actions	Actions fully achieved or on track	Actions implemented but ongoing commitment required	Actions with little or no progress	**% of actions being implemented**
Bull Creek	Nov 2012	32	26	6	0	**100%**

Summary of investment in the Bull Creek WQIP (from commencement of WQIP to June 2018)				
	DBCA investment	Other State & Federal Government investment	Local government and community	**Total investment (approximate)**
Investment in Bull Creek WQIP projects	$623,993	$428,381	$505,469	**$1,557,843**

Future priorities and actions – Bull Creek Catchment

- Relevant government and non-government organisations work collaboratively to implement the actions of the Swan Canning River Protection Strategy.
- Continue to take opportunities to retrofit existing drainage systems in line with Water Sensitive Urban Design (WSUD) principles.
- Ensure all new development and infill/retrofit proposals are in line with the State Government's *Waterwise Perth Action Plan* and *Vision and Transition Strategy for Water Sensitive Greater Perth Implementation Plan 2019-2021*.
- Ensure that all local government planning schemes and policies support the *Waterwise Perth Action Plan and Vision and Transition Strategy for Water Sensitive Greater Perth Implementation Plan 2019-2021.*
- Land-use planning decisions to ensure the State Planning Policy 2.10 (or equivalent) requirement for developers to maintain or improve water quality is upheld.
- Continue to look for, and take opportunities to improve water quality, habitat, and community benefit of wetlands and vegetated areas in the catchment.
- Maintain Light Industry Audits program to prevent industrial pollutants entering surface and groundwater.
- Develop a revised WQIP for this catchment to help continue the momentum for improved catchment management. Future actions should be specific, costed and measurable.

Bull Creek case study: *Dragonfly Dreaming* - Brentwood Living Stream

The *Dragonfly Dreaming* – Brentwood Living Stream project is an excellent example of stakeholders working collaboratively when an opportunity arises. A corroding corrugated iron pipe and trapezoidal drain were part of the Brentwood Main Drain passing through Bateman Park.

Water quality monitoring of the catchment identified high levels of nutrient and non-nutrient contaminants from the catchment. The Brentwood Main Drain is highly modified system and this site receives subsoil drainage water from the Kwinana Freeway. Stormwater enters the system from Brentwood, Winthrop and Bull Creek and it receives ground water input which results in year-round flow.

The site was weed infested and bank erosion was exacerbated by a lack of native vegetation. The opportunity for this project commenced with a need to replace a corrugated iron pipe. The stakeholders agreed that through working collaboratively, rather than just re-installing a pipeline, a better outcome could be achieved at the site.

The interpretive node at Dragonfly Dreaming, April 2019

DBCA secured a grant through the Australian Government's *Caring for our Country* program. Project contributions were received from the Water Corporation, CoM and Main Roads WA, the design and on-ground implementation were coordinated through SERCUL and the Yelakitj Moort Nyungar Association provided site monitors and interpretation for the project. The project involved an extensive collaboration and consultation process with a wide range of stakeholders with interest in this site. The community were involved early in the planning and design phase and also during the project's implementation.

The project converted approximately 150m of piped and trapezoidal drain into an open, stable and ecologically functioning living stream. Degraded infrastructure was removed, the channel was realigned, three rock riffles were installed, significant weeds were removed, and the system was stabilised with native vegetation. The project has transformed a section of rarely utilised open space into an ecological and amenity asset that is now regularly visited by the local community.

Preliminary results have shown that the living stream improves the dissolved oxygen and the pH conditions of the water while removing nitrogen and phosphorus from the system. The site is regularly visited by locals and the interpretive node provides a shaded spot to rest while listening to the water flow over the rock riffles.

Dragonfly Dreaming - Brentwood Living Stream

Before restoration, May 2015

After restoration, April 2019

Area of project site:	0.8 ha
Number of seedlings planted:	3,050 (local wetland and dryland species)
Project partners:	DBCA, Water Corporation, City of Melville, Main Roads WA, SERCUL, Friends of Bullcreek and the Yelakitj Moort Nyungar Association.
Cost of project development & construction:	$622,000

Appendix 1: Bull Creek Catchment WQIP - Action Review

Tally and explanation of WQIP actions review categories – Bull Creek			
Total number of actions	**32**	**Percentage**	**Explanation**
Action achieved	12	37%	The action has been completely fulfilled.
Action on track	14	44%	Significant progress has been made and the action is likely to be completed in the near future.
Ongoing action	5	16%	This action will require ongoing commitment or maintenance.
Projects/Programs implemented	1	3%	There are projects and programs in place that address this action, however significantly more investment is required to enable catchment wide implementation.
Little or no progress	0	0%	Little or no progress has been made on this action. This can be for various reasons.
No longer relevant or viable	0	0%	Can be for various reasons.
Summary categories			
Total number of actions	**32**	**Percentage**	**Explanation**
Action fully achieved or on track to being achieved	26	81%	First two categories above combined.
Action implemented but ongoing commitment required	6	19%	Second two categories above combined.
Little or no progress	0	0%	Last two categories above combined.

Bull Creek Catchment WQIP – Action Review							
Treatment train approach	**Management strategies**	**Implementation actions**	**Lead organisations**	**Supporting partners**	**Timing**	**Status comments**	**Review category**
1. Prevention Land Use and planning	1.1 *Review urban and infrastruc-ture planning to incorporate WSUD best practice	1.1.1 Develop a checklist to ensure Water Sensitive Urban Design (WSUD) as identified in the Stormwater Management Manual for Western Australia is incorporated into strategic planning and retrofitting processes (AH)	City of Canning (CoC), City of Melville (CoM)	Dept of Planning, Dept of Water and Environmental Regulation (DWER), Department of Biodiversity Conservation and Attractions (DBCA)	Starting 2013	• New WAterways training has been partially focussing on this process and local government officers have been taking this knowledge and applying it to their strategic processes for retrofit. •City of Melville (CoM) has developed a Stormwater Environment Plan incorporating a Water Sensitive Urban Design (WSUD) Stormwater Manual for the City. • City of Canning (CoC) Biodiversity Strategy incorporates compensating basins and drainage reserves in the action plan for this document.	
		1.1.2 Investigate in house, local focused training opportunities in WSUD (AH)	CoC, CoM, DBCA, DWER	South East Regional Centre for Urban Landcare (SERCUL)	Starting 2013	• Hosted in-house WSUD training for planners, engineer's and environmental staff at COM. • New WAterways has been leading many and varied training events which have been attended by City officers. Both of the cities are undertaking *Benchmarking for Water Sensitive Cities*, these workshops are attended by a range of staff from the Cities.	
		1.1.3 Identity and prioritise locations where disconnection of the drainage system, in accordance with current WSUD principles, (retention/detention /treatment)	CoC, CoM, DBCA	DWER, SERCUL	Starting 2013	• Site prioritisation project assessed all drainage sites in CoM for potential disconnections, increased retention and revegetation. This local information has been fed into the CoM Stormwater Manual which identifies and quantifies the potential impact of many design options. Other key sites on entry to major wetland systems have been earmarked for redesign to increase retention and local infiltration and infiltration before entry to wetland systems. • CoM have implemented WSUD design at the drainage outlets at Brentwood Living Stream, Blue Gum Lake, Booragoon Lake, Fredrick Baldwin and Quenda Wetland. These projects involved the installation of GPT's and retention basins at the outlets.	

		could be incorporated into the existing locations (AH)				• The CoC continue to undertake water quality monitoring of the Bull Creek East catchment, the reporting for this catchment provides recommendations on locations where interventions could be achieved. • The CoC have intercepted six road-side drains along the Shelley Rossmoyne foreshore, installing bubble ups and treatment swales prior to discharge into the river.	
		1.1.4 Devise a mechanism to ensure that any drainage system modifications where discharge to wetlands occurs are considered by the Environment team and that they have the time and opportunity to suggest WSUD alternatives (AH)	CoC, CoM	DWER	Starting 2013/14	• Site prioritisation project recommendations have been incorporated into the risk register at CoM to help facilitated this process. • CoM completed a strategic level stormwater management manual specific to the City and in June 2019 completed the City of Melville Stormwater Quality Management Guidelines to guide ongoing operational maintenance of drainage systems. • While there is no formal policy at the CoM, collaboration on the capital works projects is a standard practice. • The CoC Biodiversity Strategy considers stormwater discharge into the receiving environment (wetland of river system).	
		1.1.5 Develop a process to identity and incorporate WSUD opportunities into public open space review (AH, RA)	CoC, CoM, DBCA	SERCUL	Starting 2013/14	• as above 1.1.3 • The Dept of Water and Environmental Regulation (DWER) and Water Corporation's Drainage for Liveability Program has increased the potential for projects within main drainage assets adjacent to public open space. • The South East Regional Centre for Urban Landcare (SERCUL) water quality reports for the Bull Creek Catchment (City of Melville section) incorporated recommendations where potential opportunities existed within Public Open Space (i.e. John Creaney Park). These recommendations inform annual budgeting for projects within the CoM. • The CoM is progressing an asset register review for all water bodies within the City. • The CoC Biodiversity Strategy enables WSUD opportunities to be considered in public open space review.	
		1.1.6 Develop a policy to prioritise use of local native plants in landscaping of public and private	CoC, CoM		Starting 2013/14	• The CoC has adopted a local Biodiversity Strategy which incorporates the use of local native plants along road verges. • Developments are encouraged in their submission to use native plants. An action from this strategy is the development of a local planning policy for areas within ecological linkages.	

		(developers) landscaping (AH, RA, CS)				• The CoM is implementing an Urban Forrest Plan, although this doesn't have a specific use of locally native plants there is a target towards increasing tubestock planting to enhance natural areas. The City also undertakes an annual native plant give away to residents within the City.	
		1.1.7 **Explore options to improve the brownfield and infill of industrial premises in Willetton Light Industrial area to utilise best practice WSUD design standards, including modification of basins (AH)	CoC, CoM	SERCUL	Starting 2013/14	• ECU students conducted an investigation into the branch drain at Beatrice Ave, to assess potential impact of light industry on the river. • The CoC contributed funding to a DWER and SERCUL comprehensive sediment and monitoring program along this branch drain from 2013 to 2015. This was repeated in 2018-19 by Urbaqua and in 2019-20 by SERCUL. Additional water and sediment locations were added to the Roxby Basin in 2019-20 to inform possible interventions in this basin. • SERCUL developed a CFoC application for Nurdy Park living stream (downstream of Willetton Light industrial area) which was unsuccessful, but the planning and budgeting information is still relevant. •In 2019 SERCUL were successful in receiving funding from Perth NRM and the Swan Canning River Recovery Program for the project. The plan is currently out for public comment until January 2020. • Students conducted a track and trace investigation in the area to determine if any hydrocarbons were an issue. • The CoC compliance officers followed up compliance in premises identified as a priority through track and trace project. ECU students conducted drain stencilling in area. • The CoC participated in the CFoC funded light industry program in 2015-16 and 2016-17 run by DBCA in partnership with DWER where Willetton was identified as a priority location for auditing.	
	1.2 Prioritise water quality in decision support systems	1.2.1 Implement actions prioritised through International Council for Local Environmental Initiatives (ICLEI) (see notes below the table)	CoM		Ongoing	• The CoM implemented actions against the ICLEI and progress well against these actions. The program is however no longer a current local priority.	
		1.2.2 **Develop a Work Instruction to formalise the	CoC, CoM , SERCUL		2013/14	• A turf managers' training program has been developed through the *Fertilise Wise* program. This program has been delivered in partnership by SERCUL and Challenger TAFE with funding from DBCA from 2015 -18.	

		practice for fertiliser use specifying tissue and leaf testing requirements (AH, RA)					
		1.2.3 Support Cooperative Research Centre for Water Sensitive Cities program through ongoing investment; delegating internal organisational responsibility of program to ensure research outcomes inform local initiatives; and participate in workshops (SF, AH)	CoC, CoM, DBCA	Other industry partners	Ongoing	• The Cities of Melville and Canning are participants of the CRC for Water Sensitive Cities.	
		1.2.4 Review and update management plans for key wetlands in the catchment including Bull Creek Reserve, Quenda Wetland, Piney Lakes, Yagan Wetland Reserve and Shelley Foreshore Reserve (CS, AH, RA)	CoC, CoM		Starting 2013/14	• The Bull Creek Catchment Management Plans are comprised of five wetland/dampland reserves surrounding Bull Creek, including Bull Creek, Reg Bourke, Richard Lewis, Bateman and Trevor Gribble reserves have been updated for 2014-2019. Management Plans have also been developed for Booragoon & Blue Gum Lakes, Piney Lakes and Quenda Reserve which cover the period from 2014 – 2019. These plans are reviewed on a 5-year cycle. • A Shelley Foreshore Reserve Management Plan has also been completed.	
	1.3 Continue and expand	1.3.1 Continue to fund water quality monitoring and	CoC, CoM	SERCUL, DBCA, DWER	Ongoing	• The CoM have conducted water quality monitoring within the Melville part of the Bull Creek catchment from 2015 with the intent to continue this monitoring subject to funding.	

	water quality monitoring	analysis in Bull Creek catchment and seek funding to expand the program to the entire catchment and incorporate sediment and groundwater, where appropriate (AH)				• ECU students conducted an investigation into sediment and water quality along the Beatrice Ave Main Drain and provided recommendations for a future monitoring regime. • The CoC and DBCA provided $20,000 each to extend the sediment and water quality monitoring program to CoC side of catchment. The CoC has committed ongoing funding for water quality monitoring of the Bull Creek East catchment. • DWER/ DBCA fortnightly catchment sampling is undertaken within the Main Drain at Holmes St in Shelley and Beatrice Ave Main Drain (Kalangedy Drive, Riverton). • The CoM Water Quality Monitoring Program report includes site specific recommendations in it to support LGA officers in seeking commitments from Council. • Intensive water quality monitoring at three sites pre-construction of the Brentwood Living Stream was completed by the DBCA and CoM. DBCA funded summer sampling to extend winter catchment sampling at the three sites for one year after construction was completed. Ongoing winter monitoring of this site is incorporated into the Bull Creek water quality monitoring program.	
		1.3.2 **Review historical and current land use data, in particular contaminated sites, to identify potential sources of non-nutrient contaminants, prioritise areas requiring for further investigation and identify management options (AH)	DWER, DBCA	SERCUL, DWER, CoC, CoM	Starting 2013	• A publicly available GIS based contaminated sites register is now available. Further investigation into specific sites may be required to determine the potential influences of these sites. https://dow.maps.arcgis.com/apps/webappviewer/index.html?id=c2ecb74291ae4da2ac32c441819c6d47	
2. Minimisation Efficiency in nutrient use	2.1 Reduce Council nutrients and non-nutrients output	2.1.1 Maintain high attendance rates of local government officers at Fertiliser Care or similar training course (AH, RA)	CoC, CoM, SERCUL	DBCA	Ongoing	• DBCA funded the Fertilise Wise program through SERCUL from 2014-2019 •The CoM parks and gardens staff have attended training through the Fertilise Wise course. • CoC staff were well represented in course attendance.	

		2.1.2 Extend soil and leaf testing, use of soil amendments and minimal water use to 100% of active public open space across the catchment (AH, RA)	CoC, CoM		Ongoing	• Both the cities conduct soil tests, tissues and moisture tests on active management areas.	
		2.1.3 Manage aquatic weeds in drains and compensation basins to prevent spread to wetlands and waterbodies (SF, CS, AH, RA)	Water Corporation (WC), CoC, CoM	SERCUL, Main Roads	Ongoing	• External funding from CFoC, State NRM, and the Swan Alcoa Landcare Program have contributed to weed control along the Bull Creek. This work is being implemented by SERCUL and the Friends of Bull Creek with support from the CoM. • Water Corporation manage weeds in Main Drains including Bull Creek when requested. Water Corporation has committed to some weed control support for Bull Creek Canning River Recovery Project. • Bull Creek Canning River Recovery Project has received $150,000 from Perth NRM together with $38,000 from CoM to conduct weed control and revegetation activities along Bull Creek. SERCUL have now received State NRM funding to continue the project downstream to Leach Hwy. • SERCUL receive funding through Perth NRM for the control of the Japanese Pepper infestation in Booragoon Lake. This project has been completed with no remaining Japanese Pepper trees in the lake. A review will be required in two years. • SERCUL and the Friends of Booragoon & Blue Gum Lake received funding for the removal of grass and the restoration of Blue Gum Lake. SERCUL has now received a further $220,000 funding through State NRM for a three-year program to continue weed control and restoration around Blue Gum Lake. The CoM will provide support by removing introduced *Casuarina* around the lake. • The CoM collaborated to control an outbreak of *Salvinia molesta* in Marmion Lake. • The CoM is undertaking a three-year program to remove woody weeds along the Bateman foreshore. • A collaborative effort by stakeholders achieved the listing of Amazon frogbit and recognised the threat of this invasive species to WA waterways and wetlands.	

	2.2 Reduce nutrient and non-nutrient outputs from business and community	2.2.1 Expand and target residential education in efficient fertiliser management to reduce nutrient inputs (AH)	CoC, CoM, SERCUL, DBCA	Canning River Residents Environmental Protection Association (CRREPA)	Ongoing	• Phosphorus Awareness Program (PAP) focusing on school gardens FertCare courses. Opportunities to present to local land holders have been taken up (ratepayers association, aged care facilities, schools). • The CoM developed "Protect your wetland" brochures and provided them for the local community. Community information signs are also being developed for wetlands within the CoM. • Various programs through Piney Lakes education centre incorporate this message.	
		2.2.2 **Support education and projects in other larger high priority areas that are not managed by local government, for example golf courses, aged care facilities, shopping centres, school ovals (AH)	Depart of Education and Training	DBCA, SERCUL, CoC, CoM	Starting 2013	• DBCA provides funding for the Phosphorus Awareness Program (PAP) run through SERCUL which focused on school groups and Fertiliser Wise training. • A Bull Creek WQIP presentation was given at the Aviation Aged Care Facility in 2012 to increase awareness of the program. • The Brentwood Living Stream project and wider catchment issues was promoted to local residents through posters in social clubs and attendance at morning teas on site. • Rossmoyne Senior High School Bushrangers have been conducting water sampling along the Bull Creek for several years. They have been actively involved in the restoration of Bull Creek. • The CoM has undertaken drainage stencilling in parts of the catchment.	
	2.3 Reduce nutrient and non-nutrient output from industry	2.3.1 **Encourage local governments to adopt an auditing process and implement education and awareness programs for small to medium enterprises to ensure compliance with the Environmental Protection *Unauthorised Discharges Regulations 2004* and reducing stormwater	CoC, DWER	SERCUL, DBCA, CoM	Ongoing	• The CoC participated in the Light Industry Audit program in partnership with DWER in 2015-17, this included the Willetton Industrial Area. The City now has a compliance officer trained in this approach to continue the program in liaison with DWER officers. • The CoM is also running a Light Industry Audit program and employs a compliance officer for this program.	

		contamination (AH)					
		2.3.2 Explore opportunities to utilise findings from Small Factory Environmental Management Support Program (AH)	CoC, SERCUL	CoM	Starting 2013	• There was insufficient funding to continue the Small Factory Environmental Management Support Program. • The Light Industry Audits program run through DWER and local government fulfilled this need. The program resulted in the appointment of an officer within the CoC to continue this role with support from DWER as required.	
3. Reduction Source control	3.1 Reduce outputs from community by education and involvement	3.1.1 Raise community awareness of water quality and the connection of the urban drainage system to the Canning River through involvement in revegetation and education activities (CS, AH, RA)	CoC, CoM, SERCUL, DBCA	CRREPA, Friends of Bull Creek, Fo Blue Gum and Booragoon Lakes, Friends of Brolga Lake, Piney Lakes	Ongoing	• The cities provide support to community groups working in the catchment. The CoC and SERCUL have supported the development of a new group in the catchment, the Friends of Brolga Lake. • The Brentwood Main Drain Living Stream project incorporated community consultation and active involvement in the restoration of the site. • SERCUL facilitates many community planting events working with the Friends of Groups providing an opportunity to promote community awareness of catchment issues. • DBCA provides funding for the PAP education program through SERCUL engaging schools and a diverse range of community organisations providing education about catchment wide issues. • SERCUL, the Friends of Bull Creek and Yelakitj Moort Nyungar Association collaborated to provide several cultural walks through the Bull Creek reserve • Challenger TAFE students $1,000 grant to complete a work plan of restoration and rubbish removal and monitoring at Blue Gum lake in 2013. • DBCA funded the development of an interpretation node at the Brentwood Living Stream site which includes information on local culture and catchment issues. As second stage downstream of this program also incorporates a boardwalk and interpretive signage. • Direct community engagement through each of the Friends Groups within the catchment. The CoM has appointed a Friends Group Officer to support this activity and the CoC activity support their Friends Groups. • Ardross Primary School in partnership with SERCUL are growing and planting 5,000 seedlings for the restoration of Yagan Reserve. • DBCA RiverWise and River Guardians programs were implemented.	

	3.2 Apply nutrient best management practices	3.2.1 Implement sediment and erosion reduction program utilising outcomes from the DBCA's trial Southern River sediment and erosion project (SF, CS, AH, RA)	CoC, CoM, DBCA, SERCUL	DEC, DWER, Main Roads	Starting 2013	• Forum held in April 2014 to promote ideas to the Cities officers. • The Sediment Taskforce was established in 2014. Member organisations contributing to the Taskforce include DBCA, City of Armadale (CoA), City of Gosnells (CoG), City of Kwinana (CoK), WALGA, Master Builders Association (MBA), Housing Industry Association (HIA), Urban Development Industry of Australia (UDIA), SERCUL, Main Roads WA, WC, Department of Housing. The taskforce is administered by Perth NRM (with funding from DBCA to June 2020). Through this forum the following documents have been developed; - Taking Action to Control Sediment Poster - Taking Action to Control Sediment Brochure - Local Law Info Sheet - Case studies on how various councils address sediment loss from building sites • Sediment Control Guidance for developers and builders is being developed. Guidance will include current sediment control methods and costings. • A two-year research project through the CRC for Water Sensitive Cities to quantify sand/soil loss from subdivisions and individual dwellings during the construction phase has commenced. The outcomes from the project should be available in 2020. • The CoM undertook a planting program at Trevor Gribble Park to reduce erosion occurring within the park entering the stormwater network.	
4. Amelioration Conveyance and transmission	4.1 Improve urban drainage design and support structural nutrient intervention	4.1.1 Support local Friends Groups to prioritise, develop and source funding for on ground projects focused on water quality outcomes (CS, AH)	CoC, CoM, SERCUL	DBCA, CRREPA, 'Friends of'	Ongoing	• DBCA and SERCUL working with local groups on CFoC, community action and Melville grants. • The Cities have staff that provide support to the community groups in their area. • Community lead restoration projects at Bull Creek, Blue Gum Lake, Booragoon Lake and Shelly Foreshore have received multiple funding grants since the WQIP development. The WQIP provides the overarching management document for the grant funding justification.	
		4.1.2 **Increase bio filtration treatment and retention time in identified high priority sites (AH)	CoC, CoM	DWER, DBCA, WC	Starting 2013/14	• The Brentwood Main Drain Living Stream contributes to this action. • The redesign of Main Roads Compensation basin upstream of the Brentwood Living stream project aims to improve water quality through increased retention time and filtration. • The CoM have redesigned stormwater outlets to incorporate stormwater treatment prior to discharge into Booragoon Lake, Blue Gum Lake and Quenda Wetland.	
		4.1.3 **Maximise localisation of road runoff treatment (AH)	CoC, CoM		Starting 2013/14	• The CoM's Stormwater Management Manual provides the guidance to prioritise WSUD implementation within the City, this includes the local treatment of road runoff. The City is now aiming to progressively implement this plan.	

		4.1.4 Where practical create vegetated buffer zone/verges and implement WSUD principles between waterways and turf in council reserves to help prevent herbicides, fertiliser and grass clippings entering waterways (AH)	CoC, CoM	DWER, DBCA, SERCUL	Starting 2013/14	• These principals have been applied to Brentwood Main Drain Living Stream and redesign of a Main Roads compensation basin. • The CoM have restored native vegetation around the lake in Fredrick Baldwin Reserve. The lake was previously turfed to the edge of the lake. • The City working with SERCUL and the Friends of Booragoon Lake have removed turf near the lake and have established a native vegetation buffer between the walking path and the lake. • Bull Creek Living Stream project will enhance the buffer and nutrient stripping capabilities of site between the park and the river.	
5. Treatment - Reuse - Disposal	5.1 Promote structural and non-structural intervention and controls	5.1.1 Identify and investigate the benefits of the installation of pollutant trapping/treatment devices along roads in high risk areas, high traffic volume roads and/or immediately adjacent to high value wetlands or the river (AH)	Main Roads, CoC, CoM	DWER, DBCA, SERCUL	Ongoing	• As part of the collaborative effort for the Brentwood Living Stream project, Main Roads designed and built an oil pollutant trap on Leach Highway to protect the Bull Creek foreshore from potential spills and impact from traffic pollution. • The redesign of the compensation basin upstream of the Brentwood Living Stream project contributes to the trapping of pollutants resulting from the development of the freeway. • Main Roads maintains an oil trap and GPT prior to their networks discharge into Booragoon Lake. • DBCA's Riverbank program funded two projects along the Shelley Rossmoyne foreshore to improve the quality of stormwater entering the Canning River with the City of Canning. In 2012-13 two drain swales were installed and revegetated at Wadjup Point and along Riverton Drive; and in 2013-14 drain swales were restored at two sites along Riverton Drive.	
		5.1.2 **Work with Main Roads to ensure work within drainage basins does not negatively impact on the water quality of the catchment and to discuss the potential opportunities to	Main Roads, CoC, CoM	SERCUL, DBCA	Starting 2013	• The compensating basin feeding into the Brentwood living stream was redesigned to improve water quality. • Upgrades have been made to the outlet into Quenda Lake with a GPT and detention basin prior to discharge into the lake.	

		include nutrient and non-nutrient stripping design options (AH)					
		5.1.3 **Work with Water Corporation to seek opportunities for operating and capital projects to increase potential contaminant removal (AH)	WC, DBCA, CoC, CoM	SERCUL	Starting 2013	• The Brentwood Main Drain living Stream is an example of how this can be achieved. • The CoM Environmental Stormwater Management Plan has identified opportunities with Water Corporation assets for remediation in the future. • The DWER and Water Corporations *Drainage for Liveability* program has increased the potential for projects within main drainage assets adjacent to public open space. (i.e. the Brentwood Stage 2 project is a Drainage for Liveability Project). • The Drainage for Liveability program actively seeks opportunities to partner on projects where multiple outcomes can be achieved in association with a drainage asset.	
		5.1.4 ** Improve practices to reduce the impact of spills in the environment, in particular provide annual pollution response training to key local partners; and ensure local Emergency Management Plans incorporate effective pollution response strategies. (AH)	CoC, CoM, SERCUL	DEC, DBCA	Starting 2013	• Pollution response training was conducted for sub regional officers who work in the catchment. • The CoM undertakes annual spills practice involving annual pollution training, testing and auditing with Waste Works and Parks and Environmental staff. • The Light Industry Audit program is a proactive program which engages small to medium industry to improve their practices and reduce spills entering the stormwater networks.	
	5.2 Reduce nutrient input from sewage	5.2.1 Full connection of existing and proposed industrial and residential areas where a sewerage scheme is available (AH)	CoC, CoM	DBCA, WC, DWER	Ongoing	• The current areas are connected to the sewage scheme and all future development will require connection to the sewage scheme.	

		5.2.2 Manage wastewater scheme to reduce spills to the environment (AH)	WC		Ongoing	Water Corporation has an ongoing program of work to reduce spills to the environment from wastewater assets that have the potential to negatively impact on water quality in the Swan and Canning Rivers. Measures include: • Full 24hr monitoring of the pump stations via the Supervisory Control and Data Acquisition (SCADA) network • Increased on-site storage capacity (typically 3-6 hrs at peak). • Duplicating infrastructure to maintain operability (back-up pumps). • On-site and mobile generators to maintain operability during power outages. • Clean-up plans and capability in case of overflow. • Documented on-line contingency plans for all sites.	

*new management strategy

**new management actions

(SF) = streamflow

(CS) = cultural and spiritual

(AH) = aquatic ecosystem health

(RA) = recreation and aesthetics