Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

PARKS AND WILDLIFE SERVICE

Ellen Brook Catchment Local Water Quality Improvement Plan Review Summary

June 2018

Acknowledgements
Thank you to the Ellen Brockman Integrated Catchment Group (EBICG), City of Swan, Shire of Chittering, Department of Primary Industries and Regional Development (DPIRD), Department of Water and Environmental Regulation (DWER) and Perth NRM for their contributions to the review of the Ellen Brook Catchment Water Quality Improvement Plan (WQIP).

Purpose and use of this document
The Department of Biodiversity, Conservation and Attractions (DBCA), with the support of the organisations noted above, has reviewed the implementation of the Ellen Brook Catchment WQIP. The purpose of this document is to summarise that review and inform future updates of the Ellen Brook Catchment WQIP. The Swan Canning Water Quality Improvement Plan will commence a review process in 2018 including updated catchment modelling which 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 implementation of the WQIPs.

Front cover photos: Lower section of Ellen Brook Wetland. Photo – DBCA
Oblong turtle hatchling moved off vehicle access track during water quality sampling. Photo – Kate Bushby/DBCA

Local Water Quality Improvement Plans

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 (and previously the Swan River Trust) developed and invested in the implementation of local Water Quality Improvement Plans (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.

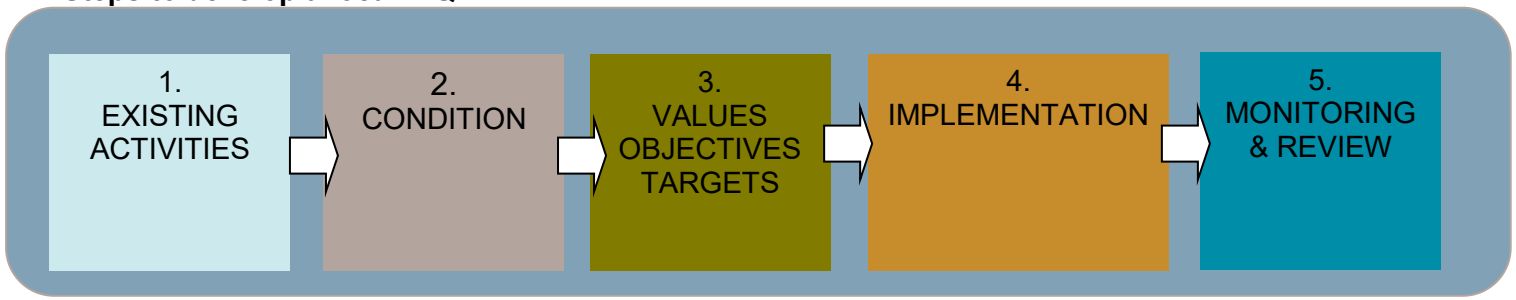
WQIP implementation takes a treatment train approach with actions falling into each of the following stages in the pathway of nutrients and non-nutrients from the source to the discharge point:

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

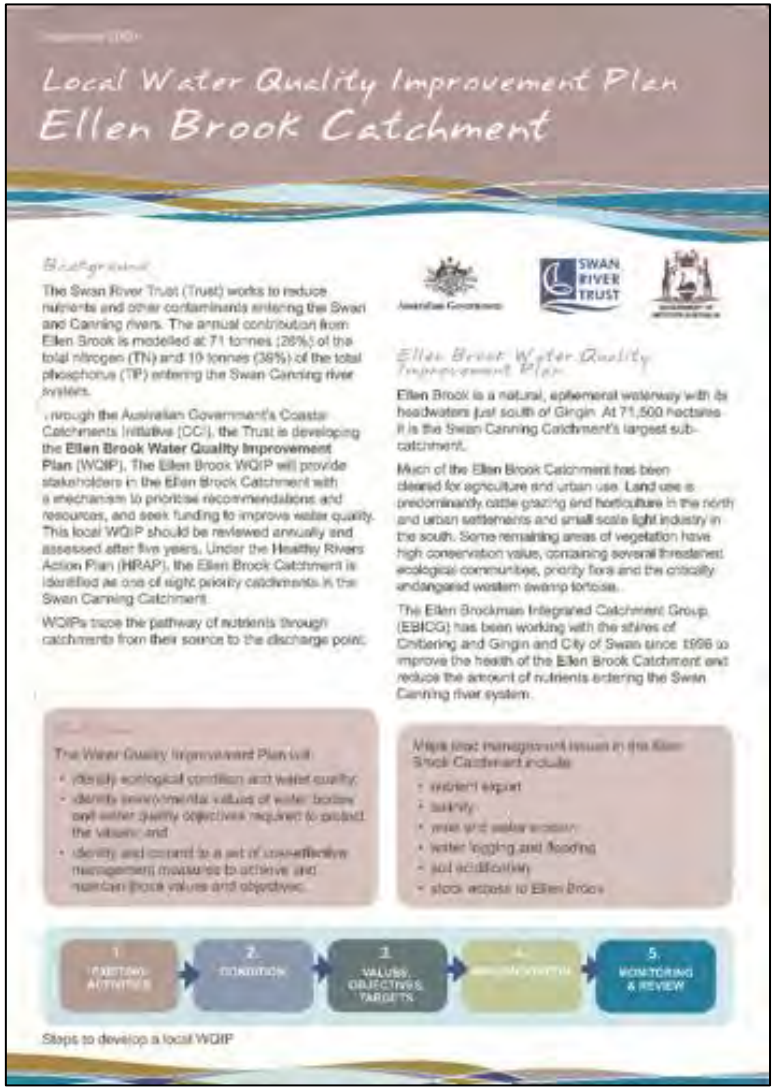


Local WQIP Review

Ten local WQIPs were developed between 2008 and 2012 with strong involvement of 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 Ellen Brook Catchment WQIP is based on achievements and stakeholder participation.

Ellen Brook Catchment was identified as a priority catchment for development of a local WQIP through the Swan Canning WQIP (SCWQIP). Implementation of management actions from the local Ellen Brook WQIP have been managed through the SCWQIP. There has been significant investment in on-ground nutrient interventions in the Ellen Brook Catchment through the SCWQIP and DBCA's Drainage and Nutrient Intervention Program (DNIP). The monitoring associated with on-ground projects in this catchment provides evidence that specific projects do improve water quality. Monitoring the effects of non-structural WQIP actions, such as community education, behaviour change programs, and changes to policies and procedures on catchment water quality is more complicated. Therefore, statistically linking WQIP actions to changes in catchment water quality is not attempted at this stage. Variations in annual flow, changes in catchment land uses, lags in uptake of practices, and the long timeframes required for some catchment management practices to affect water quality at the catchment discharge point are other factors that can contribute to discharge water quality.

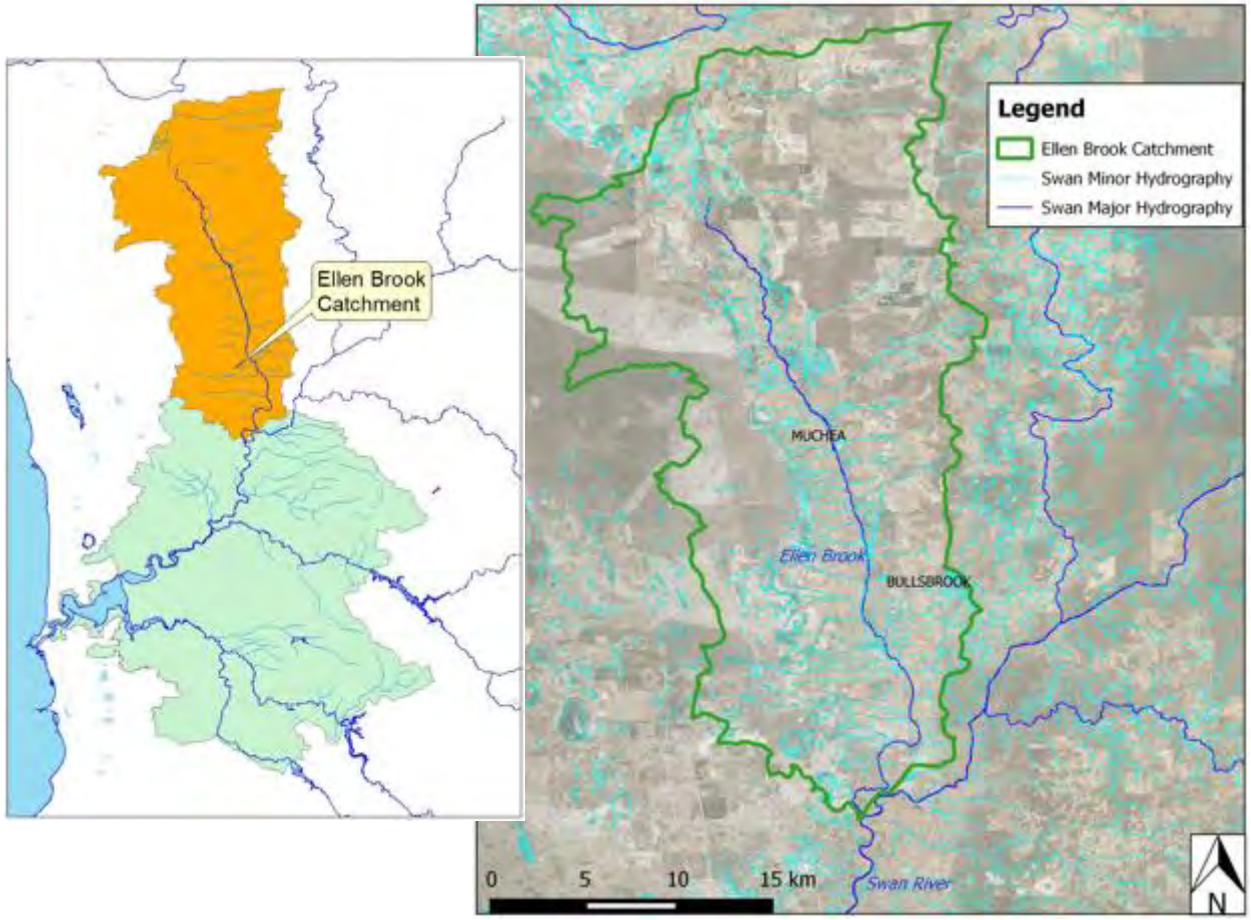
The Swan Canning River Protection Strategy supports the development and implementation of the Swan Canning and local WQIPs as an action to achieve nutrient load reduction targets and provides the framework for DBCA to update local WQIPs. This review will determine the local WQIPs to be updated based on the level of support from key stakeholders and need for further water quality improvement. The Ellen Brook Catchment will likely still be a high priority catchment based on the ongoing catchment water quality monitoring results. Modelling of water quality improvement targets is proposed to occur as part of an update of the Swan Canning WQIP in 2018.



Local WQIP front cover for illustration purposes only

Ellen Brook Catchment

Ellen Brook is a natural, ephemeral waterway with its headwaters just south of Gingin. Much of the Ellen Brook Catchment has been cleared for agriculture and urban use. At 71,500 hectares, it is the largest sub-catchment of the Swan Canning Catchment. Land use is predominantly cattle grazing and horticulture in the north with increasing residential and light industry areas in the south. Some remaining areas of vegetation have high conservation value, containing several threatened ecological communities, priority flora, the critically endangered Western Swamp Tortoise and Carnaby's Black Cockatoo. Much of the catchment has shallow groundwater and sandy soils making nutrient export a key management issue. The Ellen Brook Catchment is the biggest contributor of both total nitrogen (TN) and total phosphorus (TP) of Swan Canning sub-catchments.



Ellen Brook WQIP Review Summary

The Ellen Brook WQIP has a total of 20 actions; 65 percent of those have been addressed but will require an ongoing commitment or further investment for catchment-wide implementation. The remaining 35 percent of actions have had little or no progress (see Appendix 1 for details).

Major projects:

- Ellen Brook Wetland, Belhus– Stage 1 completed and operational
- Fencing and revegetation of creek lines in the catchment
- Drainage nutrient interventions at Muchea South, Bingham Road Creek and the Brand Highway crossing

Several of the WQIP actions were not expected to be fully achieved until 2025, however, it is important to include these actions in the current review to see if progress is being made towards those long-term goals.

DBCA's DNIP has implemented several on-ground projects in the Ellen Brook Catchment, providing demonstration sites for reducing nutrients in-stream. A nutrient filter has been installed in the main channel of the Ellen Brook at the Brand Highway crossing; a nutrient-reducing wetland basin was built in Bingham Road Creek, a major tributary of the Ellen Brook; and a smaller nutrient filter and wetland combination has been installed at a very confined site with high nutrient concentrations on the Muchea South Drain. The most recent DNIP projects in the Ellen Brook Catchment are the one-hectare Ellen Brook soil amendment trial and Stage 1 of the Ellen Brook Wetland, Belhus. The wetland, which incorporates nutrient retentive material has been operational for three seasons and is currently under thorough monitoring to determine the effectiveness of the system. Future stages of the Ellen Brook Wetland system are planned and once implemented would increase capacity and treatment significantly.

Programs involving fencing-off waterways to stock to prevent trampling, erosion and subsequent sedimentation in stream channels and the direct input of animal waste to stream water have been implemented, along with revegetation of riparian zones to improve biodiversity, habitat variety and water temperature moderation.

The Ellen Brockman Integrated Catchment Group (EBICG) and supporting partners, including Shire of Chittering and City of Swan, have provided workshops and training opportunities for rural landholders, property managers and horse owners, helping educate the community about nutrient runoff and responsible property management. Perth NRM also provides opportunities in the region for horticulturalists and rural land managers to learn how to improve nutrient efficiencies and reduce runoff.

Through the Fertiliser Action Plan and later the Fertiliser Partnership, the Whole Farm Nutrient Mapping project carried out by the Department of Primary Industry and Regional Development involved 15 farms in the Ellen Brook Catchment, including sampling and assessment of 439 paddocks with a total area of 10,350 hectares. The landholders were given detailed information about the nutrient status of their soils, from which they can derive fertiliser application requirements.

The Fertiliser Partnership also resulted in the regulation of the phosphorus content of urban-use fertilisers which is likely to have most of its effect on the urban catchments and drains of Perth and would have had minimal effect in the Ellen Brook Catchment with only a small urban-residential area in the south of the catchment.

In-catchment monitoring continues to be undertaken by EBICG with support from the local governments and partners, helping identify nutrient hotspots throughout the catchment.

Two sites near the end of the catchment are monitored to estimate nutrients leaving the catchment and entering the Swan River. The upstream site met the short-term median total nitrogen concentration target (2.0mg/L) between 2003 and 2007, however, has been failing the short-term and long-term target (1.0mg/L) since 2008. The upstream site has failed the short and long-term median total phosphorus targets (0.2mg/L and 0.1mg/L respectively) since 1998. The downstream site has passed the short-term but failed the long-term median total nitrogen target since sufficient data became available in 2012. The site was also passing the short-term median total phosphorus target from 2012, however failed the short and long-term target in 2016 (Department of Water and Department of Parks and Wildlife, Swan Canning Catchment Nutrient Report 2016 and earlier versions).

The Ellen Brook remains one of the highest priority tributaries for nutrient reduction. Engaging the rural and agricultural community in the Ellen Brook Catchment will continue to be one of the most important mechanisms for improving land management practices and water quality in the Ellen Brook and ultimately the Swan River. EBICG provides a forum for stakeholders to work together on catchment issues. An updated WQIP for the Ellen Brook would further support this catchment approach to water quality improvement.

Local WQIP Action 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
Ellen Brook	Sept 2009	20	0	13	7	**65**

There has been significant investment by the Australian, Western Australian and local governments and community in the Ellen Brook Catchment. Government officer time is an additional contribution by government departments that is not often directly attributed to specific projects. Community contributions are also likely to be underestimated as it is difficult to quantify with volunteer time not always recorded. EBICG also receives support from corporate partners Tronox to undertake its landcare projects. The funding summary below outlines known investments in the Ellen Brook WQIP projects.

Summary of investment in WQIP (from commencement of WQIP to December 2017)					
	Department of Biodiversity, Conservation and Attractions (initial WQIP investment $125,000 plus DNIP investment)	Other State Government investment	Federal Government	Local Government and Community	**Total Investment**
Investment in Ellen Brook WQIP projects	$3,000,000	$890,000	$2,090,000	$420,000	**$6,400,000**

Future priorities and actions – Ellen Brook Catchment

- Increased and ongoing engagement with rural landholders in the catchment to improve land management for nutrient runoff reductions and other ecological benefits.
- Increase community awareness, education and involvement in catchment management to reduce nutrient and contaminant outputs in residential and industrial areas.
- Implement the Swan Canning River Protection Strategy.
- Ensure all development proposals are in line with Perth's transition to a water sensitive city.
- Ensure that all local government planning schemes and policies support the transition to a water sensitive city.
- Land-use planning decisions to ensure the State Planning Policy 2.10 (Swan-Canning River System) requirement for developers to maintain or improve water quality is upheld.
- Ensure all new developments are connected to sewer and aim for infill sewer to all existing urban areas.
- Continue to look for and take opportunities to improve water quality, habitat, and community benefit of waterways and vegetated areas in the catchment.
- Reduce local government's nutrient outputs through local management practices by providing up-to-date training to all staff involved in fertiliser application, grounds keeping and maintenance of drainage infrastructure, including Water Sensitive Urban Design (WSUD) features.
- Discourage the planting of deciduous trees near drainage infrastructure to reduce organic loads and excessive nutrients entering waterways.
- Investigate construction of future stages of the Ellen Brook Wetland Project.
- Continued water quality monitoring and evaluation of water quality improvement interventions and sharing of learnings as they become available.
- Review and update the Ellen Brook Catchment Management Plan.

Ellen Brook Catchment Case Study: Ellen Brook Wetland Stage 1

The Ellen Brook Wetland is the result of several years of planning and field trials to determine a suitable design and effective nutrient-retentive material. The design included seven possible wetlands that would extend approximately one kilometre alongside the Ellen Brook upstream of the West Swan Road crossing in Belhus. Stage 1 of the Ellen Brook Wetland was constructed in 2014.

Stage 1 includes a lined sub-surface flow wetland basin approximately 60 metres in diameter containing IronMan Gypsum® (IMG) as part of a filter media blend with phosphorus and nitrogen removal capacity, and a lower wetland basin including two deep zones and two vegetated surface flow wetland compartments. The system operates during winter and spring while flows in the Ellen Brook are sufficient and nutrient loads are highest.

During operation, water is pumped from the Ellen Brook to the IMG basin (sub-surface flow wetland) where it passes through the filter media before being collected and transported to the lower wetland basin for further treatment. The deep zones encourage sedimentation of particulates in the water before flowing through the shallow vegetated zones. The water also passes over a rocked swale to increase dissolved oxygen concentrations and encourage denitrification before being released back into the Ellen Brook.

As acknowledged through the Ellen Brook WQIP and Swan Canning WQIP no single treatment system is likely to adequately reduce nutrient loads in the Ellen Brook to meet the specified nutrient reduction targets, however the Ellen Brook Wetland is expected to significantly reduce nutrient loads to the Swan Canning river system while providing additional ecological and community benefits at the site.

Thorough monitoring has occurred over the first three operating seasons as the wetland is commissioned and functioning conditions are established. To date 369 ML has been treated through the IMG basin (<1% of the average Ellen Brook flow) with removal of 86kg of phosphorus and 173kg nitrogen over this period at an average removal rate of 61% and 19% respectively.

Aerial view - before construction

Aerial view - after construction

Ellen Brook Wetland Stage 1

Before construction, March 2014

After construction and plant establishment, November 2016

Area of Stage 1 project site:	0.6 ha
Number of seedlings planted:	70,000
Volume of IronMan Gypsum® (IMG) installed:	120 tonnes
Cost of project design and construction:	$4.05 million
Volume of water treated by IMG basin:	369 ML
Project partners and funding organisations:	Department of Biodiversity, Conservation and Attractions, Ellen Brockman Integrated Catchment Group, Western Australian Planning Commission, State NRM and the Australian Government's National Landcare Program.

Appendix 1: Ellen Brook Catchment WQIP – Action Review

Tally and explanation of action review categories – Ellen Brook Catchment			
Total number of actions	**20**	**Percentage**	**Explanation**
Action achieved	0	0	The action has been completely fulfilled.
Action on track	0	0	Significant progress has been made and the action is likely to be completed in the near future.
Ongoing action	9	45	This action will require ongoing commitment or maintenance.
Projects/Programs implemented	4	20	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	7	35	Little or no progress has been made on this action. This can be for various reasons.
No longer relevant or viable	0	0	This action is no longer relevant or viable. Can be for various reasons.
Summary categories			
Total number of actions	**20**	**Percentage**	**Explanation**
Action fully achieved or on track to being achieved	0	0	First two categories above combined.
Action implemented but ongoing commitment required	13	65	Second two categories above combined.
Little or no progress	7	35	Last two categories above combined.

Ellen Brook Catchment WQIP – Action Review							
Treatment train approach	**Management strategies**	**Implementation actions**	**Lead organisations**	**Supporting partners**	**Timing**	**Status comment**	**Review category**
1. Prevention Land use and planning	**1.1** Policy development and review	**1.1.1** Councils should adopt Local Planning Policy 5.1.2 as developed by Eastern Metropolitan Regional Council (EMRC) and the Department of Biodiversity, Conservation and Attractions (DBCA - previously the Swan River Trust) which requires developers to incorporate erosion and sediment control measures in local structure plans or outline development plans.	City of Swan (CoS), Shires of Chittering (SoC) and Gingin (SoG), Department of Planning, Lands and Heritage (DPLH)	Department of Primary Industries and Regional Development (DPIRD)	100% compliance by 2015	• The Sediment Taskforce, established in 2014 and administered by Perth NRM (with funding support from DBCA to 2019), is currently reviewing the EMRC 2008 *Policy and Guidelines for Local Government 5.1.2 Erosion and Sediment Control*. The reviewed policy will be applicable to all local governments within the Swan Canning Catchment. Member organisations contributing to the Taskforce include City of Armadale, City of Gosnells, City of Kwinana, WALGA, Master Builders Association (MBA), Housing Industry Association (HIA), Urban Development Industry of Australia (UDIA), DBCA, Department of Water and Environmental Regulation (DWER), South East Regional Centre for Urban Landcare (SERCUL), Main Roads WA, Water Corporation, Department of Communities – Housing. • SoC is implementing a new Planning Strategy to underpin the Town Planning Scheme. The Strategy strongly supports the protection of the Ellen Brook. • Development approvals are sent to the Ellen Brockman Integrated Catchment Group (EBICG) for advice to ensure all environmental conditions are recognised and mitigated to protect waterways, groundwater and the Ellen Brook and its flood plain. • CoS applies conditions to Development Approvals for managing soil erosion on building sites.	

		1.1.2 Develop and implement a Fertiliser Reduction Policy for the Bassendean and Yanga soils (100% P export risk) to use best management practices to reduce nutrient and other pollutant outputs which incorporates: (i) tissue analysis and soil sampling prior to broadacre fertilisation; and (ii) the use of low water-soluble fertiliser in domestic gardens.	DPIRD, landowners, CoS, SoC, SoG	Ellen Brockman Integrated Catchment Group (EBICG)	100% landowner compliance by 2015	• No Policy developed. • DPIRD (with State NRM funding) undertook subsidised soil testing on the Swan Coastal Plain including 15 properties within the Ellen Brook Catchment. 50% of paddocks were found to have sufficient phosphorus (P) to meet production requirements, 60% of paddocks were acidic and required lime and 60% of paddocks required potassium. • CSBP developed a P fertiliser (Super SR) in 2013 with reduced solubility which is targeted on the poorly retentive sands found in the Ellen Brook Catchment. Sales figures have not been supplied. • DPIRD have tested plant tissue of sites which have been soil sampled in the Ellen Brook catchment and the Swan Coastal Plain which shows that the high concentrations of P have over-ridden the acidity of the soil enabling P uptake in the plants. This shows that it is unnecessary to apply P to overcome availability in acidic conditions. • 3 spreaders were calibrated and modified in an Accuspread field day with 14 landholders near Gingin to improve the evenness of fertiliser spreading to minimise offsite effects and increase productivity. • An initiative that is under consideration as part of the Perth-Peel Strategic Assessment is the possibility of mandatory soil testing - subsidies for the testing are being considered. • The *Environmental Protection (Packaged Fertiliser) Regulations 2010* limits the P content in fertilisers sold in small use containers (not more than 50kg or 50L), this is directed at urban users.	

		1.1.3 Explore the use of alternate policy mechanisms to protect the Ellen Brook and optimise water quality.	DBCA	Western Australian Planning Commission (WAPC)		• No exploration of alternate policy mechanisms is known to have occurred.	
	1.2 Better Urban Water Management	**1.2.1** Ensure water sensitive urban design is incorporated into all relevant planning proposals consistent with the requirements of *Better Urban Water Management.*	CoS, SoC, SoG, developers, DWER	EBICG, DPLH, Urban Development Institute of Australia (UDIA)	Ongoing	• Water Sensitive Urban Design (WSUD) should be included in all new developments within townsites and new suburbs. The appropriate features to include in a development should consider site specific conditions and any new advances in the evolving field of WSUD. The CRC for Water Sensitive Cities and other research institutes are undertaking detailed studies of the effectiveness of individual WSUD elements and as more research outcomes become available these will be considered, along with other land management and stormwater objectives. • Issues of some over-engineered WSUD features and reductions in public open space due to poorly designed features have been identified, highlighting a need for more training and resources for practitioners. • Maintenance of WSUD features has also been identified as an area where capacity and knowledge could be improved.	

	1.3 Subdivision conditions	**1.3.1** Incorporate fencing and revegetation of all tributaries as a condition of sub-division for all developments.	CoS, SoC, SoG, developers	EBICG, DPLH, UDIA, DWER	100% compliance by 2025	• WAPC is responsible for subdivision approvals in WA and will consider recommendations from other stakeholders. • Model subdivision conditions exist that can be used to require the fencing of waterways and/or require revegetation (Model subdivision conditions ENV3 and ENV6 *Department of Planning and Western Australian Planning Commission, Model Subdivision Conditions Schedule, May 2016*) • These conditions are requested by SoC on subdivision proposals or when there is a change of land use. • SoC has implemented a Biodiversity Strategy that aims to protect and enhance waterways and high value remnant vegetation. • For proposals that are referred to EBICG for comment the recommendation to restrict stock access to natural waterways is requested.	
		1.3.2 New developments to be sewered where possible or adopt best practice wastewater treatment technologies, including Muchea and West Bullsbrook townsites.	DPLH	EBICG, Water Corporation (WC)	Start immediately	• EBICG has found a recent report which recommended that Aerobic Treatment Units (ATUs) be used in the townsite of Muchea. A reticulated sewerage system was not recommended, possibly due to the cost. A sewerage system would have been high value to the Ellen Brook. • SoC requires ATUs for all developments where soil type and groundwater conditions preclude the use of septic systems.	
	1.4 Water quality monitoring	**1.4.1** Expand, review and continue water quality monitoring program.	DWER, DBCA, Perth NRM, EBICG	CoS, SoC, SoG	Ongoing	• DBCA and DWER continue to monitor water quality and flow at two sites near the end of the Ellen Brook Catchment to estimate nutrients entering the Swan River as part of the long-running catchment nutrient reports. All monitoring programs are periodically reviewed.	

						• In-catchment water quality monitoring has continued by EBICG, capturing sites throughout the catchment over the winter months (there is generally not sufficient flow in summer). The program is reviewed annually, and changes made if appropriate. If a reason to expand the current water quality monitoring program is identified it could be considered, however, sourcing additional funding to resource additional monitoring would also be required. • EBICG's water quality monitoring program identifies major sub-catchments with high concentrations of nutrients and metal contaminants (load calculations are not possible as flow data is not collected). • DNIP has also been monitoring the water quality in the Brook adjacent to the Ellen Brook Wetland. • The first three seasons throughout the commissioning of the Ellen Brook Wetland have been monitored thoroughly (more details in case study).	
		1.4.2 Prioritise sub-catchments having high discharge loads for remediation, as identified by predictive modelling and the Ellen Brook Sub-Catchment Water Quality Analysis.	DBCA, EBICG	CoS, SoC, SoG, DPIRD, landowners, DWER	Priorities completed by 2015	• The Ellen Brook Catchment water quality monitoring program (undertaken by EBICG) identifies sub-catchments with high concentrations of nutrients and contaminants (load calculations are not possible as flow data is not collected). A site prioritisation report was prepared by GHD for the DNIP in 2007 (pre-dates the WQIP). • Possible sites and priority sub-catchments will be reviewed during the proposed Swan Canning WQIP review and through a current DNIP site prioritisation process. • Priority sub catchments identified by EBICG are prioritised for future project work - subject to funding availability. Considerable work (including evaluation) has been undertaken in some priority sub catchments.	

						e.g. Bulls Brook and Rocky Creek. EBICG will undertake an evaluation of priority sub catchments in 2018 as 10 years of water quality data will be available.	
2. Minimisation Efficiency in nutrient use	**2.1** Reduce agricultural industry nutrient output through discharge regulation	**2.1.1** Assess all licensed agricultural industry for compliance, with zero nitrogen and phosphorus discharge.	DWER (Environmental Regulation)	CoS, SoC, SoG	100% compliance by 2012	No specific activity towards this action.	
		2.1.2 Develop strategies to prevent any further discharge of water of unacceptable quality from agricultural industry sites which discharge effluent water (saleyards, sewerage plants, feed lots).	DWER	CoS, SoC, SoG	100% compliance by 2010	DPIRD assessed the truck washdown facility at the Muchea Livestock Centre which contains all washdown water on-site. The facility uses solids separation, and a series of ponds including evaporation. The study was used to scope the potential for other washdown sites to discharge to sewer where there is insufficient land available for evaporation ponds. The study showed that other facilities could discharge to sewer if their effluent was similarly treated.	
	2.2 Reduce agricultural industry nutrient losses through fertiliser management	**2.2.1** Promote regular soil and groundwater testing by land managers to determine fertiliser application efficiencies for horticulture, viticulture and market gardens through nutrient and water retention in the root zone of plants.	Perth NRM, landowners	DBCA	100% compliance by 2015	• The Healthy Soils Healthy Rivers Program assists landholders and community groups implement on-ground activities that will improve soil health and water quality in the Swan and Avon rivers. These activities include 1. Broad Acre Cropping/Grazing Soil Nutrient Management, and 2. Irrigated Agriculture Nutrient Management Advisory Services. The program is a joint initiative of Perth NRM, Wheatbelt NRM and DBCA (initially Swan River Trust) with funding from the Australian and WA State governments. However, very little of this program has been implemented within the Ellen Brook Catchment, and it is	

						more closely related to the Swan Canning WQIP. • A previous program, Waterwise on the Farm, run by Perth NRM in partnership with DWER, targeted wine-grape producers working on water efficiencies which as a by-product can also help with nutrient efficiencies.	
		2.2.2 Implement the Fertiliser Action Plan.	DWER (Environmental Regulation)	DBCA, DWER, DPIRD, EBICG	Ongoing	• The Fertiliser Action Plan (2007) was replaced by the Fertiliser Partnership (2012-16). DBCA worked with DPIRD and other partners on the Fertiliser Partnership objectives. The future of the Fertiliser Partnership is being considered by State Government. • The *Environmental Protection (Packaged Fertiliser) Regulations 2010* puts limits on the P content and nitrogen (N) ratio for fertiliser in 50kg or less bags sold in WA to target urban users. However, agricultural users would not be affected.	
	2.3 Reduce outputs through increasing community capacity	**2.3.1** Develop and implement fertiliser efficiency education and provide opportunities for landowners to examine alternative farming practices (including but not exclusively tree farming, alternative cropping and pastures, farming bush foods and maintenance of remnant vegetation).	EBICG	DPIRD, DWER, CoS, SoC, SoG, DBCA	Four events annually	• Horse Property Workshops have been held in the catchment to encourage improved property management for horse health and to prevent nutrient losses. • Heavenly Hectares Workshops held - encourages good land management practices for rural and semi-rural properties. • Ongoing community liaison and workshops by EBICG and Perth NRM.	

3. Reduction Source control	**3.1** Reduce agricultural industry nutrient losses through best management practices	**3.1.1** Land managers on land units identified as having high discharge loads shall undertake actions including streamlining and revegetation, fertiliser management and alternative production regimes to reduce the exports of nutrients.	Landowners, EBICG	DWER, DBCA, DPIRD, CoS, SoC, SoG	100% compliance by 2025	• The Healthy Soils Healthy Rivers Program assists landholders and community groups implement on-ground activities that will improve soil health and water quality in the Swan and Avon rivers. These activities include 1. Broad Acre Cropping/Grazing Soil Nutrient Management, and 2. Irrigated Agriculture Nutrient Management Advisory Services. The program is a joint initiative of Perth NRM, Wheatbelt NRM and DBCA with funding from the Australian and Western Australian governments. • Between 2013 and 2016 EBICG engaged with several private landholders to plan and implement fencing and revegetation projects to protect the Ellen Brook. The program was funded through a State NRM grant secured by DBCA and the Australian Government National Landcare Program.	
		3.1.2 Landowners in the Bassendean and Yanga soil types to trial soil amendments *in situ* to determine effectiveness in reducing nutrient runoff and groundwater contamination.	Landowners, DPIRD, EBICG	DBCA, WC	100% compliance by 2015	• Soil amendment trials have been completed in the Ellen Brook Catchment and a soil amendment demonstration field day was held with around 50 stakeholders/landowners, however, further work is necessary to reach a point where amendments can be promoted and sold across the catchment. The trials were run by CSIRO and then the Swan River Trust, in partnership with ChemCentre, Water Corporation and DAFWA, between 2011 and 2015. The 1 ha soil amendment trial site has been preserved and maintained and ChemCentre are continuing to collect data that is informing development of the Leaching and Environmental Assessment Framework in Western Australia.	

		3.1.3 Implement soil amendment based on results from trials and land use change to perennial pastures.				•Further work is required before catchment-wide soil amendments are available. Whilst soil amendments studied at the Pearce trial site were all shown to be very effective at retaining P, there remains impediments to their supply due to barriers in regulations on waste re-use.	
		3.1.4 Replace annual pastures with perennial pastures on all erosion prone and high-leaching soils.	Landowners, EBICG, DPIRD	CoS, SoC, SoG	50% broadacre properties compliance by 2015	• DPIRD promote the replacement of annual pastures with perennial pastures, mainly through publications, however, the resourcing of this has reduced and it is unknown what the uptake by landholders is. In addition, DPIRD research on perennial pastures suggests they may have some capacity to reduce N loss but are unlikely to reduce P loss under the current soil fertility guidelines. • EBICG continues to advise property owners on best practice and perennial pasture establishment. • EBICG developed an Equine Management Template that property owners need to submit to SoC and CoS. This includes manure, and fertiliser management to prevent excess nutrients leaving the properties. Perennial pastures are also recommended in this process. SoC has a policy that limits the number of livestock per hectare on properties, whereby only half as many animals are allowed e.g.5DSE per hectare and no livestock on environmentally sensitive areas (ESAs).	
4. Amelioration Conveyance and transmission	**4.1** Nutrient intervention and improved drainage	**4.1.1** Implement nutrient interventions: (i) where "off paddock drains" enter Ellen Brook to prevent nutrient export (ii) to major	Landowners, DBCA	EBICG, DWER	Nutrient load reduction targets met by 2025	DBCA's DNIP projects implemented in the Ellen Brook Catchment in a partnership arrangement with EBICG include: • The first stage of the Ellen Brook Wetland was constructed in Belhus. This includes a lined sub-surface flow wetland basin approximately 60 metres in diameter containing IronMan Gypsum® (IMG) as part of a filter media blend with P and N removal	

		waterways where appropriate (iii) to treat groundwater in drains where suitable.				capacity, and a lower wetland basin including two deep zones and two vegetated surface flow wetland compartments. The wetland was planted with 70,000 seedlings, all local species, and is monitored intensively. Future stages are possible to increase capacity and performance. • The Brand Highway Nutrient Filter - in the main channel of the Ellen Brook is just upstream of the Brand Highway crossing. The filter consists of cracked laterite to adsorb phosphate, and zeolite to adsorb ammonium. There are also four rock groynes just upstream of the filter to trap organic debris and promote sedimentation to prevent the filter clogging. The filter was designed to treat low flows and allow high flows to pass over the top. • The Bingham Road Creek Wetland - located on a major tributary of the Ellen Brook is a constructed ephemeral wetland and revegetation area along the Bingham Creek. Approximately 42,000 plants were installed at the site. • Muchea North Drain Wetland and Nutrient Filter - was constructed as demonstration site within a constrained area of a railway reserve. It is a shallow ephemeral wetland and nutrient filter on a minor tributary of the Ellen Brook (in terms of flow, however one of the highest in nutrient concentrations). • 50 tonnes of Phoslock® was applied to the Ellen Brook in 2013 and estimated to reduce soluble P loads entering the Swan River by up to 500 kilograms.	
		4.1.2 Seek funding to continue fencing and revegetation of Ellen Brook tributaries until all	Landowners, EBICG	DBCA		• Between 2013 and 2016 EBICG engaged with several private landholders to plan and implement fencing and revegetation projects to protect the Ellen Brook. The program was funded through a State NRM grant secured by	

		are protected from stock incursion.				DBCA (then Swan River Trust) and the Australian Government's National Landcare Program. • EBICG seeks funding each year to continue this program.	
5. Treatment – Reuse - Disposal	**5.1** Full connection to infill sewerage	**5.1.1** Ensure full connection of all properties to deep sewerage in the Muchea and West Bullsbrook townsites.	CoS, SoC, WC	EBICG	100% compliance by 2025	• These areas are not currently on the State Government Infill Sewerage Program, administered by the WC. From the local governments' perspective all they can do is request/advocate for infill sewer in priority areas. • A recent study of the Muchea townsite has recommended against reticulated sewerage, likely due to cost. SoC continues to advocate for its construction.	