Bayswater Brook

Bayswater Brook is a permanently flowing drainage network with both open and covered sections. Many of the current drains were once natural watercourses that were modified for use as drainage to allow development of the area. The main drain discharges into the Middle Swan Estuary upstream of Garratt Road Bridge in Bayswater.

Clearing and development in the catchment began in the late 1800s and very little native vegetation now remains. This has affected water levels and flow patterns in the drains in two ways. Firstly, groundwater levels have risen, increasing the volume of groundwater entering the drains and causing them to flow year-round. Secondly, the large proportion of the catchment covered by hard surfaces (i.e. roofs and roads) has increased the amount of surface run-off to the drain.

Bassendean sands are the most common soil type in the catchment. This soil type is characterised by its poor nutrient-retention capabilities. Any nutrients applied to the surface will rapidly leach into the groundwater after water is applied. Before development, several peaty swamps were present, most of which have now been in-filled, leaving a peaty layer of soil in some areas.

Water quality is monitored fortnightly at the Department of Water and Environmental Regulation gauging station near the catchment's lower end, shortly before the drain flows into the King William Street Main Drain and subsequently into the estuary. The site is positioned to indicate nutrient concentrations leaving the catchment and flowing into the Swan Estuary, so the data may not represent nutrient concentrations in upstream areas.

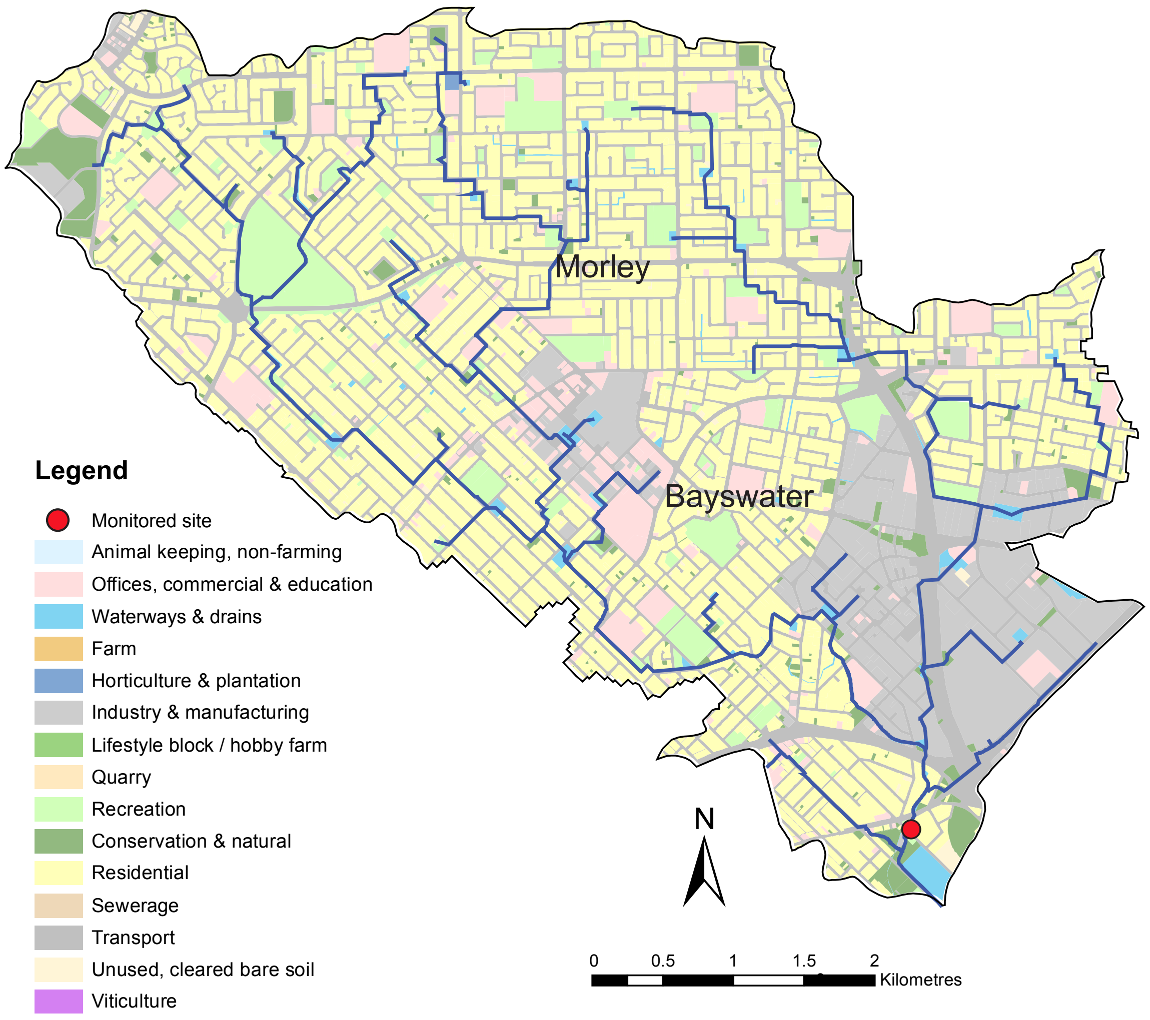



Photo: Water Science Branch

Outlet of Eric Singleton Bird Sanctuary, November 2015.

Bayswater Brook – facts and figures

Average rainfall (2012–16)	~ 680 mm per year (Perth metro)
Catchment area	27 km^2
Per cent cleared area (2005)	97%
River flow	Permanent No major water supply dams in catchment
Average annual flow	~ 7.5 GL per year (2012–16 average)
Main land uses (2005)	Residential and transport (roads). Historically agriculture in the form of market gardens was also common

Nutrient Summary: concentrations, estimated loads and targets

Year	Site	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Annual flow (GL)	616082	3.2	6.0	11.2	6.9	4.3	6.3	8.2	6.4	5.3*	6.5*	11.3*
TN median (mg/L)	SWS10	1.10	1.30	1.20	1.30	1.30	1.60	1.35	1.40	1.40	1.40	1.30
TP median (mg/L)	SWS10	0.068	0.047	0.060	0.060	0.057	0.056	0.059	0.061	0.049	0.047	0.045
TN load (t/yr)	SWS10	4.45	7.92	13.49	8.98	5.93	8.37	10.66	8.52	7.26*	8.49*	13.09*
TP load (t/yr)	SWS10	0.25	0.42	0.84	0.50	0.32	0.46	0.56	0.45	0.35*	0.46*	0.61*

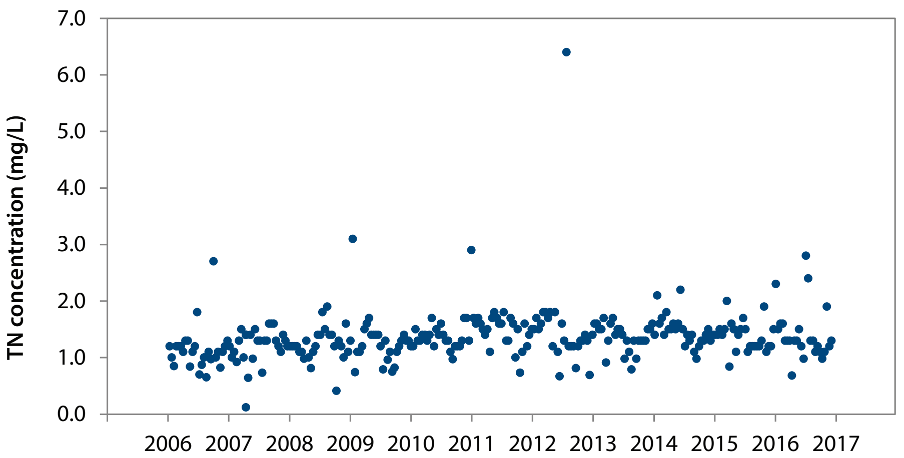
TN short term target = 2.0 mg/L TN long term target = 1.0 mg/L TP short term target = 0.2 mg/L TP long term target = 0.1 mg/L

insufficient data to test target | failing both short and long-term target | passing short but failing long-term target | passing both short and long-term target

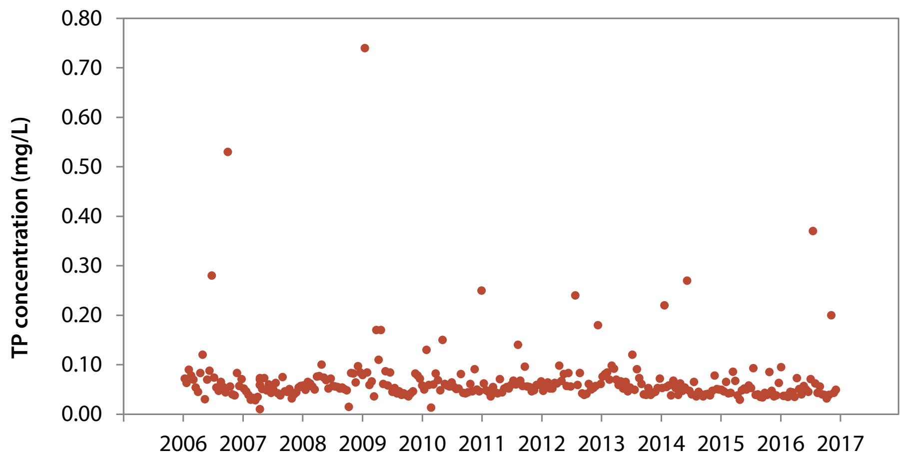
* Best estimate using available data. # Statistical tests that account for the number of samples and large data variability are used for testing against targets on three years of winter data. Thus the annual median value can be above the target even when the site passes the target (or below the target when the site fails).

Changes in nutrient concentrations over time in Bayswater Brook

Total nitrogen concentrations over the 2006 to 2016 monitoring period



Total phosphorus concentrations over the 2006 to 2016 monitoring period



Trend

Total nitrogen (TN) concentrations were relatively stable over the reporting period with perhaps a slight increase between 2006 and 2012 followed by a minor decrease. There were no trends detected over either the long- or short-term (2007–16 and 2012–16 respectively).

Target

Bayswater Brook has been passing the short-term but failing the long-term TN target for the reporting period.

City of Bayswater staff, partly funded through the Department of Biodiversity, Conservation and Attractions DBCA), sampling water quality in a revegetated section of Bayswater Brook. Photo: DBCA.

Trend

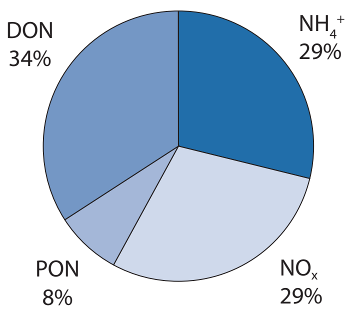
Total phosphorus (TP) concentrations were fairly steady until 2013 after which they appeared to decrease. No long-term (2007–16) trend was detected however there was a slight emerging decreasing trend of 0.004 mg/L/yr over the short-term (2012–16). There were not enough data points to verify this trend.

Target

Bayswater Brook has been passing the short- and long-term TP targets for the reporting period.

Nutrient fractions and estimated loads in Bayswater Brook

Average composition of nitrogen (N) in Bayswater Brook over the 2012 to 2016 monitoring period



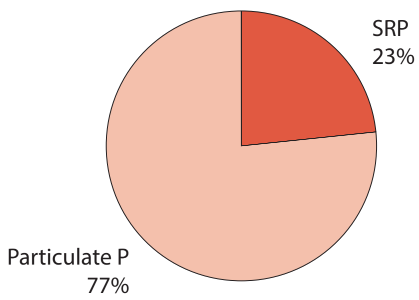
Nitrogen

Almost two-thirds of the nitrogen (N) was present as dissolved inorganic N (DIN, consisting of ammonium – NH_4^+ and N oxides – NO_x) which is readily available for plant and algal uptake. It was probably derived from fertilisers used on parks and gardens, industrial runoff, animal waste and septic tank leachate from those areas that are not sewered and have a high groundwater level. Organic N made up the remainder of the N and consisted of dissolved (DON) and particulate (PON) fractions. DON largely comprised organic compounds leached from peaty sub-soils and degrading plant and animal matter and is available for uptake by plants, algae and bacteria. PON is composed of plant and animal debris and needs to be further broken down to be available.

The brook had the fourth-largest average TN load (2012–16) of the nine subcatchments with flow data and the largest average TN load per unit area (0.32 t/km²/yr).

Average composition of phosphorus (P) in Bayswater Brook over the 2012 to 2016 monitoring period

Just over three-quarters of the phosphorus (P) was present in the form of particulate P which is not readily available for plants and algae. This form of P consists of sediment-bound forms of P and organic waste materials, as well as algae and bacteria. Soluble reactive phosphorus (SRP), which is readily available for plant and algal growth, was present in relatively low concentrations. The proportion of SRP to particulate P was very low compared with other catchments that have predominantly leached sandy soils (in fact it is the second-lowest of the 33 sites sampled). It is likely that physical and chemical conditions cause most of the



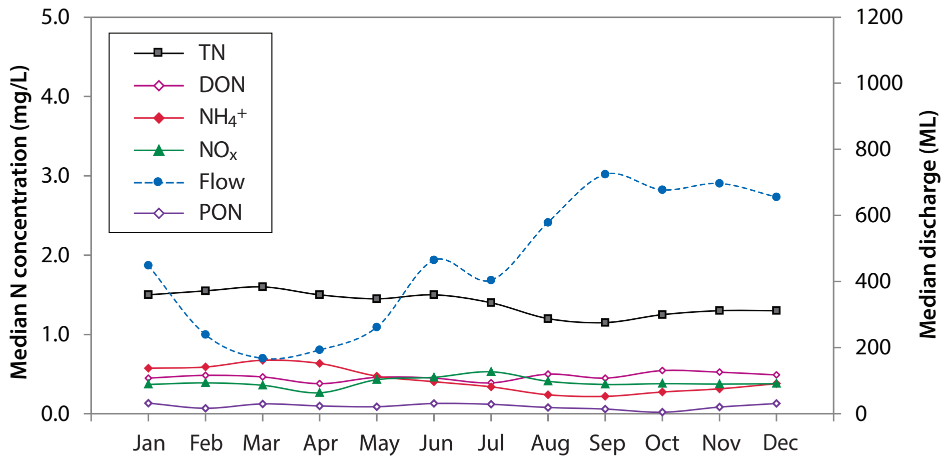
Phosphorus

SRP entering the drain to form insoluble particles by binding with metals such as iron and aluminium.

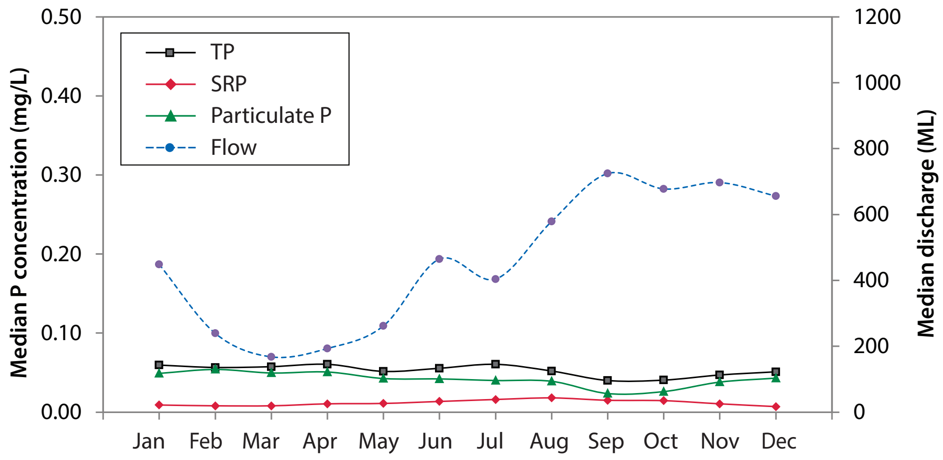
Bayswater Brook had the fourth-largest average TP load of the nine catchments with flow data (2012–16). It also had the third-largest TP load per unit area (0.015 t/km²/yr).

Seasonal variation in nutrient concentrations in Bayswater Brook

Nitrogen seasonal variation over the 2012 to 2016 monitoring period



Phosphorus seasonal variation over the 2012 to 2016 monitoring period



Nitrogen

No strong seasonal pattern was evident for N, though there was a slight decrease in TN and NH_4^+ concentrations after the onset of winter rains. It is reasonable to conclude that most of the N was entering the drain from sub-surface and groundwater sources (and hence being slightly diluted by the increase in discharge following the onset of winter rains). Large-scale clearing in the catchment has raised groundwater levels, bringing them closer to the surface and increasing their relative contribution to stream-flow. The porous soils of the catchment allow any N applied to the surface (e.g. in the form of fertilisers) or leaching from septic tanks to flush through and rapidly enter the drain through either sub-surface flow or groundwater.

Phosphorus

Phosphorus concentrations remained reasonably constant throughout the year; that is, they were not greatly influenced by season (or rainfall). As discussed for the N, it is likely that most P is entering the drain as SRP through subsurface and groundwater flows and, once in the drain, forms particulate P by binding with metals such as iron and aluminium. Particulate P is also present as algae, bacteria and plant and animal debris, from both in-stream and catchment sources.

Photo: Water Science Branch

Photo: Dominic Heald

Photo: Dominic Heald

Photo: Department of Biodiversity, Conservation and Attractions

Photographs of Bayswater Brook: (Top left) Bayswater Brook sampling site, August 2012. (Bottom left) Bayswater Brook sampling site following heavy winter rains, August 2017. (Right) Revegetation along Bayswater Brook, November 2015.

Local nutrient reduction strategies for Bayswater Brook

Nutrient reduction strategies being undertaken or recently completed within the Bayswater Brook catchment include but are not limited to:

- Riverwise Sustainable Gardening Workshops Autumn series held in 2017.
- The Eric Singleton Bird Sanctuary Wetland which has been constructed through a partnership between the City of Bayswater and the Department of Biodiversity, Conservation and Attractions (DBCA) to decrease the amount of nutrients entering the Swan River from the brook.
- The 2015–17 Light Industry Program, which is a project delivered by the Department of Water and Environmental Regulation (DWER) in partnership with DBCA and seven local governments in the Swan Canning Catchment, including the City of Bayswater. Businesses in Bayswater have been audited and provided recommendations or requirements to reduce the risk of releasing nutrient and non-nutrient contaminants into Bayswater Brook and groundwater systems. This program follows and earlier Light Industry Auditing Project, which saw around 250 small to medium enterprises audited by local government environmental health officers (supported by Perth NRM).
- City of Bayswater in partnership with DBCA is engaging with the Water Corporation and the DWER's Drainage for Liveability Program.
- The *Bayswater Brook Action Plan* has been developed and focuses investment and prioritises nutrient-reduction strategies within the catchment.
- Weld Square living stream project and other compensating basin improvement works have been implemented with assistance from Weld Square primary school students.
- A concept plan has been developed for the Russell Square compensating basin redevelopment including a pop-up park.
- The DBCA Riverbank Program which has funded erosion control and revegetation projects, including in areas along the foreshore at Hinds Reserve, Riverside Gardens, Tranby House and Bath Street Jetty.
- Ongoing sub-regional partnership projects whereby the DBCA and City of Bayswater are working together to deliver water quality and community capacity-building outcomes.
- The Phosphorus Awareness Project which assists the community in reducing their nutrient outputs through education, promotion and behaviour change programs.
- The DBCA's Healthy Catchments Program aims to protect the environmental health and community benefit of the Swan Canning river system by improving water quality in the catchments. This is achieved through engaging partners and focusing the effort of local governments, sub-regional groups, the community and other organisations in water quality improvement activities.

Swan Canning water quality improvement plan

The Swan Canning water quality improvement plan (SCWQIP) complements the River Protection Strategy (RPS) and presents a roadmap for reducing nutrient inputs into the Swan Canning river system. It uses sophisticated modelling to identify nutrient sources and provides nutrient-reduction targets for each of the subcatchments.

The Bayswater Brook catchment has a local WQIP that draws together activities for improving water quality in the catchment and helps to target future investment for better water quality outcomes.

SCWQIP load and concentration targets for Bayswater Brook

	Max. load (t/yr)	Conc. target (mg/L)	% reduction
TN	4.0	0.50	59%
TP	0.44	0.050	27%

For further information on the RPS and the SCWQIP contact rivers.info@dbca.wa.gov.au

Summary: Bayswater Brook

- Bayswater Brook is currently passing both the short- and long-term TP targets.
- It is passing the short- but failing the long-term TN targets.
- Compared to the other 32 sites, little phosphorus is present as highly bioavailable SRP.
- There was an emerging decreasing short-term trend in TP concentrations however the magnitude of this trend is very small.
- Of the 33 sites sampled, Bayswater Brook has the second-highest proportion of N present as bioavailable DIN.
- Of the nine sites with flow data, it has the largest average TN load per unit area and the third-largest average TP load per unit area.
- The proportion of P present as SRP has increased by nearly 9% since the last nutrient reports (2011).
- To enable it to meet the SCWQIP targets, a 59% reduction is required in TN and a 27% reduction in TP.

For further information please contact the
Water Science Branch, Department of Water and Environmental Regulation
catchmentnutrients@dwer.wa.gov.au

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