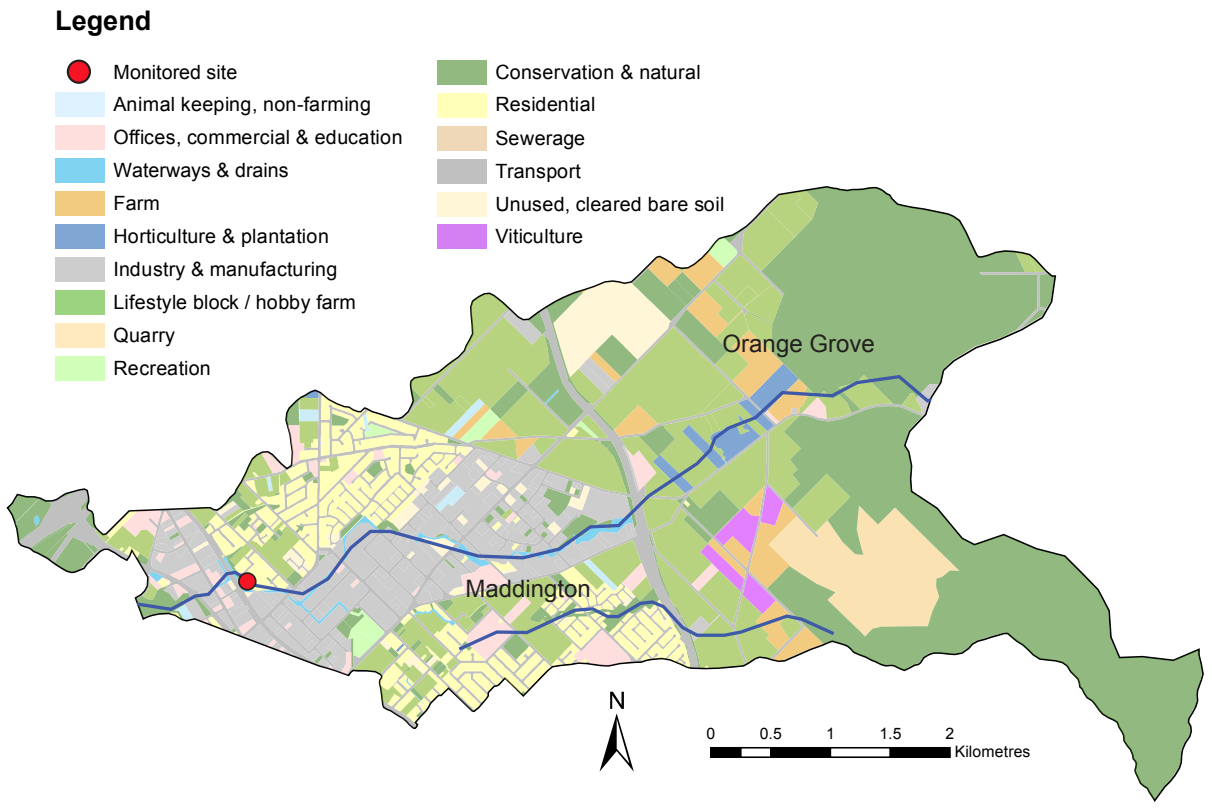
Bickley Brook

Bickley Brook is a natural system at its headwaters in the Darling Scarp, but changes to a deeply incised drain on the Swan Coastal Plain. It discharges into the Canning River in Maddington, upstream of the Kent Street Weir. The Bickley Brook catchment is 21 km^2, however the upstream Munday Brook catchment (not shown on map) also contributes flow to the Canning River through Bickley Brook, leading to a total catchment area of 72 km^2.

Much of the catchment has been cleared for agriculture and urban development. There is some remnant vegetation in poor condition at the top of the catchment. A large quarry is situated at the top of the catchment, near the southern edge. Erosion is a significant problem along firebreaks, roadsides, embankments and drainage lines. Weed infestation along watercourses is also widespread.

Bickley Brook flows west from the steep slopes and incised valleys of the Darling Scarp. Soils here are predominantly shallow red and yellow earths with rock outcrops. Moving west the brook passes through gravelly and sandy Forrestfield soils in the foothills of the scarp. Further west the brook is deeply incised into yellow duplex Guildford soils, finally intersecting a small area of alluvial red earth adjoining the Canning River. Bickley Brook soils have a relatively high capacity to retain nutrients. Groundwater in the catchment's coastal plain portion is reasonably shallow (approximately 4 m or less).

Water quality is monitored fortnightly at a site near the brook's lower end, close to Austin Avenue in Kenwick, where the Water Corporation also measures flow. This site monitors nutrients leaving the catchment, so the data may not accurately represent nutrient concentrations in upstream tributaries.



Bickley Brook – facts and figures

Average rainfall (2012–16)	~ 680 mm per year (Perth metro)
Catchment area	21 km^2 (total of Bickley Brook sub-catchment, the brook itself starts upstream of this)
Per cent cleared area (2005)	36% (Munday and Bickley Brooks)
River flow	Ephemeral Bickley Brook Reservoir is located on Bickley Brook; one of its tributaries, Munday Brook, has the Victoria Reservoir on it. Both of these are upstream of the Bickley Brook sub-catchment
Average annual flow	1.7 GL per year (2015–16 average)
Main land uses (2005)	Conservation and natural (Munday and Bickley Brooks).

Nutrient Summary: concentrations, estimated loads and targets

Year	Site	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Annual flow (GL)	616047	0.8	2.4	2.9	2.4	0.8	2.9				0.7*	2.6*
TN median (mg/L)	SWS4	0.71#	1.60	1.30	0.95#	0.90#	0.77#	0.71#	0.65#	0.74#	0.62#	0.94#
TP median (mg/L)	SWS4	0.039	0.042	0.031	0.041	0.030	0.049	0.054	0.046	0.037	0.041	0.044
TN load (t/yr)	SWS4	1.05	3.36	4.27	3.42	1.17	4.24				0.92	3.60
TP load (t/yr)	SWS4	0.01	0.06	0.09	0.07	0.02	0.09				0.04	0.17

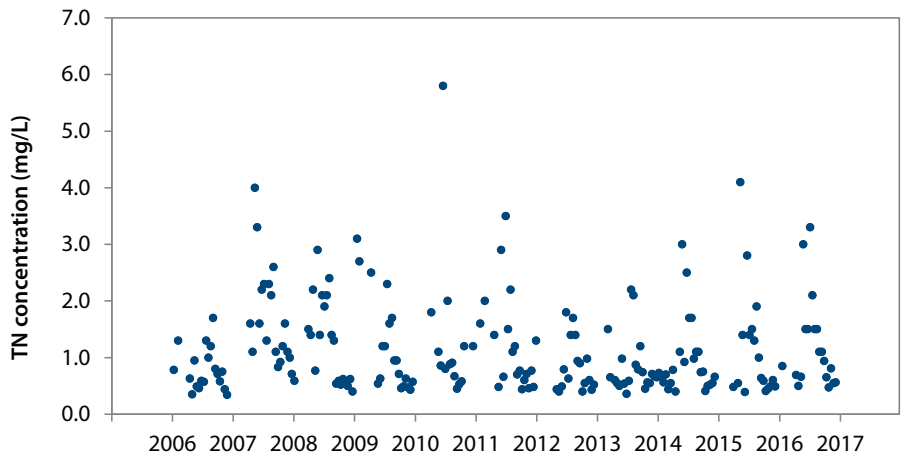
TN short term target = 2.0 mg/L TN long term target = 1.0 mg/L TP short term target = 0.2 mg/L TP long term target = 0.1 mg/L

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 Bickley Brook

Total nitrogen concentrations over the 2006 to 2016 monitoring period



Trend

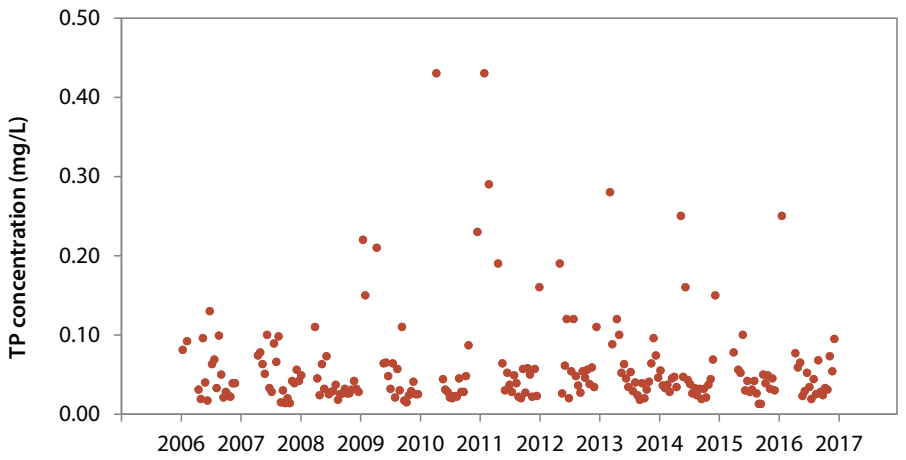
With the exception of 2007 when concentrations were higher, total nitrogen (TN) concentrations remained stable in Bickley Brook. There was no trend recorded over either the short- or long-term (2012–16 and 2008–16 respectively). Why TN concentrations were higher in 2007 than surrounding years is unknown. The number of unusually high TN concentrations has reduced since 2012 when the last nutrient reports were published. This may be due to TN point sources in the catchment being switched off or removed.

Target

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

Bickley Brook; turbid following heavy rains, August 2017. Photo: Dominic Heald.

Total phosphorus concentrations over the 2006 to 2016 monitoring period



Trend

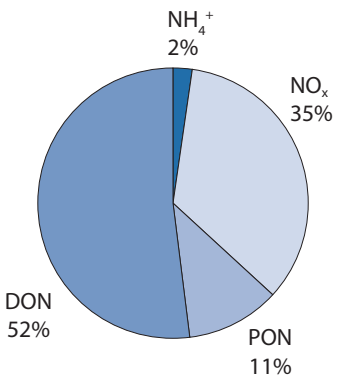
There were some slight fluctuations in total phosphorus (TP) concentrations over the reporting period. No trends were detected over either the short- or long-term (2012–16 and 2007–16 respectively). Unlike TN, there were still occasional high TP concentrations and, in fact, the number of these high concentrations appears to have increased since the last full nutrient report, published in 2012.

Target

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

Nutrient fractions and estimated loads in Bickley Brook

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

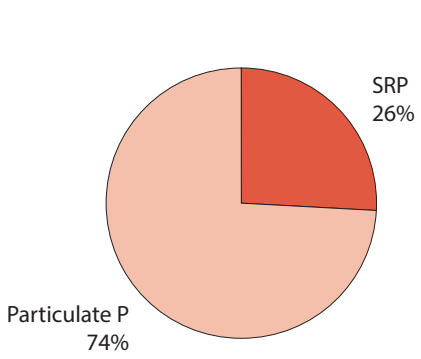


Nitrogen

Sixty three per cent of the nitrogen (N) was organic N which consists of both dissolved (DON) and particulate (PON) fractions. DON largely comprises organic compounds leached from peaty subsoils 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 become available. The remaining N was present as dissolved inorganic N (DIN, consisting of ammonium – NH_4^+ and N oxides – NO_x) which is mostly derived from animal waste and fertilisers. These forms of N are readily available for plant and algal uptake.

As Bickley Brook did not have flow (and therefore load) information available for the last five years (2012–16) it was not possible to compare its loads with the other subcatchments.

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



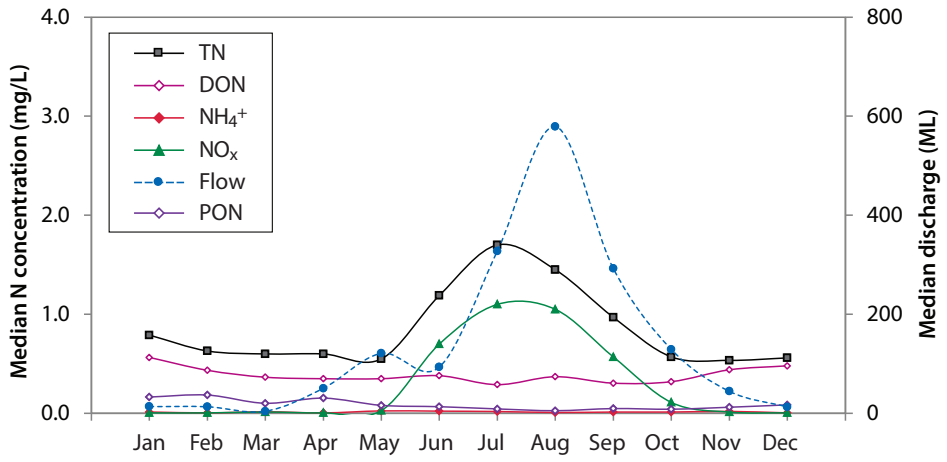
Phosphorus

Almost three-quarters of the phosphorus (P) was present as particulate P, which is not immediately available for plant and algal uptake. Likely sources of this kind of P include organic matter and sediment-bound forms of P. Particulate P is commonly derived from soil erosion in the catchment. The remaining P was present as soluble reactive phosphorus (SRP) which is commonly derived from fertilisers used in the catchment, runoff from industry, animal waste and septic tank leachate. This form of P is a readily available nutrient source for plants and algae.

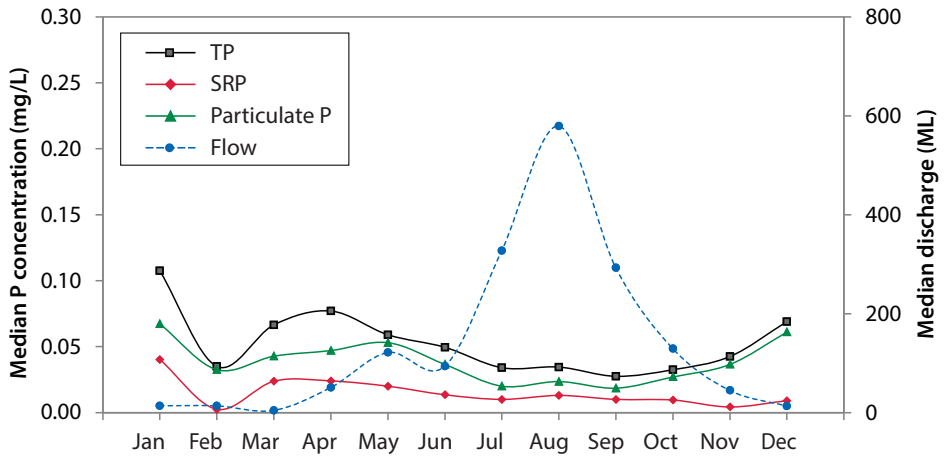
As Bickley Brook did not have flow (and therefore load) information available for the last five years (2012–16) it was not possible to compare its loads with the other subcatchments.

Seasonal variation in nutrient concentrations in Bickley Brook

Nitrogen seasonal variation over the 2012 to 2016 monitoring period



Phosphorus seasonal variation over the 2012 to 2016 monitoring period



Nitrogen

TN and NO_x concentrations showed a seasonal pattern, rising with the onset of winter rains and increased flow and falling again as flow eased. This indicates that groundwater, surface and subsurface flows are all contributing N to the brook during the winter months when increased runoff flushes N from the soil. On the other hand, organic N (both particulate and dissolved) tended to have slightly higher concentrations in summer and lower in spring. The brook does not generally flow year-round so the values for January to March are due to only a few data points.


Photo: Kelli O'Neill

Phosphorus

Particulate P concentrations showed a slight reverse seasonal response, reducing in winter and increasing again in summer. The higher concentrations in January and March were due to a few data points collected during a period that the brook does not often flow. The peak in particulate P in April was probably due to a first flush effect where nutrients are washed into the brook with the onset of winter rains. For the remainder of the year, P is most likely to be entering the brook via groundwater, and subsurface flows. Particulate P will also be forming through in-stream sources.


Photo: Kelli O'Neill


Photo: Dominic Heald

Photo: Kelli O'Neill


Photo: Water Science Branch

Photographs of Bickley Brook: (Top left) Looking downstream to the Bickley Brook gauging station, August 2017. (Bottom left) A Pearl Cichlid (*Geophagus brasiliensis*), an aggressive introduced fish which outcompetes native species for food and resources, May 2013 (Right) A rock riffle installed as part of the Urban Waterways Renewal project, May 2013.

Local nutrient reduction strategies for Bickley Brook

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

- The Bickley Brook Urban Waterways Renewal Project which includes three sections of living stream that have been designed, developed and installed: the Bickley Brook confluence living stream, the Mandarin Road living stream and the Eva Street to Tonkin Highway living stream. Two rain gardens were installed in the light industrial area. These remediation works aim to reduce nutrient loads leaving the brook and entering the Canning River, and to improve the brook's ecological values.
- Mapping of illegal stormwater outfalls along Bickley Brook from Tonkin Highway to the confluence with the Canning River.
- Ongoing subregional partnership projects whereby the South East Regional Centre for Urban Landcare, Department of Biodiversity, Conservation and Attractions (DBCA) and community groups are working together to deliver water quality and community-capacity building outcomes.
- The Phosphorus Awareness Project which aims to assist the community in reducing their nutrient outputs through education, promotion and behaviour change programs.
- The 2015–17 Light Industry Program, delivered by the Department of Water and Environmental Regulation in partnership with DBCA and seven local governments in the Swan Canning catchment, including the City of Gosnells. Businesses in the Maddington and Kenwick light industrial areas have been audited and provided with recommendations or requirements to reduce the risk of releasing nutrient and non-nutrient contaminants into waterways and groundwater systems.
- 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 systems. It uses sophisticated modelling to identify nutrient sources and provides nutrient-reduction targets for each of the subcatchments.

The Bickley 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 Munday-Bickley Brook

	Max. load (t/yr)	Conc. target (mg/L)	% reduction
TN	2.3	1.00	21%
TP	0.14	0.100	0%

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


Photo: Kelli O'Neill

Summary: Bickley Brook

- Bickley Brook is currently passing both the short- and long-term TP targets.
- It is passing the short- but failing the long-term TN target.
- Of the 33 sites sampled, Bickley Brook has one of the lowest proportions of P present as bioavailable SRP.
- There were no trends detected in either TN or TP concentrations.
- To enable it to meet the SCWQIP TN target, a 21% reduction is required.
- The TP load is currently considered acceptable and no reduction in TP is required to meet the SCWQIP target.

www.dwer.wa.gov.au
www.dbca.wa.gov.au

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

ISSN 2209-6779 (online only)

Publication date: April 2019