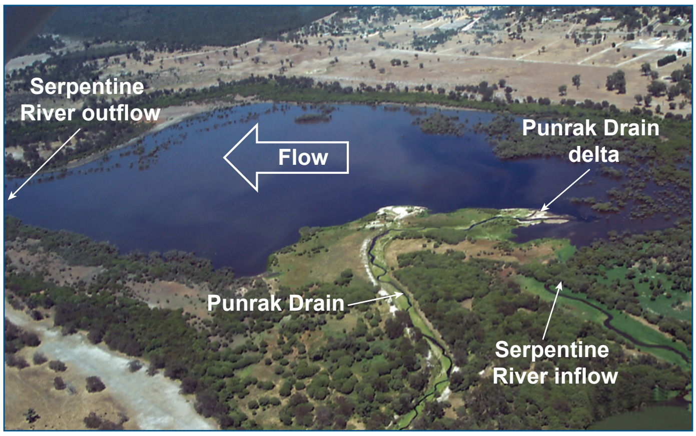
Dirk Brook – Punrak Drain

Dirk Brook begins on the Darling Plateau before flowing onto the Swan Coastal Plain where it is joined by Myara Brook. To the north, Karnet Brook also flows from the plateau, becoming Karnet Drain before its confluence with Dirk Brook. It is at this point the modified drainage system is re-named Punrak Drain.

Punrak Drain flows into Lake Amarillo, one of the Serpentine Lakes. It is responsible for contributing large amounts of nutrients, especially nitrogen, to the Serpentine River and lakes and depositing sediment at the drain's outflow – widening the delta.



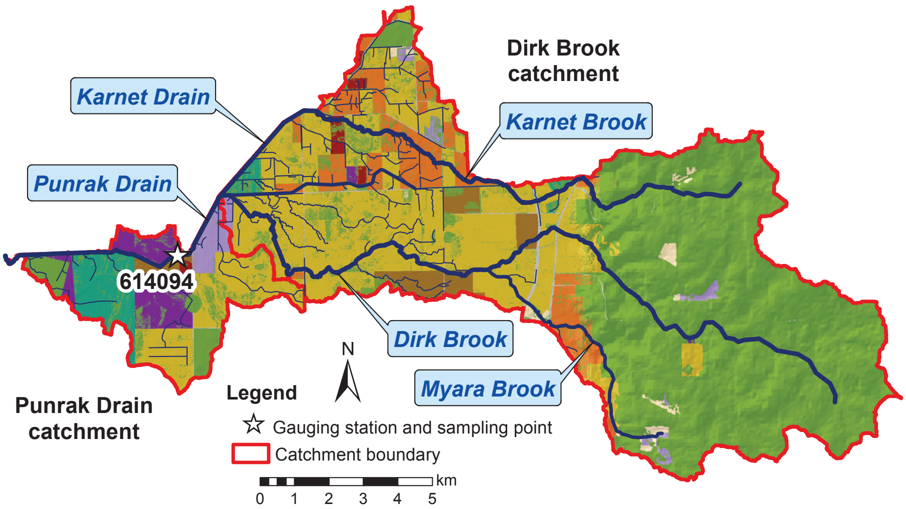
Since July 2006, water quality has been monitored near the bottom of the catchment at the gauging station at Yangedi Swamp (614094). Before this, samples were collected approximately 600 m upstream near the Punrak Road Bridge. No samples were collected between April and June 2006.

Flow has been measured at the gauging station since 1995. Initially this was done by the Water Corporation, but in 2005 the Department of Water assumed responsibility. There was a period of approximately two years when flow was not measured (April 2004 to March 2006).

Punrak Drain flows year-round during wet years but stops flowing from around December to May in dry years. Much of the Punrak Drain catchment is subject to seasonal inundation (52%).

To the east of the Darling Scarp the catchment remains relatively undisturbed. To the west, the land has been cleared, mostly for agriculture (e.g. stock grazing), as well as more intensive land uses (e.g. piggeries and turf farms). The soils in the greater catchment vary, however the Punrak Drain catchment consists entirely of sandy and clayey swamps and leached sands and has a high or very high risk of phosphorus leaching to waterways.

Land use classification (2006)[1]		Area (km^2)	Area (%)
Animal keeping – non-farming (horses)	orange	8.9	6.6
Cattle for beef (predominantly)	gold	37	28
Cattle for dairy	brown	3.5	2.6
Conservation and natural	green	70	53
Horticulture	lilac	2.4	1.8
Industry, manufacturing and transport	grey	1.3	1.0
Intensive animal use	dark red	0.87	0.65
Lifestyle block	cream	1.0	0.75
Mixed grazing	purple	4.1	3.1
Plantation	teal	3.9	2.9
Residential	yellow	<0.01	<0.01
Total		**134**	**100**



Nutrient summary: median concentrations, loads and status classification at 614094

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Annual flow (GL)	4.3	15	42	-	-	4.1*	15	15	18	6.8	12	5.5	11	9.6
TN median (mg/L)	5.1	2.2	1.3	1.6	2.4	2.1*	1.7	2.0	2.8	2.4	2.8	3.0	2.6	1.9
TP median (mg/L)	0.73	0.17	0.14	0.16	0.24	0.26*	0.17	0.23	0.32	0.30	0.26	0.30	0.25	0.21
TN load (t/yr)	7.2	29	95	-	-	8.3*	31	31	38	12	24	10	21	18
TP load (t/yr)	0.77	3.3	11	-	-	0.97*	3.8	3.6	4.3	1.3	2.7	1.1	2.4	2.0

Status classification[2]: Low | Moderate | High | Very high

Status reported for three-year period end (i.e. 2012–14 reported in 2014)

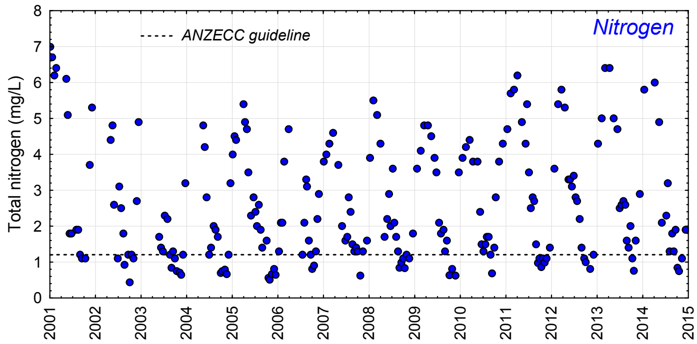
TN = total nitrogen   TP = total phosphorus

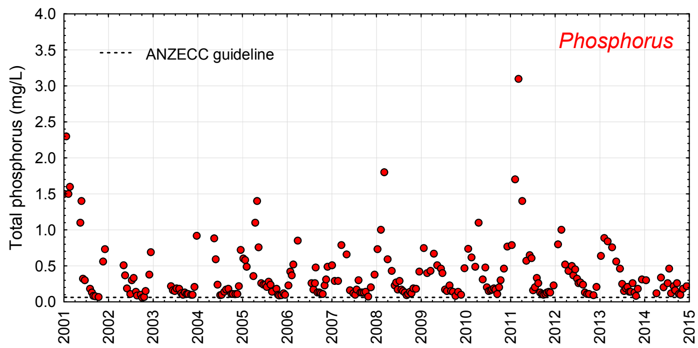
* Best estimate using available data

(- not applicable)

Values are different to those previously reported as only routine grab sample data collected by Department of Water staff is included. In previous nutrient reports for Dirk Brook extra data collected by the Peel-Harvey Catchment Council for a targeted study was included (May to October 2000–05)[3].

Total nitrogen (TN) and total phosphorus (TP) concentrations (2001–14) at 614094





TN concentration:

The annual percentage of TN samples that exceeded the ANZECC[4] guideline for lowland rivers (1.2 mg/L) ranged from 50% (2003) to 94% (2007).

Between 2001 and 2014, 75% of samples exceeded the guideline. This value increased to 80% for the period between 2010 and 2014.

TN trend:

Trend analysis[2] used data from 2010 to 2014 inclusive.

No trend was detected.

TP concentration:

Between 2001 and 2014 all but one sample (2002) exceeded the ANZECC[4] guideline for lowland rivers (0.065 mg/L).

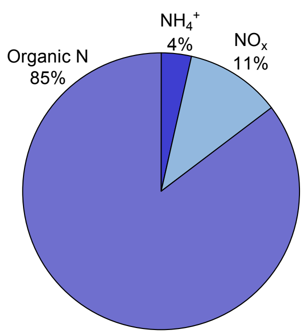
In fact, 15% of TP samples exceeded 0.65 mg/L, 10 times the guideline. With the exception of 2014, each year had at least one sample with a TP concentration greater than 0.65 mg/L.

TP trend:

Trend analysis[2] used data from 2010 to 2014 inclusive.

No trend was detected.

Nutrient fractions (2010–14) at 614094



Nitrogen:

Most of the nitrogen (N) was organic in nature. Organic N consists of both dissolved organic and particulate N. It is derived from degrading plant and animal matter and fertilisers. It often needs to be further broken down before it can be used by plants and algae.

The remaining N was dissolved inorganic N (DIN) such as ammonium (NH_4^+) and N oxides (NO_x).

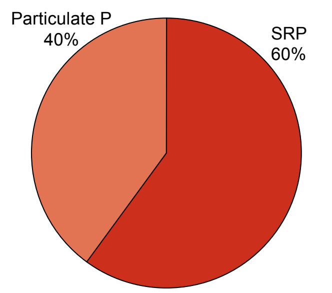
DIN is also derived from animal wastes and fertilisers but is readily available to plants and algae.

Of the five catchments that drain into the Serpentine River, Dirk Brook – Punrak Drain had the highest proportion of DIN (15%).

Phosphorus:

Over half of the phosphorus (P) was present as soluble reactive phosphorus (SRP). SRP is derived from fertilisers and animal wastes and is readily available for uptake by plants and algae.

The remaining P was present as particulate P which consists of sediment-bound forms of P and organic waste materials.

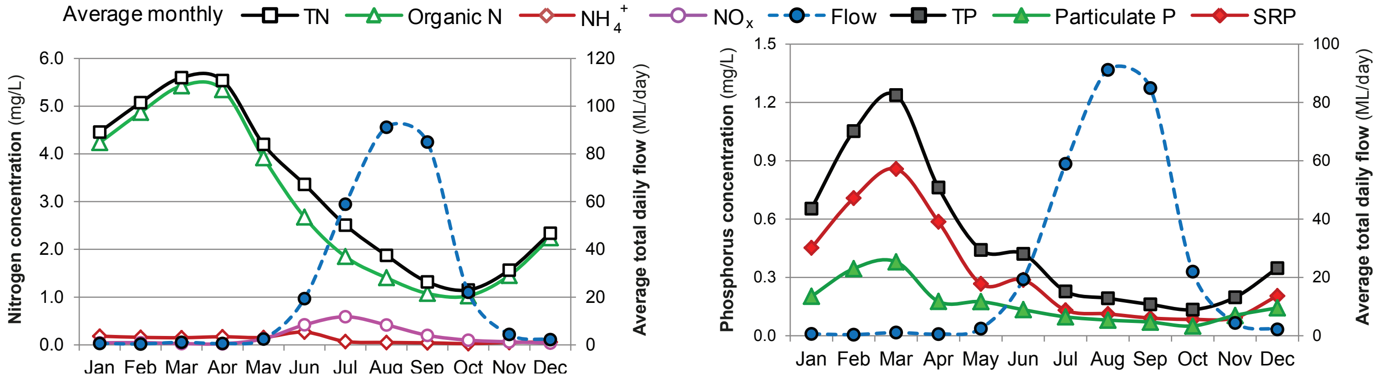


Particulate P is not readily available for uptake by plants and algae, but may become available over time as particles decompose or release bound P.

Dirk Brook – Punrak Drain was one of four sites within the Peel-Harvey catchment that had more than half of the P present as SRP. Of the four, two others flow to the Serpentine River (Gull Road and Nambeelup Brook) while Meredith Drain flows to the Harvey River at the south of the Peel-Harvey catchment.

Punrak Drain, downstream of 614094 – May 2008

Seasonal variations in nutrient concentrations and riverine flow (2010–14) at 614094



Nitrogen:

TN and organic N concentrations were highest during low flows. The high concentrations during the summer were possibly caused by algal blooms, decaying plant matter, nutrient-rich groundwater seepage or from evapo-concentration.

Winter flows diluted the organic N but average monthly NO_x concentrations increased, possibly due to excess fertilisers and animal wastes being flushed into the system.

Average monthly concentrations of TN exceeded ANZECC[4] guidelines throughout the year (except in October).

ANZECC[4] guideline concentrations were also exceeded in summer and autumn by average monthly NH_4^+ concentrations and in winter by average NO_x concentrations.

Phosphorus:

TP concentrations were highest between January and April when flow was at its lowest, possibly due to nutrient-rich groundwater seepage or from evapo-concentration.

	ANZECC 2000[4]	Months exceeded
TN	1.2 mg/L	All*
NH_4^+	0.08 mg/L	Jan–Jun
NO_x	0.15 mg/L	Jun–Sept
TP	0.065 mg/L	All
SRP	0.04 mg/L	All
* Except October		

Average monthly SRP concentrations were greater than particulate P concentrations except in November.

All average monthly TP and SRP concentrations exceeded ANZECC[4] guideline values.

Catchment remediation[3]

Many nutrient reduction measures have been made in the Dirk Brook catchment. In 2001 an artificial wetland was constructed and riffles and meanders were also installed in several waterways. Revegetation and stock exclusion occurred during subsequent years. The aim was to reduce nutrient concentrations and sediment loads, while enhancing the system's ecological values by slowing the flows, increasing oxygen concentrations and providing habitat.

The effect of individual interventions on nutrient concentrations could not be assessed due to insufficient data. Similarly, ecological monitoring was not undertaken after these activities so their effectiveness in improving stream health could not be determined.

No improvement was observed in nutrient concentrations at the bottom of the catchment This is not surprising given the extent of the remediation works relative to the size of the catchment, as well as land use intensification.

Artificial wetland entrance – 2001
Punrak Drain, upstream of 614094

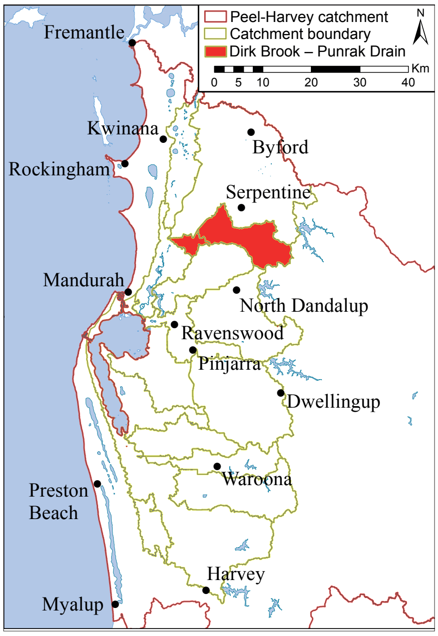
Meander and riffle – 2001
Unnamed drain, north of Karnet Brook

Plant growth

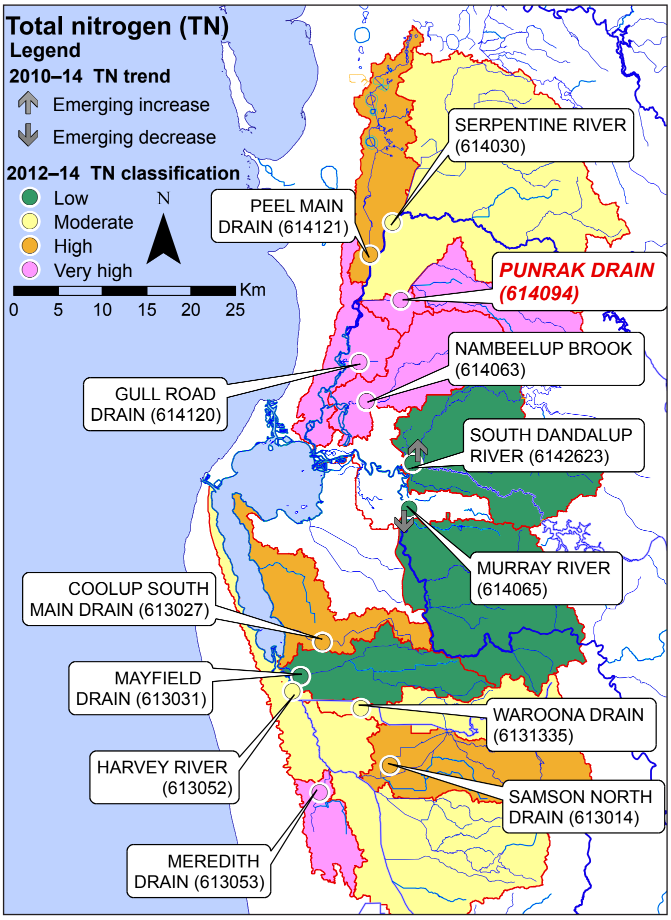
Punrak Drain can become choked with grass and weeds despite ongoing efforts to remove them.

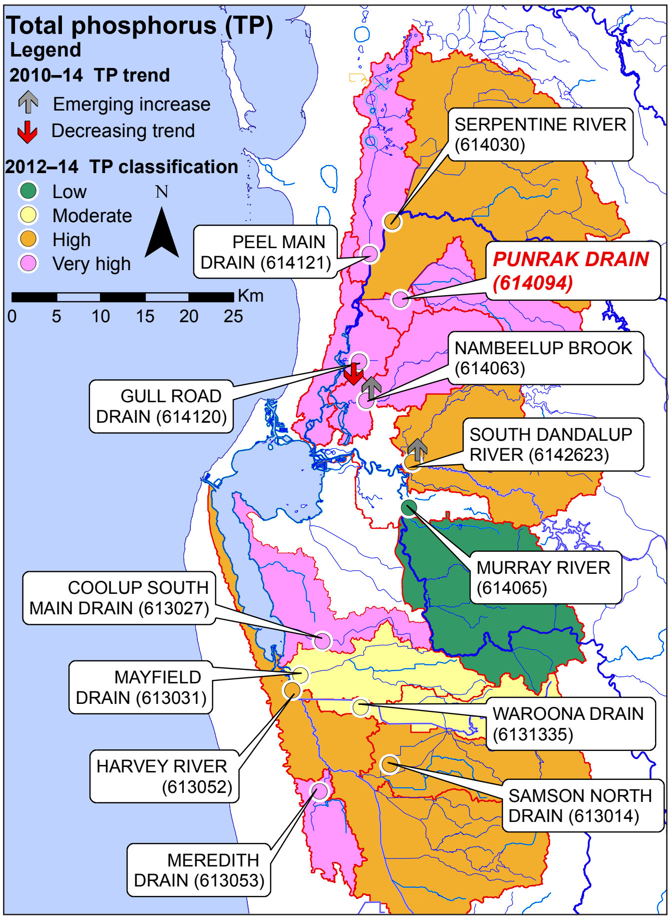
Punrak Drain, 614094 Above: Clear – December 2005 Below: Choked – January 2010

How Dirk Brook – Punrak Drain fits within the Peel-Harvey catchment: location and statistics



Catchment	Receiving waterbody	Sample site (AWRC)	Area (km^2)	2014 Flow (GL)	2014 TN median (mg/L)	2014 TP median (mg/L)
Peel Main Drain	Serpentine River	614121	120	5.0	1.7	0.19
Upper Serpentine River	Serpentine River	614030	502	28	0.79	0.13
Dirk Brook – Punrak Drain	**Serpentine River**	**614094**	**134**	**9.6**	**1.9**	**0.21**
Nambeelup Brook	Serpentine River	614063	143	9.7	3.7	0.60
Lower Serpentine River - Gull Road Drain	Peel Inlet	614120	94	-	4.4	0.93
South Dandalup River	Murray River	6142623	243	-	1.1	0.11
Mid Murray River	Murray River	614065	293	153	0.57	0.01
Coolup South Main Drain	Harvey Estuary	613027	113	2.1	2.1	0.31
Mayfield Drain	Harvey Estuary	613031	119	15	0.73	0.03
Harvey River	Harvey Estuary	613052	408	98	1.4	0.15
Drakes Brook – Waroona Drain	Harvey River	6131335	107	-	0.99	0.07
Samson North Drain	Harvey River	613014	195	-	1.5	0.18
Meredith Drain	Harvey River	613053	56	-	2.8	0.38





References

[1] Kelsey, P, Hall, J, Kretschmer, P, Quinton, B & Shakya, D 2010, *Hydrological and nutrient modelling of the Peel-Harvey catchment*, Water Science Technical Series, Report no. 33, Department of Water, Western Australia.

[2] Department of Water 2015, *Catchment nutrient reports* (methods for the analysis of status classification, loads and trends), <http://www.water.wa.gov.au/water-topics/waterways/assessing-waterway-health/catchment-nutirent-reports>.

[3] Cousins, MD 2010, *Water quality in Dirk Brook, Western Australia – assessing the impact of best management practices in rural drains.* Water Science Technical Series, Report no. 27, Department of Water, Western Australia – unpublished draft.

[4] ANZECC & ARMCANZ 2000, *Australian guidelines for water quality monitoring and reporting,* National Water Quality Management Strategy, Paper no. 7, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

For further information please contact the
Water Science Branch, Department of Water
catchmentnutrients@water.wa.gov.au

ISBN 978-1-925174-75-5 (online)
Publication date: November 2016