Government of Western Australia
Department of Water

Peel-Harvey catchment
Nutrient report 2010

Middle Murray River

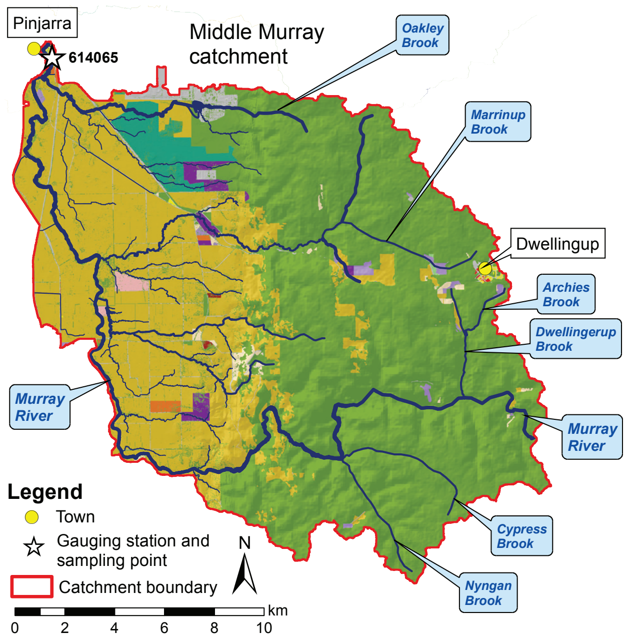
The middle Murray River starts on the Darling Plateau south of Dwellingup and flows towards Pinjarra. The Marrinup and Oakley brooks also start on the plateau north of Dwellingup, both flowing west to join the Murray River.

The sampling site on the Murray River at Pinjarra Road (614065) is one of three long-term monitoring sites within the Peel-Harvey catchment. Nutrients have been monitored at the site since 1983 (except 1994 and 1995) and flow since 1992. The Murray River flows year-round with river height varying by more than 6 m in wet years (i.e. 1996).

Flooding at Pinjarra, highest flow for the year – August 2009

Much of the catchment lies on the Darling Plateau where the soils are mostly ironstone gravel with hard acidic red or yellow soils, although to the west sandy acidic yellow mottled soils dominate. The catchment is not subject to seasonal inundation and only a small percentage has a high or very high risk of phosphorus leaching to waterways (7.5%).

To the Darling Scarp's east the catchment remains relatively undisturbed. West of the scarp the land has been cleared, mostly for agriculture such as stock grazing, as well as horticulture (plantations). Industrial land uses are also present with roads, railways and the southern end of Alcoa's alumina refinery within the catchment. Most of the refinery is located in the lower Murray catchment to the north.



Land use classification (2006)		Area (km²)	Area (%)
Animal keeping – non-farming (horses)		0.76	0.26
Cattle for beef (predominantly)		94	32
Cattle for dairy		0.01	0.01
Conservation and natural		177	60
Cropping		0.10	0.03
Horticulture		1.5	0.52
Industry, manufacturing and transport		6.2	2.1
Intensive animal use		0.14	0.05
Lifestyle block		1.6	0.56
Mixed grazing		2.6	0.89
Offices, commercial and education		0.10	0.03
Plantation		7.0	2.4
Recreation		0.05	0.02
Residential		0.33	0.11
Viticulture		0.92	0.31
Total		**293**	**100**

In 2009 the Murray River had the equal-lowest median TN concentration and the lowest median TP concentration of all the sample sites in the Peel-Harvey catchment.

Nutrient summary: median concentrations, loads and status classification at 614065

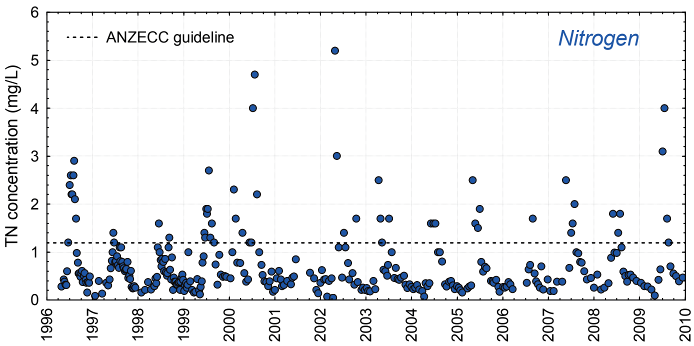
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Annual flow (GL)	585	166	251	348	354	81	184	293	244	334	85	226	237	314
TN median (mg/L)	0.56	0.66	0.47	0.48	0.75	0.45	0.45	0.51	0.32	0.39	0.35	0.67	0.53	0.49
TP median (mg/L)	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01
TN load (t/year)	892	112	209	357	565	46	149	293	276	345	77	266	257	419
TP load (t/year)	22	4.5	7.9	9.2	9.5	1.4	4.1	7.5	6.2	11	2.4	9.6	7.9	12

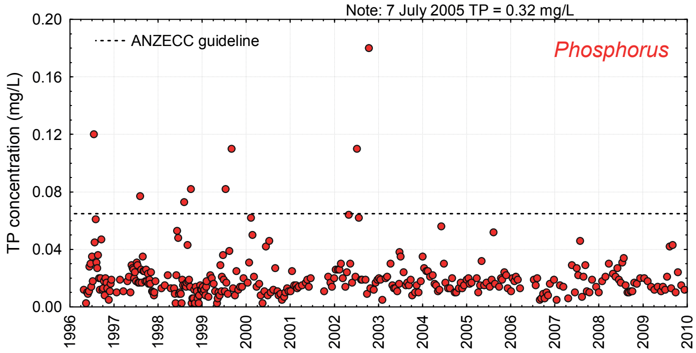
Status classification: Low | Moderate | High | Very high

Status reported for three-year period end (i.e. 1996–98 reported in 1998)

TN = total nitrogen TP = total phosphorus

Total nitrogen (TN) and total phosphorus (TP) concentrations (1996–2009)





TN concentration:

The annual percentage of TN samples that exceeded the ANZECC[1] guideline for lowland rivers (1.2 mg/L) ranged between 0% (2001) and 26% (1996).

Between 1996 and 2004, 14% of samples exceeded the guideline. This value increased to 17% for the period between 2005 and 2009.

TN trend:

Trend analysis was undertaken using data from 2005 to 2009 inclusive.

Once the data were adjusted for flow and seasonality, an emerging increasing trend (0.05 mg/L/year) was detected.

TP concentration:

Between 1996 and 2009 only 3% of TP samples exceeded the ANZECC[1] guideline for lowland rivers (0.065 mg/L).

The weir at Pinjarra – August 2006

In the years when exceedences occured (1996-99 and 2002), only one or two samples had concentrations greater than 0.065 mg/L.

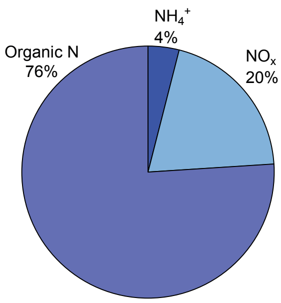
Between 2005 and 2009 only one sample was greater than 0.065 mg/L (0.32 mg/L in 2005).

TP trend:

Trend analysis was undertaken using data from 2005 to 2009 inclusive.

No trend was detected.

Nutrient fractions (2005–09)



Nitrogen:

Most of the nitrogen (N) was organic in nature. Organic N consists of both dissolved organic and particulate nitrogen. 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.

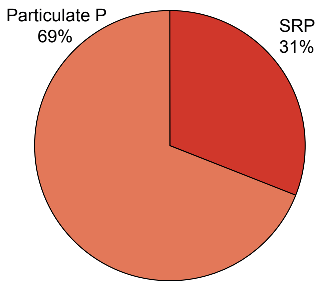
The sampling site on the Murray River had one of the highest percentages of DIN and the highest percentage of NO_x of the 13 sites routinely sampled in the Peel-Harvey catchment.

However, in 2009 this site also had the equal-lowest median TN concentration.

Phosphorus:

Just over two-thirds of the phosphorus (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 organic matter decomposes or soil particles release bound phosphorus.

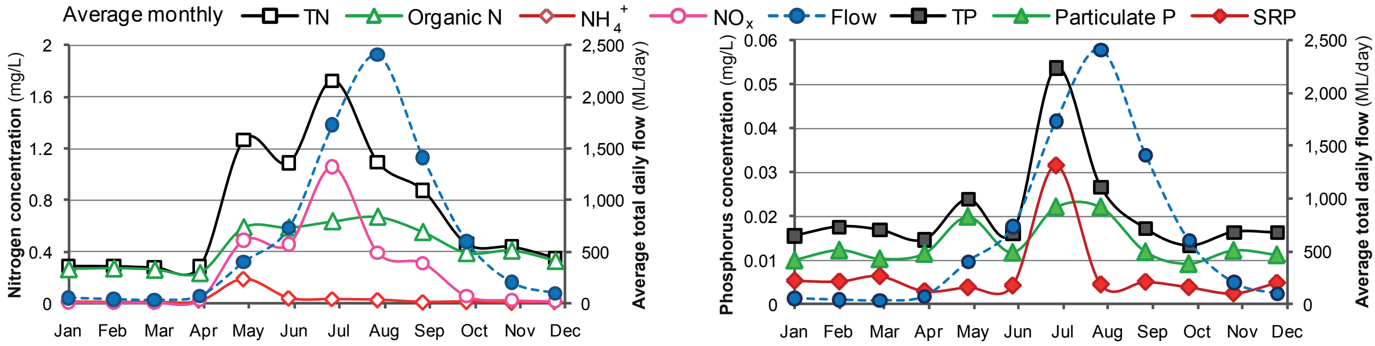


The remaining P was present as soluble reactive phosphorus (SRP), which is derived from fertilisers and animal wastes. SRP is readily available for uptake by plants and algae.

The sampling site had one of the lowest percentages of SRP of the 13 routine sampling sites in the Peel-Harvey catchment. It also had the lowest median TP concentration in 2009.

Upstream view at Pinjarra – December 2005

Seasonal variation in nutrient concentrations and riverine flow (2005–09)



Nitrogen:

Average monthly nitrogen concentrations were greatest in autumn and winter, starting with the first flush in May.

During July average monthly NO_x concentrations increased substantially, possibly due to excess fertilisers and animal wastes being mobilised and flushed into the system.

Average monthly TN, NO_x and NH_4^+ concentrations exceeded ANZECC[1] guidelines during May. Average monthly NO_x concentrations continued to exceed the guideline throughout winter and average TN concentrations also exceeded it in July.

View of the gauging station at Pinjarra – December 2005

View of the gauging station at Pinjarra – August 2009

Phosphorus:

TP and particulate P concentrations were greatest in autumn and winter, starting with the first flush in May.

Average monthly SRP concentrations increased substantially in July (similar to NO_x), when it became the dominant form of phosphorus.

Average monthly TP and SRP concentrations did not exceed ANZECC[1] guideline values.

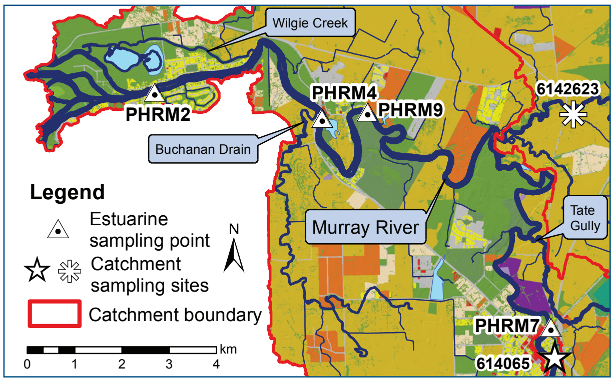
	ANZECC 2000	Months exceeded
TN	1.2 mg/L	May, Jul
NH_4^+	0.08 mg/L	May
NO_x	0.15 mg/L	May – Sep
TP	0.065 mg/L	None
SRP	0.04 mg/L	None

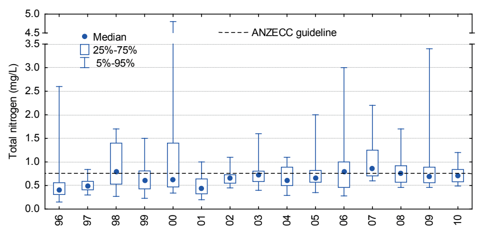
Murray River – estuarine water quality

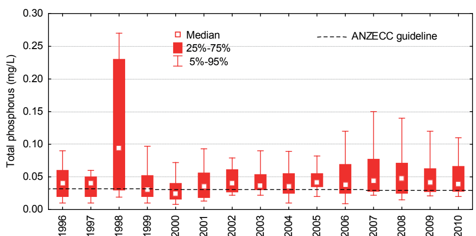
Water quality monitoring along the estuarine section of the Murray River occurred at four sites between 1996 and 2010.

Annual median TN concentrations rarely exceeded the ANZECC[1] guidelines for estuarine waters (0.75 mg/L). However, annual median TP concentrations rarely fell below the guidelines (0.03 mg/L).

Most of the nitrogen present was organic however DIN concentrations increased substantially with winter flows. Phosphorus was present mostly as particulate P through-out the year.







Surface scum and fish deaths

In March 1998 surface scum was observed in the lower reaches of the Murray River, and continues to occur during the summer months. Analysis found the scum was a complex mixture of metal oxides, silica and organic secretions from bacteria and phytoplankton, along with high densities of microbes. It appeared to be worse after periods of high boating activity, suggesting that increased water column mixing may contribute to scum formation.

Between 1999 and 2010, 13 fish death incidents were reported in the Murray River's estuarine reaches. More than 200 fish died in over half of the incidents – with one involving 2000 bream (2010). Most deaths were attributed to algal blooms, scum events or low oxygen conditions following storms. On a few occasions ichthyotoxic dinoflagellates were responsible for the deaths.

Dead fish in surface scum, lower reaches of the Murray River – January 2002

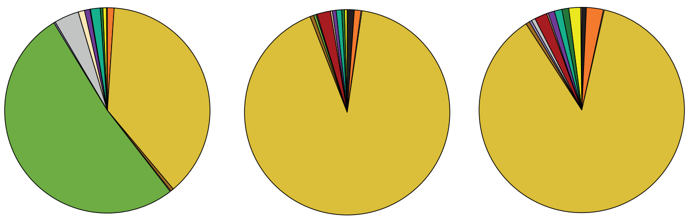
Modelled results (1997–2007)[2]

This page reports results from the Streamflow Quality Affecting Rivers and Estuaries (SQUARE) model. It estimated flow, nitrogen and phosphorus loads from the 13 subcatchments of the Peel-Harvey estuary. Outputs reported here include the lower Murray, middle Murray and Dandalup subcatchments.

Nutrient sources

'Cattle for beef' was the dominant nutrient source in the lower Murray, middle Murray and Dandalup catchment. While it only covered 38% of the catchment, it contributed 92% of the nitrogen and 87% of the phosphorus load.

Area: **Nitrogen:** **Phosphorus:**



- Septic
- Animal keeping – non-farming (horses)
- Cattle for beef (predominantly)
- Cattle for dairy
- Conservation and natural
- Cropping
- Horticulture
- Industry, manufacturing and transport
- Intensive animal use
- Lifestyle block
- Mixed grazing
- Offices, commercial and education
- Plantation
- Recreation
- Residential
- Viticulture

Annual exports to Peel Inlet

The lower Murray, middle Murray and Dandalup catchment is 7.5% of the area that drains to the Peel Inlet. On average it contributed to the Peel Inlet:

- 15% of the flow (74 GL/year)
- 23% of the nitrogen load (198 tonnes/year)
- 7% of the phosphorus load (5 tonnes/year).

Remediation priority

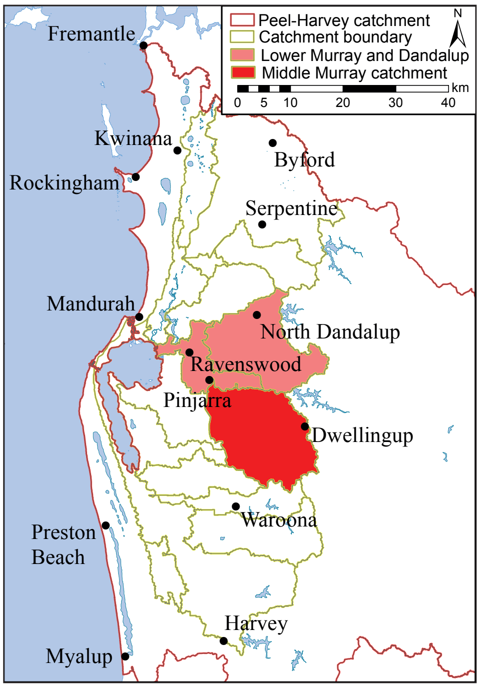
The SQUARE-modelled data indicated that based on nutrient loads per cleared area (kg/ha/year):

- The lower Murray, middle Murray and Dandalup catchment requires high-priority nitrogen and low-priority phosphorus remediation action.

The lower Murray, middle Murray and Dandalup catchment had the third-highest nitrogen load per cleared area of all the Peel-Harvey catchments.

However, it had the lowest phosphorus load per cleared area.

How the lower Murray, mid Murary and Dandalup fits within the Peel-Harvey catchment: location and statistics



Catchment draining to estuary	Area (km²)	Flow (GL)	TN load (tonnes/ year)	TN load per cleared area (kg/ha)	TP load (tonnes/ year)	TP load per cleared area (kg/ha)
Peel Main Drain	120	11	26	3.0	4.5	0.52
Upper Serpentine	502	55	106	3.8	21	0.75
Dirk Brook – Punrak Drain	134	18	51	7.5	5.6	0.82
Nambeelup	143	19	44	3.6	10.5	0.86
Lower Serpentine	94	6.2	9.7	1.6	2.9	0.49
Mandurah	24	3.0	7.9	5.0	1.3	0.84
Upper Murray	6 752	286	204	0.51	4.9	0.01
Lower Murray, mid Murray and Dandalup	**638**	**74**	**198**	**6.4**	**4.9**	**0.16**
Coolup (Peel)	151	23	42	3.2	15	1.2
Subtotal Peel Inlet	**8 558**	**496**	**701**	**1.4**	**73**	**0.14**
Coolup (Harvey)	113	16	26	3.3	14	1.8
Mayfield Drain	119	19	33	3.1	7.1	0.67
Harvey	710	142	259	6.9	39	1.0
Meredith Drain	56	11	16	4.3	8.3	2.2
Subtotal Harvey Estuary	**998**	**188**	**334**	**5.6**	**69**	**1.2**
Total Peel-Harvey Estuary	**9 556**	**684**	**1 035**	**1.8**	**142**	**0.25**

References

[1] 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.

[2] 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.

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