Nutrient Enrichment of the Canning River

by
R.P. ATKINS

WATERWAYS COMMISSION
SWAN RIVER MANAGEMENT AUTHORITY
REPORT No. 7
1985

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WATERWAYS COMMISSION
PERTH WESTERN AUSTRALIA

REPORT NO 7
ISSN 0814 - 6322

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Introduction

The Canning River (Figure 1) is dammed at the Darling Scarp reducing the catchment to the foothills and mainly coastal plain except in years when the dam overflows. The coastal plain catchment is characterised by rural land in the upstream areas becoming more urbanised downstream.

Early in 1978, the Swan River Management Authority routine monitoring of the Canning River showed increasing levels of phosphorus downstream of the confluence of the Southern River, while upstream phosphorus levels maintained a consistently lower level (Figure 2). Initial investigations of the Southern River catchment showed that a waste water treatment plant and its associated subsoil drainage system, located some 2 km west of Armadale, may be contributing to the nutrient loading of this river (Gorman 1978, Platell, 1978).

A sampling programme designed to isolate nutrient point sources in this catchment was carried out in December 1980 and repeated in April 1982. During the period 1978-82 the routine monitoring of the Canning River showed a continuation of the upward trend of phosphorus levels discussed earlier.

A review of the routine water quality monitoring data for three estuarine systems, collected at three monthly intervals between September 1977 and January 1981, showed that the tidal portion of the Canning River had higher nutrient levels than any estuarine waters under Waterways Commission jurisdiction, (see Figure 4) reinforcing the Authority's concern expressed in 1978 (Waterways Commission, 1981).

The Metropolitan Water Supply Sewerage and Drainage Board (MWSS&DB) commissioned the Westfield Wastewater Treatment Plant in the 1960's. The site selected is bounded by Keane, Westfield and Armadale Roads in Forrestdale (Figure 3). It was chosen because of its remoteness from population centres and the presence of sand in a low lying area.

The area on which the plant is situated consists of Bassendean Sand formation approximately 12 metres deep. A bank of ferruginous sand ("coffee rock") approximately 2 metres wide is located 1.5 - 2.5 metres below ground level.

The area overlays a Guildford formation composed of silt to sandy clay which is found on the surface of the swampy margin to the east of the plant (MWA pers. comm.).

Summary

Routine water quality monitoring records showed that nutrient levels in the Canning River were high compared to other waters of the Swan-Canning, Peel-Harvey and the Leschenault Estuarine systems and that the Southern River was the dominant local input. A more detailed investigation of the Southern River catchment was made on two occasions during periods of low stream flow. This investigation concluded that the source of most of the nutrients during periods of low stream flow was the waste water disposal fields at the Westfield Wastewater Treatment Plant. The waste water is now directed to Woodman Point.

In the winter of 1976 static ground water levels in boreholes to the east and west of the plant were 2.3 metres and 3.0 metres respectively (Pers. comm. J. Gozzard Geological Survey W.A.)

Initially, disposal of treated effluent was carried out by flooding into surface gutters and ground soakage. In 1970 a sprinkler irrigation ground disposal system of secondary treated sewage was commenced in an area south of the plant.

This irrigation disposal area was increased between 1975 and 1977 to an area north of the plant. Extension of the Westfield Treatment Works' capacity to cater for a population of 52 000 was completed in 1977 (MWA pers. comm.).

Reports prepared by the Government Chemical Laboratories for the 1980 and 1982 sampling programmes identified the Keane Street drain, which surrounds the Westfield Waste Water Treatment Plant, as the principle source of phosphorus in the Southern River catchment (Appendices 1 & 2).

This report compares the nutrient data, calculated as loads, from these reports and data collected as part of the long term monitoring of the Canning River.

Methods

Figures 1 & 3 shows the sample locations used in the investigations. A description of the sites is given in Table 1.

Sampling was carried out on 3rd December 1980, when flow measurements showed rainfall derived surface and subsurface flows to be minimal isolating stream flow caused by waste water disposal.

Flow measurements were made using an OTT (C2) flow meter at designated points within the drainage system (Figure 3). No allowance was made for seepage into or out of the drains between measuring points.

Measurements were made by measuring mid stream flow and multiplying by cross-sectional area. Although imprecise, these measurements are satisfactory for comparative purposes.

Samples were collected in 1 litre plastic containers and kept on ice for transportation to the laboratory.

Various analyses were carried out (Appendix 1 and 2), but in this paper attention is directed to the plant nutrients nitrogen and phosphorus.

Results

For the purposes of this report, the following results have been extracted from the Government Chemical Laboratories reports and Swan River Management Authority water quality monitoring records.

Inputs Between Canning River Sampling Points 19a & 20

Table 2 shows phosphorus loads for the three largest drains discharging into the Canning River between McKenzie Grove and Herbert Street, Maddington.

Calculations are based on 16 sampling occasions from March 1979 to April 1983. Southern River phosphorus loads are an estimated two orders of magnitude greater than the other drains. Southern River experienced measurable flow all year, whereas the Helm Street drain and Ellis Brook only flowed during winter and spring.

Comparison of Other Drains

Table 3 compares Southern River to three major drains, all draining the grey sands of the Bassendean Dune system (Seddon, 1972). The catchment land use ranges from urban with a large rural area (Southern River, D29 and Thornlie Golf Drain, D30) to mainly urban (Bannister Creek, D31 and Riley Road drain, D32) (Figure 1). These data are based on 16 measurements made over a five year period; flows were measured at all drains on each visit.

The inorganic nitrogen loads in Southern River are one to two orders of magnitude greater than the other drains, and phosphorus loads are two orders of magnitude higher in Southern River.

Southern River Drainage System

Figures 5 to 8 presents the total nitrogen and phosphorus loads calculated at each site for the 3rd December 1980 and 29th April 1982. In all cases, the major contribution of N and P is from the Forrestdale main drain.

Discussion

Whilst no attempt has been made to determine the total annual nutrient loading of the Canning River from all sources, the Southern River must be regarded as a major contributor. The increasiong phosphorus levels between McKenzie Grove and Herbert Street, Maddington, can be attributed to the Southern River input, based on mean loading calculated from quarterly monitoring over a 15 year period. The comparison with three major inputs draining the Bassendean sands, suggests that the Southern River is one of the most significant sources of nutrients into the Canning system from surface flows.

The primary concern of the Swan River Management Authority is the nutrient enrichment of the Canning River, causing excessive plant growth. Although inorganic nutrients are important for plant growth in the short term, total nutrients take account of instream uptake by phytoplankton and also include sources which may generate inorganic nutrients through recycling. This discussion therefore focuses primarily on total nitrogen and phosphorus loads.

It is useful to look at the variation within groups of sites in the Forrestdale main drain, that lie between the major stream confluences. It is assumed that inputs (such as ground water seepage and minor drainage ditches) and losses between the measured stream confluences were negligable. Differences between sites in each group, including the summation of the immediate upstream confluences, were attributed to measurement and sampling errors.

The groups consisted of sites 2, 4, 15+5; 5, 6, 7+8; 8, 9+10; 10, 11+12; 12, 13+14. Within each group, the means differed by less than 14%. While in hydrological terms this variation may seem high, when compared to the variation between the major confluences it is quite acceptable as the following discussion will illustrate (see Figures 5 - 8).

In terms of characterising the sub-catchments and identifying the nutrient source, four stream confluences along the Forrestdale main drain were of particular interest. The Wungong/Southern (sites 15, 5), Baileys B drain (7, 8), drainage area 9 (9, 10) and Keane Road B drain (13, 14). The stream branches off Wungong/Southern Baileys, 9 and Forrestdale at site 14 all contributed less than 10% of the downstream nutrient load in 1980. This situation was repeated in 1982 with the exception of area 9, the contribution of which had increased to a level similar to that of the Forrestdale branch at site 10 (equivalent P and 25% more N). The Armadale Road drain contribution was less than 10% on both occasions. Clearly in 1980 the Keane Road B drain, and in 1982 the same drain and area 9, were the major contributors to the nutrient loading of the Southern River drainage system at times other than the annual winter flow.

Inorganic species of nitrogen and phosphorus are generally assimilated in a ratio (by atoms) of between 10:1 and 15:1 by phytoplankton (Riley & Chester, 1971). It has been the experience in the Peel-Harvery Estuarine System that low N : P ratios favour the growth of nitrogen fixing blue-green algae or cyanobacteria.

The N : P ratio in the Forrestdale main drain averaged 5:1 in December 1980 and 4:1 in April 1982. indicating that phosphorus was in excess when compared to nitrogen. After this water had mixed with Canning River water, the N:P ratio at Herbert Street, Maddington was 9:1 and 12:1 for 1980 and 1982 respectively. These ratios are in the range where neither nutrient would be regarded as limiting for plant growth. These ratios are also not likely to favour the growth of cyanobacteria, and none have been reported for the area.

The dominant phytoplankton species in the Canning River upstream of the Kent Street Weir where the water is fresh is Euglena. Euglena blooms tend to form a green scum on the surface with Chlorophyll a levels decreasing rapidly below a few centimetres. This is attributed to poor light penetration as a result of the

high water colour. These reaches of the river experience abundant submerged and emergent macrophyte growth which take advantage of the high nutrient levels. The significance of these plants as a nutrient sink, immobilising nutrients that may otherwise be available for algal growth is unknown.

Since the analysis of these data the waste water from the treatment plant has been diverted to the Woodman's Point Waste Water Treatment Plant. Nutrient leaching from this point source is expected to decrease over time.

ACKNOWLEDGEMENTS

I wish to thank Mr. W. Hosja and staff of the Swan River Management Authority for undertaking the field work and assisting in the preparation of the report. Associate Professor Arthur McComb critically reviewed the report and his comments were of valuable assistance.

REFERENCES

Gorman, R.C. (1978) Pollution of Southern River, Gosnells. Report to the SRMA, Government Chemical Laboratories, Perth W.A.

Platell, N. (1978) Report to the SRMA, Government Chemical Laboratories, Perth W.A. Unpublished.

Riley, J.P. & Chester, R. (1971) Introduction to Marine Chemistry. Acad Press Land, N.Y.

M.W.A. (undated) Metropolitan Water Supply, Sewerage and Drainage Board of Western Australia, Westfield Wastewater Treatment Plant. Information paper unpublished.

Seddon, G. (1972) Sense of Place, University of W.A. Press.

Waterways Commission (1981) Annual Report 1980/81. Waterways Commission, Perth W.A.

TABLE 1: WATER QUALITY SAMPLING SITES

S.R.M.A. ROUTINE MONITORING

River

19	Canning River at Brookton Road Bridge.
19 A	Canning River at P.W.D. Gauge Station McKenzie Grove, Seaforth.
20	Herbert Street Maddington.

Drains

D 27	Helm Street Main Drain at Albany Highway, Maddington.
D 28	Ellis Brook at Mills Road, Gosnells.
D 29	Southern River at Fremantle Road, Huntingdale.
D 30	Thornlie Golf Drain at Southdown Place, Langford.
D 31	Bannister Creek at Adenia Road, Ferndale.
D 32	Riley Road Main Drain at Adenia Road, Riverton.

SOUTHERN RIVER CATCHMENT (1980, 1982)

1	Canning River u/s of Southern River.
2	Southern River at Fremantle Road.
3	Canning River at Herbert Street, Maddington.
4	Southern River at Leslie Street.
5	Forrestdale main drain off Leslie Street.
6	Forrestdale main drain at Ranford Road.
7	Bailey's Board drain at Anstey Road.
8	Forrestdale main drain at Anstey Road.
9	Drain from sewage lagoons into Forrestdale Main Drain.
9 B	Drain input into 9.
9 C	Drain input into 9 upstream of 9B.
9 D	Drain input into 9 upstream of 9C.
9 E	Drain from Lagoon area upstream of 9D.
10	Forrestdale main drain above 9.
11	Drain along Armadale Road.
12	Forrestdale main drain above Armadale Road input.
13	Keane Road Board drain.
14	Forrestdale main drain u/s of Keane Street main drain.
15	Southern River above drain input.
16	Second Road main drain.
17	Southern River at Westfield Road.
18	Wungong Brook at Forrest Road.

TABLE 2: TOTAL PHOSPHORUS LOADS (kg hr^{-1}) FOR THE MAJOR INPUTS TO THE CANNING RIVER BETWEEN McKENZIE GROVE AND MADDINGTON

DATE	HELM ST MD D 27	ELLIS BROOK D 28	SOUTHERN RIVER D 29
22.3.79	-	-	.319
21.6.79	.0004	-	2.04
20.9.79	.005	.010	1.7
13.12.79	-	-	.15
20.3.80	-	-	.3
12.6.80	-	-	3.66
9.10.80	.0003	.001	1.91
15.1.81	-	-	.71
30.4.81	-	-	.95
2.7.81	.026	.011	4.85
2.11.81	.0003	.001	.82
11.2.82	-	-	2.49
20.5.82	-	-	1.08
23.9.82	.005	.001	3.92
13.1.83	-	-	2.23
21.4.83	-	-	3.6
mean	0.01	0.01	1.92
range	<0.01-0.03	<0.01-0.01	0.15-4.85
n	6	5	16

(-) No flow measured

TABLE 3: NUTRIENT LOADS (kg hr^{-1}) IN FOUR DRAINS DISCHARGING INTO THE CANNING RIVER ON BASSENDEAN SANDS

	RURAL		RURAL				URBAN	
	SOUTHERN RIVER D 29		THORNLIE GOLF DRAIN D 30		BANNISTER CREEK D 31		RILEY RD M.D. D 32	
Date	Inorganic Nitrogen	Total Phosphorus	Inorganic Nitrogen	Total Phosphorus	Inorganic Nitrogen	Total Phosphorus	Inorganic Nitrogen	Total Phosphorus
22.3.79	0.06	0.32	0.05	<.01	0.07	0.04	0.02	0.01
21.6.79	3.99	2.04	0.54	0.03	0.47	0.07	0.12	0.03
20.9.79	4.68	1.70	0.23	0.04	1.43	0.22	0.10	0.05
13.12.79	0.18	0.15	0.45	0.02	0.09	0.01	0.04	0.02
20.3.80	0.02	0.30	0.05	<.01	0.03	0.01	0.02	<.01
12.6.80	9.53	3.66	0.79	0.03	1.03	0.10	–	–
9.10.80	5.64	1.91	0.42	0.07	1.04	0.28	0.10	0.04
15.1.81	0.42	0.71	0.05	<.01	0.07	0.02	0.03	0.01
30.4.81	0.78	0.95	0.02	<.01	0.05	0.02	0.02	0.01
2.7.81	14.66	4.85	1.09	0.35	1.67	0.25	0.45	0.06
2.11.81	1.25	0.82	0.08	0.02	0.15	0.06	0.06	0.02
11.2.82	2.41	2.49	0.08	0.01	0.06	0.02	0.08	0.02
20.5.82	1.44	1.09	0.01	<.01	0.05	0.09	0.02	<.01
23.9.82	4.68	3.92	0.22	0.15	0.34	0.11	0.12	0.08
13.1.83	1.38	2.23	<.01	<.01	<.01	<.01	0.02	<.01
21.4.83	2.22	3.60	0.01	<.01	<.01	<.01	0.02	<.01
Mean	3.33	1.92	0.26	0.05	0.41	0.08	0.08	0.03
range	0.02–14.66	0.32–4.85	<0.01–1.09	<.01–.35	<0.01–1.67	<.01–.28	0.02–0.45	<.01–.08
n	16		16		16		15	

FIGURE 1

Canning River and Main Drain Sites

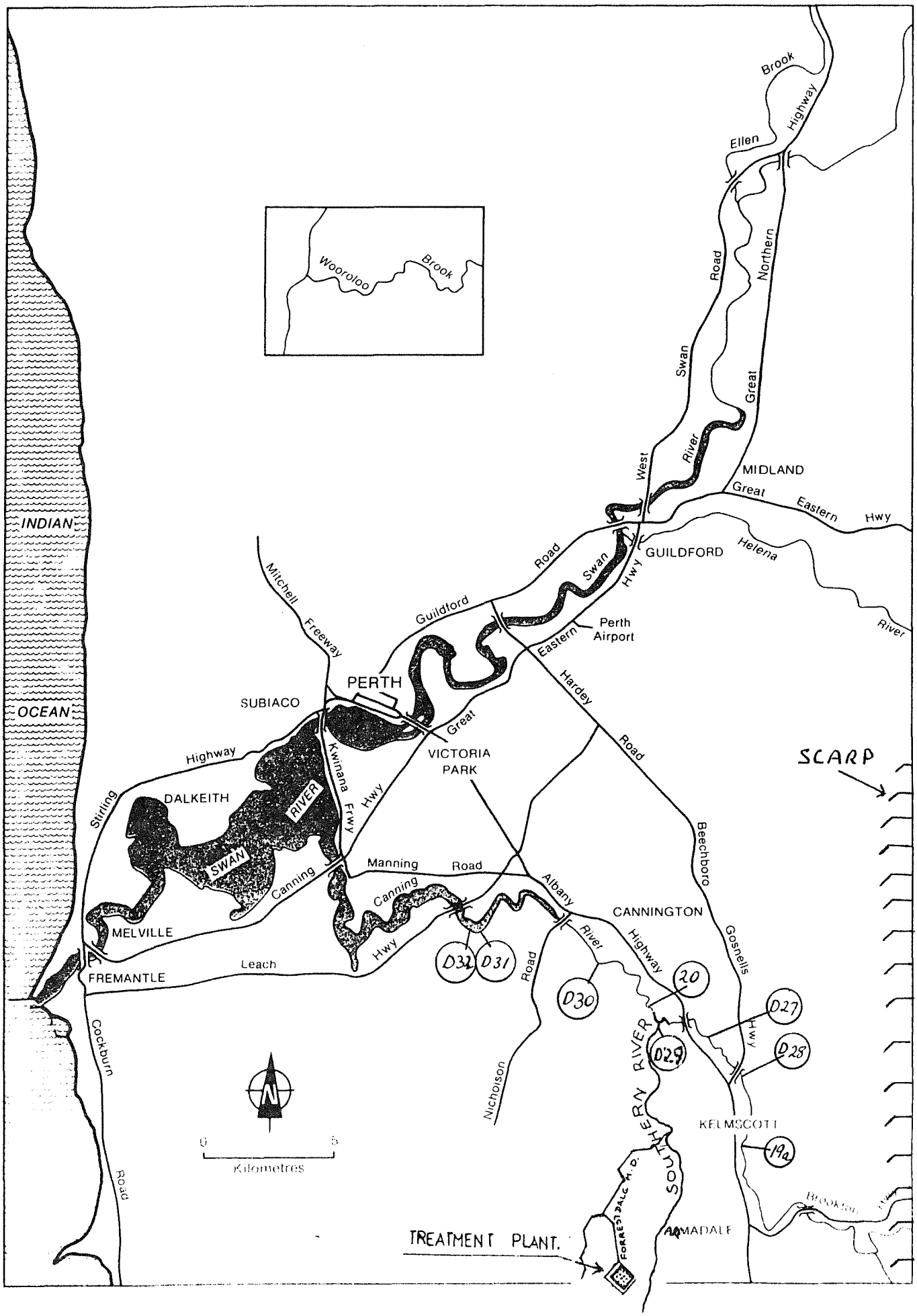
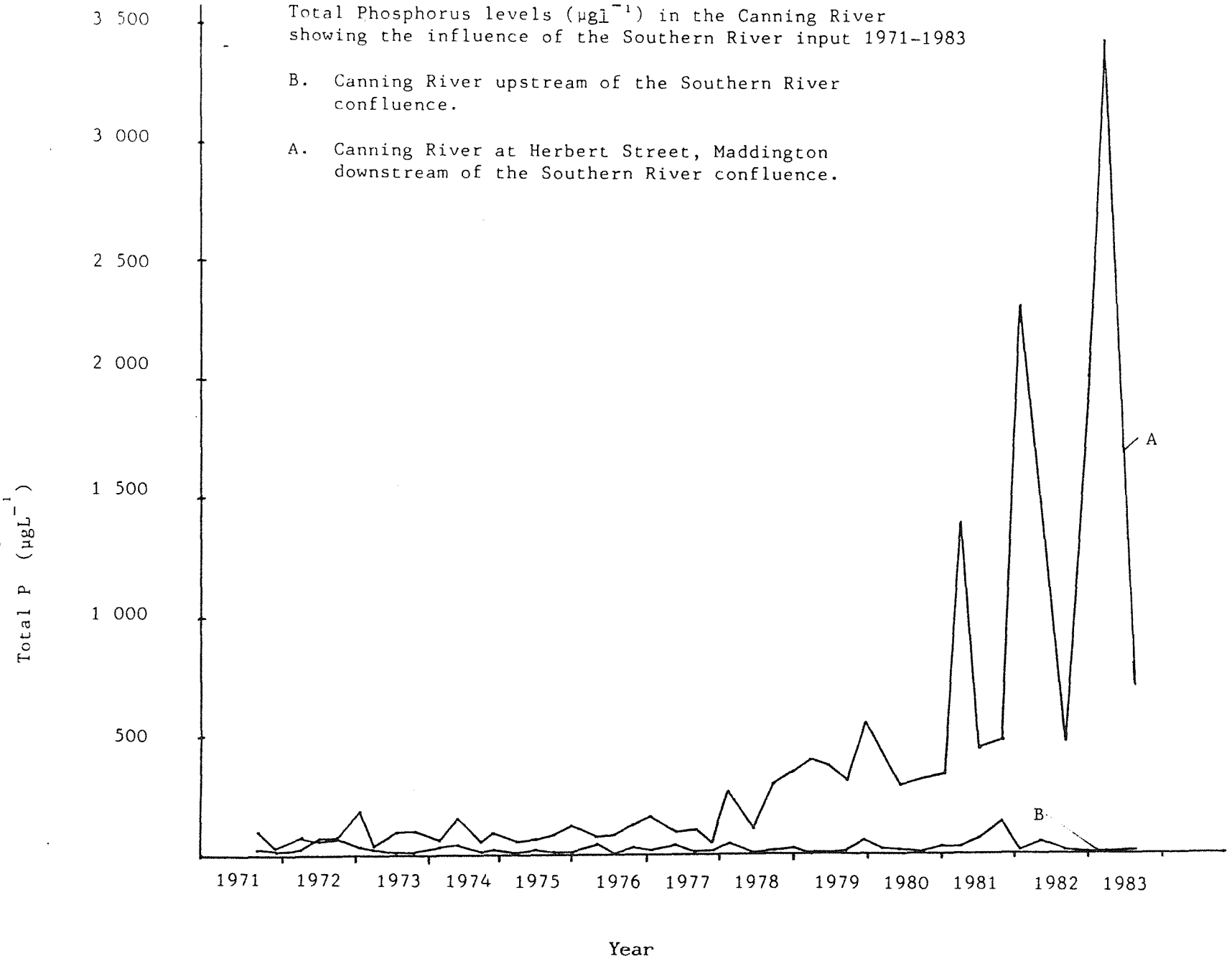


FIGURE 2

Total Phosphorus levels ($\mu g l^{-1}$) in the Canning River showing the influence of the Southern River input 1971-1983

B. Canning River upstream of the Southern River confluence.

A. Canning River at Herbert Street, Maddington downstream of the Southern River confluence.



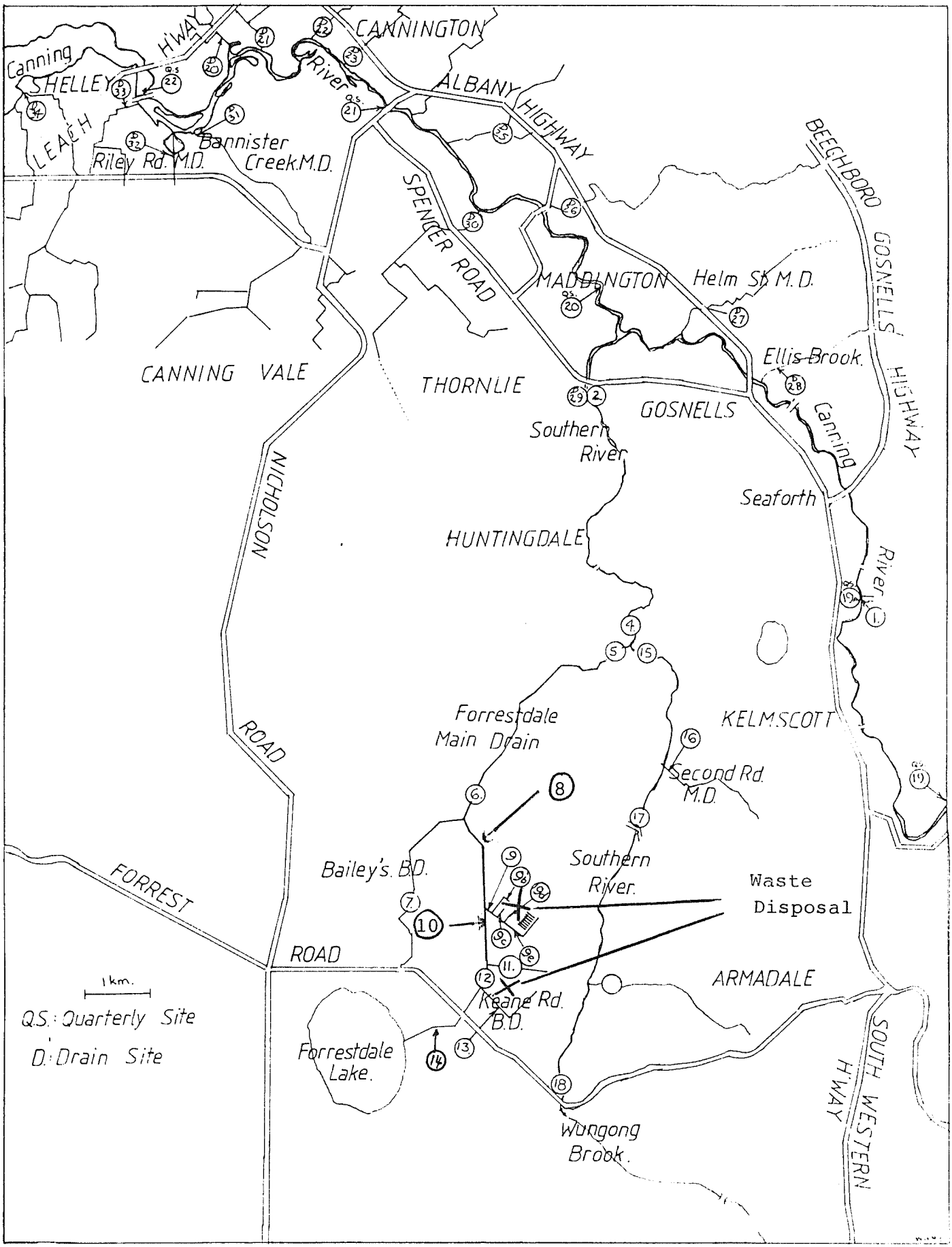
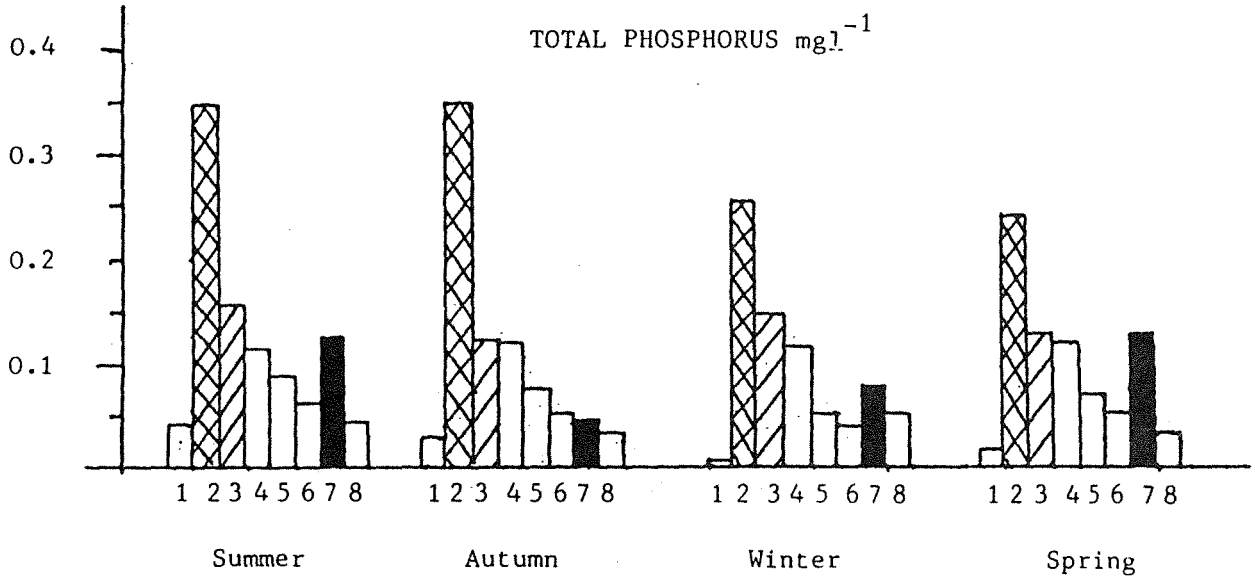


FIGURE 3 WESTFIELD TREATMENT PLANT AND ASSOCIATED DRAINAGE SAMPLING LOCATIONS

FIGURE 4

Mean nutrient levels in the waters of three south-west estuaries



(1) Canning River upstream of Southern River. (SR 19A)

(2) Canning River downstream of Southern River. (SR 20)

(3) Canning River (tidal).

(4) Swan River upstream of Causeway.

(5) Swan River Melville water.

(6) Peel Inlet.

(7) Harvey Estuary.

(8) Leschenault Inlet.

FIGURES 5 TO 8

Nutrient loads at each site shown on a schematic diagram of the Southern River, Forrestdale Main Drain and Canning River

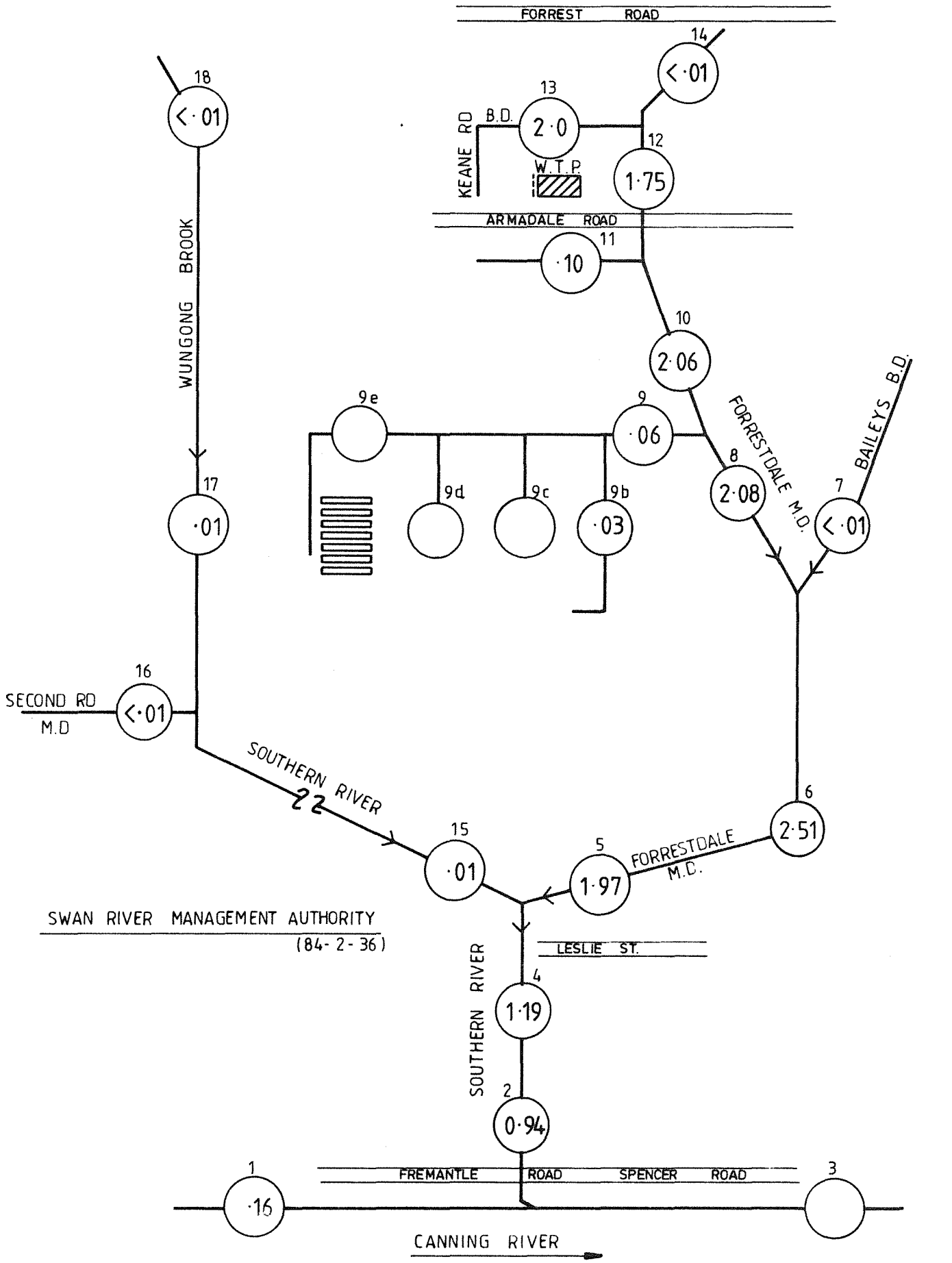


FIGURE 5

TOTAL PHOSPHORUS kg Hr^{-1}

CANNING RIVER

SOUTHERN RIVER & FORRESTDALE DRAIN 3 DEC. 1980

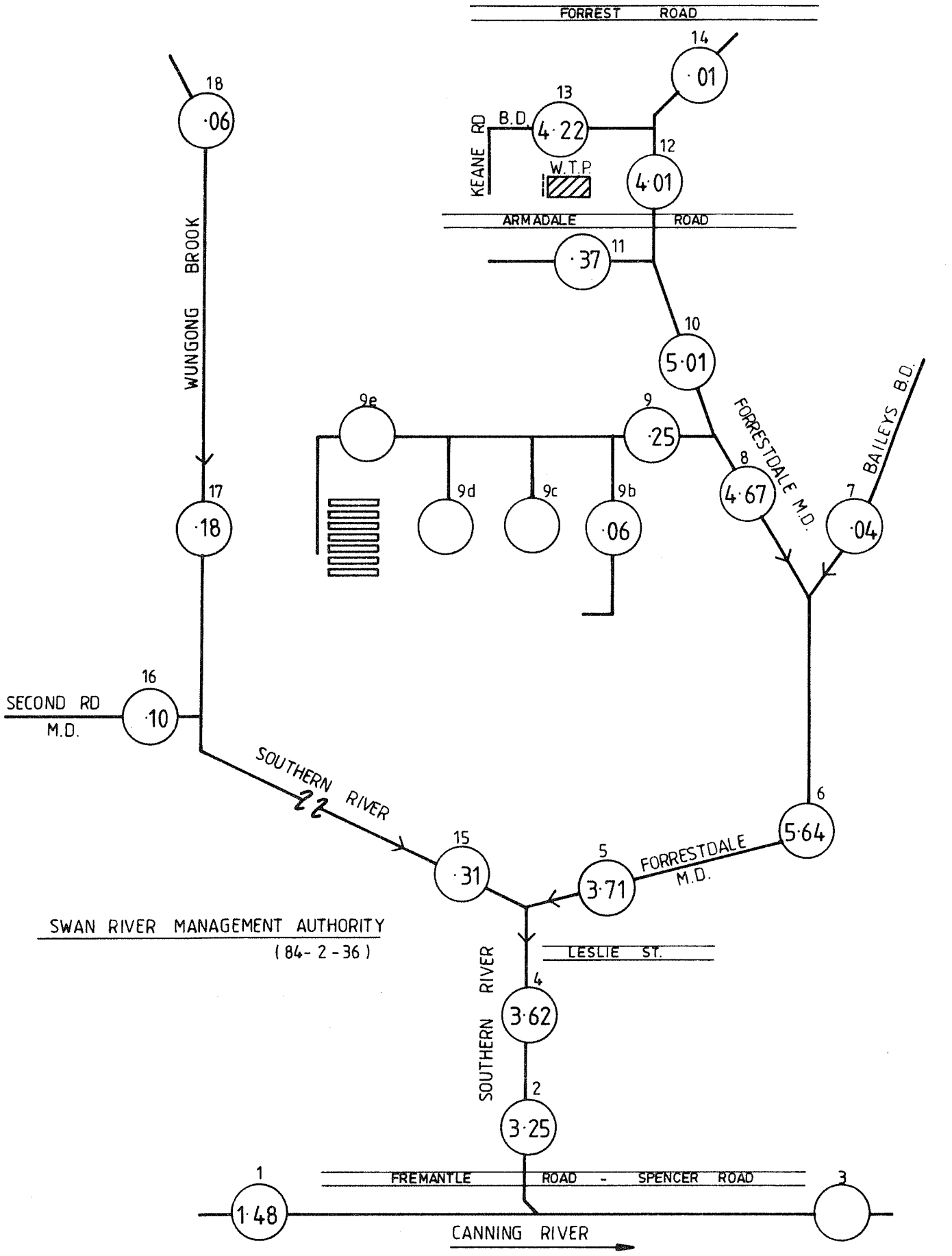


FIGURE 6

TOTAL NITROGEN kg Hr^{-1}

CANNING RIVER

SOUTHERN RIVER & FORRESTDALE DRAIN 3 DEC. 1980

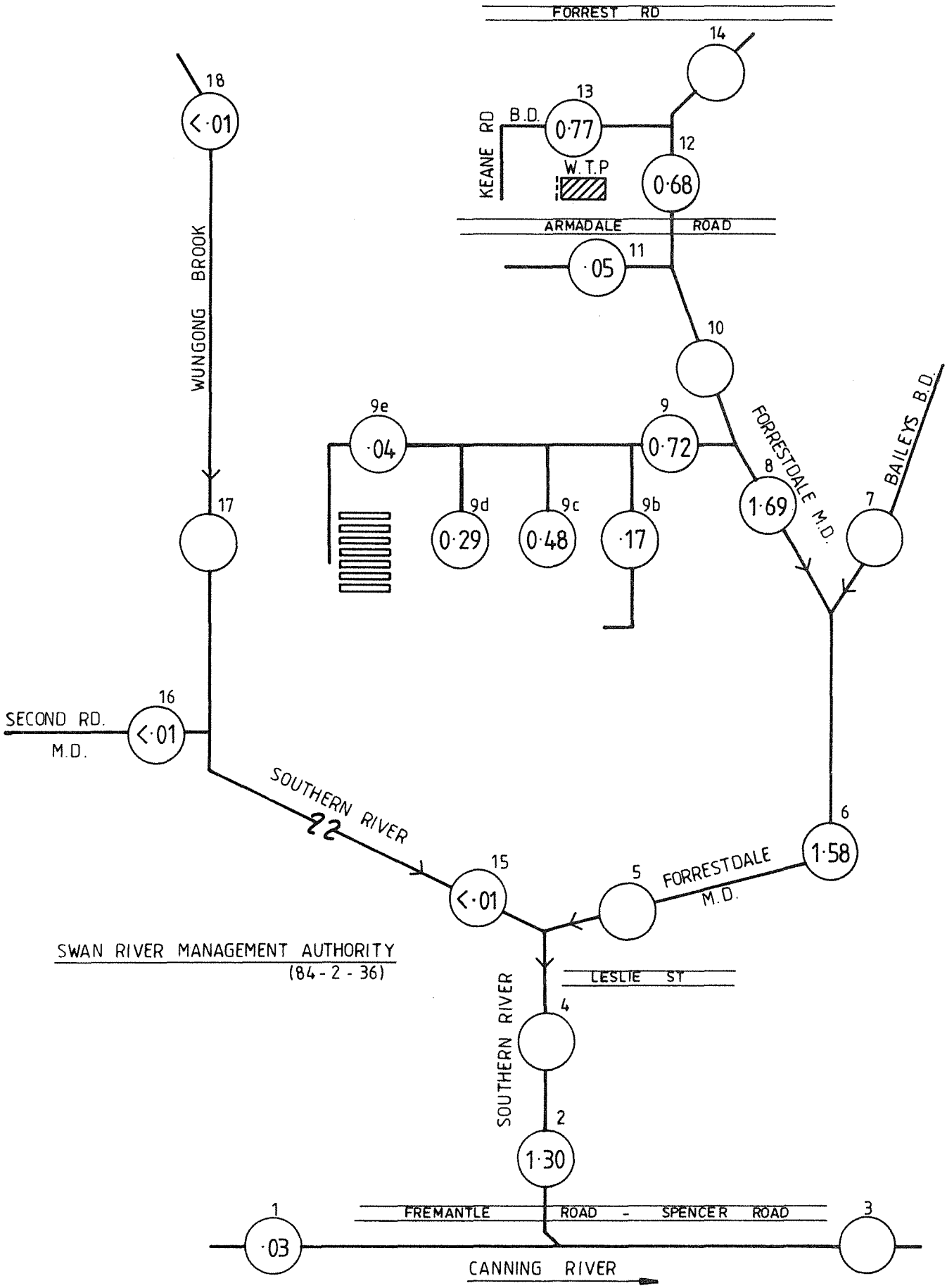


FIGURE 7

TOTAL PHOSPHORUS kg Hr^{-1}

CANNING RIVER

SOUTHERN RIVER & FORRESTDALE DRAIN 29 APRIL 1982

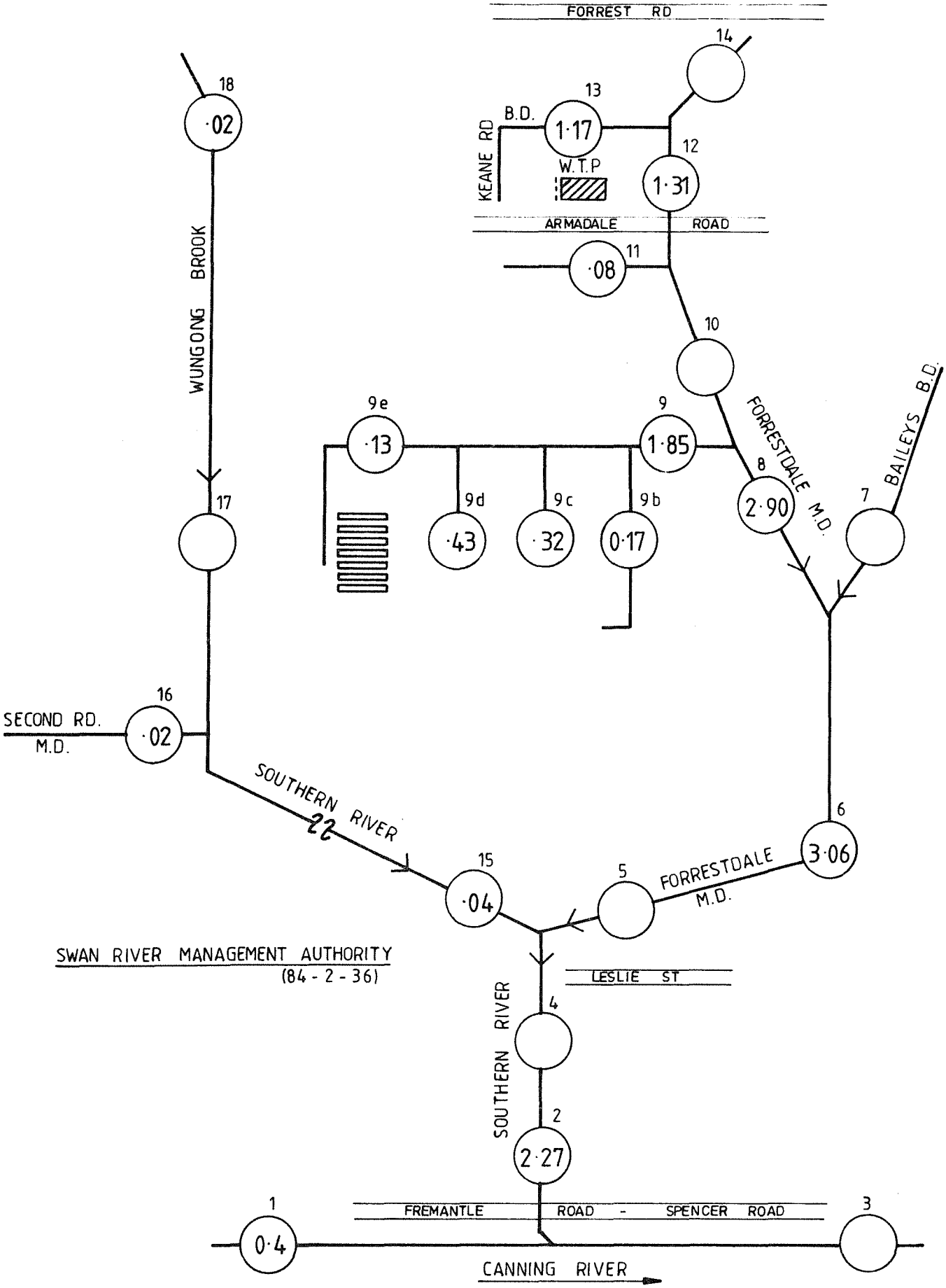


FIGURE 8

TOTAL NITROGEN kg Hr^{-1}

CANNING RIVER

SOUTHERN RIVER & FORRESTDALE DRAIN 29 APRIL 1982

APPENDIX 1

Report by Government Chemical Laboratories

January 1981

GOVERNMENT CHEMICAL LABORATORIES

30 Plain St., Perth, Western Australia 6000.
Telephone: 325 5544

Address all
correspondence to
The Director

Secretary
Swan River Management Authority
Bown House
184 St. George's Terrace
PERTH WA 6000

OUR REF:

YOUR REF:

WESTFIELD PLANT - FORRESTDALE DRAIN -
WUNGONG/SOUTHERN/CANNING RIVER.

Enclosed are the results of analysis of the survey of drain and river flows in the above area (Lab. No's 86510-29/80) collected on 3 December 1980.

The results of this survey, the first of the regular monthly surveys proposed for this area during this dry season, confirm what was suspected and outlined in the quarterly monitoring survey report for the June 1980 samples (Lab. No's 82702-64/80); namely that the Westfield sewage plant is responsible for the increased level of nutrients, particularly phosphorus, in the Southern and Canning Rivers since 1978.

Previous results from a limited number of sites in this area, taken in May and October 1978 (Lab. No's 82427-32 and 86274-8/78 respectively) indicated a contribution of phosphorus from the Westfield plant entering the Southern River of approx. 0.3 kg/hour, which is only about one sixth of the present calculated input of 2 kg/hour. This is in reasonable agreement with the approximately threefold increase in average phosphorus levels found at the Herbert St and Nicholson Rd sites over a similar interval of time.

The drainage system is not as simplistic as that represented by flow rates and analyses, because seepage into or from the drains and rivers will have an effect. In addition the flow rate measurements are imprecise (middle stream velocity x cross sectional area). The measurements are nevertheless satisfactory for the purposes intended and leave little doubt as to the source of nutrients, as outlined in the comments associated with these analytical results.

N. PLATELL
CHIEF
WATER DIVISION

15 January 1981 CD

50 Hain Street, Perth, Western Australia 6000
Telephone: 325 5544
Address all correspondence to the Director

OUR REF:
YOUR REF: 62/84.2.19
ENQUIRIES TO:

Secretary
Swan River Management Authority
Bown House
184 St. George's Terrace
PERTH WA 6000

15 January 1981 CD

MATERIAL: Twenty samples of water from Southern River and Forrestdale main drain, marked: "3/12/80 1-9, 9B, 10-19".

LAB. No. 86510-29/80

FROM WHOM RECEIVED AND DATE Swan River Management Authority on 3 December 1980.

RESULT OF EXAMINATION:

Sample	1	2	3	4	5
Lab. No.	86510	86511	86512	86513	86514
pH	7.0	7.2	7.2	6.9	6.8
Appearance	clear with a very slight deposit				
Colour	colourless	light brown	very pale brown	light brown	brown
Odour	swampy				
Flow rate (m^3/hr)	5300	854		540	328
	milligrams per litre				
Chloride Cl	123	184	246	198	272
Nitrogen N					
ammonia	<0.02	0.02	0.02	0.68	2.9
nitrate	0.18	2.6	0.70	4.4	6.0
total kjeldahl	0.10	1.2	0.43	2.3	5.3
Phosphorus P					
inorganic	0.01	1.1	0.18	2.2	4.7
total	0.03	1.1	0.30	2.2	6.0
Biochemical oxygen demand (5 day B.O.D.)	<4	<4	<4	5	10
Chlorophyll a	0.002	0.002	0.003		

../2

Sample	6	7	8	9	9B
Lab. No.	86515	86516	86517	86518	86519
pH	6.9	5.1	6.9	6.9	6.7
Appearance	clear with a very slight deposit				
Colour	light brown	deep brown	light brown	brown	deep brown
Odour			swampy		
Flow rate (m^3/hr)	344	10	254	13	5
	milligrams per litre				
Chloride Cl	230	303	245	209	234
Nitrogen N					
ammonia	10	0.14	9.6	14	7.0
nitrate	4.4	0.30	3.4	0.43	0.06
total kjeldahl	12	4.0	15	19	12
Phosphorus P					
inorganic	7.2		8.1	4.2	5.7
total	7.3	0.20	8.2	4.3	5.7
Biochemical oxygen demand (5 day B.O.D.)	15	<4	11	7	5

Sample	10	11	12	13	14
Lab. No.	86520	86521	86522	86523	86524
pH	6.9	6.8	6.9	6.9	4.3
Appearance	clear with a very slight deposit				
Colour	pale brown	light brown	pale brown	pale brown	deep brown
Odour			swampy		
Flow rate (m^3/hr)	215	20	175	182	0.06
	milligrams per litre				
Chloride Cl	212	245	203	197	910
Nitrogen N					
ammonia	12	13	12	14	0.02
nitrate	5.3	0.42	4.9	5.2	0.18
total kjeldahl	18	18	18	18	11
Phosphorus P					
inorganic	9.6	4.6	10	11	
total	9.6	5.0	10	11	0.46
Biochemical oxygen demand (5 day B.O.D.)	14	4	15	13	11

Sample	15	16	17	18	19
Lab. No.	86525	86526	86527	86528	86529
pH	7.4	7.0	7.3	7.4	7.2
Appearance	clear with a very slight deposit				
Colour	pale brown	pale brown	colourless		pale brown
Odour	swampy				
Flow rate (m^3/hr)	349	54	184	197	
	milligrams per litre				
Chloride Cl	121	153	97	82	255
Nitrogen N					
ammonia	0.02	0.18	0.06	0.02	0.06
nitrate	0.60	0.65	0.34	0.19	1.4
total kjeldahl	0.28	1.2	0.64	0.12	0.99
Phosphorus P					
inorganic	0.01	0.04	0.03	<0.01	0.46
total	0.02	0.04	0.03	0.01	0.64
Biochemical oxygen demand (5 day B.O.D.)	<4	<4	<4	<4	<4
Chlorophyll a					0.002

Inorganic phosphorus determinations were not done on samples from sites 7 and 14 because of interference due to the deep brown colour of the samples. However the remaining samples show the phosphorus to be present essentially in the inorganic form and the samples mentioned would not be expected to be different.

The information supplied by your inspector with the samples outlines some discrepancies in the measured flows. These are attributed to the inadequacy of the flow meter when low flows were encountered. The discrepancies mentioned were between sites 15, 16 and 17, and between sites 6 and 8. Discrepancies of a similar magnitude which were not mentioned also occur between sites 5, 15 and 4 and between sites 4 and 2.

The analytical results also show some inconsistencies as follows.

The chloride value of sample 8 and 3 and the nitrate nitrogen and B.O.D. values of sample 6 are in each case higher than the samples from sources contributing to them.

The ammonia and kjeldahl nitrogen values of sample 5 indicate a loss of approximately 7 mg/L from site 6.

Blending of waters from sites 5 and 15 at the flowrates shown could not give the nutrient values found at site 4.

Similar comments apply to sites 1 and 2, particularly with respect to chloride.

../4

SOUTHERN RIVER UPSTREAM

Sample 18 as would be expected is the least contaminated of the samples provided, and is a suitable background sample against which the other samples may be compared.

The 2-3 fold increase in nutrient levels between samples 18 and 17 could be attributed to leaching from the Westfield sewage plant. However there is a further increase of the same order in sample 16 which could not be affected by the sewage plant.

The overall contribution of phosphorus and inorganic nitrogen from the Southern River upstream of its junction with the Forrestdale main drain is less than 5 per cent that from the drain itself.

FORRESTDALE MAIN DRAIN TO POINT 5

Mr. Hosja reported that sample 14 was taken from an area of shallow stagnant pools which could not truly be said to be flowing. The results for this sample should not be considered to contribute to the drain.

Sample 13 therefore, is the first upstream sample, flowing unaltered to site 12, which is evident from the analyses.

Apart from the discrepancies measured at sites 5, 6 and 8, the samples from sites 5 to 13 show consistently high nutrient and B.O.D. values which are supported by the relatively low oxygen levels found by your inspector.

Comparison with sample 18 shows the nitrogen and phosphorus values in the drain samples to be approximately 100 - 1000 times higher respectively.

CONCLUSION :

Overall the picture is clear. With respect to nutrient status the Southern River downstream of site 4 is in a polytrophic state which appears to be directly attributable to the contribution from the Forrestdale main drain and, in turn, the Westfield treatment plant.

Upstream of site 4 the river is also in a eutrophic condition as in the Canning River at site 3.

Sample 19, even further downstream in the Canning River, indicates a polytrophic condition existing, and should be re-examined to see if it is truly representative of the river at that point. There will probably be considerable variation at site 19, because of irregular scouring of the Canning by the M.W.B.

It will be observed however that the chlorophyll a levels at these eutrophic and polytrophic sites is quite low and not in keeping with the nutrient status. Chlorophyll a levels would be anticipated to rise in the near future.

It is recommended that samples be taken monthly for all analyses other than inorganic phosphorus and kjeldahl nitrogen.

N. PLATELL
CHIEF
WATER DIVISION

T. WEBB
CHEMIST & RESEARCH OFFICER

APPENDIX 2

Report by Government Chemical Laboratories

June 1982

GOVERNMENT CHEMICAL LABORATORIES
30 Plain Street, Perth, Western Australia 6000
Telephone: 325 5544

Address all correspondence to the Director

Secretary
Swan River Management Authority
Bown House
184 St. George's Terrace
PERTH 6000

OUR REF
YOUR REF
ENQUIRIES TO
30 June 1982 MR

Attention : Mr. Hosja

MATERIAL Twenty samples of water from Southern River and Westfield, marked as below.

LAB No. 82W2115-34

FROM WHOM RECEIVED AND DATE Swan River Management Authority on 29 April 1982.

RESULT OF EXAMINATION.

Marks :

1.	Canning riv. u/s of Southern river	1025 m^3/hr
2.	Southern river at Fremantle rd.	352 m^3/hr
3.	Canning river at Herbert st. Maddington	ND
4.	Southern river at Leslie st.	ND
5.	Forrestdale main drain	ND
6.	Forrestdale main drain at Ranford rd.	225 m^3/hr
8.	Forrestdale main drain at Anstey rd.	220 m^3/hr
9.	Drain from sewage lagoons	99 m^3/hr
9B	Drain from direction opposite 9	17 m^3/hr
9C	Drain from sewage lagoons u/s 9	40 m^3/hr
9D	Drain from sewage lagoons u/s 9C	33 m^3/hr
9E	Drain from sewage lagoons u/s 9D	10 m^3/hr
10.	Forrestdale M.D. above 9	ND
11.	Drain along Armadale rd	8 m^3/hr
12.	Forrestdale M.D. above Armadale rd input	87 m^3/hr
13.	Keane rd B.D.	94 m^3/hr
15.	Southern River above drain input	89 m^3/hr
16.	Second rd M.D.	15 m^3/hr
17.	Southern River at Westfield rd.	ND
18.	Wungong Brook at Forrest st.	85 m^3/hr

..../2

Sample	1	2	3	4	5
Lab. No. 82W	2115	2116	2117	2118	2119
pH	7.5	7.3	7.6	6.7	6.5
Appearance	clear with a very slight brown deposit	clear with a very slight brown deposit			
Colour APHA	9	140	100	200	410
Odour	nil	- - - - - - weedy - - - - - - -			
Flowrate m^3/hr	1025	352	ND	ND	ND
		milligrams per litre			
Chloride Cl	226	172	199	155	206
Nitrogen N					
ammonia	0.02	0.02	0.02	1.6	4.7
nitrate	0.24	5.5	3.2	3.8	5.5
total kjeldahl	0.15	0.94	0.71	2.6	6.5
Phosphorus P					
inorganic	<0.01	3.6	0.57	4.0	7.8
total	0.03	3.7	2.3	4.0	8.1

Sample	6	8	9	9B	9C
Lab. No. 82W	2120	2121	2122	2123	2124
pH	6.5	6.8	6.9	7.0	7.2
Appearance	clear with a slight brown deposit	clear with a very slight brown deposit			
Colour APHA	450	440	590	740	270
Odour	- - - - - - - - - - -weedy- - - - - - - - - - -				
Flowrate m^3/hr	225	220	99	17	40
		milligrams per litre			
Chloride Cl	204	206	214	240	218
Nitrogen N					
ammonia	5.8	6.5	9.5	5.3	6.0
nitrate	5.1	4.9	0.64	0.32	0.57
total kjeldahl	8.5	8.3	18	9.5	6.0
Phosphorus P					
inorganic	6.5	7.6	7.3	10	11
total	7.0	7.7	7.3	10	12

..../3

Sample	9D	9E	10	11	12
Lab. No. 82W	2125	2126	2127	2128	2129
pH	7.0	7.0	6.7	6.9	6.6
Appearance	- - -clear with a very slight brown deposit- - -				
Colour APHA	810	540	230	480	240
Odour	- - - - - - - - - - -weedy- - - - - - - - - - -				
Flowrate m^3/hr	33	10	ND	8	87
	milligrams per litre				
Chloride Cl	223	206	189	211	187
Nitrogen N					
ammonia	5.8	13	2.1	8.0	2.0
nitrate	1.8	0.06	9.8	0.42	11
total kjeldahl	6.1	13	3.2	9.3	4.1
Phosphorus P					
inorganic	8.7	4.0	7.1	5.8	7.8
total	8.9	4.2	7.4	6.2	7.8

Sample	13	15	16	17	18
Lab. No. 82W	2130	2131	2132	2133	2134
pH	6.8	7.2	7.0	7.0	7.3
Appearance	- - clear with a very slight brown deposit - -				
Colour APHA	200	17	67	12	6
Odour	weedy	nil	weedy	nil	nil
Flowrate m^3/hr	94	89	15	ND	85
	milligrams per litre				
Chloride Cl	187	107	163	92	82
Nitrogen N					
ammonia	2.8	0.03	0.10	0.04	0.03
nitrate	9.6	0.25	0.57	3.5	0.04
total kjeldahl	2.8	0.19	0.45	0.32	0.23
Phosphorus P					
inorganic	8.0	0.02	0.02	<0.01	<0.01
total	8.2	0.09	0.03	0.02	0.02

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As found previously, the contribution of nutrients from the Southern River upstream is less than 5% of that from the Forrestdale drain.

Although individual concentrations and flowrates differ from those in the previous survey, the final contribution of nutrients from the drain to the Canning River, as measured at point 2, is essentially the same i.e. approx. 2 kg/hr of inorganic N and 1 kg/hr of phosphorus.

The measured flowrates correlate well with the analytical results found. Three exceptions are the nitrate value of sample 17, the kjeldahl value of sample 9 and the phosphorus of sample 3.

T. WEBB
CHEMIST & RESEARCH OFFICER

P.M. JACK
ACTING CHIEF
WATER DIVISION