AN INVESTIGATION INTO THE EFFECTS OF WOKING STW ON THE RIVER WEY

H10

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SUMMARY

The River Wey at Newark Lane failed to meet its RQO of 1B for Ammoniacal Nitrogen in 1990. Woking STW discharging upstream of Newark Lane, is the main contributor of high ammonia concentrations in the river. Archive data for the STW and river were examined to identify historical changes that have taken place and 3 surveys were carried out to determine diel range of Ammoniacal Nitrogen discharging from the STW and in the river. Woking STW was found to be operating near to its consent limits and Local Authority information indicates it is approaching its design capacity in terms of catchment population. The STW discharges to one branch of a multi-channelled system and so some consideration with given to the diversion of river flow and dilution of the effluent. It appears that most of the flow (approximately 57%) travels down the main channel into which the STW discharges. The additional dilution provided by the navigation channel below the confluence does not appear to significantly reduce ammoniacal nitrogen concentrations. Although the river is unable to achieve its RQO of 1B, in general water quality supports the rivers present uses. Even so, extra capacity is needed at the STW to stop the effluent deteriorating with increasing catchment population size.

1. Aims and Objectives

Woking STW discharges to the River Wey at Old Woking. The RQO for the river below the STW is normally 1B but the River Quality Assessment for October 1990 to Sepember 1991 indicates the reach is actually achieving an RQO of 2A for ammonia. The aims of this study are to:-

1. Confirm that the RQO is failing;

2. Determine which factors are responsible for the failure;

3. Provide information on which to base changes to consent limits with respect to Water Quality Objectives.

2. Woking STW

A plan of Wokin STW is shown in Fig. 1. The STW is a filter bed works receiving mainly domestic sewage from the Woking area. They were designed for a population of 58,750 but council estimates put the actual catchment population at approximately 65,000 which suggests the STW may be overloaded. The breakdown of the wards is shown in Fig. 2 together with the catchment area discharging to the STW.

2.1 Operations

Flow statistics for the STW are as follows:-

Average Daily flow	16,000m^3/d (0.19 cumecs)
Design dry weather flow	18,400m^3/d (0.21 cumecs)
Peak flow	115,700m^3/d

Sewage entering the works passes through the recently installed fine screens and discharges to four primary tanks. Sewage is then distributed to sixteen filter beds for secondary treatment after which settlement takes place in six humus tanks. Sludge from these passes back to the primary tanks and the effluent is discharged to the river. To compensate for periods of low flow, final effluent is passed back through the works to ensure hydraulic pressure is maintained for operating the filter arms.

Sludge from the primary tanks is disposed of to the primary digesters and then stored in the sludge beds adjacent to the land treatment plot. At one time sludge liquor was recirculated through the works, but this operation has since ceased due to the resulting high ammonia levels found in the final effluent.

Storm sewage is collected in six storm tanks and then passes the land treatment area for discharge to a tributary system joining the River Wey at Newark Lane below the RQO sampling point. However, the land treatment plot has not been used for a number of years.

2.2 Consents

There are two consents for the STW, one for fully treated effluent and one for stormwater:-

Consent 1364 (fully treated final effluent)
(Revised 1984)

Suspended solids at 105^{o}C	45mg/l
Biological Oxygen Demand (ATU) in 5 days at 20^{o}C	25mg/l
Ammoniacal Nitrogen	15mg/l
Maximum discharge of sewage	80,000m^3/day

FIG. 1.

PLAN OF WOKING SEWAGE TREATMENT WORKS
(NOT TO SCALE)

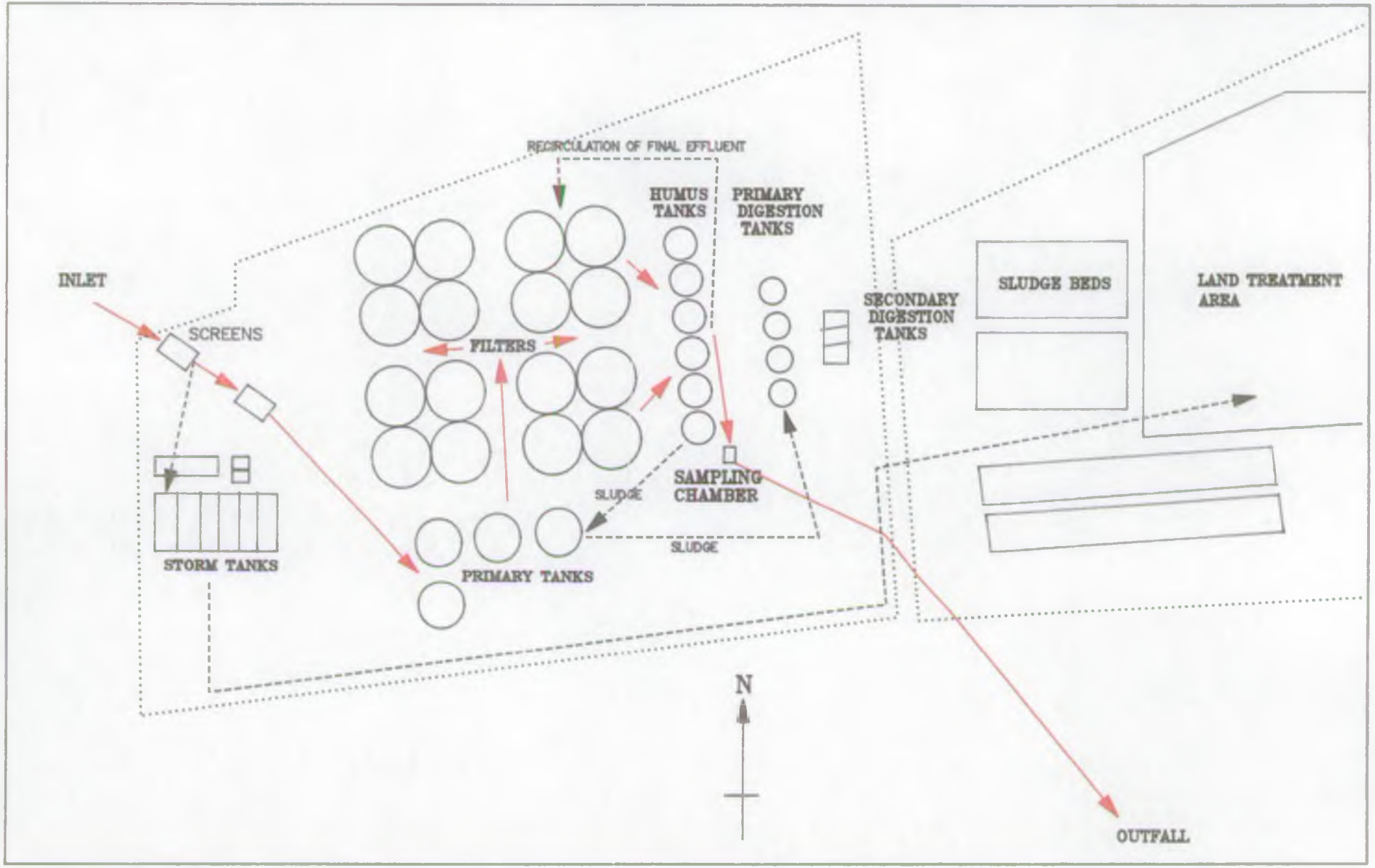
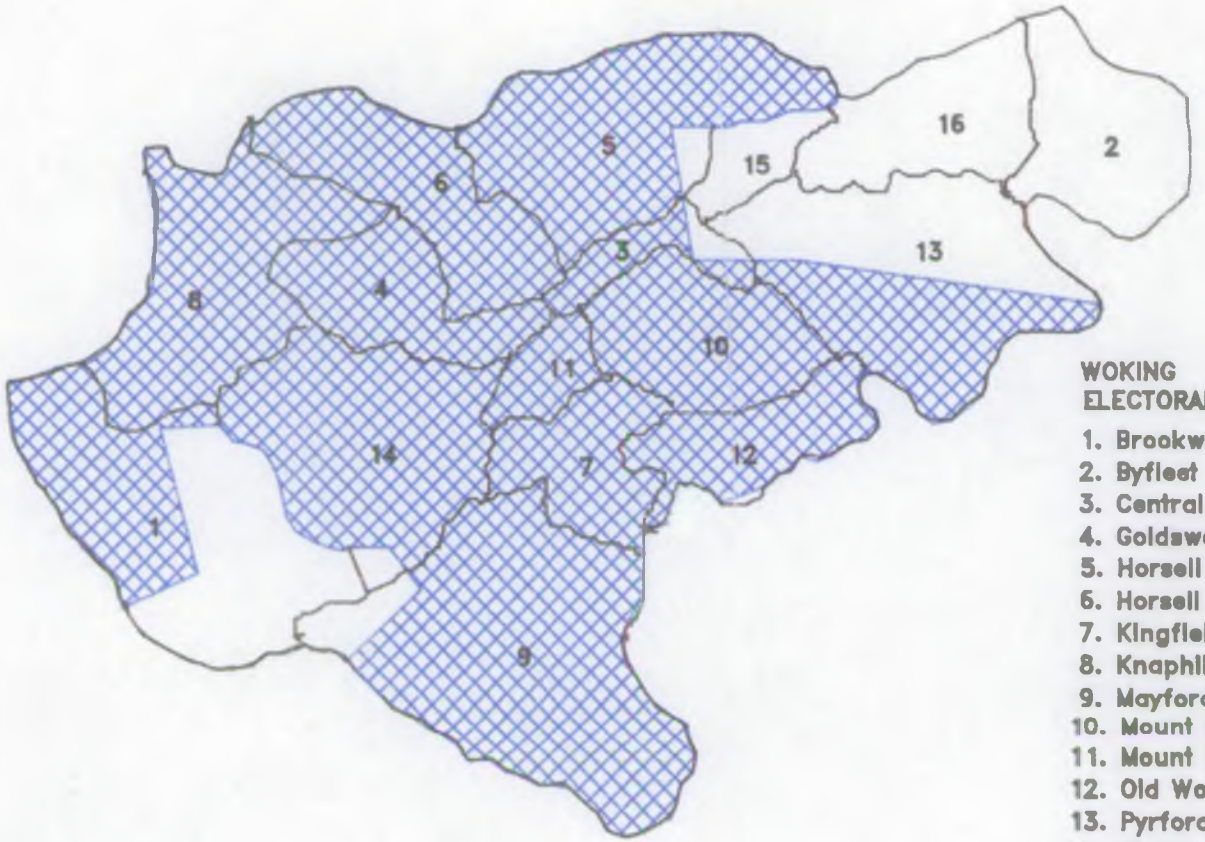


FIG.2.

CATCHMENT POPULATION / AREA FOR WOKING STW



AREA DISCHARGING TO WOKING STW

WOKING ELECTORAL WARDS	POPULATION 1991
1. Brookwood	1956
2. Byfleet	7088
3. Central & Maybury	4717
4. Goldsworth Park	11156
5. Horsell East & Woodham	3784
6. Horsell West	6719
7. Kingfield & Westfield	5011
8. Knaphill	10062
9. Mayford & Sutton	2120
10. Mount Hermon East	4301
11. Mount Herman West	4062
12. Old Woking	2519
13. Pyrford	5167
14. St.John's	7894
15. Sheerwater	3161
16. West Byfleet	4661
	TOTAL 84378

Consent 1184 (Stormwater)

No discharge of stormwater to be made until the discharge rate of sewage effluent exceeds 80,000m^3/day

Quantity of stormwater discharged shall not exceed	16,300m^3/day
Suspended solids at 105^{o}C	30mg/l
Biological Oxygen Demand (ATU) in 5 days at 20^{o}C	20mg/day

3. River Wey, Old Woking

Fig. 3 shows the division of the River Wey into its various channels at Old Woking. The river divides into three main channels just upstream of Worsfold Gates at St. Christophers boat yard:-

a. **River Wey Navigation**

The Navigation channel, controlled by the National Trust, carries boat traffic between Worsfold Gates and Papercourt Lock. Worsfold Gates normally remain open unless there is a risk of flooding at Papercourt.

b. **Broadmead Cut**

This is a flood relief channel running between Broadmead weir and Papercourt, joining the main channel downstream of Woking STW. The gates at Broadmead weir are usually closed and the only flow this section receives is from the Ashburton Stream which can be controlled by adjusting the overall at St. Christophers boat yard.

c. **River Wey**

The main river passes through Unwins mill and receives Woking STW effluent. The mill plays the major role in controlling flow. In high flows water backs-up and runs over the Mill Moor overfall and by-passes the mill.

The three main channels join up to form a broader navigable stretch flowing down to Newark Lane.

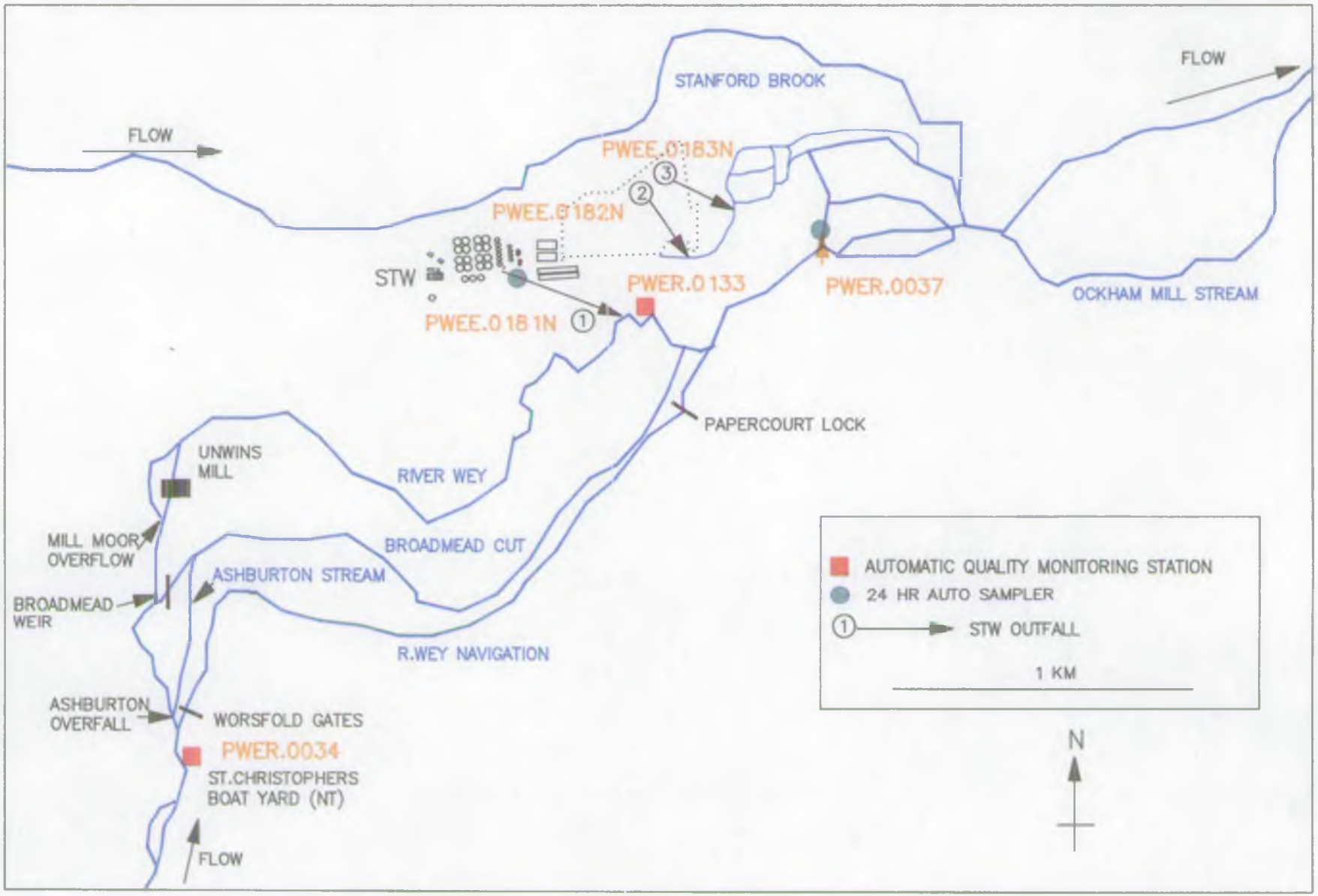
For the duration of this study the Broadmead weir remained closed. Boat traffic and the subsequent operation of Papercourt Lock was the main factor responsible for increasing flow down the Navigation channel.

3.1 RQO's

The RQO for the River Wey in the Woking area is 1B. River Quality assessment for October 1990 to September 1991 indicates that the Woking STW to Wisley STW reach is failing its RQO for ammoniacal nitrogen and is achieving Class 2A (see Appendix 1). The sampling point for the reach assessment is at Newark Lane, Pyrford. The Guildford STW to Woking STW reach achieved its RQO of 1B.

FIG.3.

WOKING STW SURVEY AREA



3.2 Hydrometereological Data

The London Weather Centre provided sunshine hours, rainfall and air temperature data for the survey period.

Flow data were used to calculate ammonia loads in the STW effluent and river. Flows are recorded at Tilford and Weybridge with some data collected in the Woking area. This was used for estimating flows at Cartbridge upstream of the STW. In addition an 8 hour survey was carried out by the hydrology section with flows recorded at Newark Lane and upstream of the STW. Hydrographs for Tilford and Weybridge from October 1990 to February 1992 are shown in Figs 4(i) and 4(ii).

Thames Water Utilities provided flow data recorded at the inlet of the STW.

3.3 Times of Travel

Ove Arup and Partners have recently concluded a survey commissioned by the NRA for the River Wey catchment. The times of travel for the Woking reaches are as follows:-

Flow Weybr. (cumecs)	Date		
2.750	17/10	Guildford STW to Cartbridge, Send	19.38hrs
2.660	14/10	Cartbridge, Send to Woking STW	11.20hrs
2.680	10/10	Woking STW to Wey Navigation	1.38hrs
2.670	11/10	Wey Navigation to Stanford Brook	4.30hrs
2.810	9/10	Stanford Brook to Ockham Mill Stream	5.92hrs

Flow conditions were similar during the survey periods so the above results are directly relevant to this study.

FIG.4(i).

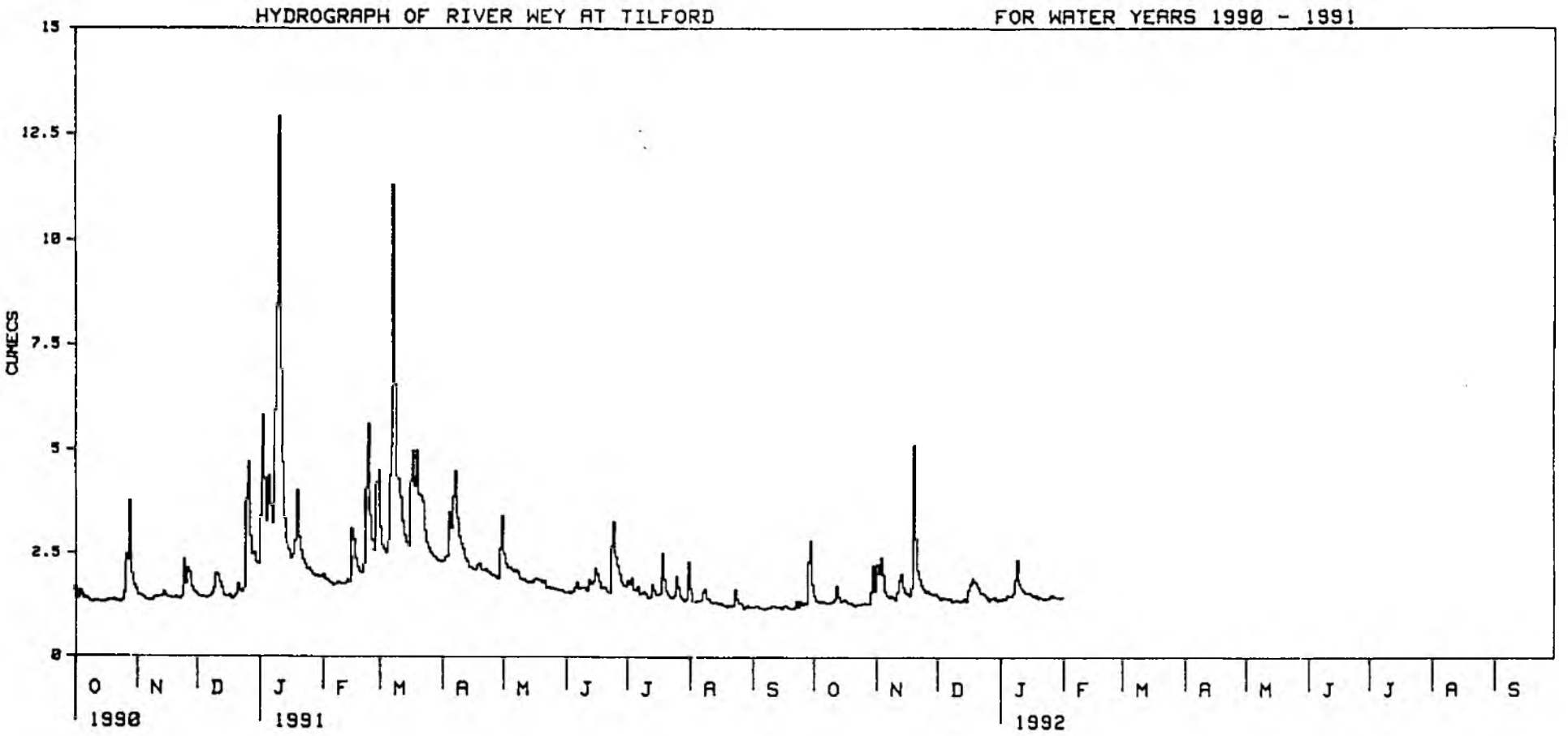
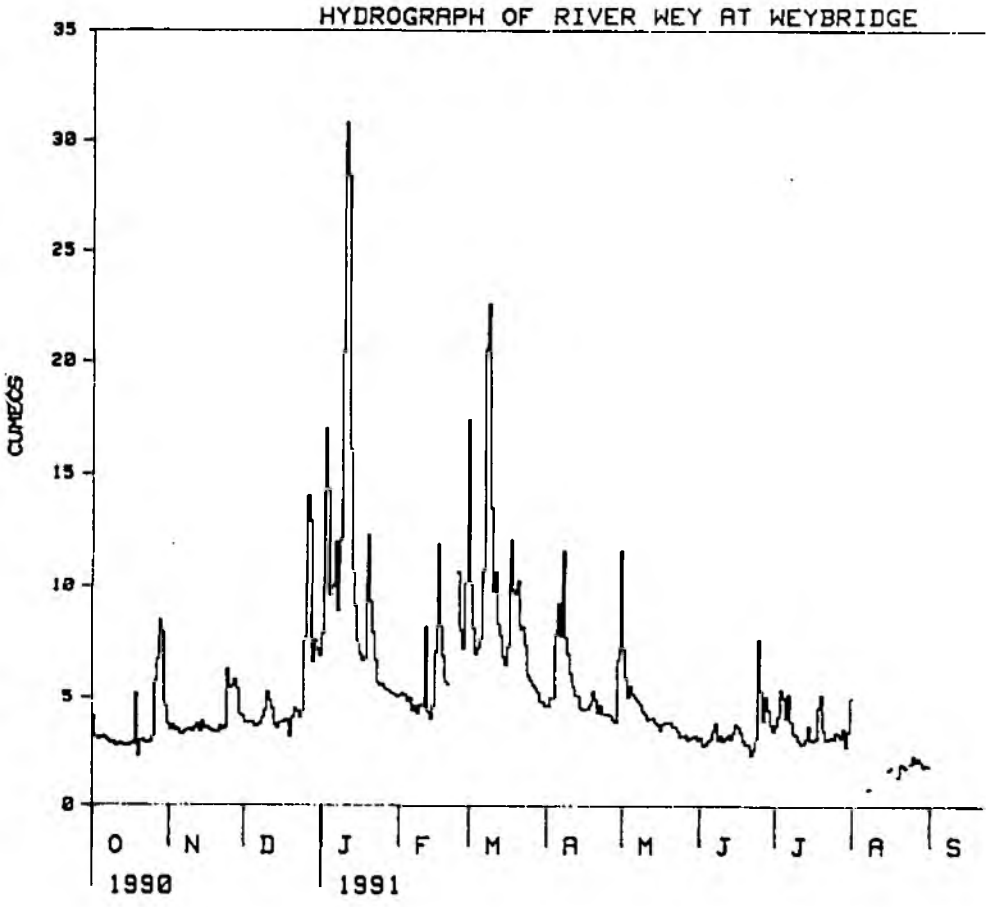
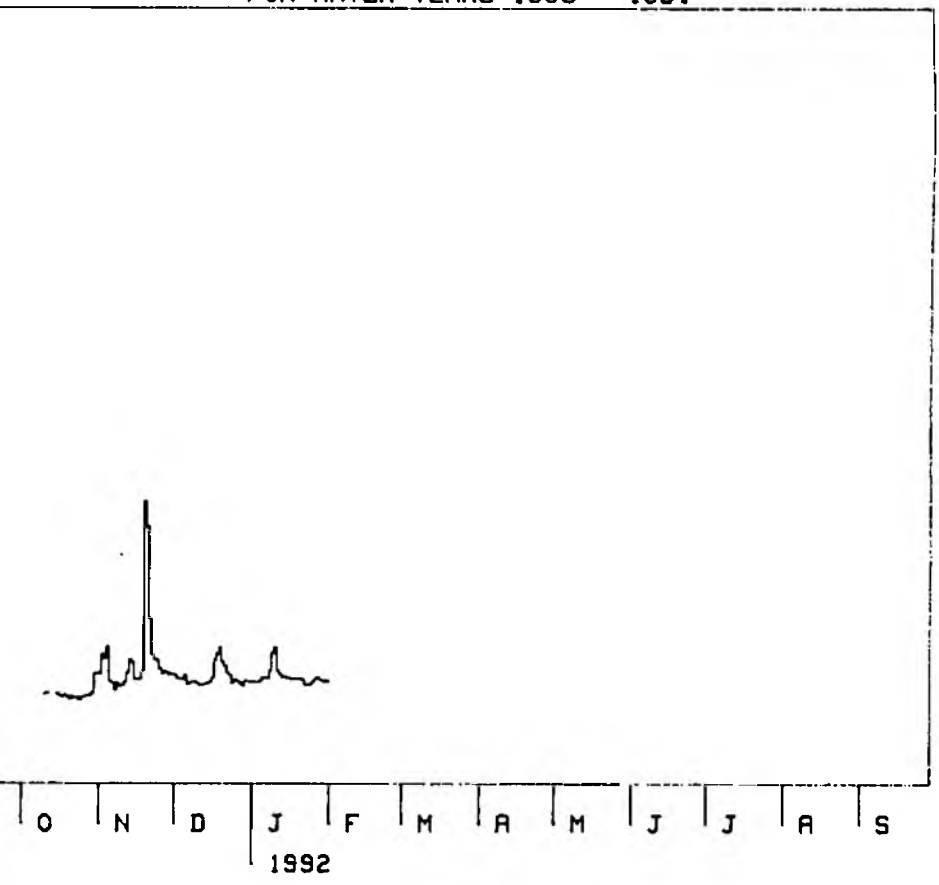

HYDROGRAPH OF RIVER WEY AT TILFORD
FOR WATER YEARS 1990 - 1991
CUMECS
15
12.5
10
7.5
5
2.5
0
O N D J F M A M J J A S O N D J F M A M J J A S
1990
1991
1992

FIG.4(ii).


HYDROGRAPH OF RIVER WEY AT WEYBRIDGE
CUMECS
35
30
25
20
15
10
5
0
O
N
D
J
F
M
A
M
J
J
A
S
1990
1991

FOR WATER YEARS 1990 - 1991



4. Methods

4.1 Archived Data

Spot sample data recorded since 1975 for ammoniacal nitrogen at Woking STW (PWEE.0181), R. Wey below Woking STW (PWER.0133) and R. Wey at Newark Lane (PWER.0037) were retrieved from the archive to examine the changes in STW performance.

4.2 Surveys - Water quality monitoring

Three surveys were carried out in the Old Woking area looking at the effect of Woking STW on the River Wey with the main emphasis on ammoniacal nitrogen.

a. **February 1991**: Autosamplers were installed on the main STW outfall to check performance with respect to the final effluent consent.

b. **June - July 1991**: A major survey was undertaken with Mobile Automatic Quality Monitoring Stations (AQMS) monitoring the river quality upstream of the STW at Cartbridge, Send (PWER.0034) and downstream Woking STW (PWER.0133). 24 hour autosamplers were installed at Newark Lane (PWER.0037) and on the final effluent from the STW (PWEE.0181N). Telemetry enabled continuous monitoring of the river quality via the AQMS with data recorded on a computer terminal at the Guildford office. Samples from the 24 hour auto samplers were analysed using a DWMP Water Dipper (multimeter) with a number of samples sent to the laboratory to cross-check the results (see Appendix 2).

   Four boat surveys were undertaken to determine the spatial variability of water quality. The multimeter was used to measure the quality at regular intervals along the river between the STW and Newark Lane.

c. **January 1992**: 24 hour auto samplers and recording DO meters were used to sample the river at Cartbridge, upstream and downstream STW and at Newark Lane. The survey was supplemented with manual sampling. Final effluent samples were also taken at the STW using an auto sampler. The survey lasted 24 hours and all samples were analysed at the laboratory.

5. Results

5.1 Archive Data

Plots of ammoniacal nitrogen concentrations in spot samples taken at Woking STW and in the river at Newark Lane are shown in Figs 5(i) to 5(iii).

Only data recorded at both sites on the same day have been used, with records dating back to 1975. Samples taken from 1975 to 1977 show the STW to be breaking its consent most of the time with the ammoniacal nitrogen limit of $5mgl_{-1}$. Key changes took place in 1976 with the construction of 8 new filters, 2 new primary tanks and 2 new humus tanks. With these fully commissioned by early 1977, the effluent shows a marked improvement. Consent changes are illustrated in the figures with the ammoniacal nitrogen limits shown. Although considerably fewer samples were taken from the mid 80's onwards a slight increase in the levels of ammoniacal nitrogen can be detected, possibly as a result of the increasing catchment population and subsequent pressure on the STW.

As far as the river at Newark Lane is concerned, levels of ammoniacal nitrogen appear to fluctuate seasonally with higher ammoniacal nitrogen during higher river flows over the winter period. This may be as a result of:-

1. higher flows through the STW with a reduction in retention time;

2. higher background ammoniacal nitrogen due to urban run-off and STW's upstream of Woking; and

3. a faster time of travel in the river between Woking STW and Newark Lane with less time for nitrification.

The time of travel between the STW and Newark Lane is an important factor to consider with respect to spot sampling. Peak loads of ammoniacal nitrogen in the works effluent may reach Newark lane outside the current sampling window and this will depend on the flow regime and therefore change seasonally.

5.2 Surveys

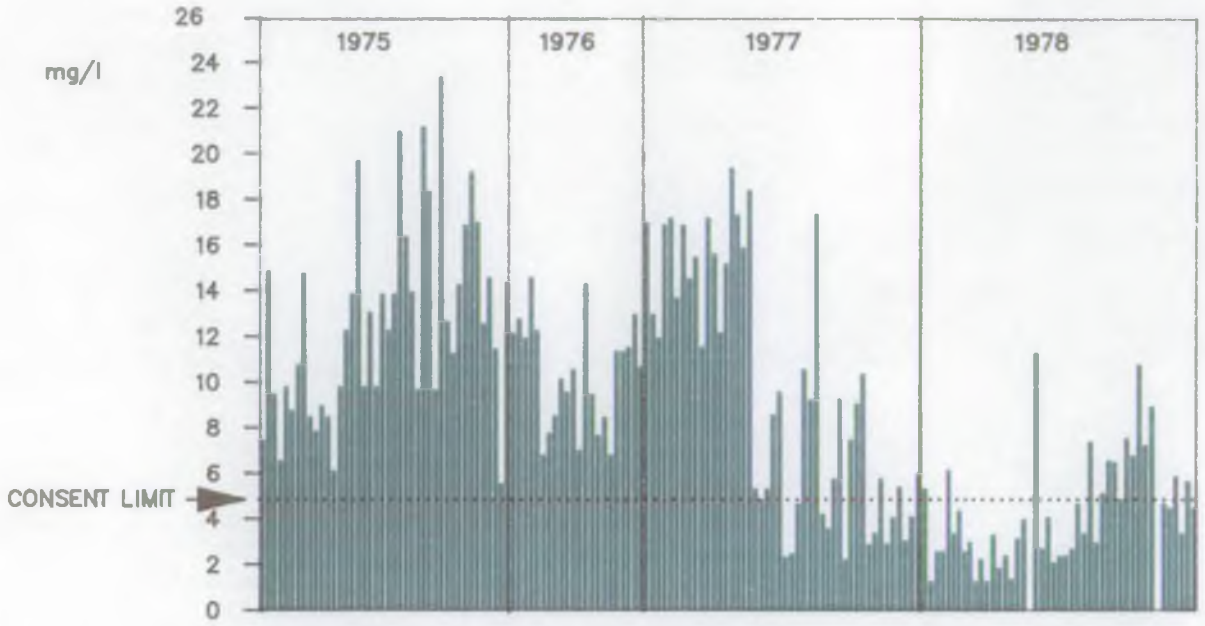
5.2(a) February 1991:

An initial survey was undertaken to give some indication of the diel fluctuations in suspended solids, BOD and ammonia in the STW final effluent and results are shown in Fig. 6. All parameters peaked around midnight with BOD only rising slightly above its consent limit at this time. No flow records were obtained from the STW and therefore ammonia loads could not be calculated. The survey showed Woking STW to be operating very close to its consent limits.

FIG.5(i).

ARCHIVED DATA – AMMONIACAL NITROGEN

PWEE.0181 N WOKING STW



PWER.0037 – R.WEY AT NEWARK LANE, PYRFORD

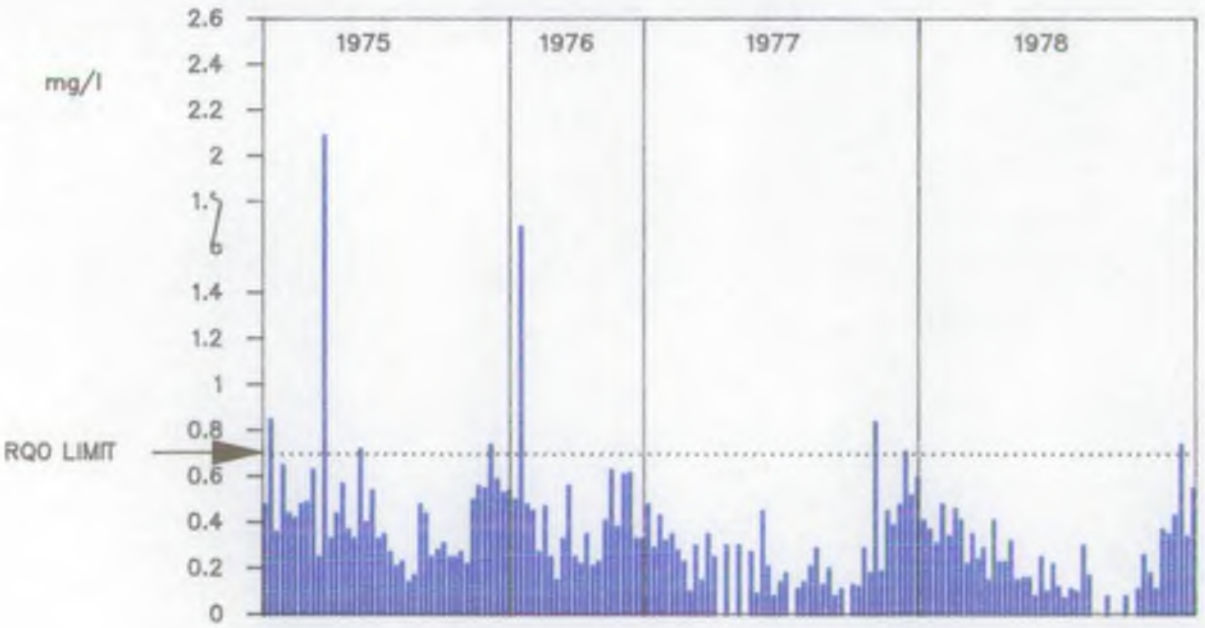
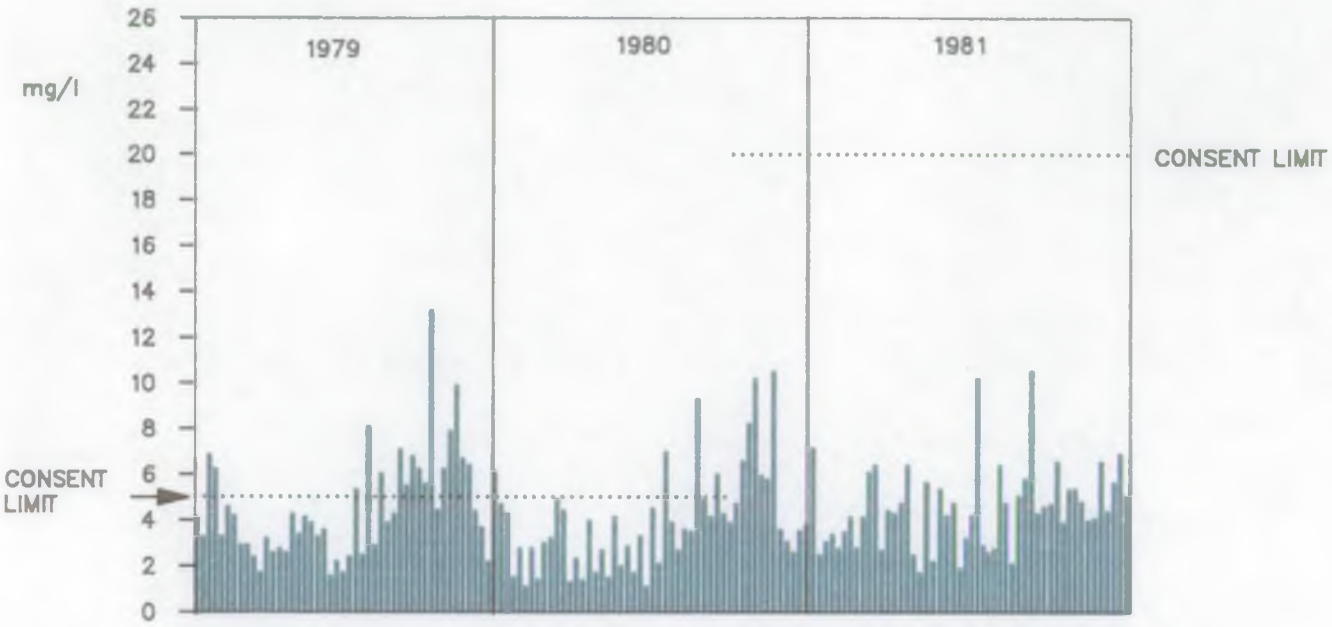


FIG.5(ii)

ARCHIVED DATA – AMMONIACAL NITROGEN

PWEE.0181N WOKING STW



PWER.0037 – R.WEY AT NEWARK LANE, PYRFORD

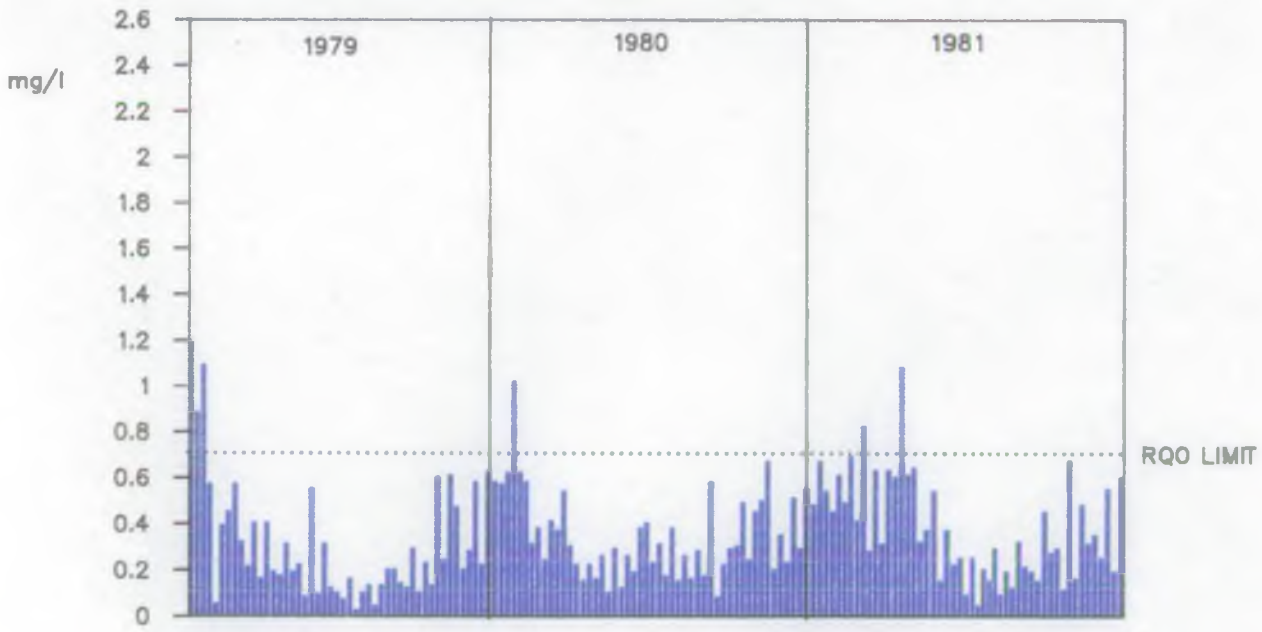
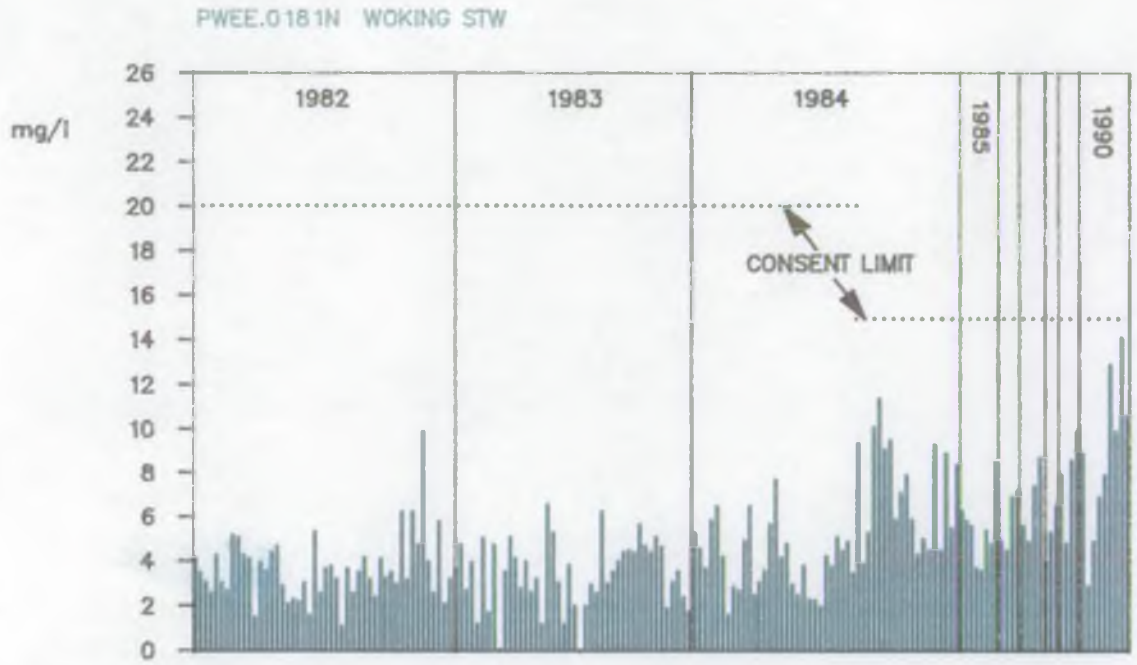


FIG.5(iii).

ARCHIVED DATA – AMMONIACAL NITROGEN



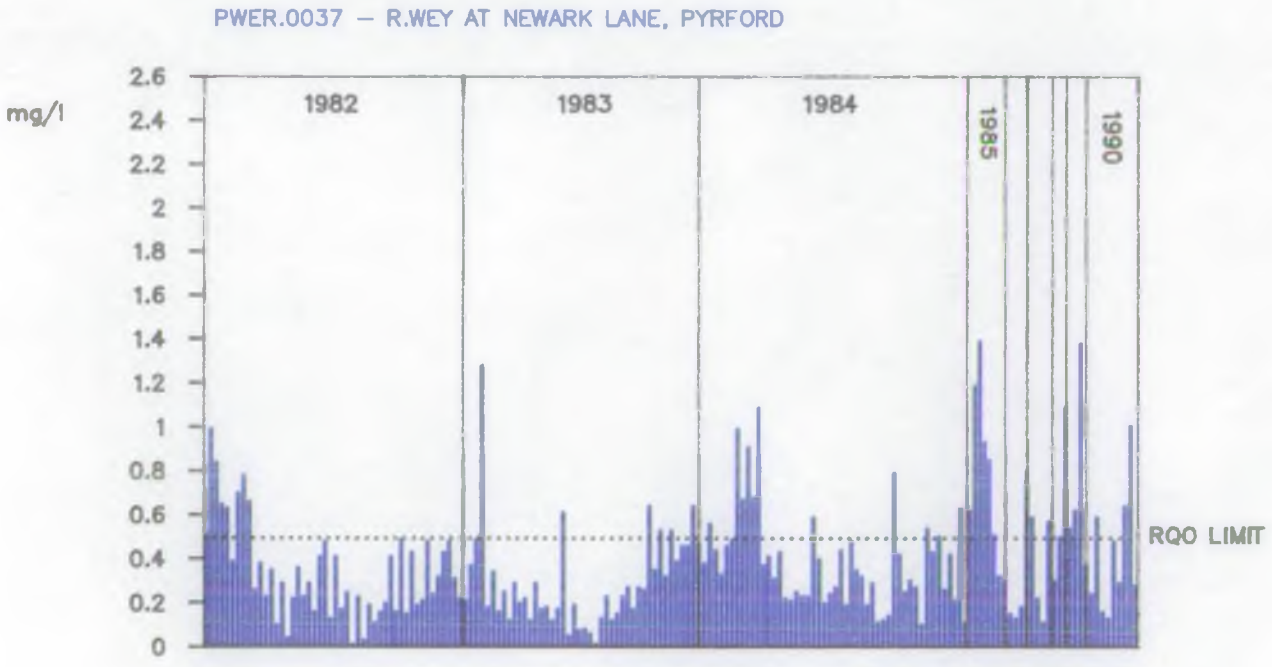


FIG.6.

WOKING STW FINAL EFFLUENT
AUTOSAMPLER SURVEY – FEBRUARY 1991

5.2(b) **June - July 1991:**

Hydrometereological data has been provided for the duration of this survey. Fig. 7 shows river flows at Weybridge and Tilford together with hypothetical flows at Worsfold gates and in the main river channel upstream of Woking STW. The latter two flows were estimated from the few flow readings previously collected in the Woking area. The flow at Worsfold Gates was approximately 88% of the flow at Weybridge and 156% of the flow at Tilford. The flow entering the main channel upstream of Woking STW was approximately 74% of the flow recorded at Worsfold Gates. These figures are given in Appendix 3. River flows generally remained low throughout the survey period.

Fig. 8 shows the rainfall and sunshine (hrs) for the survey period. The period was mainly sunny with lighter showers towards the end of June.

The AQMS station data recorded up- and downstream of Woking STW are shown in Figs. 9 and 10 respectively. Expected diel patterns were exhibited for temperature, pH and nitrate. DO% was on average slightly higher below the STW resulting from photosynthetic activity of macrophytes and plytoplankton benefiting from the rich supply of nutrients in the sewage effluent. Ammoniacal nitrogen remained below the limit of detection upstream of Woking STW while a clear diel pattern was found below the STW with values of up to $1.3mgl^{-1}$ at the AQMS station (PWER.0133) and $2.3mgl^{-1}$ at Newark Lane (PWER.0037).

Data for ammoniacal nitrogen concentration and load in the STW effluent are plotted in Fig. 11. Peaks in ammonia concentration occurred between 1900 and 0200 hrs while loads appeared to peak at 1100 hrs and 2200 hrs. Data collected between 10/6 and 25/6 have been superimposed to illustrate the clear diel pattern (see Fig. 12). The red line gives the mean diel trend while the black lines indicate individual daily trends.

Fig. 13 displays the STW load together with the concentration found in the river just below the STW and further downstream at Newark Lane. Fig. 14 shows daily data superimposed to give an indication of the diel trend in ammoniacal nitrogen concentration found in the river below the STW. The diel trend recorded at the AQMS station just below the STW outfall (Fig. 4) closely follows that exhibited by the ammoniacal nitrogen load from the STW (Fig. 12), with peaks at about 1100 hrs and 2200 hrs. At Newark Lane the pattern is less obvious although the average diel trend gives a peak at 1200 hrs with elevated levels between 2300 hrs and 0500 hrs.

FIG.7.

R.WEY FLOWS : TILFORD, WOKING & WEYBRIDGE

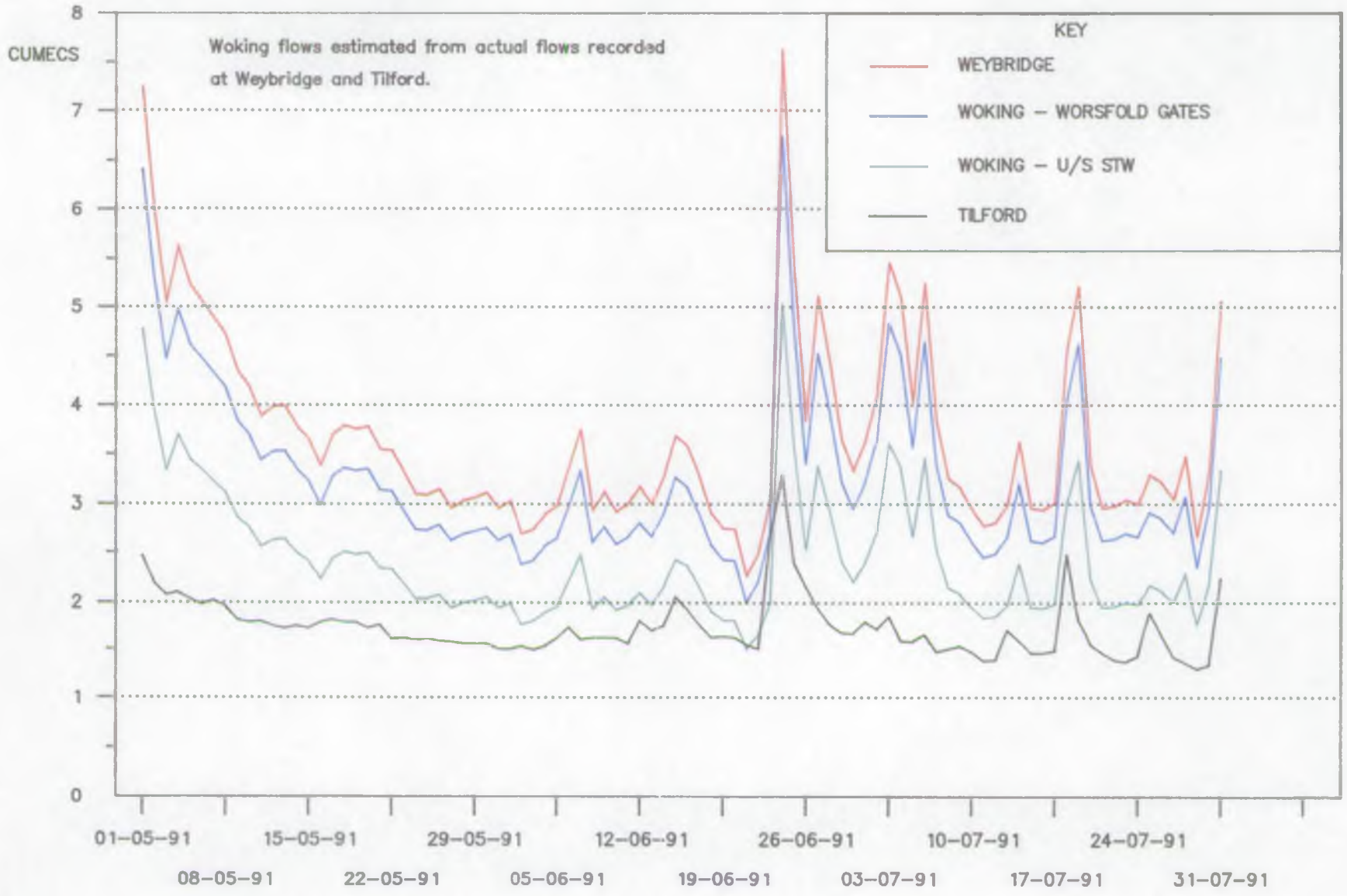


FIG.8.

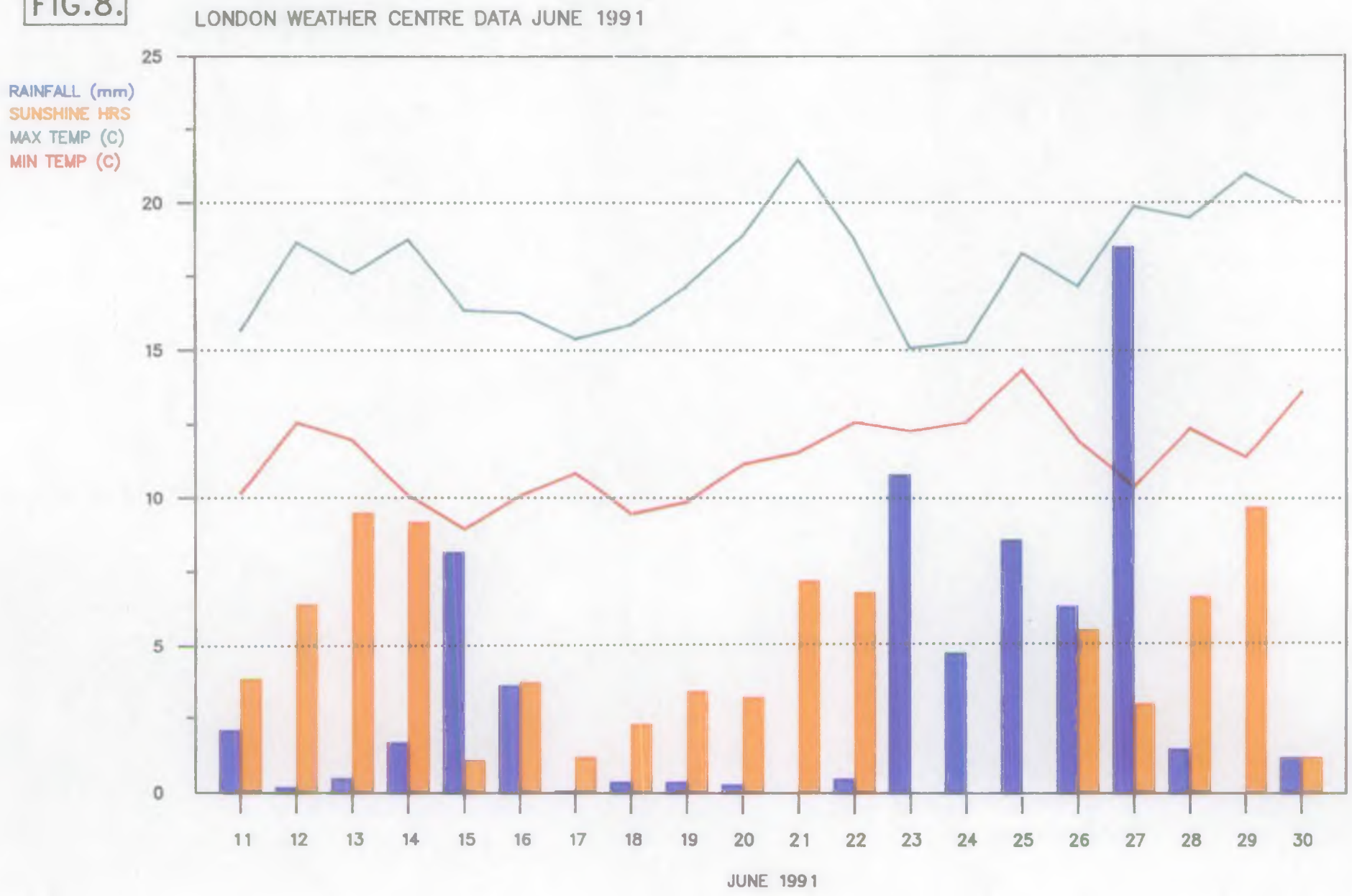

LONDON WEATHER CENTRE DATA JUNE 1991
RAINFALL (mm)
SUNSHINE HRS
MAX TEMP (C)
MIN TEMP (C)
25
20
15
10
5
0
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
JUNE 1991

FIG.9.

AQMS U/S WOKING STW
PWER.0034 R.WEY U/S CARTBRIDGE, SEND

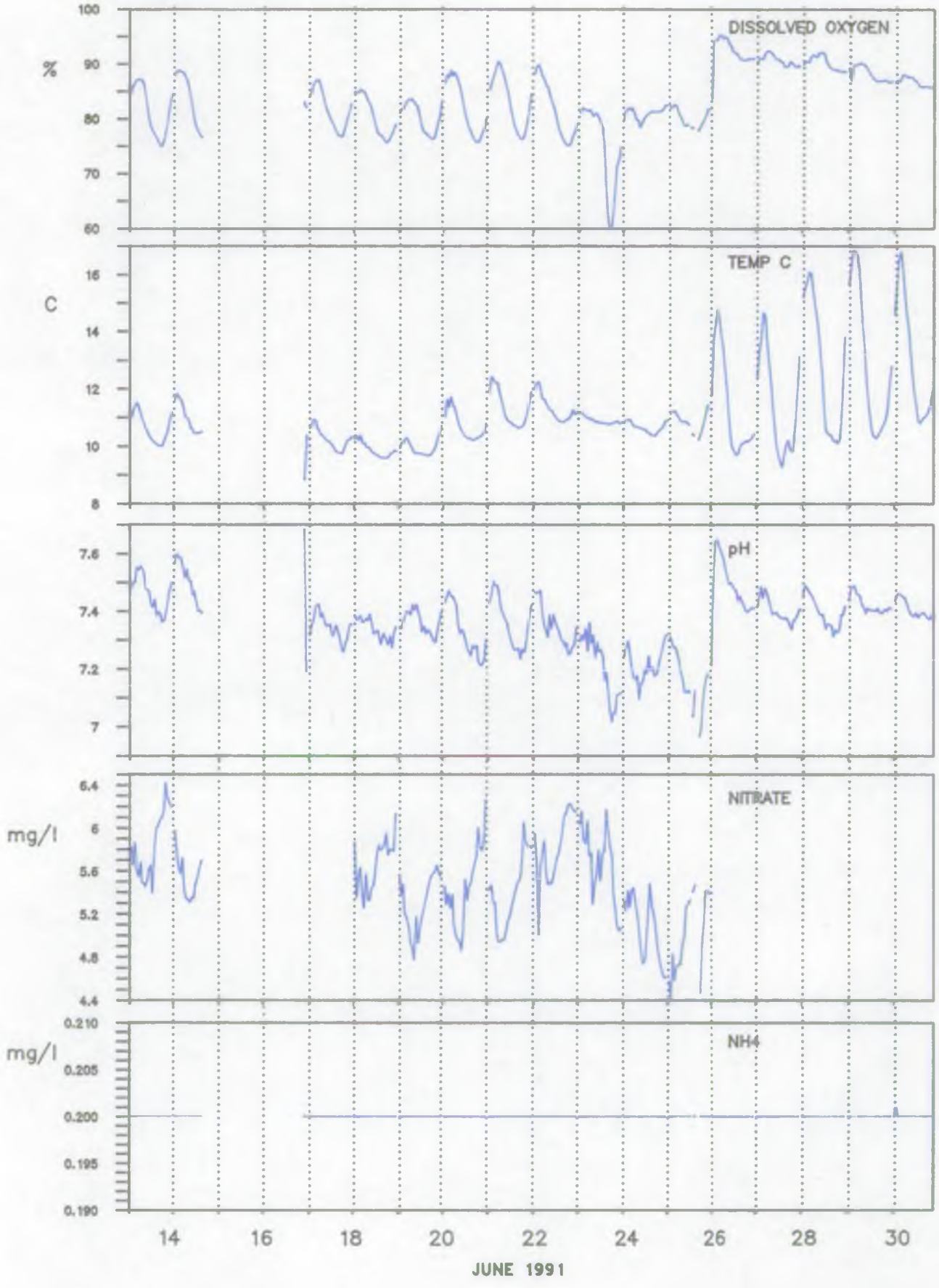


FIG. 10.

AQMS D/S WOKING STW
PWER.0133 R.WEY D/S WOKING STW

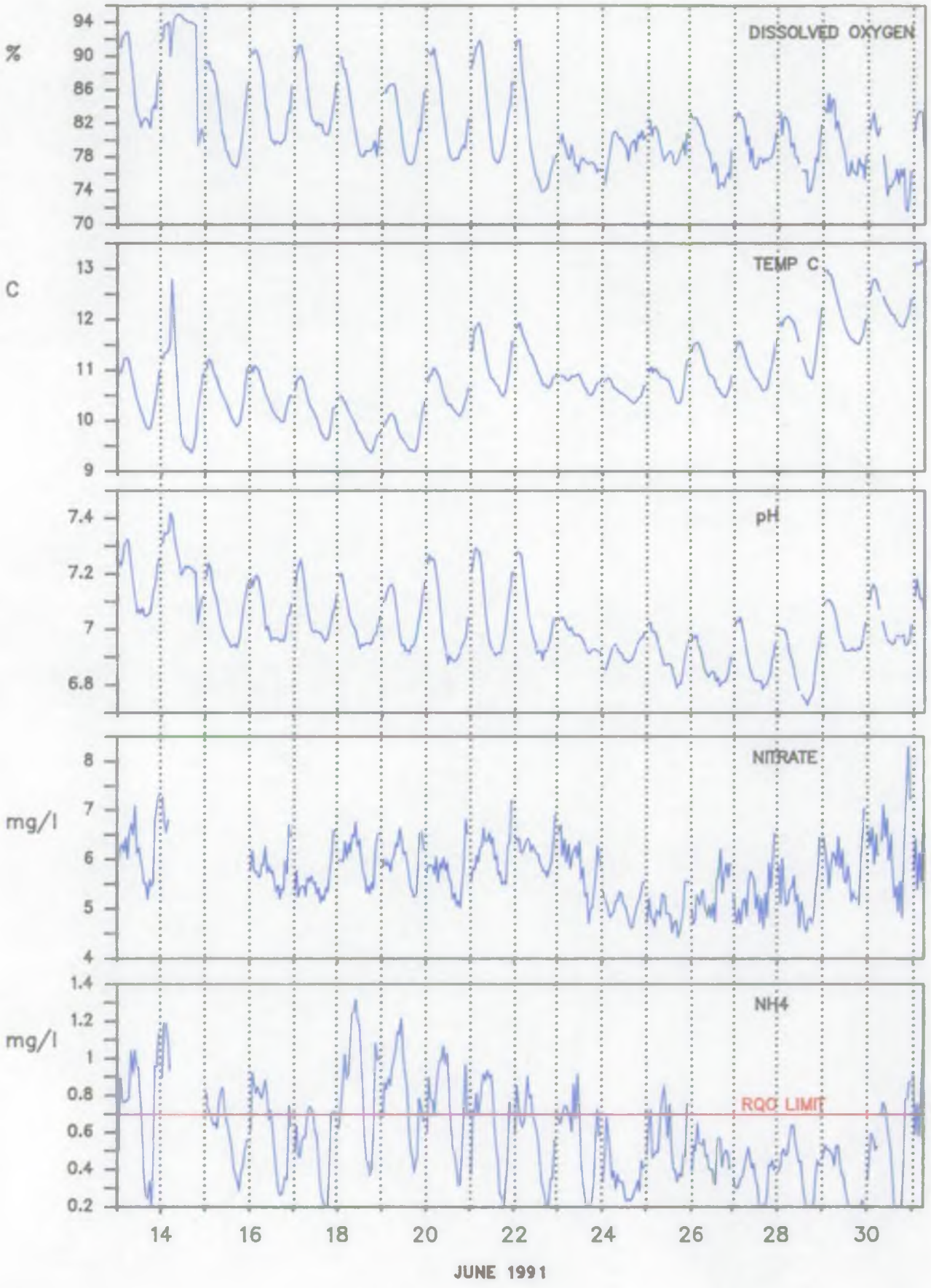


FIG. 11.

AMMONIACAL NITROGEN

EFFLUENT LOAD (Kg/hr) COMPARED WITH CONCENTRATION IN EFFLUENT (mg/l)

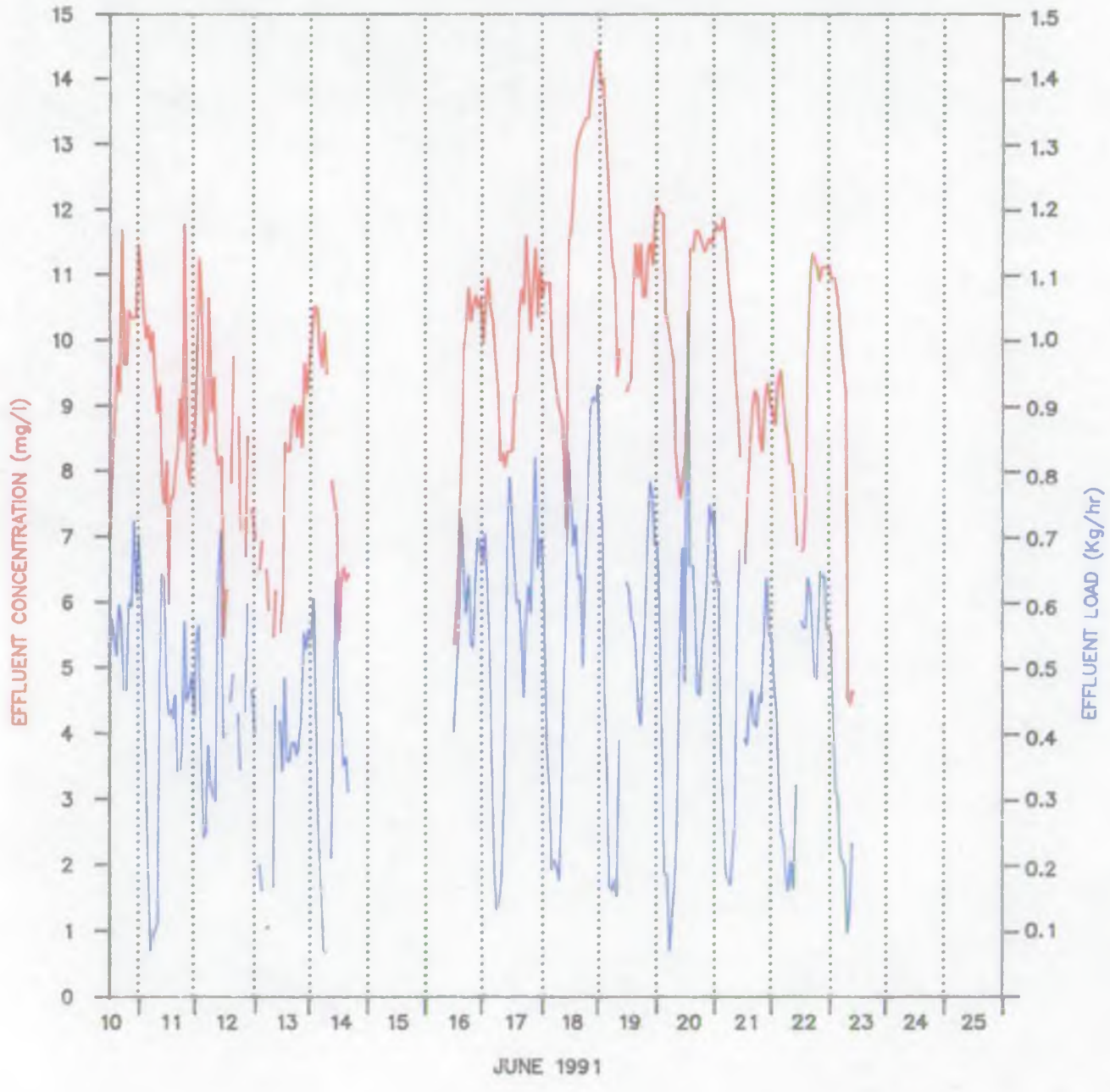
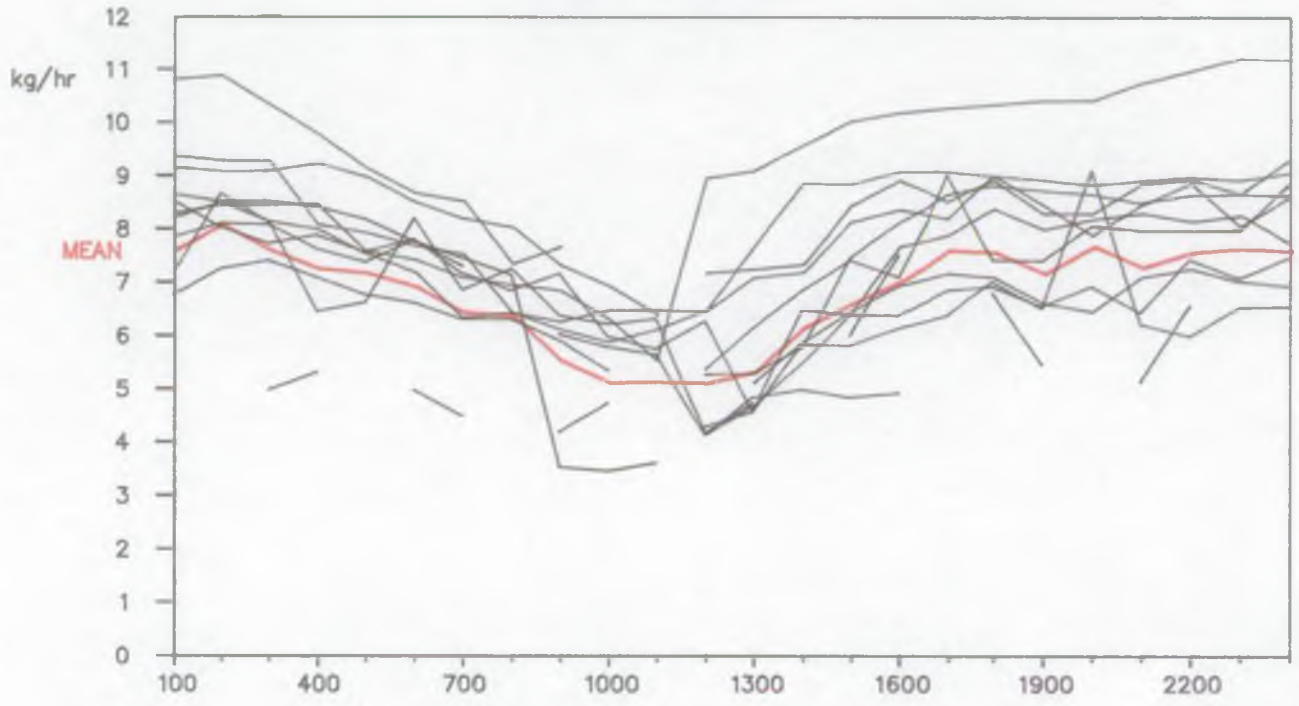


FIG. 12.

DAILY DATA SUPERIMPOSED – WOKING STW

WOKING STW FINAL EFFLUENT
DIEL PATTERN EXHIBITED BY AMMONIACAL NITROGEN LOAD kg/hr
10/06/91 TO 25/06/91



WOKING STW FINAL EFFLUENT
DIEL TREND EXHIBITED BY AMMONIACAL NITROGEN CONCENTRATION
10/06/91 TO 25/06/91

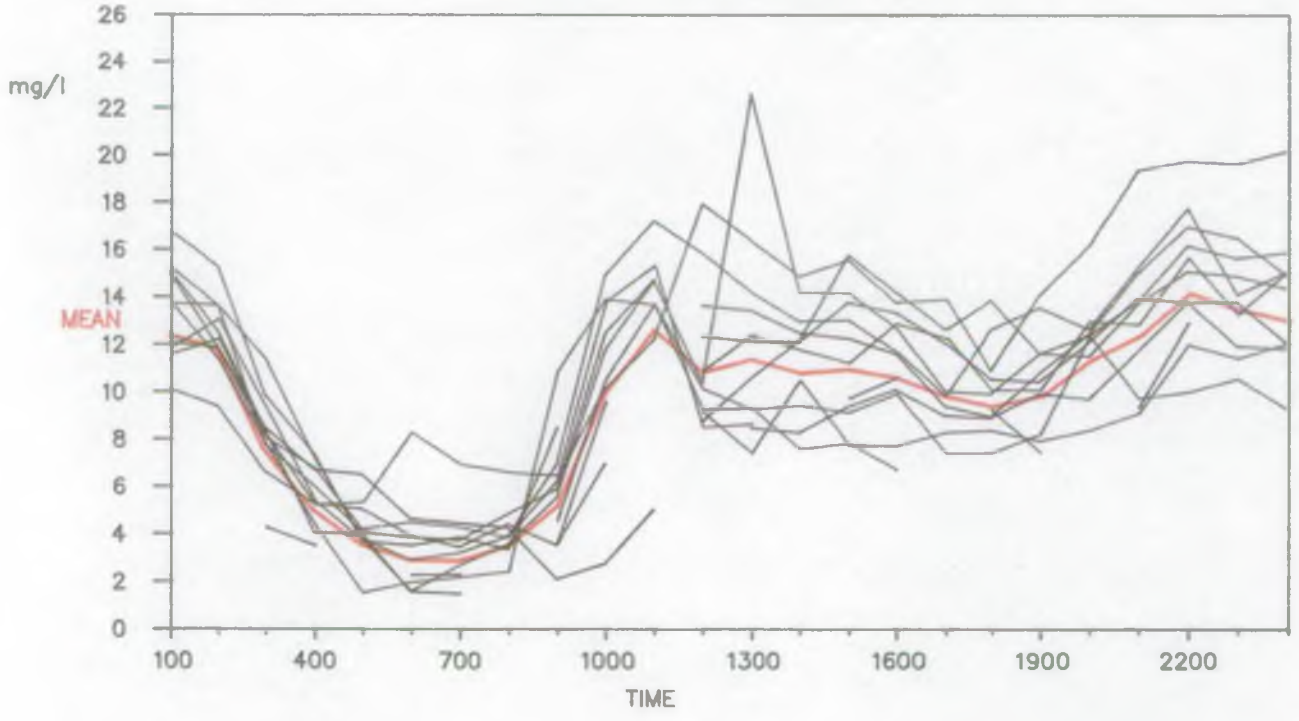


FIG. 13.

AMMONIACAL NITROGEN
COMPARISON OF STW LOAD AND RIVER CONCENTRATIONS

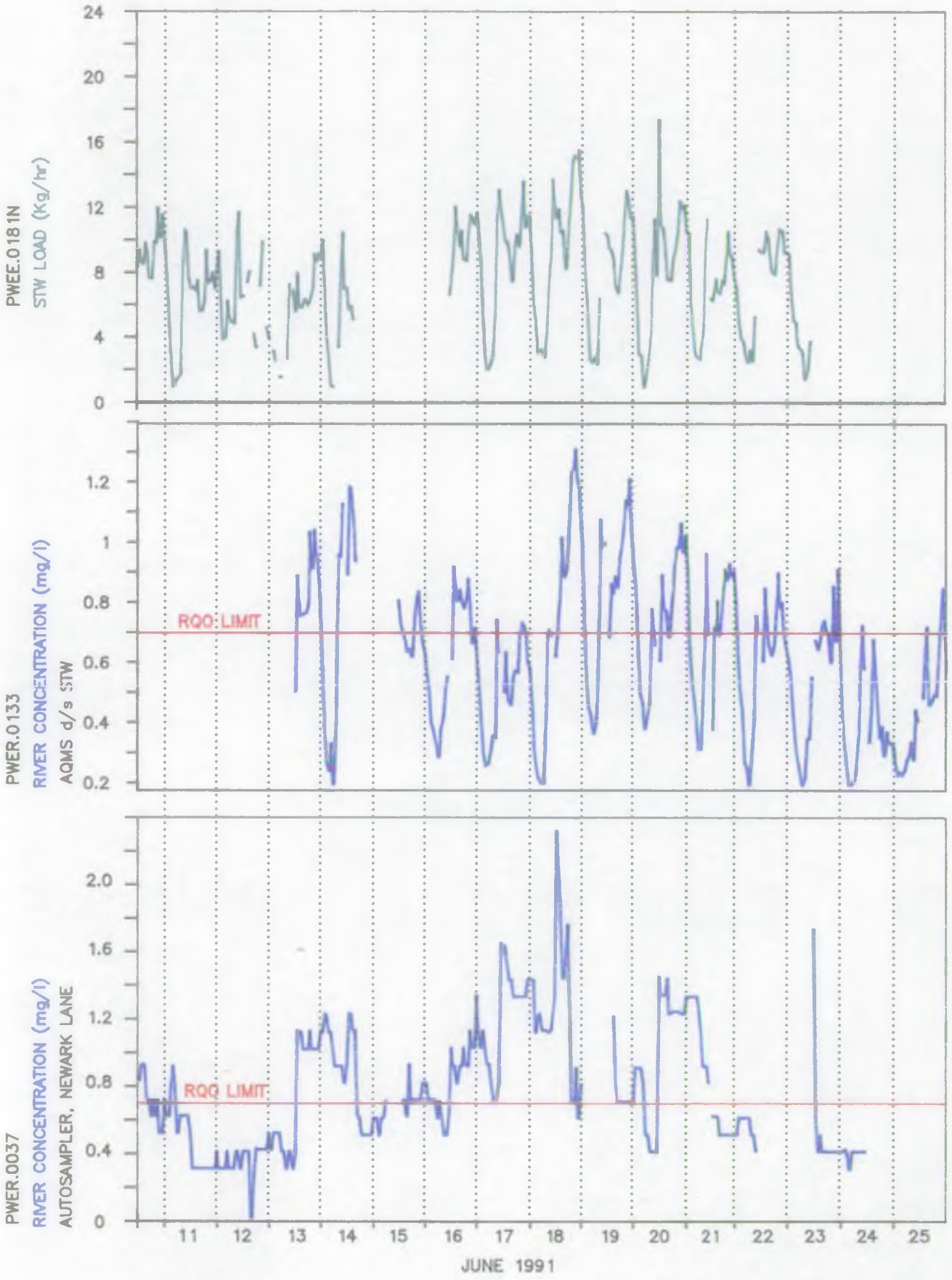


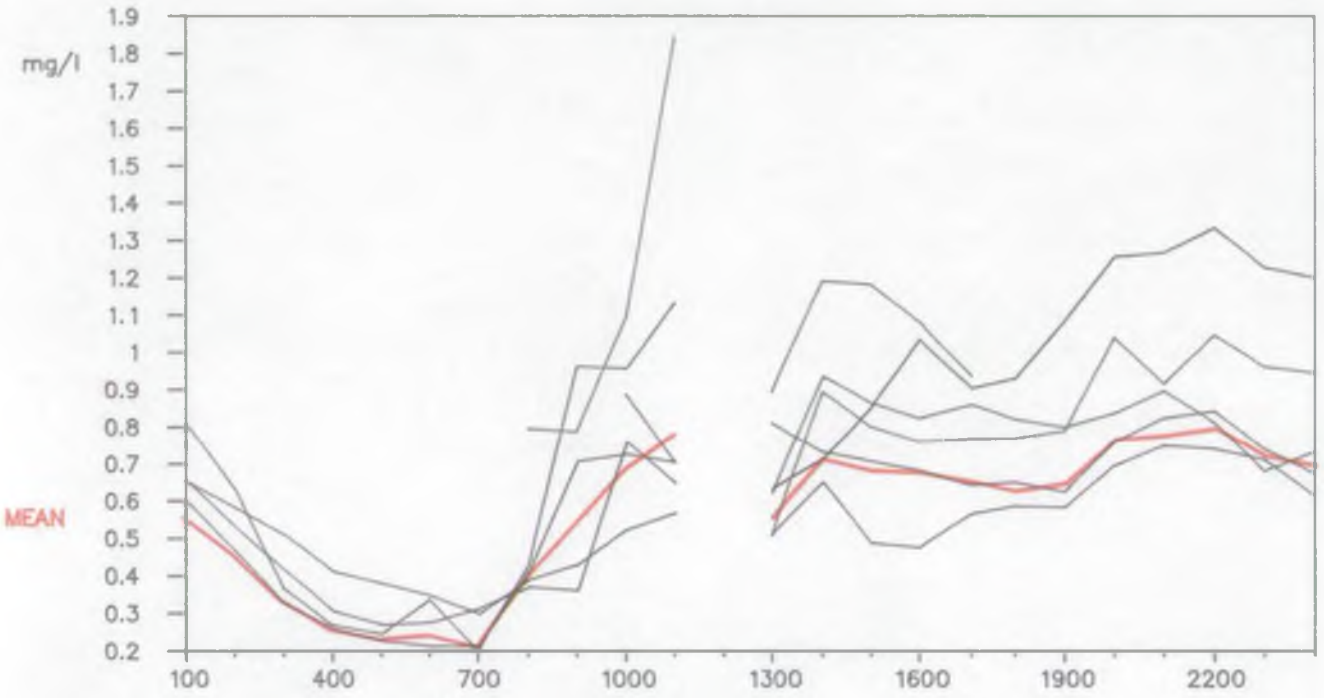
FIG. 14.

DAILY TRENDS SUPERIMPOSED – R.WEY D/S WOKING STW

AQMS D/S WOKING STW : PWER.0133

DIEL PATTERN EXHIBITED BY AMMONIACAL NITROGEN CONCENTRATION mg/l

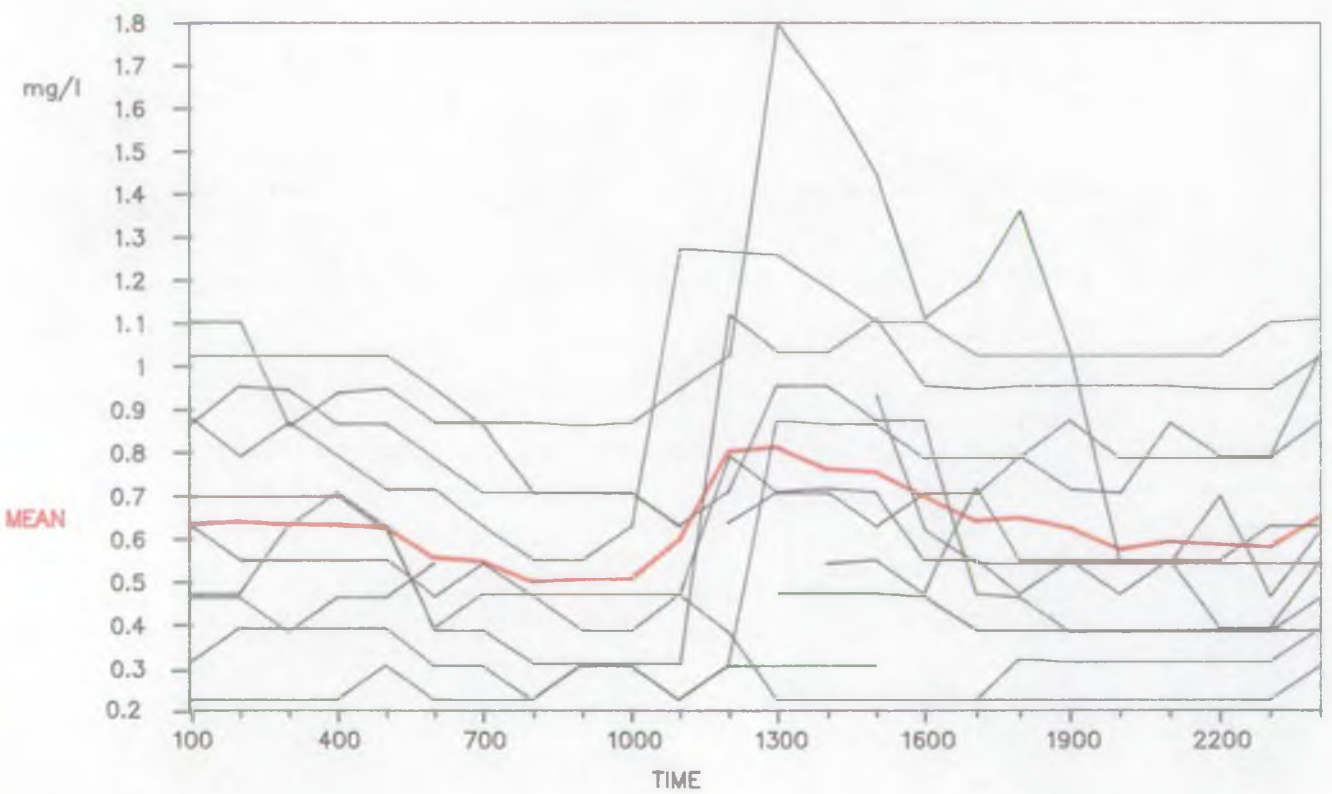
10/06/91 to 25/06/91



R.WEY, NEWARK LANE : PWER.0037

DIEL PATTERN EXHIBITED BY AMMONIACAL NITROGEN CONCENTRATION mg/l

10/06/91 to 25/06/91



Survey sites for the boat surveys are shown in Fig. 15. Results for the surveys carried out on 17/6 and 26/6 are displayed in Tables 1 and 2 with data for dissolved oxygen and ammoniacal nitrogen plotted in Figs 16 and 17. As expected, survey sites 4 and 5 produced poor quality water being within 15 metres of the STW outfall. Initial low levels of DO (%) and high ammonia resulted from sampling in unmixed water with a high proportion of effluent. From survey site 6 downstream to Newark Lane (site 16) the level of D.O. appeared to drop off proportionally with ammoniacal nitrogen, probably as a result of nitrification. Nevertheless, throughout the boat surveys ammoniacal Nitrogen remained above the RQO limit for a 1B watercourse. The survey on 17/6 followed very dry weather and the STW appeared to double the level of ammonical nitrogen recorded upstream of the outfall. Rainfall on 25/6 appears to have increased the upstream levels to about 1mg/l of ammoniacal nitrogen with the STW only adding approximately 0.3mg/l to the concentration downstream.

5.3(c) **January 1992**

River flows recorded at Tilford and Weybridge (Figs 4(i) and 4(ii)) show flows remained almost as low as those exhibited during the June 91 survey. Fig. 18 illustrates the rainfall, sunshine and temperatures recorded for January 1992 by the London Weather Centre. The period had very little rain and sunshine with low temperatures. Results for the survey are recorded in Table 3. Figure 19 shows the ammoniacal nitrogen, D.O.(%) and Temperature recorded upstream of Woking STW at Cartbridge, Send. The ammoniacal nitrogen at Cartbridge appears to show a diel pattern which may be the result of Guildford STW upstream.

Woking STW effluent ammonia load peaked at 1200 hrs (Fig. 20) with concentration in the river just below the STW (Fig. 21) also high at this time but peaking at 2200 hrs. The autosamplers at the STW and the downstream site both froze during the night and so no information was obtained for the early morning periods.

Fig. 22 illustrates the trends recorded at Newark Lane with a peak in ammoniacal nitrogen occurring at 2300 hrs. The river failed its RQO limit between 1400 hrs and 0700 hrs.

FIG. 15.

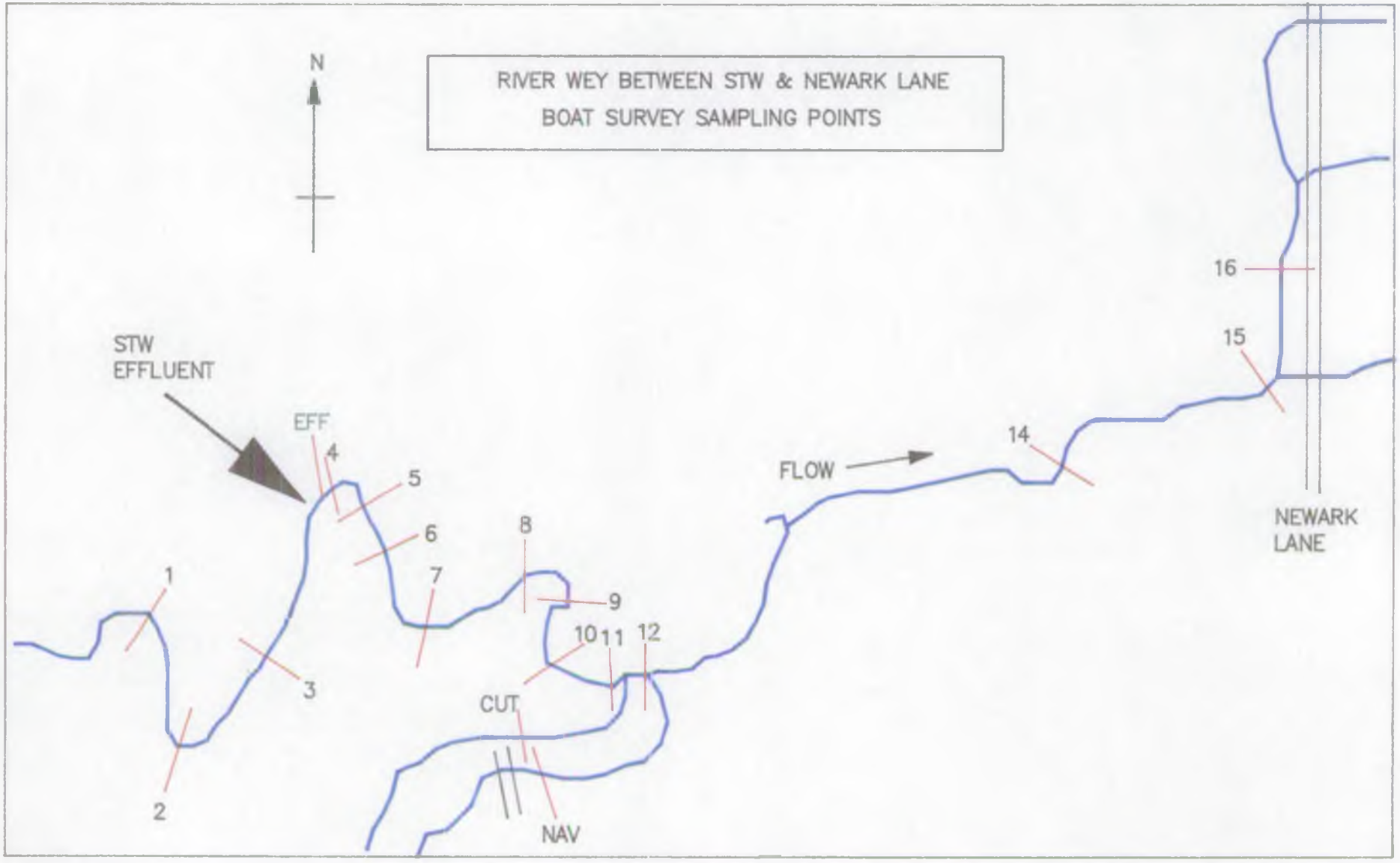

N
RIVER WEY BETWEEN STW & NEWARK LANE
BOAT SURVEY SAMPLING POINTS
STW
EFFLUENT
EFF
1
2
3
4
5
6
7
8
9
10
11
12
CUT
NAV
FLOW
14
15
16
NEWARK
LANE

TABLE 1

RIVER WEY BOAT SURVEY
WOKING STW TO NEWARK LANE 17/06/91

SITE	TIME	TEMP	pH	DO	TURB	COND	NH4	NH3
15	1425	15.4	8	87	39	389	0.9	0.02
15	1600	15	8	92	27	382	0.9	0.01
14	1430	15	7.9	90	38	386	0.8	0.01
14	1556	15	7.9	94	27	375	0.8	0.01
13	1435	15	7.9	90	30	384	0.9	0.01
13	1553	15.1	8	94	26	380	0.9	0.01
12	1438	15	7.9	90	28	386	0.9	0.01
12	1540	15	7.9	92	26	382	1	0.01
11	1440	15	7.9	92	28	388	1	0.01
11	1535	15.1	7.9	92	27	386	1.3	0.02
10	1445	15	7.9	94	28	377	0.9	0.01
10	1530	15.1	7.9	93	27	397	1.3	0.02
9	1446	15	7.9	94	30	381	0.9	0.01
9	1529	15	7.9	92	29	397	1.3	0.02
8	1448	14.9	7.9	94	28	387	1	0.02
8	1525	15	8	90	29	398	1.3	0.02
7	1451	15	7.9	95	28	390	1.1	0.02
7	1523	15	7.9	93	27	392	1.1	0.02
6	1454	14.9	8	96	27	368	0.8	0.01
6	1520	15	8	94	27	363	0.8	0.01
5	1456	14.9	8	97	26	351	0.6	0.01
5	1516	15	8	94	26	363	1	0.02
EFF	1456	15.9	7.6	54	46	946	8	0.1
EFF	1516	15.7	7.6	55	45	950	7.8	0.09
3	1500	14.9	8	97	25	346	0.6	0.01
3	1512	14.9	8	97	26	346	0.5	0.01
2	1504	14.9	8	97	25	346	0.5	0.01
2	1509	14.9	8	95	29	346	0.5	0.01
1	1506	14.9	8	96	25	346	0.5	0.01
NAV	1642	15	8	96	28	348	0.5	0.01

TABLE 2

RIVER WEY BOAT SURVEY
WOKING STW TO NEWARK LANE 26/06/91

SITE	TIME	TEMP	pH	D.O.%	TURB	COND	NH4	NH3
16	1445						1.0	
14	1300	15.7	8.0	82	58	344	0.8	0.01
14	1443	15.8	7.8	84	43	341	1.1	0.01
13	1305	15.6	7.8	81	51	341	0.6	0
13	1439	15.8	7.8	85	45	337	1.2	0.01
NAV	1310	15.8	7.8	89	68	317	0.7	0.01
NAV	1434	16.1	7.8	89	58	319	1.0	0.01
12	1313	15.5	7.7	80	46	340	1.0	0.01
12	1430	15.7	7.7	82	43	339	1.2	0.01
CUT	1307	15.2	7.8	75	41	317	0.7	0
CUT	1425	15.4	7.7	77	39	317	1.0	0.01
11	1314	15.6	7.8	82	48	348	1.1	0.01
11	1421	15.7	7.7	84	45	345	1.4	0.01
9	1318	15.6	7.8	83	48	346	1.2	0.01
9	1417	15.7	7.8	83	46	345	1.4	0.02
7	1324	15.5	7.9	84	47	342	1.2	0.01
7	1412	15.7	7.8	83	45	340	1.4	0.01
5	1330	15.5	7.7	83	47	360	1.3	0.01
5	1410	15.7	7.8	84	46	340	1.5	0.02
4	1340	15.5	7.8	83	47	380	1.7	0.02
4	1405	15.6	7.8	84	46	340	1.5	0.02
EFF	1335	16.5	7.7	51	60	890	7.7	0.11
EFF	1400	16.5	7.7	52	58	906	7.9	0.11
3	1345	15.5	7.8	84	46	311	1.1	0.01
3	1355	15.5	7.8	86	46	312	1.0	0.01
2	1347	15.5	7.8	84	45	311	1.1	0.01
2	1352	15.5	7.7	84	46	312	1.0	0.01
1	1349						1.0	

FIG. 16.

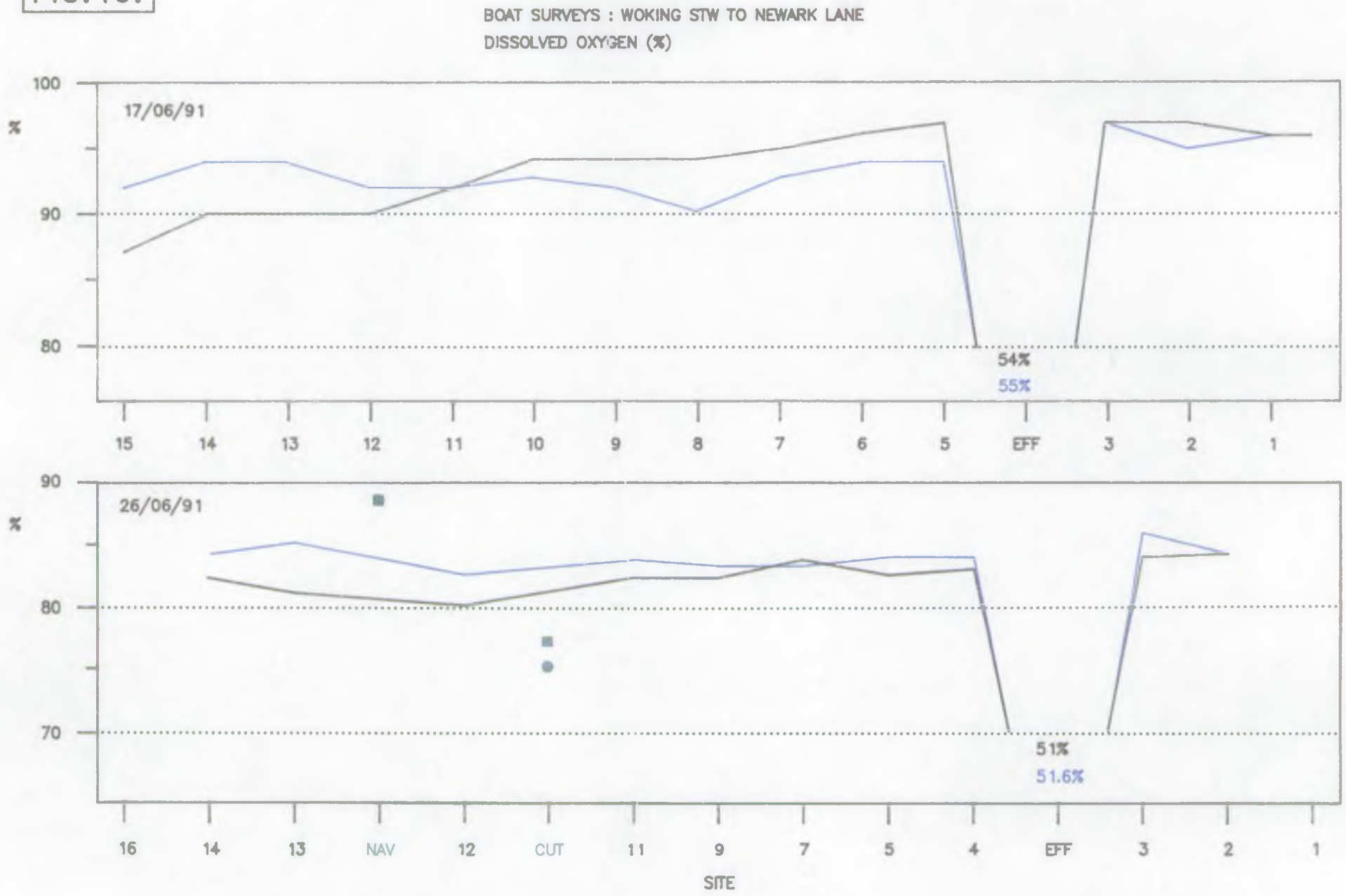

BOAT SURVEYS : WOKING STW TO NEWARK LANE
DISSOLVED OXYGEN (%)
17/06/91
%
100
90
80
54%
55%
15
14
13
12
11
10
9
8
7
6
5
EFF
3
2
1
26/06/91
%
90
80
70
51%
51.6%
16
14
13
NAV
12
CUT
11
9
7
5
4
EFF
3
2
1
SITE

FIG. 17.

BOAT SURVEYS : WOKING STW TO NEWARK LANE
AMMONIACAL NITROGEN (NH4) mg/l

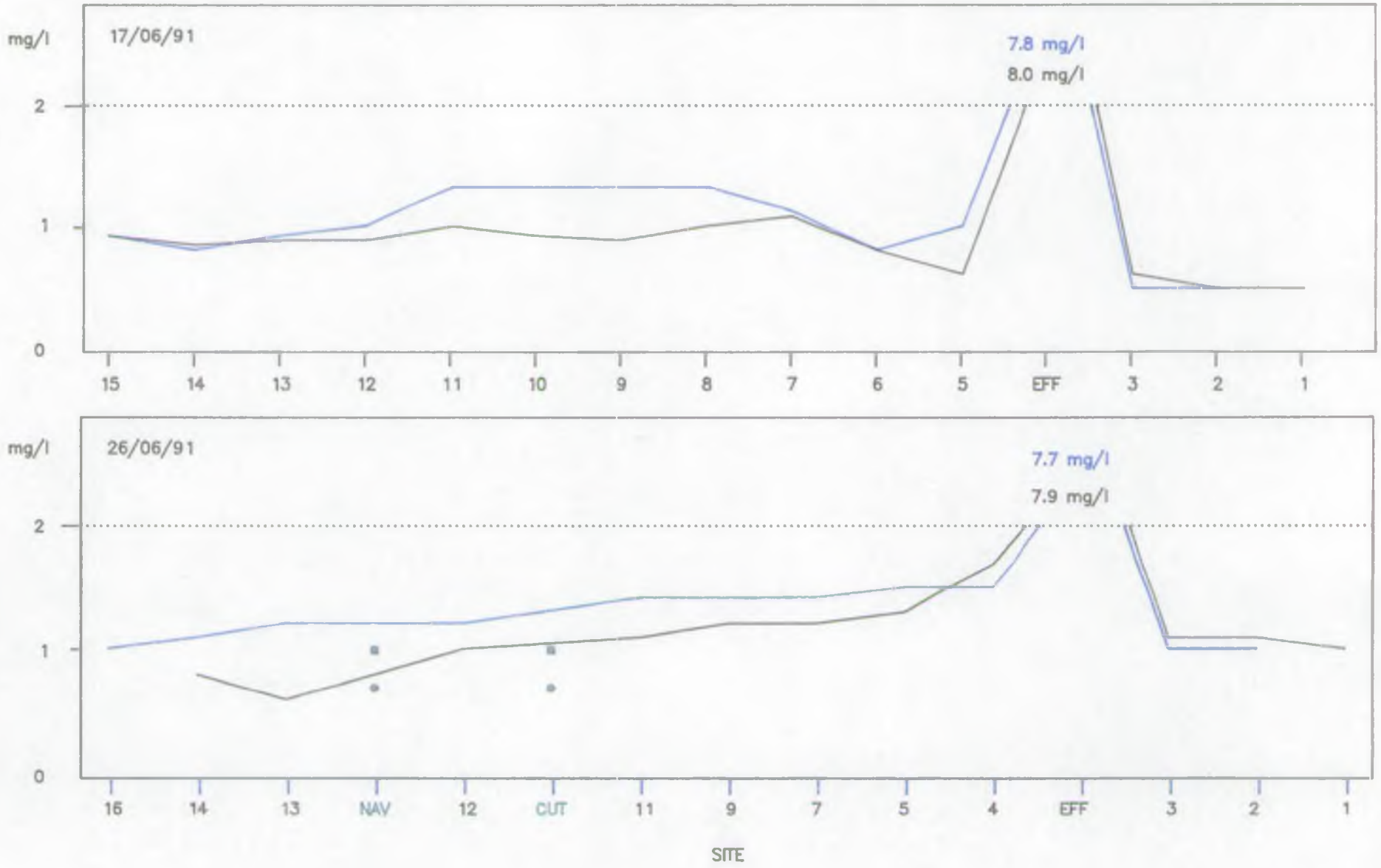


FIG. 18.

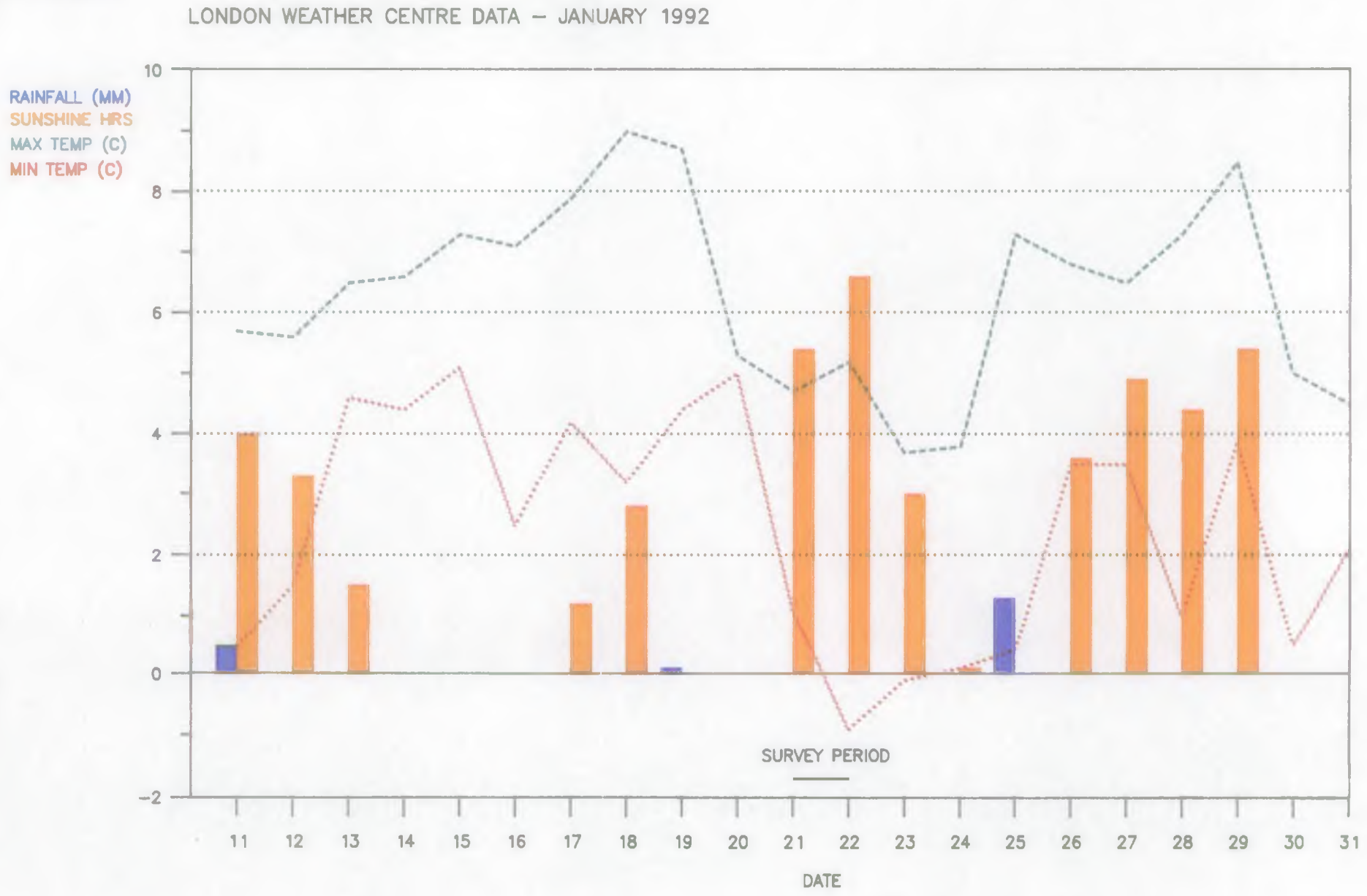

LONDON WEATHER CENTRE DATA – JANUARY 1992
RAINFALL (MM)
SUNSHINE HRS
MAX TEMP (C)
MIN TEMP (C)
10
8
6
4
2
0
-2
SURVEY PERIOD
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
DATE

TABLE 3

WEY SURVEY, OLD WOKING - 20/02/92 - 21/02/92

CARTBRIDGE			WOKING STW				D/S WOKING STW			NEWARK LANE		
TIME	TEMP	NH4	TIME	TEMP	NH4	BOD	TIME	TEMP	NH4	TIME	TEMP	NH4
1000	4	0.5	1020	8	8.8	18.7	1030	5	1.53	1045	4	0.7
1200	5	0.58	1205	9	13.7	15.8	1220	5	1.53	1245	5	0.49
1400	5	0.63	1410	9	11.4	16.5	1420	5	1.14	1445	5	0.89
1600	5	0.62	1609	5	13.7	18.1	1618	5	1.63	1630	4.5	0.88
1800	5	0.49	1800		14.4	9	1800		1.86	1818	4.5	1
2005	4.5	0.35	2000			20.5	2000		1.77	2020	4	1.03
2210	4.5	0.25	2200			21	2200		2.1	2220	4.5	1.16
15	5	0.28	2400			16.8	2400		1.9	26	4.5	1.33
203	4	0.35	200		15.2	22.6				215	4	1.3
400	4	0.37								415	4	1.16
615	4	0.36								625	4	0.76
800	4	0.38								815	4	0.53
1000	4	0.41								1105	3.5	0.53

FIG. 19.

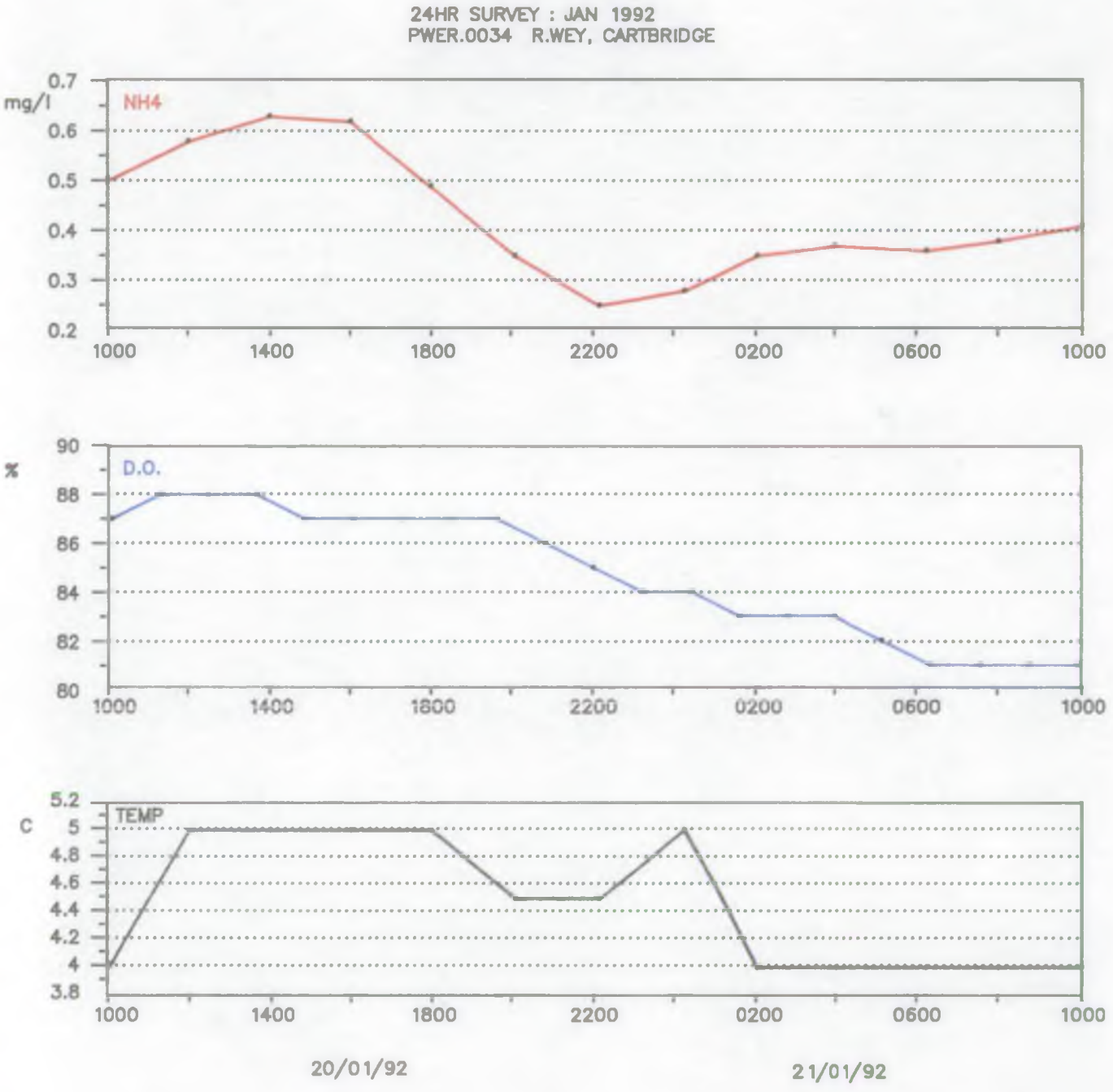

24HR SURVEY : JAN 1992
PWER.0034 R.WEY, CARTBRIDGE
mg/l
NH4
0.7
0.6
0.5
0.4
0.3
0.2
%
D.O.
90
88
86
84
82
80
C
TEMP
5.2
5
4.8
4.6
4.4
4.2
4
3.8
1000
1400
1800
2200
0200
0600
1000
20/01/92
21/01/92

FIG.20.

24HR SURVEY : JAN 1992
PWEE.0181N WOKING STW

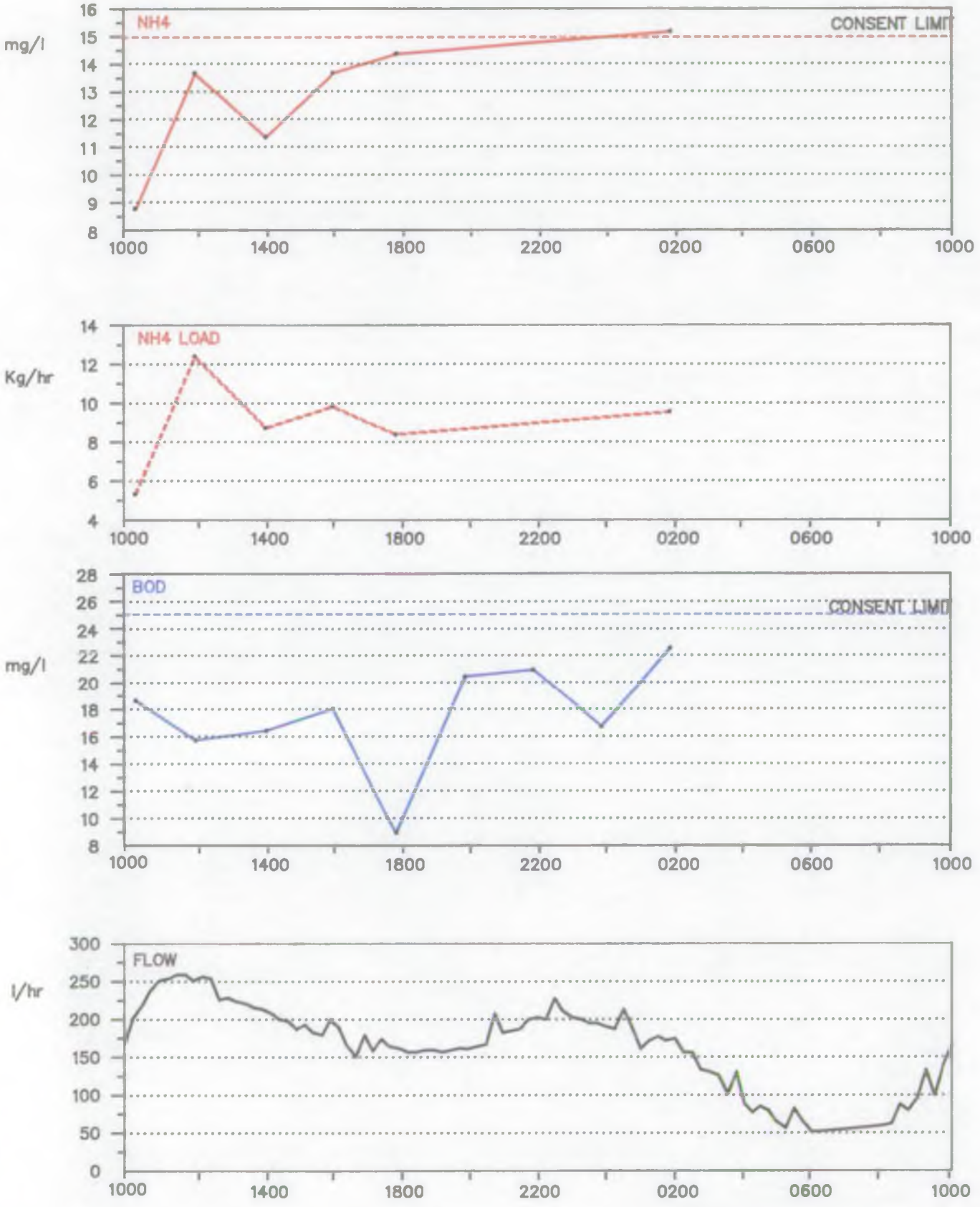


FIG.21.

24HR SURVEY : JAN 1992
PWER.0133 R.WEY D/S WOKING STW

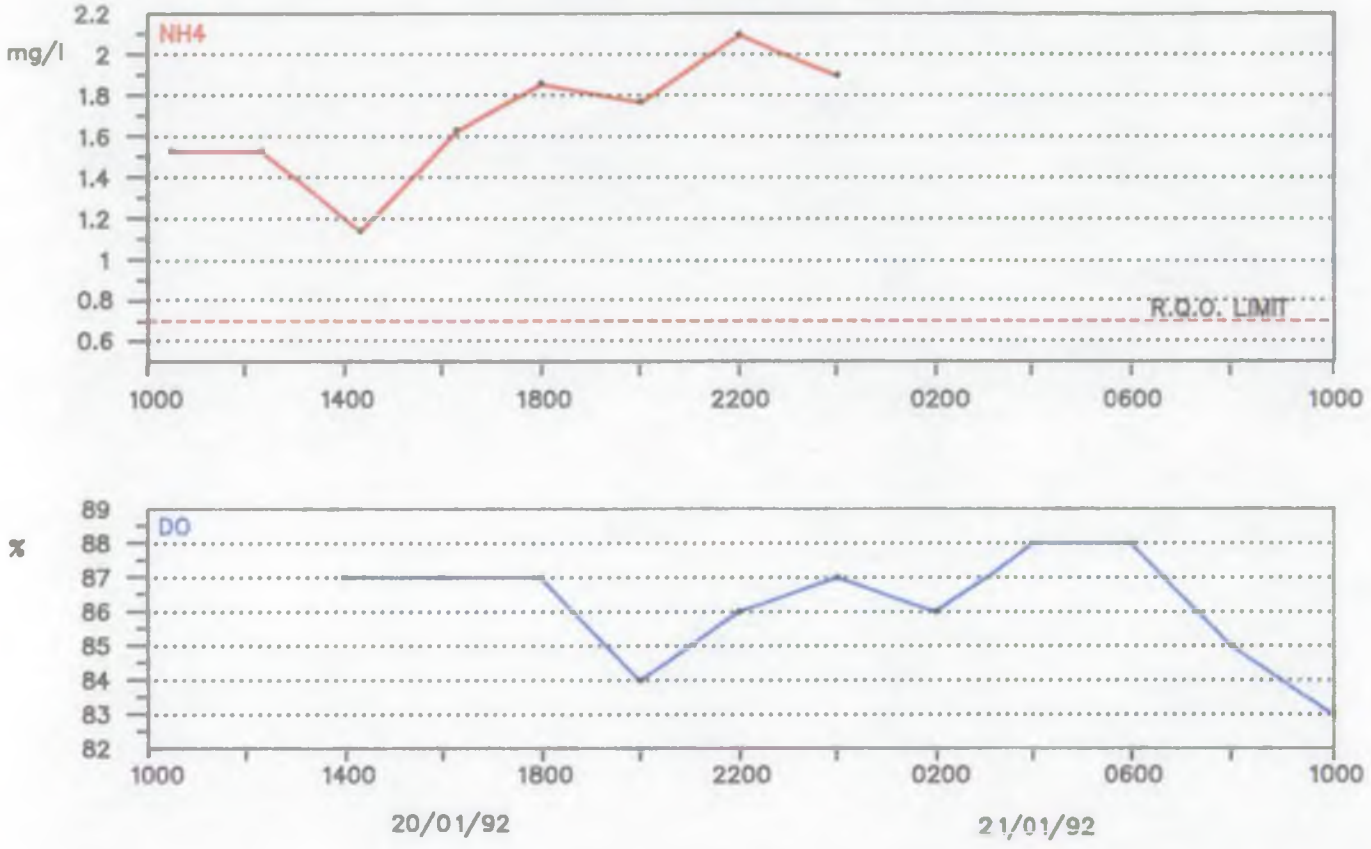
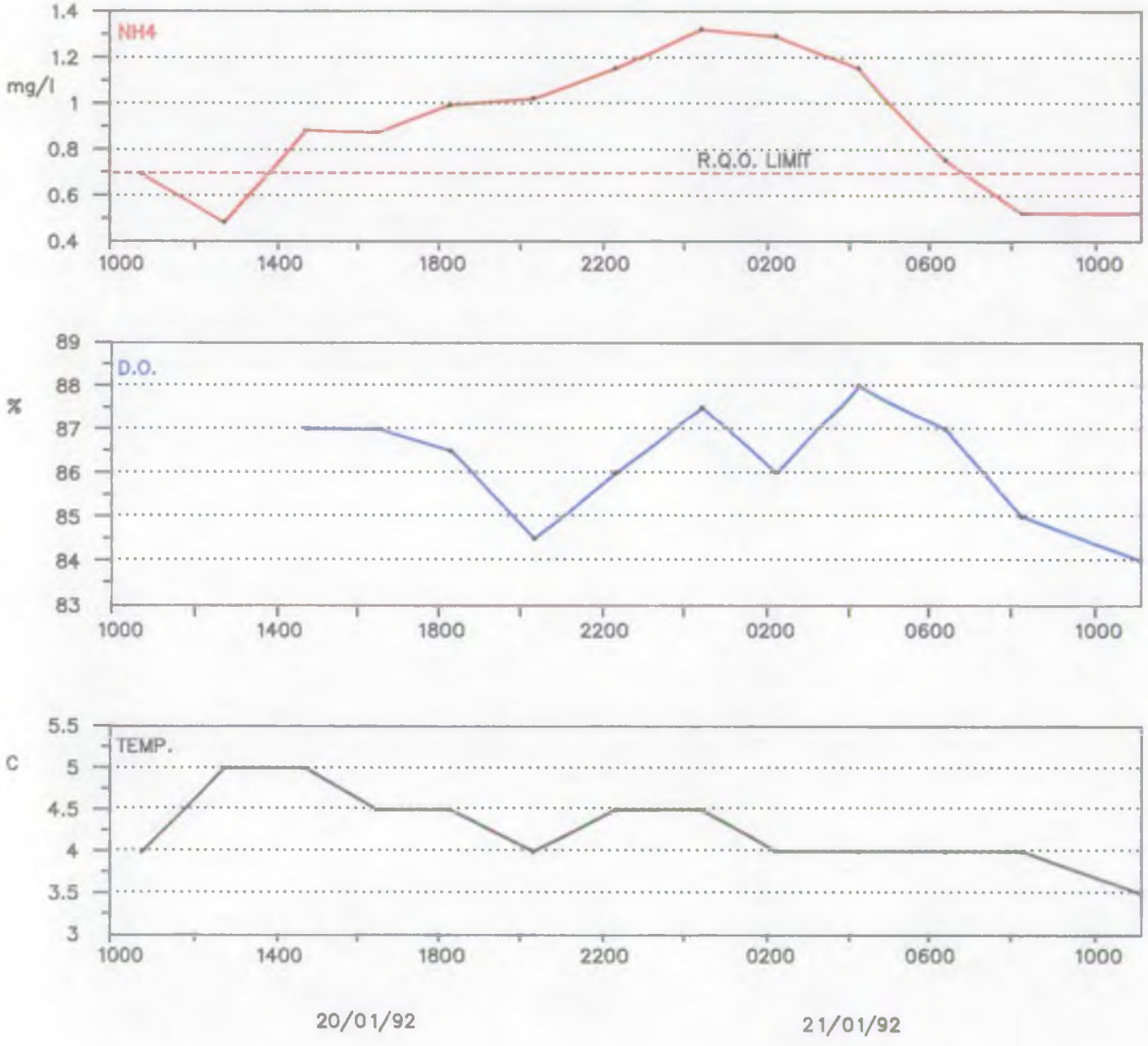


FIG.22.

24HR SURVEY : JAN 1992
PWER.0037 R.WEY, NEWARK LANE



6. Interpretation of Results

Comparison of Figs. 12 to 14 (for June 1991 survey) and Figs 19 to 22 (January 1992 survey) showed differences in the times of ammoniacal nitrogen peaks at the study sites. These are summarised in Fig. 23.

Flows for the two survey periods were similar with the main variable being the weather conditions. The June survey was conducted in a period of hot, mainly dry weather with temperatures ranging from 9 to 22°C. The ammoniacal nitrogen concentration in the river at Cartbridge remained below the limit of detection. The load from the STW was at its lowest level between 1000 hrs and 1300 hrs and then rose steadily throughout the day to peak at about 0300 hrs. The river below the STW followed a similar pattern although ammoniacal nitrogen concentrations appeared to follow more closely concentration in the effluent rather than ammonia load with peaks at 1100 hrs and 2200 hrs. This may indicate a channelling effect with the AQMS probe lying directly in the path of the effluent and little mixing with receiving river water. The peaks at Newark Lane occurred at about 1300 hrs and 0200 hrs indicating a 2 to 3 hour time of travel between the sites.

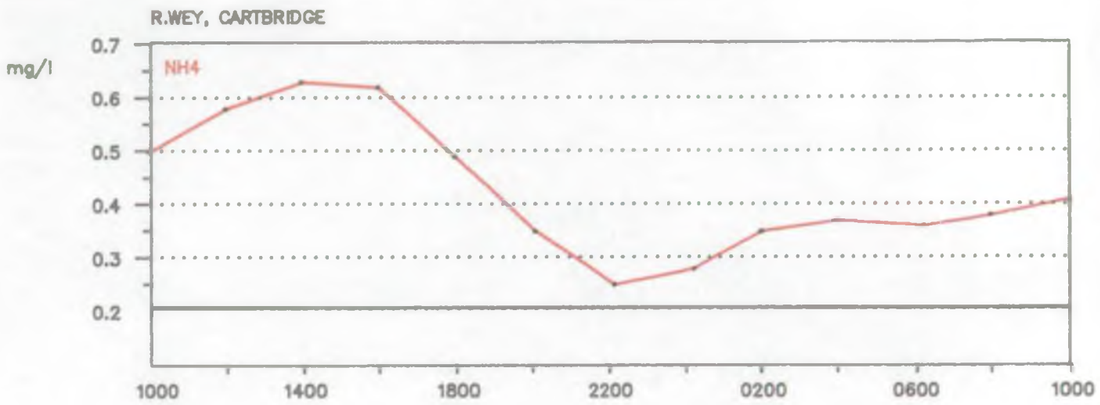
The January 1992 survey was conducted in a period of cold (-1°C to 9°C) but dry weather thereby giving an indication of the effect of cold weather on the nitrification at the STW.

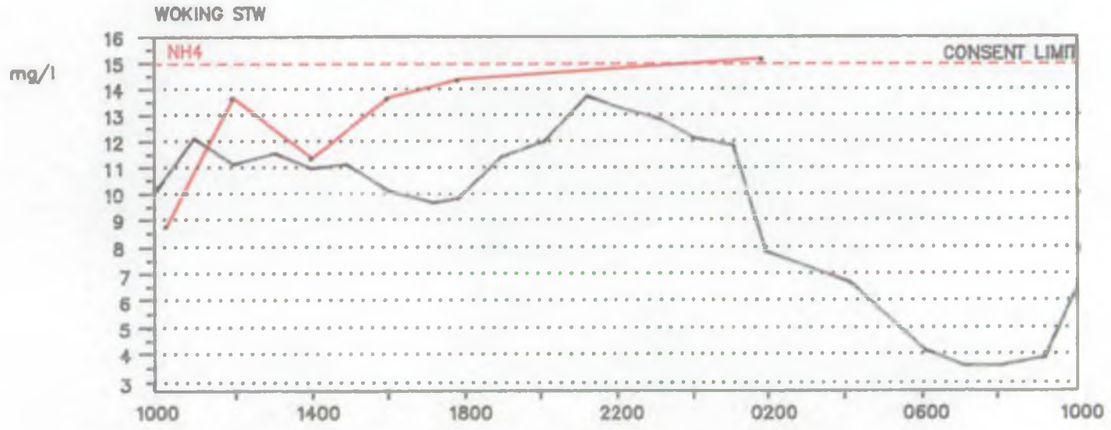
Ammonical nitrogen levels at Cartbridge appeared to show a diel pattern with a peak at 1400 hrs. This may have been the result of a poorer quality effluent from Guildford STW and will have to be investigated further. In general the concentrations and subsequently the ammonia load in Woking STW effluent was higher during this colder weather than in the June survey but nevertheless remained within its consent limit. The concentration of ammonia in the effluent appeared to follow the same pattern as in June but the load showed a defined peak at midday which was absent during the summer survey. Ammoniacal Nitrogen levels in the river almost doubled with the downstream Woking STW site failing its RQO limit throughout the survey period and Newark Lane only managing to achieve its RQO for approximately 25% of the time, all within the current NRA sampling "window". Again, the peaks in NH_4 concentration indicate a time of travel of about 2 hours, which is slightly faster than the 4 hours recorded by the Ove Arup Time of Travel Study.

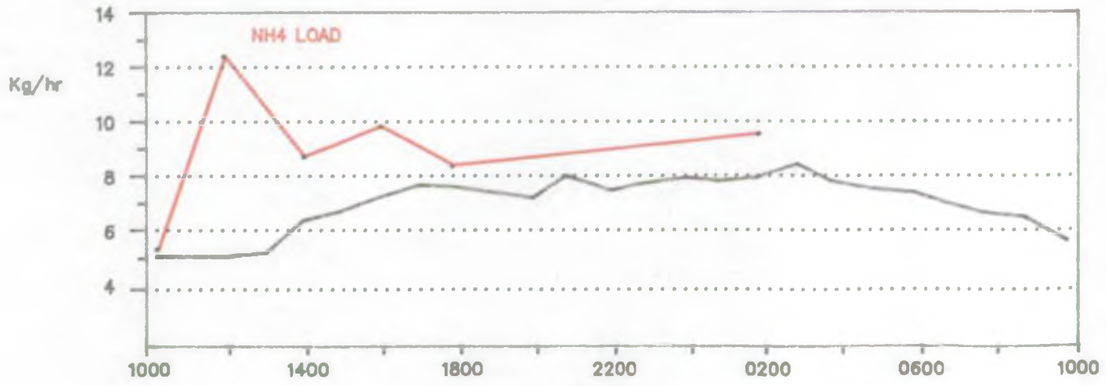
Dilution of the effluent is obviously an important factor when considering consent limits for the STW. With the multi channelled river system at Woking consideration of the point of discharge would appear to be of paramount importance in order that maximum dilution is achieved. However, the boat surveys (Figs 16 and 17) indicate that the extra dilution provided by the Navigation and flood relief channels do not appear to significantly reduce ammonia levels. It should be noted that the slight drop in ammonia concentrations recorded during the suveys would have resulted from natural purification as well as the dilution. A discharge further

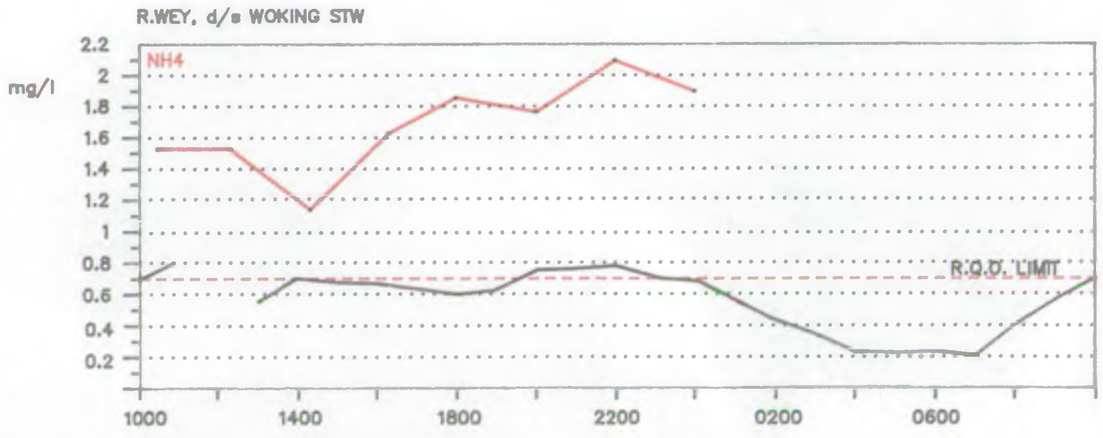
FIG.23.

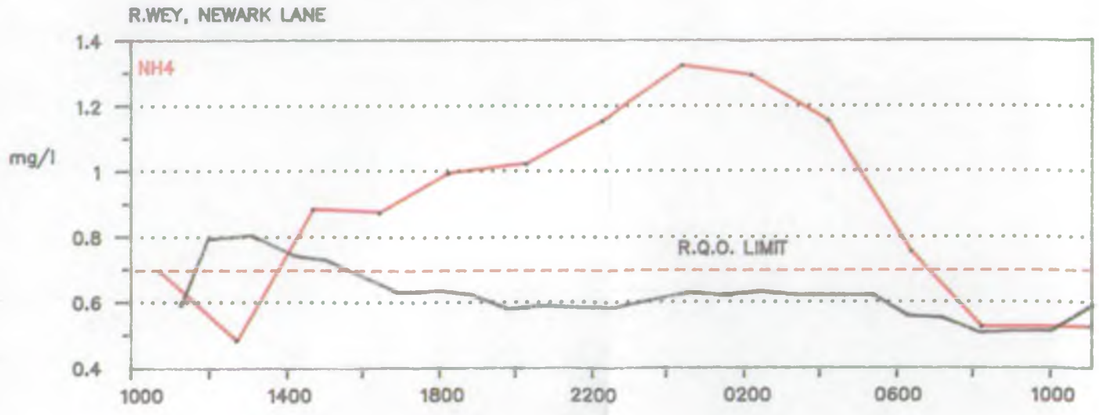
COMPARISON OF AMMONIACAL NITROGEN LEVELS RECORDED DURING JUNE 1991 AND JANUARY 1992 SURVEYS.











downstream, where Navigation and main river flows are combined, would therefore not appear to make a great deal of difference to the ammonia levels in the river and would in fact reduce the time for nitrification before meeting Ripley STW effluent downstream.

As far as Water Quality Objectives are concerned it appears that the river quality is adequate to meet its uses. Initial indications are that the fish population, at least as far as biomass is concerned, is not adversely effected by the sewage effluent although this is to be confirmed.

7. Conclusions

The surveys show that Woking STW is able to perform within its consent limits even during the cold weather.

Cold weather appears to result in an increase of about 10-30% in ammonia load while river ammonia loads increase by between 80 - 100%. This indicates that a reduction in river nitrification rates during colder weather is more significant than the nitrification at the STW in producing a good river quality.

Flow data show that Navigation usage does not appear to have a significant influence on the volume of water flowing through the main river channel and the subsequent dilution of sewage effluent.

Although Woking STW remains largely within its consent the river is failing to achieve an RQO of 1B for ammonia, but nevertheless maintains a quality necessary to supports its uses.

Woking STW is approaching its capacity as far as catchment population is concerned and performing near to its consent limits. It would therefore appear that improvements/additions will be needed at the STW to cope with the increasing catchment population. As far as the RQO is concerned a reclassification to a 2A would be acceptable on the basis of its uses although analysis of biological and fisheries data has yet to be completed.

APPENDIX 1

WATER COURSE : Wey
REACH : Woking STW to Wisley STW RQO : 1B LENGTH : 6.2
SPTS:

PWER.0037 2 WEY AT NEWARK LANE, PYRFORD

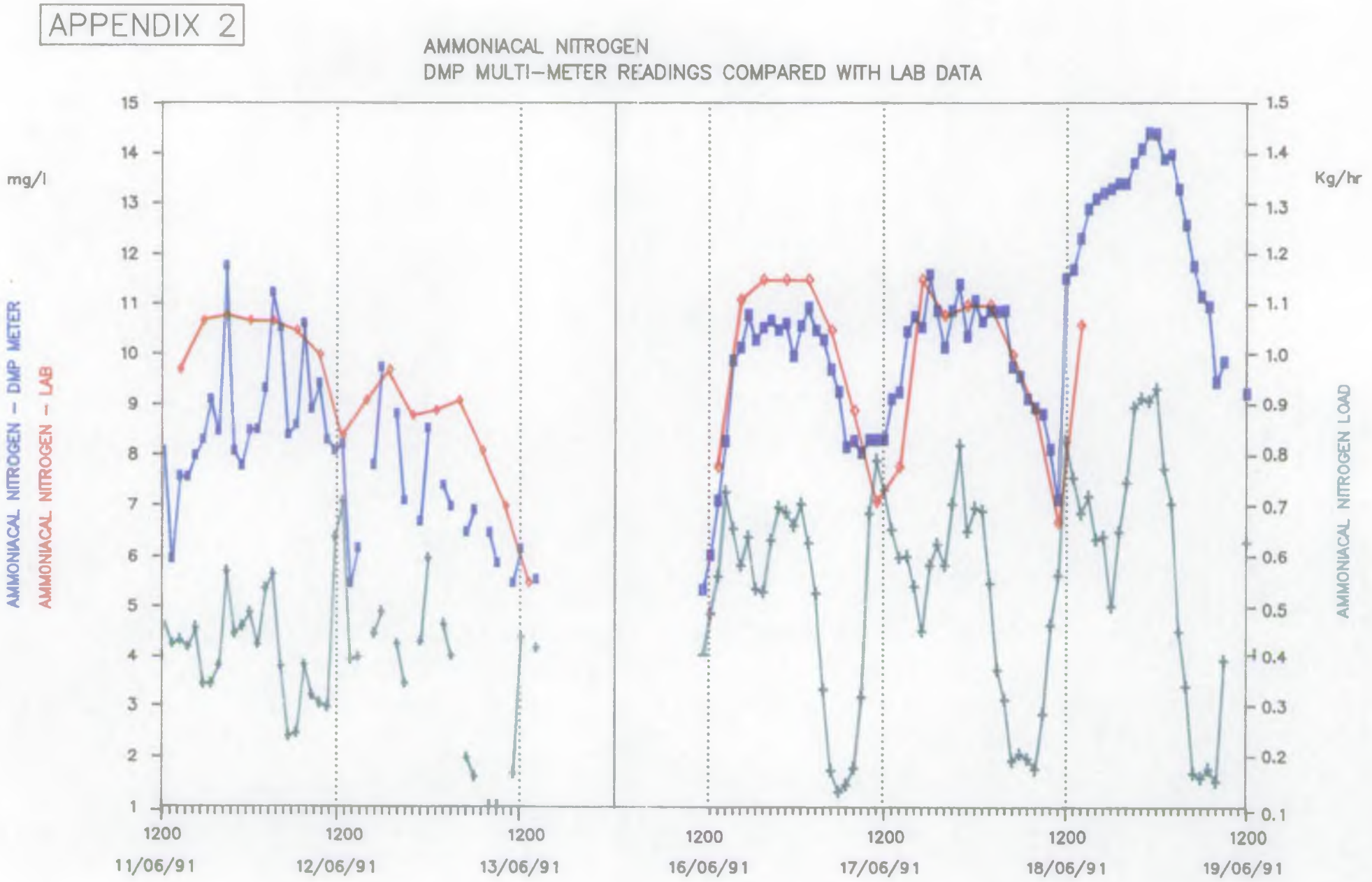
PASS / FAIL ANALYSIS

CLASS	BOD (8)	D.O.(%) (14)	AMM. N.(15)	UN.AMM.(16)
1A	9/11(81%)	8/11(72%)	3/12(25%)	12/12(100%)
1B	11/11(100%)	11/11(100%)	9/12(75%)	12/12(100%)
2A	11/11(100%)	11/11(100%)	12/12(100%)	12/12(100%)
2B	11/11(100%)	11/11(100%)	12/12(100%)	12/12(100%)
3	11/11(100%)	11/11(100%)	12/12(100%)	12/12(100%)
4	11/11(100%)	11/11(100%)	12/12(100%)	12/12(100%)

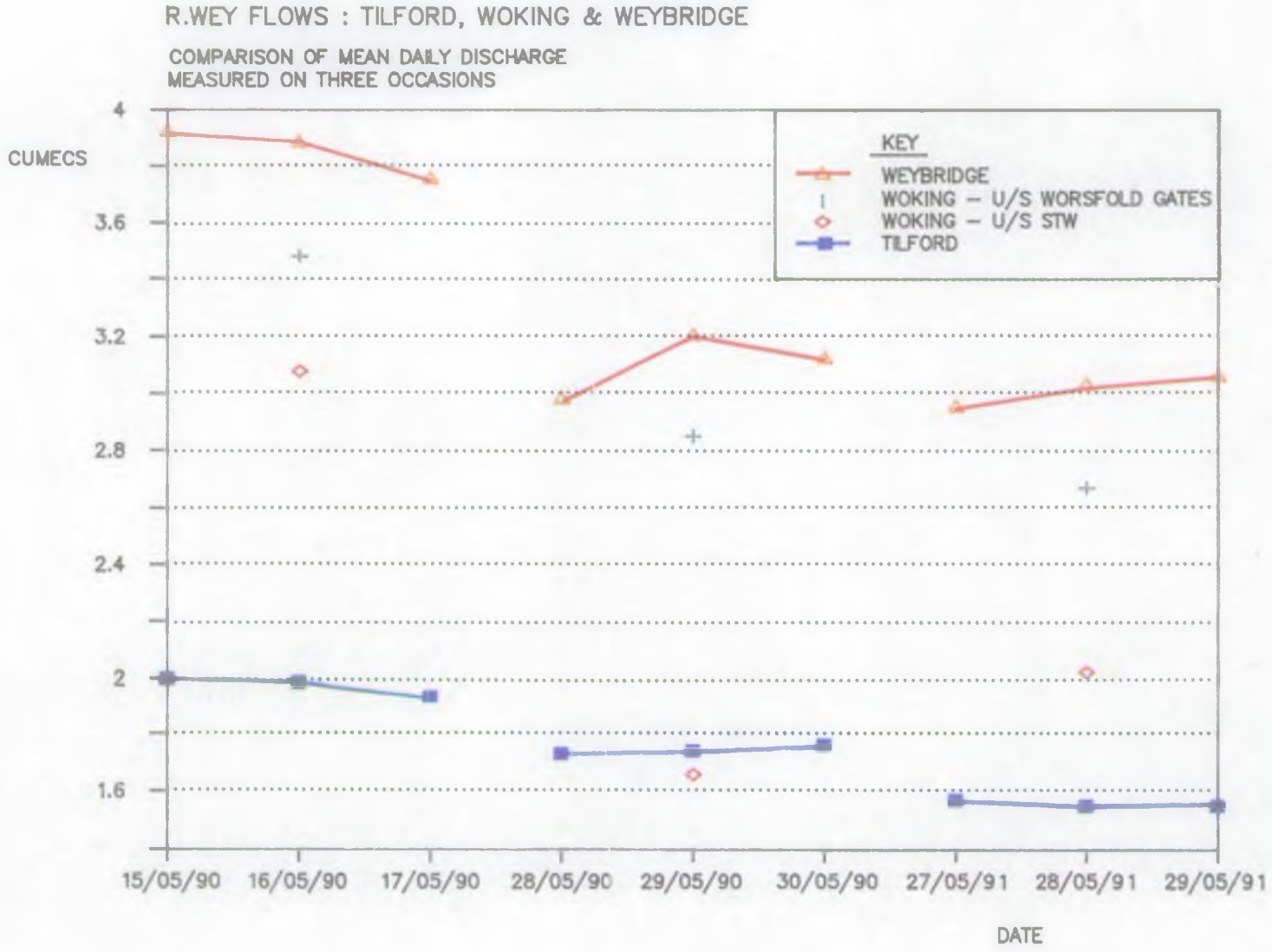
ACTUAL QUALITY ACHIEVED :

2A - LOOK UP TABLE METHOD

APPENDIX 2


AMMONIACAL NITROGEN
DMP MULTI-METER READINGS COMPARED WITH LAB DATA
mg/l
Kg/hr
AMMONIACAL NITROGEN - DMP METER
AMMONIACAL NITROGEN - LAB
AMMONIACAL NITROGEN LOAD
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1200
11/06/91
1200
12/06/91
1200
13/06/91
1200
16/06/91
1200
17/06/91
1200
18/06/91
1200
19/06/91

APPENDIX 3


R.WEY FLOWS : TILFORD, WOKING & WEYBRIDGE
COMPARISON OF MEAN DAILY DISCHARGE
MEASURED ON THREE OCCASIONS
CUMECS
4
3.6
3.2
2.8
2.4
2
1.6
KEY
WEYBRIDGE
WOKING – U/S WORSFOLD GATES
WOKING – U/S STW
TILFORD
15/05/90
16/05/90
17/05/90
28/05/90
29/05/90
30/05/90
27/05/91
28/05/91
29/05/91
DATE