



**DEVON AREA  
INTERNAL REPORT**

**TIME OF TRAVEL FOR THE  
GREADON FARM POLLUTION  
INCIDENT ON THE UPPER  
TORRIDGE OF 19 AUGUST 1997**

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(CATCHMENT 29C)**

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# TIME OF TRAVEL FOR THE GREADON FARM POLLUTION INCIDENT ON THE UPPER TORRIDGE OF 19 AUGUST 1997.

## 1. BACKGROUND

A pollution incident was reported to the Environment Agency on 19 August 1997 by Mr Allen Walter Pomeroy (of Greadon Farm). Slurry had entered the upper reaches of the River Torridge (NGR SS 2985 1834) via a small tributary from Greadon Farm itself (see Figure 1).

There has been some speculation as to the approximate time of the incident. As such, it was decided that Investigations Devon Area would conduct a Time of Travel study to determine approximately how long the slurry had taken from release to reach Fordmill Bridge, Ashmansworthy Bridge and the R. Torridge / Dipple Water confluence.

## 2. TERMS OF REFERENCE

### 2.1 OBJECTIVES

To determine the Time of Travel from Horton Bridge on the River Torridge to Fordmill Bridge, Ashmansworthy Bridge and the R. Torridge / Dipple Water confluence.

### 2.2 PROJECT TEAM

T. Cronin (Project Leader)  
P. Rose (Project Manager, author)  
J. Bartlett (Project Technician)  
R. Pearson (Project Technician)

### 2.3 METHOD

*Bacillus globigii*, a harmless, non-native bacterial tracer is supplied as a liquid concentrate in the form of spores. A 'Time of Travel' between two points is determined by adding a quantity of the tracer to the watercourse, taking samples at a site downstream of the injection site over a period of time, analysing the samples for the bacterium then looking for the sample with the maximum or peak concentration of bacteria. The time / date when this sample was taken minus the time / date of injection of the spores is the 'Time of Travel' between the two points for that stretch of water under the flow conditions during the period of the study.

The spores of *B. globigii* can be air-borne and as such, measures must be taken to reduce risks of cross contamination. All handling of the spores, injection, containers in contact with the tracer concentrate etc was carried out by one person. This person was not allowed to come into close proximity of the sampling equipment, bottles or people carrying out the sampling.



SWWS Ltd were notified of the intention to use this tracer incase they were going to or had recently used the same bacterium locally for any reason.

At the injection site (Horton Bridge, see Figure 1), half a bucket of water was taken from the river; 100 ml of the tracer concentrate were added and the bucket gently swirled round to mix. The contents of the bucket were then quickly poured into the River Torridge by the bridge; The time was 13:00 hrs BST on 23 September 1997.

The Epic auto samplers were deployed at Fordmill Bridge, Ashmansworthy Bridge and at the River Torridge / Dipple water confluence to sample the river over 24 hour periods (see figure 1). At sites where it was thought the 'Time of Travel' would be greater than 24 hours (Ashmansworthy Bridge and R. Torridge / Dipple Water confluence), 2 auto samplers were placed side by side with one being delayed to start one hour after the first finished. The samplers had been previously cleaned and calibrated to take approximately 200 ml of river water into separate bottles every hour. Prior to deployment, a sample was taken from each auto sampler to check for residual background concentrations of the tracer in the equipment from previous use / possible contamination.

During the following two days the resulting samples were taken from the Epics and carefully transferred into bottles and analysed for the presence and quantity of *B. globigii*; all the auto samplers were removed from site.

### 3. RESULTS

The blank samples taken from the auto samplers to check for residual tracer showed very small quantities of the bacterium to be present (maximum concentration of 162 no / 100 ml). At such levels this residue would have insignificant effect on the Time of Travel results.

The results are graphed in Figure 2, Time of Travels given in Table 1, and tabulated in APPENDIX I

**Table 1.** The time of travel between the specified sites for the period 23 -25 September 1997 on the upper reaches of the River Torridge were as follows:

From	To	Time
Horton Bridge	Fordmill Bridge	16 hrs
Horton Bridge	Ashmansworthy Bridge	25 hrs
Horton Bridge	R. Torridge / Dipple confluence	32 hrs
Fordmill Bridge	Ashmansworthy Bridge	9 hrs
Fordmill Bridge	R. Torridge / Dipple confluence	16 hrs
Ashmansworthy Bridge	R. Torridge / Dipple confluence	7 hrs

#### 4. DISCUSSION

The results illustrated in Figure 2 clearly show the Time of Travel between Horton Bridge to Fordmill / Ashmansworthy bridges and the River Torridge / Dipple Water confluence.

The split peaks observed in the Ashmansworthy Bridge and River Torridge / Dipple Water confluence site graphs suggest a split watercourse somewhere between Fordmill Bridge and Ashmansworthy Bridge where one route the water takes is slower or longer than the other thus giving a blip in the results when the watercourses join again. Just upstream of Ashmansworthy Bridge appears to be an old leat which splits from the main river for just over 0.5 km and then joins back gain; this may be the cause of the double peaks.

The Time of Travel determined during this investigation is obviously specific to this stretch of river under the flow regime at the time of the study. The investigation was carried out under similar weather conditions as the pollution incident itself, ie after a several days of very little rain. Ideally, to gain confidence in the extrapolation for the Time of Travel from the investigation to the pollution incident, the flow regime of the river at the pollution site during both the incident and the study should be known. If these flows proved to be similar then the Times of Travel could also be said to be similar.

In reality, the nearest flow gauging station is approximately 31 km downstream at Rockhay (NGR SS 5068 0698). River flows at this site on the day of the incident and study were recorded as 0.693 and 1.261 m<sup>3</sup> sec<sup>-1</sup> respectively. On first sight these figures are quite different, suggesting the Time of Travel on the day of the incident to have been nearly twice that found from the study (on the basis of less flow, more time taken to travel).

However, great care must be taken in comparing the ratio of these flows with the Time of Travel determined for upstream. For example, the River Waldon joins the R. Torridge upstream of the gauging station at Rockhay. The flows within this river will have an effect on the flows recorded downstream at Rockhay on the R. Torridge. If during the few days prior to the survey the conditions were the same (as to those during the days prior to the pollution) in the upper reaches of the R. Torridge but there was, for example, much rain in the Waldon sub catchment, then the higher flows in the R. Waldon would elevate the flows recorded at Rockhay. The two readings would therefore be different for the incident and study but the flows at the site of interest may well have been similar. As such, the flows recorded such a great distance downstream from the incident must be viewed with caution.

#### 5. CONCLUSIONS

1. The Time of Travel between Horton Bridge and the River Torridge / Dipple Water confluence was approximately 32 hours on 23-24 September 1997.
2. The Time of Travel study was carried out under similar local weather conditions to those experienced before / during the Greadon pollution (several dry weather days prior to incident) and as such probably reflects the Time of Travel during the incident.

## 6. RECOMMENDATIONS

1. Comparison of the determined Time of Travel to that at the date of the incident can be potentially misleading.

If the incident response team gave a rough estimate of the velocity and height of the river, as well as prevailing weather conditions immediately after the pollution, this would help increase the confidence of the estimated Time of Travel for that date.

Figure 1. Map showing the upper reaches of the River Torridge, tracer injection and auto sampler sites.

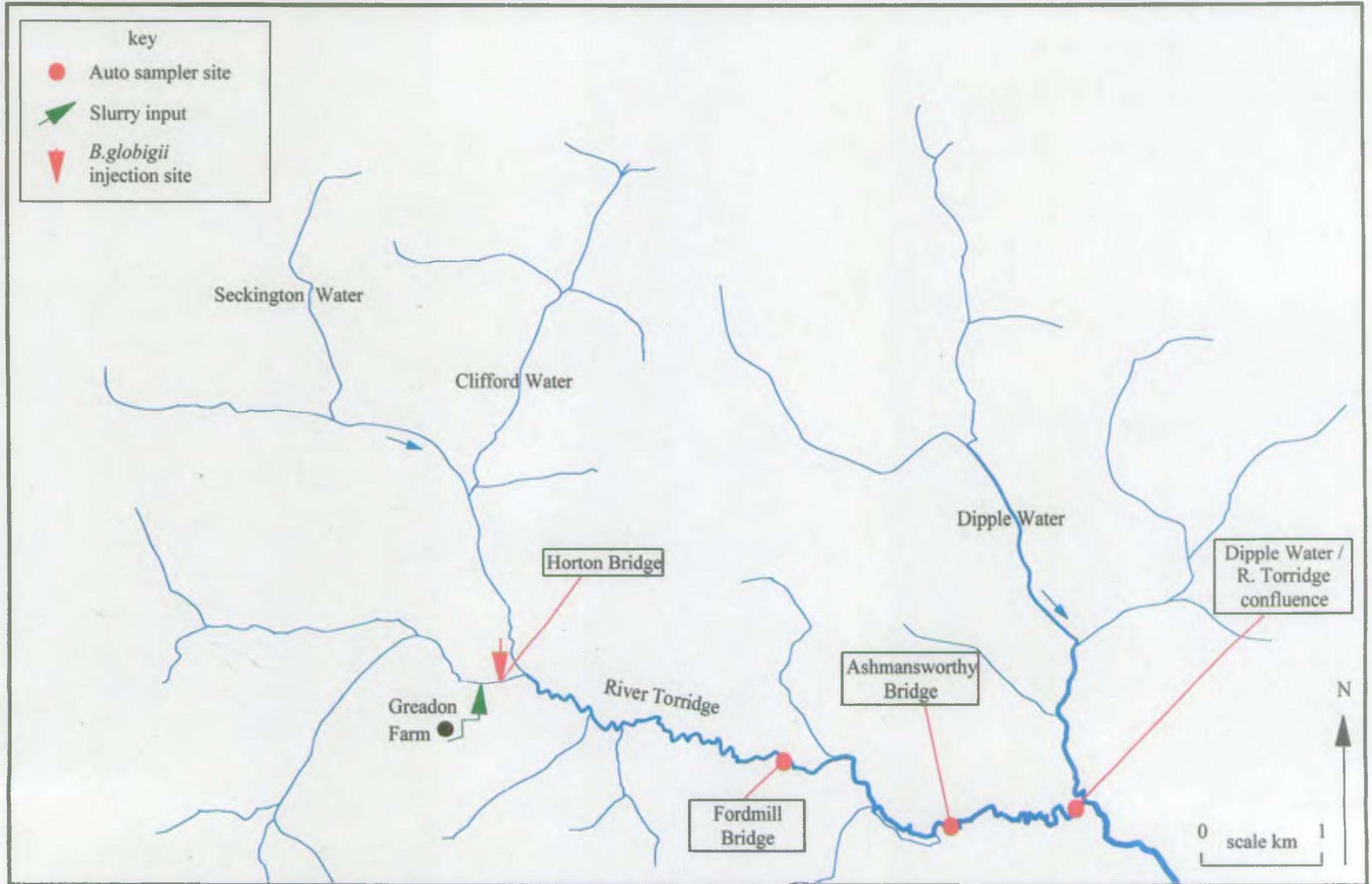
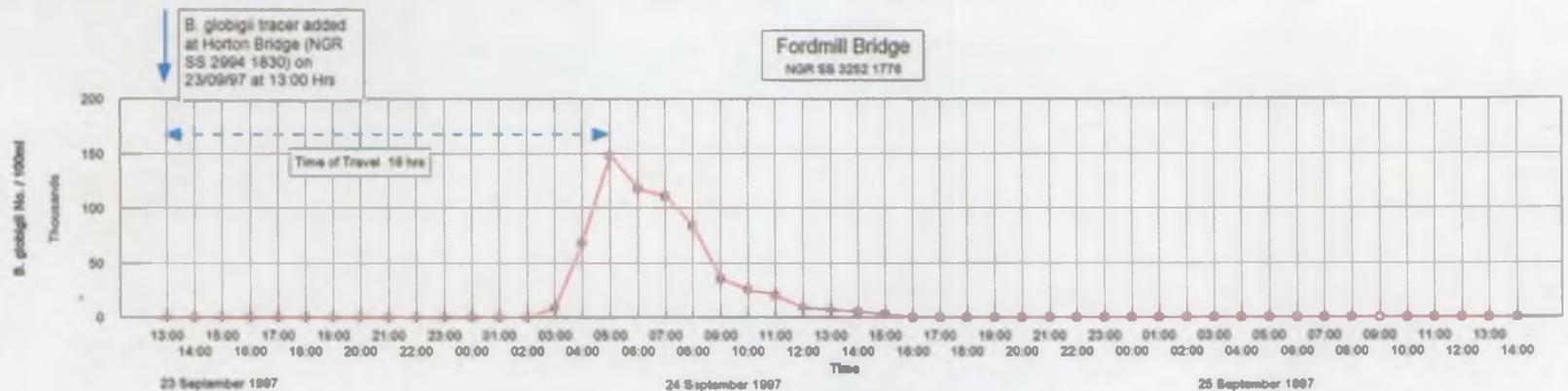


Figure 2. Graphs showing Time of Travel for River Torridge Pollution incident: Greadon Farm 19 August 1997.

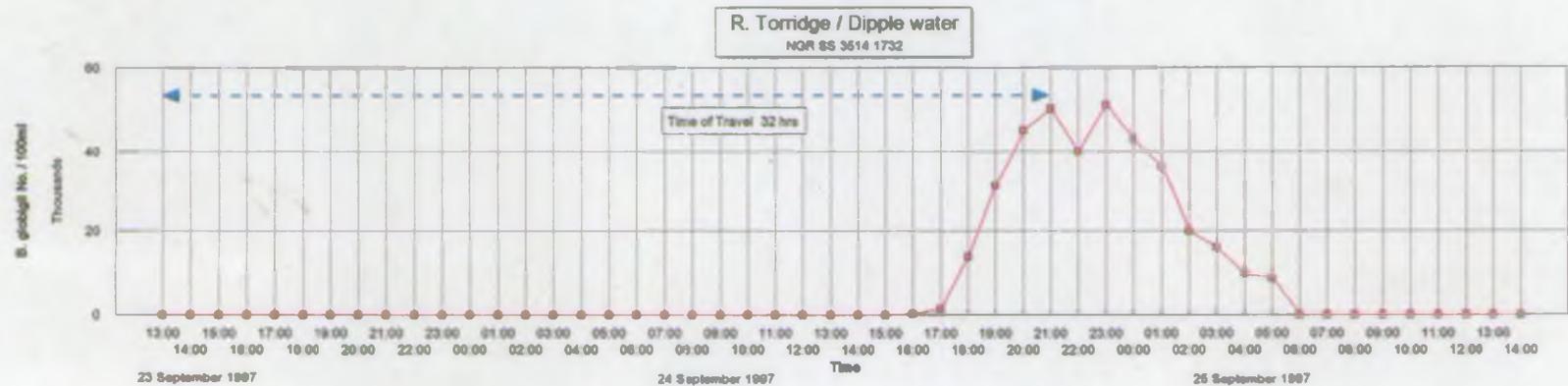
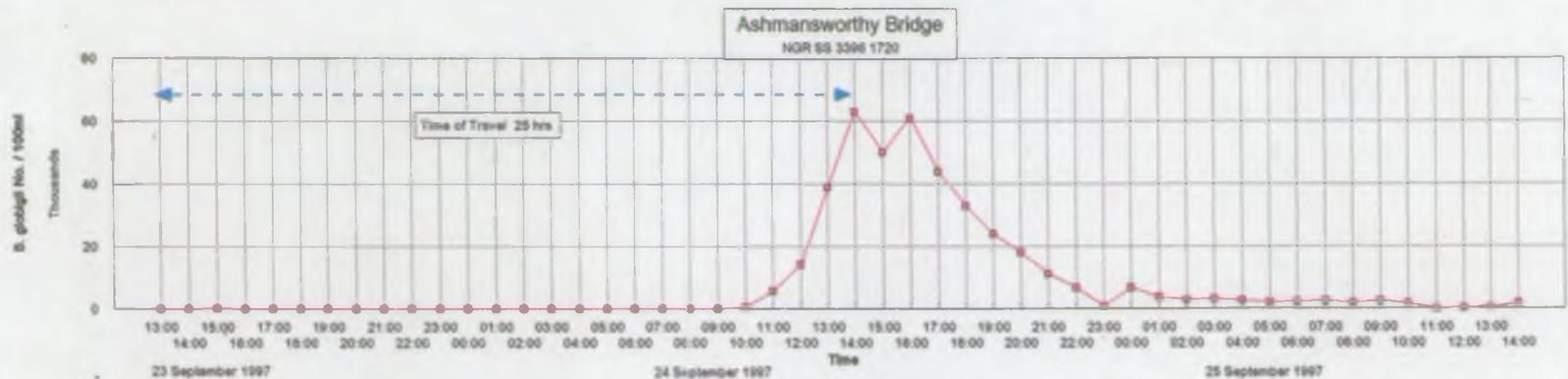


**Flows on the R. Torridge**

Gauging Station: Rocthay  
NGR: SS 5068 0898  
Approx. distance D/S from Horton Bridge: 31 km

Pollution Incident Date: 19-Aug-97  
Daily Mean Flow: 6.683 m<sup>3</sup> / sec

Time of Travel Date: 23-Sep-97  
Daily Mean Flow: 1.261 m<sup>3</sup> / sec



**APPENDIX I**

# Time of Travel for the Greadon Farm pollution incident of 19 August 1997

Upper Torridge

Tracer: *Bacillus globigii*

100 ml added at 13:00 hrs on 23 September 1997 at Horton Bridge.

Site: Fordmill Bridge		
Date	Time (BST)	No/ 100ml
23/09/97	13:00	-
23/09/97	14:00	-
23/09/97	15:00	-
23/09/97	16:00	27
23/09/97	17:00 <	10
23/09/97	18:00 <	10
23/09/97	19:00 <	10
23/09/97	20:00 <	10
23/09/97	21:00 <	10
23/09/97	22:00 <	10
23/09/97	23:00 <	10
24/09/97	00:00 <	10
24/09/97	01:00 <	10
24/09/97	02:00	220
24/09/97	03:00	8909
24/09/97	04:00	69000
24/09/97	05:00	149000
24/09/97	06:00	118000
24/09/97	07:00	111000
24/09/97	08:00	84000
24/09/97	09:00	36000
24/09/97	10:00	26000
24/09/97	11:00	21000
24/09/97	12:00	9273
24/09/97	13:00	7500
24/09/97	14:00	5200
24/09/97	15:00	3400
24/09/97	16:00	-
24/09/97	17:00	-
24/09/97	18:00	-
24/09/97	19:00	-
24/09/97	20:00	-
24/09/97	21:00	-
24/09/97	22:00	-
24/09/97	23:00	-
25/09/97	00:00	-
25/09/97	01:00	-
25/09/97	02:00	-
25/09/97	03:00	-
25/09/97	04:00	-
25/09/97	05:00	-
25/09/97	06:00	-
25/09/97	07:00	-
25/09/97	08:00	-
25/09/97	09:00	-
25/09/97	10:00	-
25/09/97	11:00	-
25/09/97	12:00	-
25/09/97	13:00	-
25/09/97	14:00	-

Site: Ashmansworthy Bridge		
Date	Time (BST)	No/ 100ml
23/09/97	13:00	-
23/09/97	14:00	-
23/09/97	15:00	230
23/09/97	16:00 <	10
23/09/97	17:00 <	10
23/09/97	18:00 <	10
23/09/97	19:00 <	10
23/09/97	20:00 <	10
23/09/97	21:00 <	10
23/09/97	22:00 <	10
23/09/97	23:00 <	10
24/09/97	00:00 <	10
24/09/97	01:00	9
24/09/97	02:00 <	10
24/09/97	03:00 <	10
24/09/97	04:00 <	10
24/09/97	05:00 <	10
24/09/97	06:00 <	10
24/09/97	07:00 <	10
24/09/97	08:00 <	10
24/09/97	09:00	9
24/09/97	10:00	400
24/09/97	11:00	5700
24/09/97	12:00	14000
24/09/97	13:00	39000
24/09/97	14:00	63000
24/09/97	15:00	50000
24/09/97	16:00	61000
24/09/97	17:00	44000
24/09/97	18:00	33000
24/09/97	19:00	24000
24/09/97	20:00	18000
24/09/97	21:00	11000
24/09/97	22:00	6700
24/09/97	23:00	901
25/09/97	00:00	6600
25/09/97	01:00	3700
25/09/97	02:00	3000
25/09/97	03:00	3100
25/09/97	04:00	2800
25/09/97	05:00	2200
25/09/97	06:00	2400
25/09/97	07:00	2600
25/09/97	08:00	1818
25/09/97	09:00	2500
25/09/97	10:00	1727
25/09/97	11:00	27
25/09/97	12:00	186
25/09/97	13:00	420
25/09/97	14:00	1727

Site: R. Torridge / Dipple water Confluence		
Date	Time (BST)	No/ 100ml
23/09/97	13:00	-
23/09/97	14:00 <	10
23/09/97	15:00 <	10
23/09/97	16:00 <	10
23/09/97	17:00 <	10
23/09/97	18:00 <	10
23/09/97	19:00 <	10
23/09/97	20:00 <	10
23/09/97	21:00 <	10
23/09/97	22:00 <	10
23/09/97	23:00 <	10
24/09/97	00:00 <	10
24/09/97	01:00 <	10
24/09/97	02:00 <	10
24/09/97	03:00 <	10
24/09/97	04:00 <	10
24/09/97	05:00 <	10
24/09/97	06:00	18
24/09/97	07:00 <	10
24/09/97	08:00 <	10
24/09/97	09:00 <	10
24/09/97	10:00 <	10
24/09/97	11:00 <	10
24/09/97	12:00	9
24/09/97	13:00	9
24/09/97	14:00 <	10
24/09/97	15:00 <	18
24/09/97	16:00 <	360
24/09/97	17:00 <	1455
24/09/97	18:00 <	13909
24/09/97	19:00 <	31000
24/09/97	20:00 <	45000
24/09/97	21:00 <	50000
24/09/97	22:00 <	40000
24/09/97	23:00 <	51000
25/09/97	00:00 <	43000
25/09/97	01:00 <	36000
25/09/97	02:00 <	20000
25/09/97	03:00 <	16000
25/09/97	04:00 <	9818
25/09/97	05:00 <	8727
25/09/97	06:00	-
25/09/97	07:00	-
25/09/97	08:00	-
25/09/97	09:00	-
25/09/97	10:00	-
25/09/97	11:00	-
25/09/97	12:00	-
25/09/97	13:00	-
25/09/97	14:00	-