

# Environmental Protection Final Draft Report

## A Second Stage Evaluation of the Grant YSI 3815 Water Logger

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**NRA**

*National Rivers Authority  
South Western Region*

## A SECOND STAGE IN THE EVALUATION OF THE GRANT YSI 3815 WATER LOGGER.

### 1. INTRODUCTION.

The National Rivers Authority has nationally selected the Grant YSI 3815 Water Logger as the most suitable portable water quality monitor for measuring dissolved oxygen, temperature, pH, conductivity, turbidity, ammonium, and ammonia in freshwater.

This report presents the findings of a second evaluation carried out by the NRA South Western Region Freshwater Investigation Team (FWIT), Exeter and follows on from Water Quality Report FWI/92/010, Evaluation of the Grant YSI Water Logger and should be read in conjunction with this report.

### 2. OBJECTIVES.

- 1) Carry out a second evaluation of the operational functions of the monitor.
- 2) Assess the accuracy of the modified ammonia probe.
- 3) Determine a method of training for potential field users.
- 4) Liaise with Grant Instruments and Malcolm Gorton (Wessex Region) on improving the design and operation of the monitor.

### 3. METHODS.

#### 3.1 Bench Testing.

This reviewed the following :

- a) Calibration of modified ammonia probe.
- b) Accuracy of modified ammonia probe using an AQC standard prepared by the regional laboratory.

#### 3.2 Training Programme and Field Performance.

Three Pollution Inspectors, based in Exeter, were issued with YSI Grant water loggers. They participated in a two part training programme designed to outline :-

- a) Basic operation and handling properties.
- b) Calibration and data handling facilities.

After training was completed, the Pollution Inspectors installed the water loggers at suitable sites to evaluate their field performance.

Each Pollution Inspector was requested to complete a questionnaire and submit a report outlining the advantages, disadvantages and problems encountered with the water logger.



#### 4. RESULTS.

##### 4.1 Bench testing.

###### a) Calibration of modified ammonia probe.

- \* Before initial calibration could be achieved all new probes had to be thoroughly soaked in a solution of 100mg/l NH<sub>3</sub> as N. This conditioning procedure lasted in some cases for up to two days before the probe was able to operate efficiently. This time delay before the probe can operate is unacceptable.
- \* After conditioning, calibration was easily achievable although the probe required at least five minutes to fully stabilise in each calibration standard. This stabilisation time and probe sensitivity therefore requires improvement.
- \* The probe required calibrating at least twice weekly which requires improvement. The instrument should be able to hold its calibration for at least two weeks.

###### b) Accuracy of modified ammonia probe.

- \* The use of a 50mg/l NH<sub>3</sub> as N confidence solution showed the accuracy of the probe to be within 5% of the AQC standard which was prepared by the regional laboratory.
- \* After delivery of the sondes fitted with the modified ammonia probe, it was discovered that some of the membranes had become inverted. These probes could not be calibrated and were subsequently returned to Grant Instruments for refurbishment. Grant Instruments could not offer an explanation for this inversion of the membrane.

##### 4.2 Training Programme and Field Performance.

Each Pollution Inspector submitted a short report upon the completion of the training programme (see Appendices 2, 3, and 4). General comments of these reports were :

###### a) Handling Properties.

- \* The water logger was heavy and cumbersome which provided handling problems.
- \* The backpack provided was useful for carrying the monitor over long distances.
- \* The housing of the water logger is not fully waterproofed for operating in wet weather and permanently damp environments.

b) Keyboard Operation.

- \* The key pads situated on the front of the water logger were awkward to use and occasionally stuck.
- \* The keyboard operation is far too complicated. The software encompasses too many functions for a non technical operator with limited experience.
- \* The programming of site identities is complicated since it includes a large number of unnecessary symbols prior to the display of the alphabet.
- \* The lifespan of the batteries is sufficient. However a more conspicuous method of verifying battery life is required.

c) Evaluation of monitor operation.

- \* The ammonia probe is considered the most essential aid in water quality monitoring. All measurements taken were accurate to within 5% of any ad hoc samples taken on site after a one minute period of stabilisation.
- \* The accuracy and reliability of the monitor for all parameters is excellent (compared to ad hoc samples taken on site). However problems were encountered with silting up of the turbidity probe when logging over long periods. This produced artificially high readings.
- \* In effluents or heavily polluted environments the sonde modules, especially turbidity, become contaminated very quickly reducing the accuracy of the monitor.

d) Ease of operation.

- \* The calibration procedure was reasonably comprehensible although Pollution Inspectors do not have the time or facilities to calibrate the instrument on a regular basis. This would be more suitably performed by a skilled technician in a laboratory.
- \* The training programme was essential to understand the operation of the YSI Grant Water Logger. The manual provided was complicated to follow and requires the production of a very simplified field users handbook.

e) Downloading and handling of data.

- \* The method for installing Grantware Filewise software is satisfactorily outlined in the instruction manual although a knowledge of computer techniques is advantageous.
- \* Once installed, the data downloading procedure is simple and easy to follow.

- \* Data handling methods are easily achievable on both Supercalc and Lotus 1-2-3 software producing high quality graphical presentation.

The results of a survey carried out at a local sewage treatment works are submitted in Appendix 1. Graphs 1 - 3, produced on Lotus 1-2-3, show pH, dissolved oxygen and ammonia parameters operating efficiently over a seventeen day period. The turbidity data (graph 4) highlights the problems encountered by the silting of the integral cone. This produced a gradual increase in turbidity values with time until the probe was cleaned. The silting procedure was then repeated.

## 5. CONCLUSIONS.

1. The type of casing currently in use on the water logger provides insufficient waterproofing.
2. The performance of the ammonia probe has improved considerably since the previous evaluation. Further work should be undertaken to determine the frequency of calibration required and to establish the stabilisation period of the probe.
3. The ammonia probe is the most important facility available to field users on the YSI Grant water logger. Periodic improvement and assessment are essential so that the probe is continually updated to provide the most accurate performance available.
4. The turbidity probe requires redesigning to improve its operational performance over longer periods.
5. The software is too complicated for persons of limited technical ability.
6. The design of the back pack is a welcome addition to the overall instrument package.
7. There are two options with regard to the operation of the YSI Grant within the region :-

Option 1 : The water loggers should not be individually issued to each field user within the South Western Region. The monitors should be available on a pool basis within each area. Calibration and regular maintenance should be performed by a technician who is trained in the operation of the water quality monitor.

Option 2 : The monitors should be issued to each field user who would be trained in both the operation and calibration of the YSI Grant. The monitors could then be individually calibrated and maintained by each field user.

## 6. RECOMMENDATIONS.

1. An IP 67 fully waterproof casing should be considered an essential development on future YSI Grant waterloggers.

Action : Grant YSI.

2. The present key pad format should be improved to encompass a pressure pad system to eliminate water infiltrating the water logger.

Action : Grant YSI.

3. After consultation with the proposed field users who include both pollution inspectors and members of the field control section it is recommended that Option 1 of conclusion no.7 is implemented regarding the maintenance and calibration of the water quality monitors.

Action : NRA South Western Region Environmental Managers.

4. The software requires simplification for ease of operation by persons of limited experience.

Action : Grant YSI.

5. The programming of site identities requires simplification.

Action : Grant YSI.

6. An audible alarm or LED is required to alert the operator if the lifespan of the batteries drops below an operational voltage.

Action : Grant YSI.

7. A method of cleaning the turbidity probe is necessary to avoid silting of the integral cone.

Action : Grant YSI.

8. There is a requirement to produce a simplified field users manual.

Action : National Centre for Instrumentation and NRA South Western Region.

9. All problems encountered with water loggers should be relayed back to Grant Instruments via the proposed National Centre for Instrumentation. All areas would then report to the National Centre for spares and servicing problems instead of directly to Grant Instruments. This should reduce both maintenance time and servicing costs.

Action : National Centre for Instrumentation.

10. A National policy for handling, presentation and archiving of data, as well as calibration procedure needs to be implemented. This would take place in collaboration with the proposed National Centre for Instrumentation and members of the Instrumentation Steering Group.

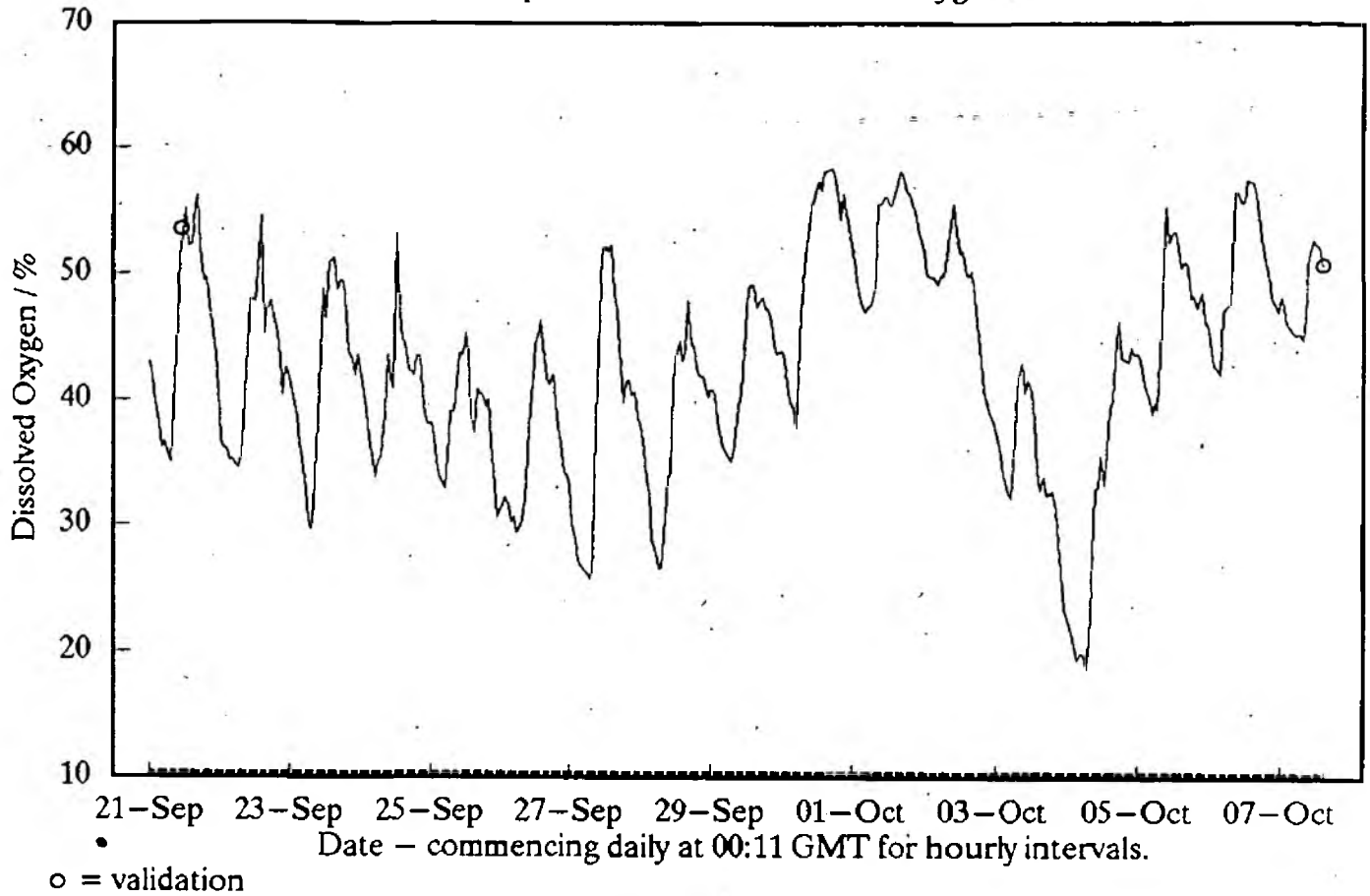
Action : National Centre for Instrumentation.

Appendix 1 : Graphs displaying Dissolved Oxygen, Ammonium, pH and Turbidity,  
from Fluxton Sewage Treatment Works.



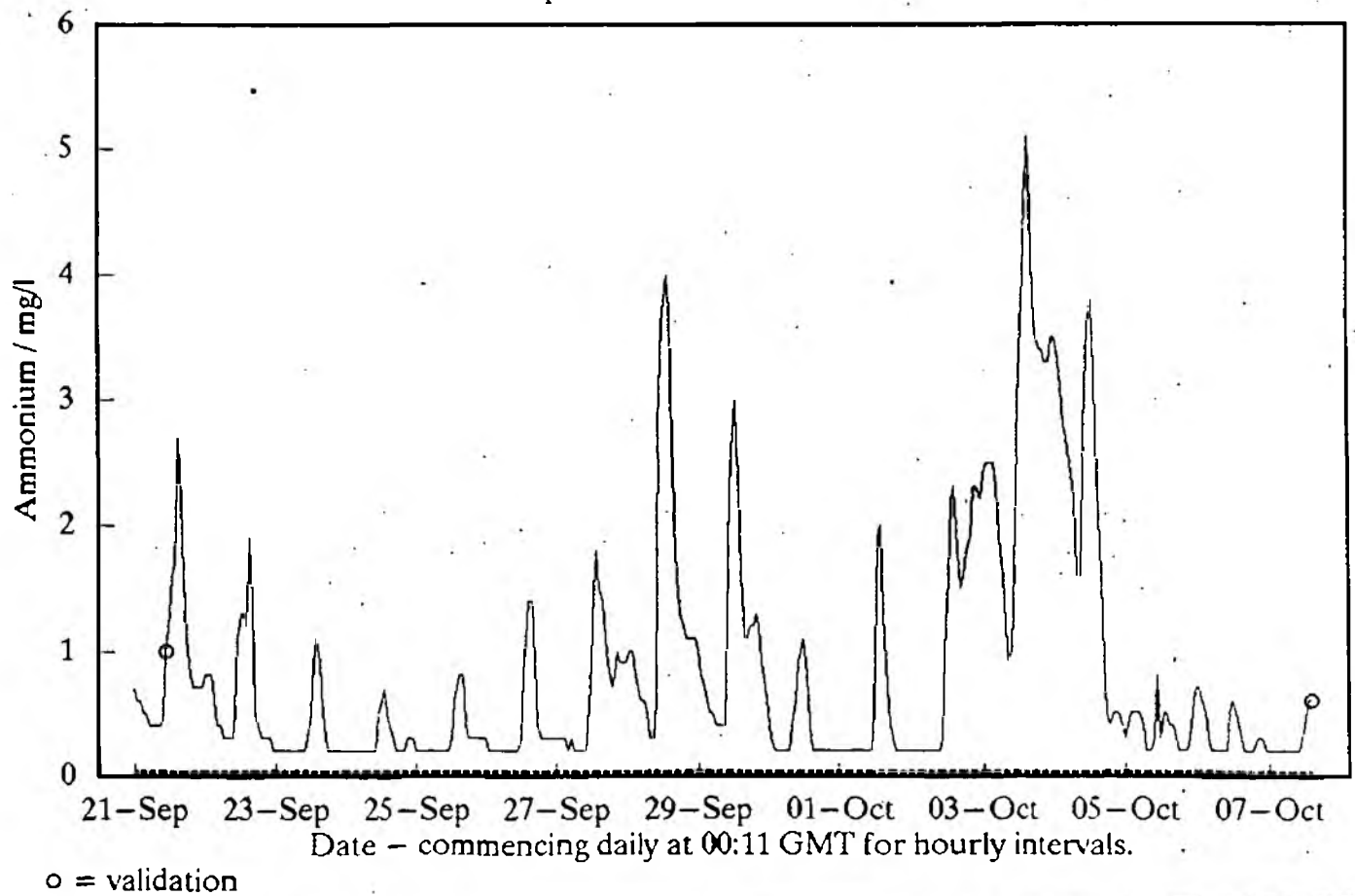
# YSI GRANT EVALUATION PROGRAMME

Graph 1 : Fluxton - Dissolved Oxygen



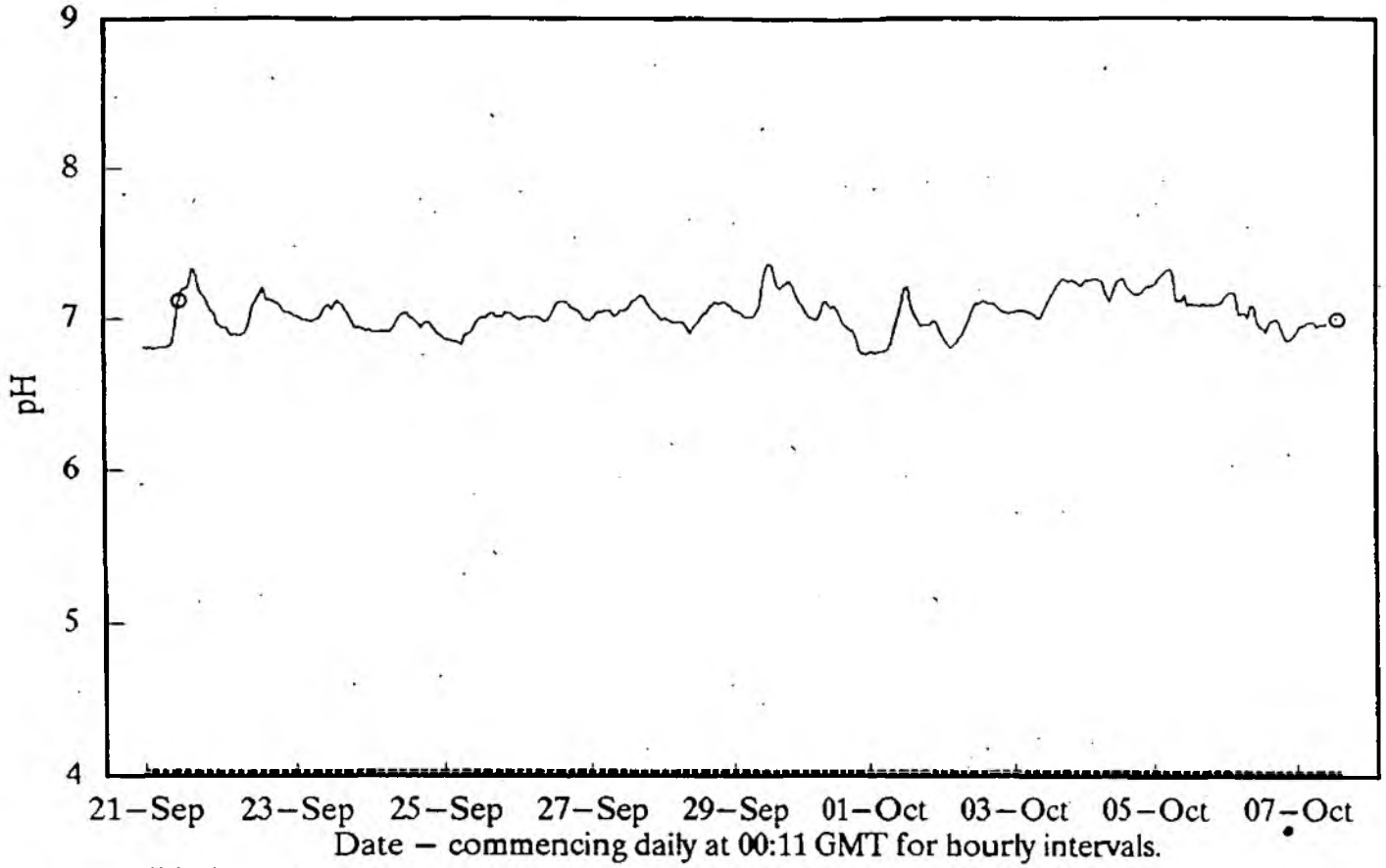
# YSI GRANT EVALUATION PROGRAMME

Graph 2 : Fluxton - Ammonium



# YSI GRANT EVALUATION PROGRAMME

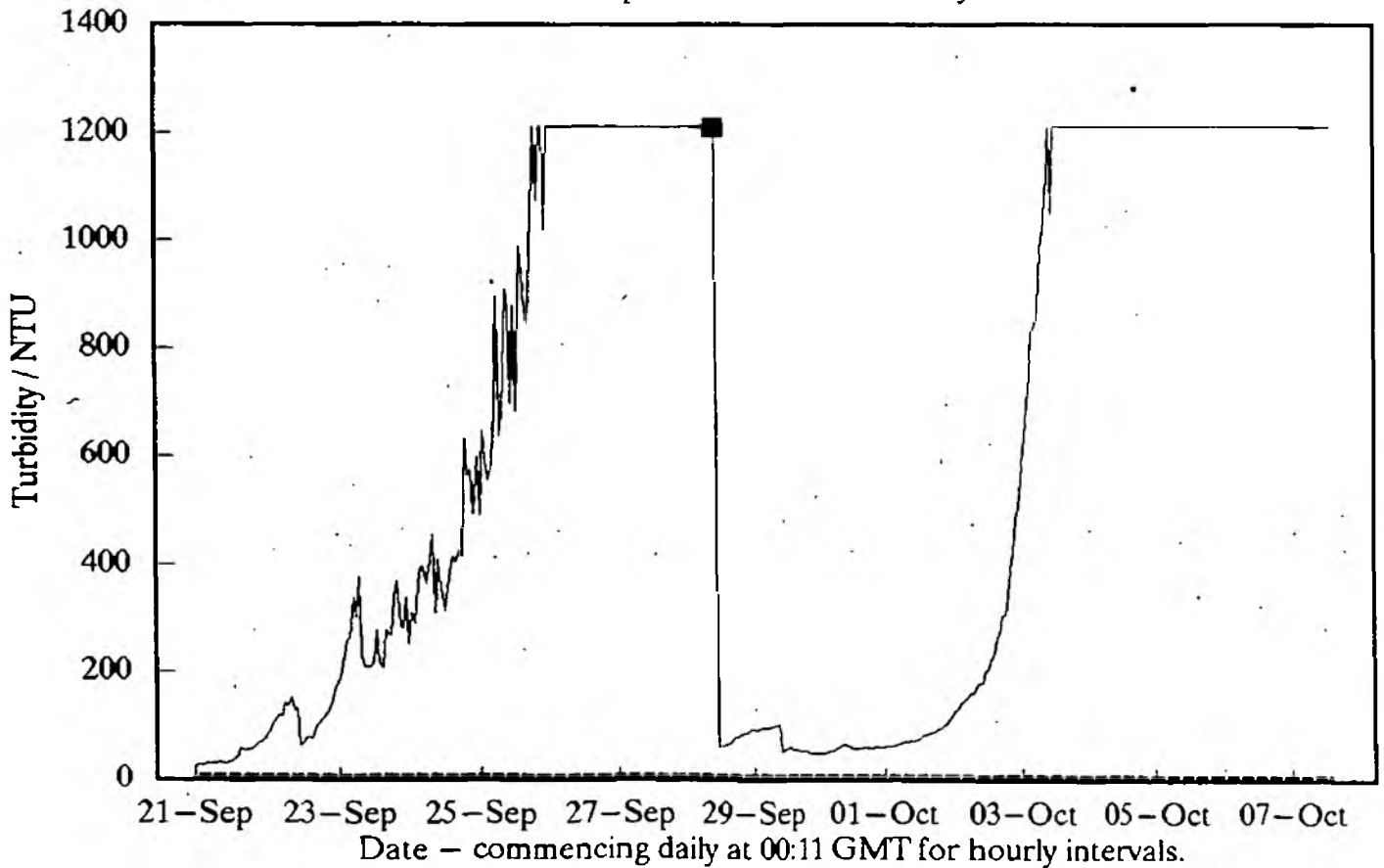
Graph 3 : Fluxton - pH



○ = validation

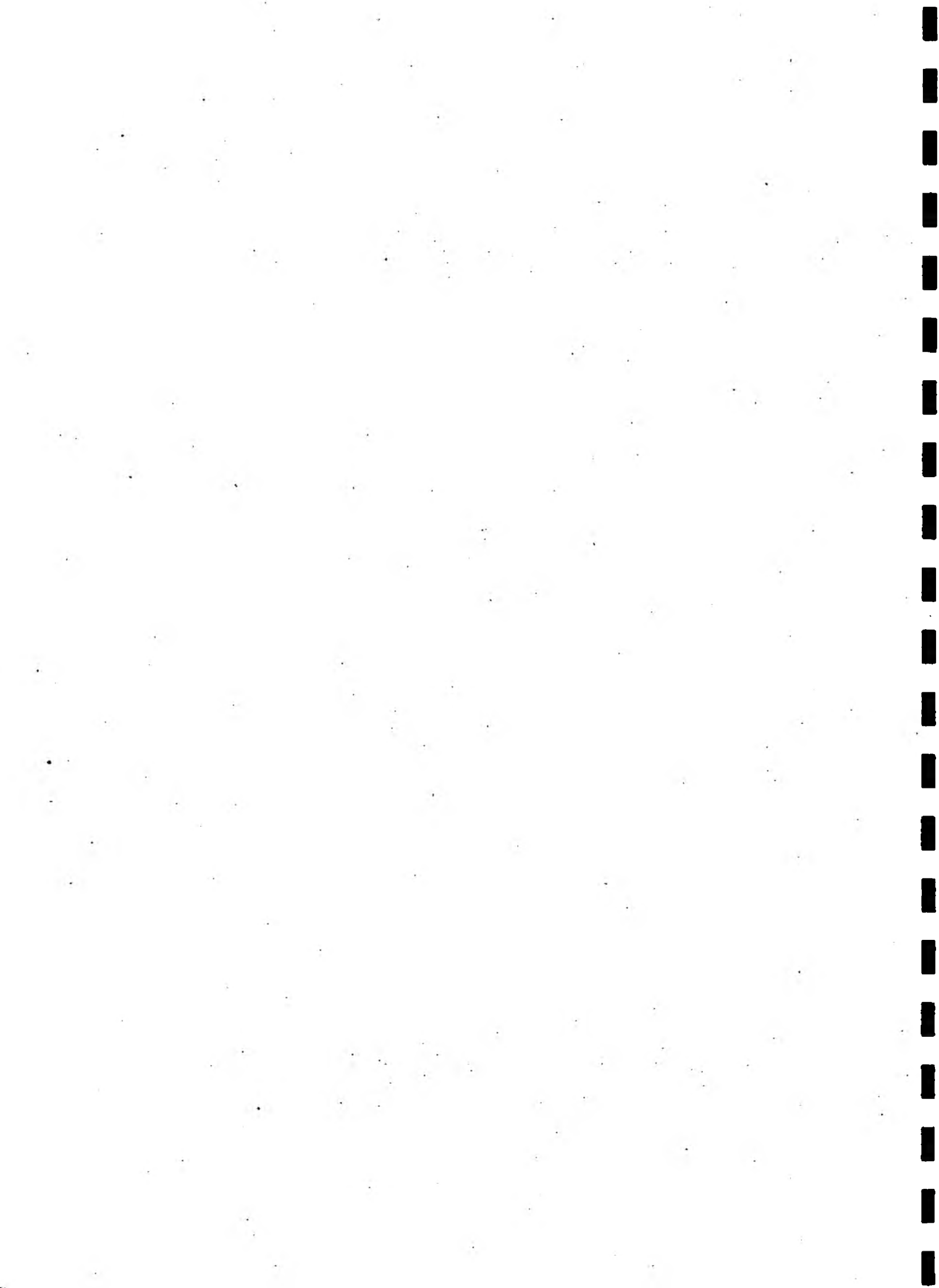
# YSI GRANT EVALUATION PROGRAMME

Graph 4 : Fluxton - Turbidity



■ = probe cleaned

Appendix 2 : Validation results of Grant YSI water logger from Fluxton STW.



Appendix 2.

Validation Results.

Validation was carried out at the beginning and end of the survey using Semat meters for D/O and pH. A Palintest kit was used to validate the ammonium.

21st September 1993 – 1110 Hrs.

	Dissolved Oxygen / (%)	Ammonium / (mg/l)	pH
Grant YSI	53.1	1	7.11
Semat / Palintest	55	0.91	7.21

7th October 1993 – 1420 Hrs.

	Dissolved Oxygen / (%)	Ammonium / (mg/l)	pH
Grant YSI	50.61	0.6	7.02
Semat / Palintest	54	0.68	7.15

Appendix 3, 4, and 5 : Reports submitted by Pollution Inspectors involved in  
the Second YSI Grant Evaluation Programme.

### Appendix 3.

Report submitted by Tim James (Pollution Inspector for River Exe and Culm Catchments).

#### Notes on Field Trials for YSI Grant Monitor.

##### 1. Good Points :

- a) Accuracy and reliability of D/O probe appears good. Seems to hold calibration well.
- b) Useful to have Ammonia and Turbidity readings.
- c) Rucksack carry case well designed for carrying equipment long distances if necessary.
- d) Sonde probes well protected against accidental damage.

##### 2. Bad Points :

- a) Unit heavy, bulky, and awkward to hold and operate in difficult terrain (which is where it would normally be used).
- b) Datalogger unit needs to be redesigned such that :
  - i) Unit is waterproof.
  - ii) On - off switch is outside case.
  - iii) Backup data battery is provided so battery changing is less vital.
  - iv) Less complex - more user friendly software for calibration / logging.
- c) The sonde is too tall to stand below parcel shelf in car in its protective cap. We don't want it on the back seat !
- d) In effluents / polluted water the sonde modules (especially D/O and turbidity) become quickly contaminated reducing accuracy. We are not likely to want to use equipment in clean water.
- e) There is an extensive daily maintenance schedule which is not suited to the occasional use the equipment will get or to home based officers (due to space / equipment requirement for maintenance).
- f) Daily polarisation time and calibration requirements are not compatible with predicted use.

##### 3. Conclusions and Recommendations :

- i) If this equipment was specified for field use by pollution control staff either it was badly specified or poorly designed.
- ii) The accuracy of the monitor appears very good.

- iii) The frequency of use does not warrant the high capital costs.
- iv) It would be better suited as a laboratory pool machine which is fully maintained and can be provided for field use when required. This would reduce the number that need to be purchased, and improves the chance of accuracy.
- v) Significant design improvements are required to make it suitable for field use.

Tim James.

Pollution Inspector.



Appendix 4.

Report submitted by Chris Westcott (Pollution Inspector for River Torridge).

Short Report on Grant YSI - Water Quality Logger.

Since receiving my Grant YSI I have tried to use it as routinely as possible to give it a thorough trial.

The Grant YSI has proved heavy and cumbersome to use and the fact that you have to take the instrument apart to turn the machine on is unbelievable and impractical especially in wet weather.

The ammonia probe did not work from day one (due to an inverted membrane) which was a pity because it is an important parameter in our work.

The calibration required by the skilled technicians results in additional visits to the office.

It is not a useful tool for our job until they develop a more accurate and reliable ammonia probe. One Grant YSI could be kept in the office or at Clyst Honiton for serious incidents but does not need to be issued to each Inspector / Officer. The present ammonia test kits are probably more practical and certainly cheaper.

The advantage of the Grant YSI is for continual monitoring / logging of serious incidents / discharges but this is open to problems of vandalism, adequate power source, calibration flooding of monitoring site and technical / manpower backup to assess and present the data.

Chris Westcott

Pollution Inspector:

Appendix 5.

Report submitted by Derek Carter (Pollution Inspector for River Otter).

YSI Grant.

1. No on / off switch on the outside for easy use.
2. Calibration will be very time consuming.
3. In the field this instrument is very bulky and quite heavy for carrying over long distances.
4. The most useful parameter is the ammonia reading but this reading seems to be rather unstable.
5. Silting of the turbidity probe provides problems in logging over long periods.
6. These problems can put you off using this wonderful, amazing piece of equipment.

Derek Carter

Pollution Inspector.