ENVIRONMENTAL PROTECTION

NRA

National Rivers Authority

South West Region

INVESTIGATION INTO THE CAUSE OF HIGH pH IN THE BUDLEIGH BROOK

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1. INTRODUCTION

On 30 July 1991 routine monitoring of river quality in the Budleigh Brook recorded a pH reading of 9.1 at the river abstraction point near East Budleigh. (see Table 1.)

An investigation into the cause of the high pH was carried out as the Environmental Quality Standard (EQS) specified in the Surface Water Abstraction Directive was exceeded (EQS = pH 6.0-9.0)

1.1 Catchment Description.

The Budleigh Brook, a small tributary of the River Otter, rises on Woodbury Common and flows in an easterly direction for approximately six kilometres (see Figure 1). The main land uses of the area are dairy farming and common grazing land. Water is abstracted from the Budleigh Brook near East Budleigh and used for potable supply. A silt trap has been installed in the river upstream of East Budleigh as part of a flood prevention scheme.

1.2 Routine Monitoring.

The Budleigh Brook has a River Quality Objective of Class 1A and the National Rivers Authority South West Region (NRA SW) have adopted the following use related Environmental Quality Objectives for the river:

* Protection of Direct Abstraction for Potable Supply
* Protection of Aesthetic Quality
* Protection of Other Aquatic life/Dependant Organisms
* Protection for Livestock Watering
* Protection for Irrigation of Crops

Water quality was monitored at Yettington (NGR SY 0538 8568) until the end of 1990 for the NWC Classification and in this year achieved class 1A. Since then water quality has been routinely monitored at the river abstraction point (NGR SY 0732 8418) during 1991 when the EC Surface Abstraction Directive Monitoring Programme was introduced. (see Table 1).

Table 1. Routine Water Quality Data for 1991 at the East Budleigh Abstraction Point.

DATE	TIME	pH
11/02/91	0930	7.70
15/03/91	0955	8.00
25/04/91	1130	8.00
24/05/91	1000	8.00
11/06/91	0955	8.10
30/07/91	1500	9.10

2. METHODS.

The pH of the Budleigh Brook at the abstraction was measured using a WTW pH meter. pH readings were taken upstream at the sites shown in Figure 1.

3. RESULTS.

pH was found to steadily increase downstream (see Figure 1 & Table 2.). At site 5, immediately downstream of the silt trap at East Budleigh, pH increased to 9.08. Immediately upstream of the silt trap, pH was 7.89.

Table 2. Results of survey.

Site	Time	pH reading
1	1640	7.19
2	1715	7.26
3	1745	7.59
4	1700	7.89
5	1627	9.08
6	1600	9.08
7	1542	8.50

4.DISCUSSION.

The cause of the high pH in the Budleigh Brook was found to be a silt trap constructed by the National Rivers Authority (SW) Land Drainage Section (see Figures 2-4). The silt trap had dense blooms of algae growing in it which were undoubtedly the cause of the high pH. The proliferation of algae in freshwaters can cause a rise in pH (-log [H+]). This is due to carbon dioxide or hydrogen carbonate being utilised during photosynthesis resulting in a decrease in the number of [H+] ions.

All samples obtained during 1991 have shown higher than expected pH values suggesting an algal bloom has been occuring in the silt trap for most of the this period. The majority of the samples were obtained in the morning and were within the EQS. However, the samples taken in the afternoon exceeded the EQS. It is likely the EQS was exceeded in the afternoon on most days and the pH problems would have been identified earlier in the year if all samples had been taken in the afternoon.

The slight rise in pH between Site 1 and Site 4 is thought to result from dense growths of the macrophyte Callitriche sp.(see Figure 5). Algae are capable of raising the pH to a higher level than macrophytes as they can utilise sources of inorganic carbon other than carbon dioxide, which affect pH.

Algae were particularly abundant in the silt trap because of its location and design. Undesirable features include:

1. The large surface area of the silt trap (approx. 40 metres by 20 metres).

2. The shallow depth of the silt trap (approx. 0.4 metres deep).
3. The lack of shade in the immediate vicinity of the silt trap allowing maximum sunlight for photosynthetic activity at high temperatures.
4. The low velocity of the water in the silt trap.

5. CONCLUSIONS

1. The cause of high pH in the Budleigh Brook at the potable abstraction point was traced to an algal bloom in an instream silt trap just upstream of East Budleigh.

2. The algal bloom in the silt trap has probably been present in the silt trap since February or March 1991.

3. The design of the silt trap is such that it will frequently experience significant algal blooms.

6. RECOMMENDATIONS

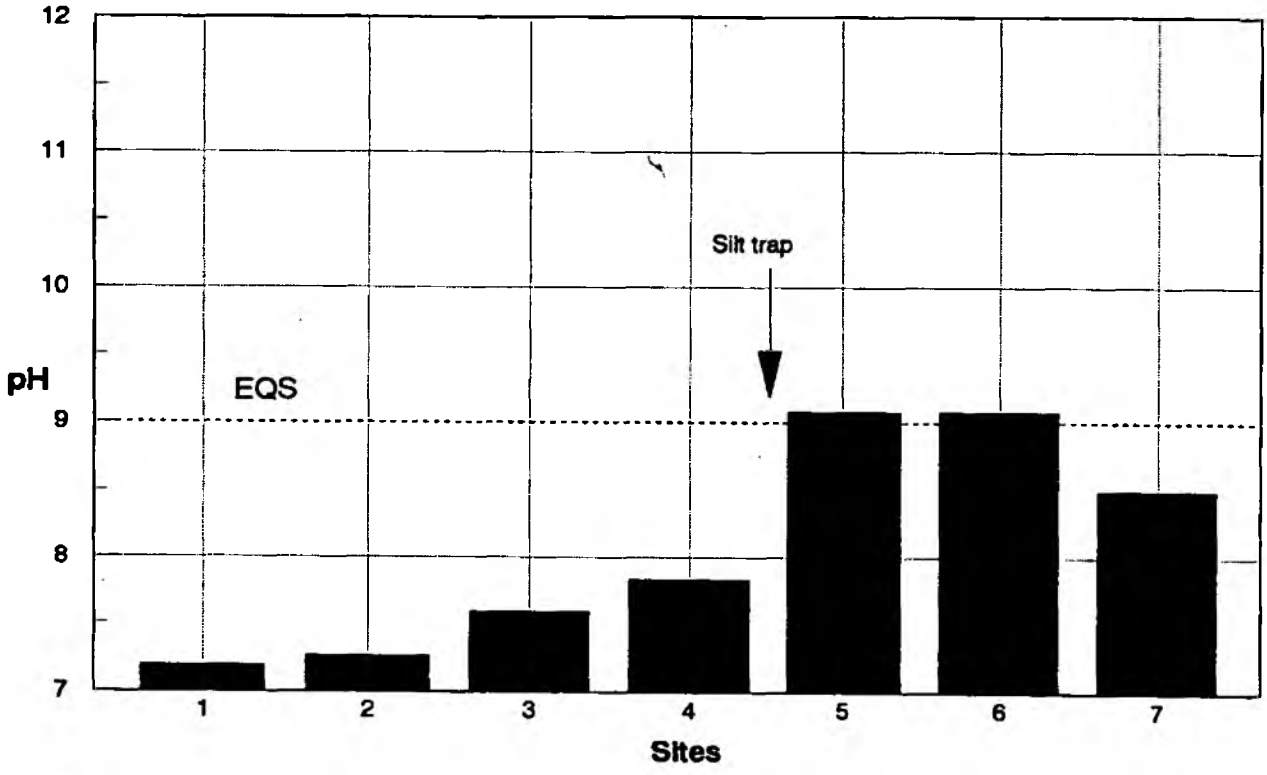
1. Consultation should take place with the Land Drainage Section to assess if the silt trap can be altered to avoid the developement of algal blooms.

   - Action by Freshwater Officer.

2. To ensure maximum protection of river quality routine monitoring samples should be collected randomly.

   - Action by Freshwater Scientist.

FIGURE 1. LOCATION OF SAMPLING SITES AND CHANGES IN pH ALONG THE BUDLEIGH BROOK



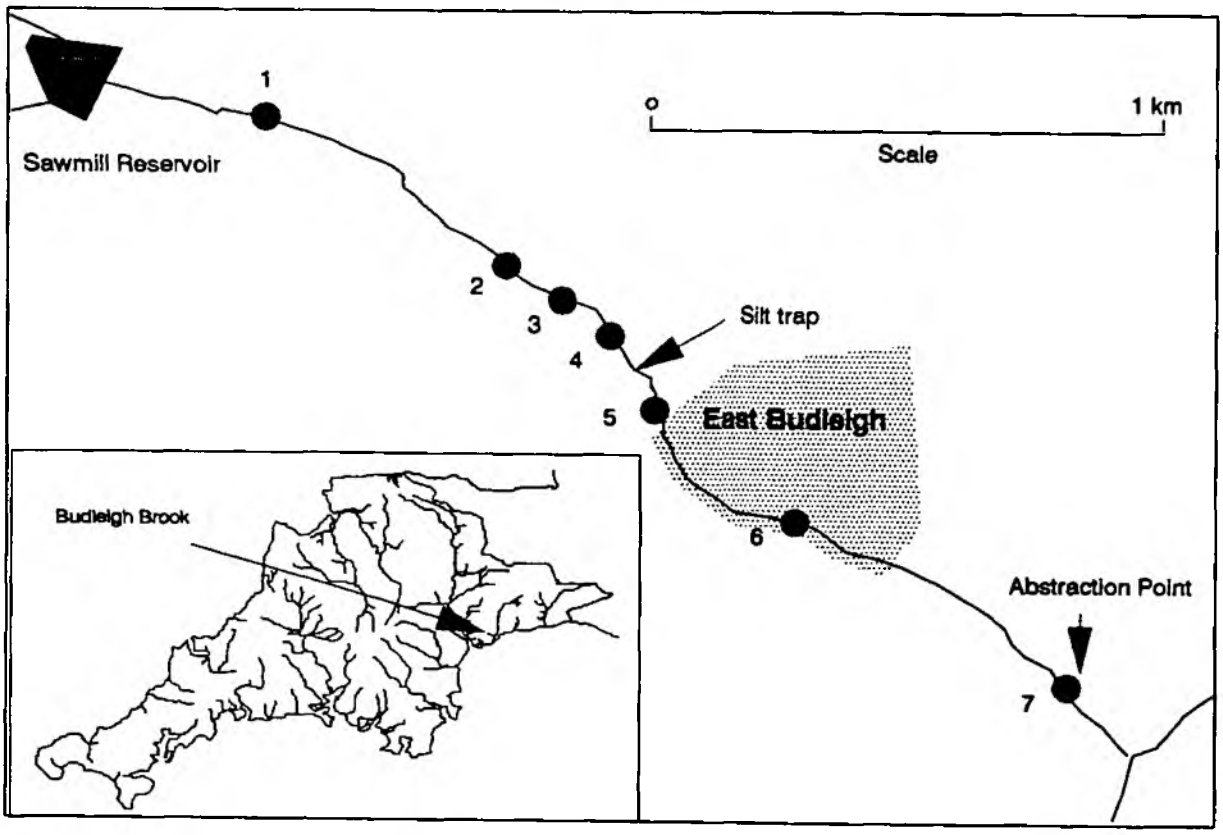


FIGURE 4. DENSE GROWTH OF ALGAE IN SILT TRAP

FIGURE 5. BUDLEIGH BROOK U/S OF SILT TRAP SHOWING DENSE GROWTH OF CALLITRICHE

FIGURE 2. GENERAL VIEW OF SILT TRAP

FIGURE 3. CLOSE UP OF ALGAE IN SILT TRAP