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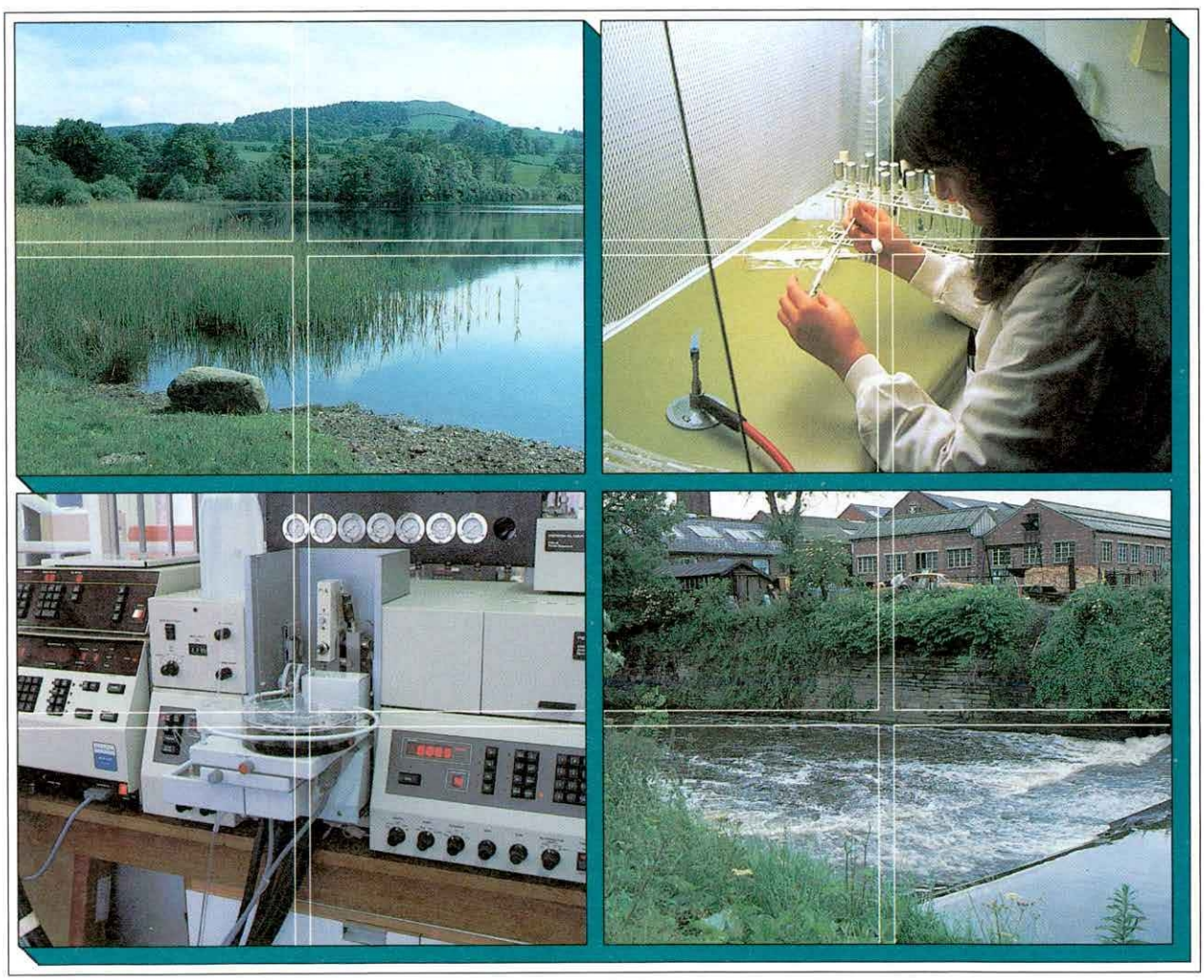
Quality assurance report on the draft report: Supervision of construction of the works report on 1996 water quality monitoring programme, November 1996

J Hilton PhD

Report To:	Sir Alexander Gibb & Partners Ltd
CEH Project No:	T04050U7
IFE Report Ref.No:	RL/T04050U7/3



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The report is well written with a logical progression of arguments and assumptions. There is one possible misunderstanding of terminology within the text and some extra detail could be added to some of the arguments as follows:

1. p.4-12. section 4.1.1, para 3
   The sums do not add up here 70 - 25 - 5 = 45, not 35? Is there an extra component not reported?

2. p.4-12. section 4.1.1, para 4. and p.4-13 para 3.
   These both appear to be estimates of flow into the coffer dam. Is this true. If so the differences need reconciling.
   para 4. Flow at 1 drops from 120 to 40 l/s due to 35 l/s diversion. Where does the extra 45 l/s go? Is it due simply to moving the sampling point. It is a large proportion of the total.
   para 3. Flow into coffer dam = 62 l/s (Ground water) - 8 l/s (road wetting) = 54 l/s. Where does the 45 l/s contractors estimate come from? Is it fortuitous that it is the same value (45 l/s) as in para 4? Should not flow at 1 (para 4) = flow into coffer dam?

3. p.4 - 14. para beginning "Table 2 ..."
   It is possible to extend the explanation a little. If we assume that EC, Boron, Chloride, sulphate and total phosphate are conservative, it is possible, using a simple mass balance, to calculate a number of estimates of the proportions of KAC and Zarqa water contributing to KAC at the turnout point (2), i.e.

   $$V_2C_2 = V_3C_3 + V_4C_4 \text{ and } V_3 + V_4 = 1 \text{ (working in proportions of } V_2\text{)}$$

   For 1995 the % contributions are calculated as 67, 76, 65, 67 and 64% respectively and 61, 66, 61, 57 and 60% respectively, for 1996. Taking 65% (ignoring B estimate) and 61% as the best estimates (from these calculations) for 1995 and 1996 then it is possible to calculate from the mass balance an estimate of the N concentration at turnout 2 assuming no changes in NO_3 concentrations. Using mean concentrations, estimates are 20 and 31 mg/l for 1995 and 1996 respectively, compared to measured values of 26 and 23, respectively. This suggests that in 1995 there were significant additions of nitrate from elsewhere during its passage along the KAC. Conversely in 1996 there were, apparently, no additions but bacterially mediated nitrate reduction (to nitrogen gas) was taking place. Nitrate reduction by bacteria in bottom muds, etc is normal behaviour and, in fact, suggests that the inputs in 1995 were even higher than measured since denitrification would have been taking place in 1995 as well.

4. In the following sections there is apparently a misunderstanding of the meaning of eutrophication. Eutrophication is the excessive growth of algae resulting from increased inputs of nutrients (normally P) by man. It can result in deoxygenated bottom waters in stratified lakes but this is a result of eutrophication, not eutrophication itself.

p.5-27. section 5.3
para 2. I suggest amending sentences 2 and 3 to read:
A build up of ..... encourage the **excessive** growth of algae in the reservoir leading to eutrophication. Oxygen demand caused by the settlement of senescent algae into the isolated bottom waters of a stratified lake may lead to the development .....
para 4. Suggest changing the last sentence to:
Algal growth will still occur at these lower phosphorus concentrations but the mean algal biomass will be lower and the likelihood of deoxygenation of bottom waters will be reduced.

5. para 3. It should also be borne in mind that the extraction experiments on soils and on the salt crust were for a fixed time. The assumption of 10% soluble salt assumes that there are no kinetic effects, i.e. if the experiment had been allowed to go for a longer time, or if new water had been introduced then more salt may have come out. Although it was not documented I recall that there was some evidence of a rate effect on the extraction method.

6. p.6 - 34, para 12. Stratification either occurs or it does not. It cannot occur in one part of the lake and not in another. If the bubblers do not completely destroy stratification, it will occur all over the lake but will be destroyed by much lower wind speeds than if the bubblers had not been there.

Minor amendments

Executive summary page 1 last paragraph, li.9 and p.1-2 para 3. li.7
I suggest deletion of "and eutrophication". See above.

p.2-5. table 1.
The units of nitrite, nitrate, ammonia and soluble reactive phosphorus, BOD and COD should include the reporting method. e.g. nitrate = mg/l as N or mg/l as NO_2.
Are the units of Chlorophyll *a* really mg/l or µg/l?

p.5-19. section 5.1, para 1, li.12. delete "at" after water.

p.5-28. para 3. li.2.
replace "eutrophication" with "stratification".

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