River Dee Steering Committee

The Effects of Flow Reduction in the River Dee on the aquatic environment.

An Initial Assessment.

National Rivers Authority

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1. INTRODUCTION

The River Dee supports a number of major abstractions from its lower reaches. In total these abstractions supply drinking water to 2 million people in Wales and England. To support these abstractions, the flow in the Dee is highly regulated by releases from three large reservoirs in the head-waters. The Dee is also industrialised in its lower reaches and effluents from such industries discharge into the River.

The Dee is also one of the most important salmonid fisheries in Wales, supports a significant coarse fishery in its lower reaches, is the base for a thriving recreational boating interest and is also noted for its great beauty as it meanders from its source in North Wales down to the historic town of Chester.

In dry weather conditions, the reservoirs are used to supplement the flow to enable water to be abstracted in its downstream stretch. Under normal operating conditions, the water flowing in the river equates to the volume abstracted plus an additional 4.2 cumecs which flows over Chester weir to the sea. Under drought conditions reductions in the level of residual flow may be allowed. Such decisions are taken by the Dee Consultative Committee who may decide in extreme conditions to allow the flow over Chester weir to revert to 'natural' flow (i.e. the flow that would have been occurred had the regulating reservoirs and the abstractions not been in existence).

In 1984, a major pollution incident occurred on the River Dee as a result of

which phenol contaminated water was abstracted, chlorinated and put into supply. The drinking water so produced was seriously tainted. The incident led to an investigation and the production of the 'Ridley' report. This in turn led to the setting up of the Dee Steering Committee (D.S.C.) upon which sit representatives of all the major abstractors (and the NRA since September 1989).

The D.S.C. coordinates actions taken to minimise pollution of drinking water and to ensure consistent and effective communications and action in the case of incidents. The D.S.C. has long been concerned about the number of significant pollution incidents that occur which have their origin in industrial premises either through accidents or failure to meet consent conditions, or through the presence of low levels of organic materials that could adversely affect the potability of drinking water.

One possible solution to the problems of intermittent pollution from sources in the middle and lower Dee would be to pipe the water from a point above the industries. A suitable location would have to be situated in the Llangollen area. The suggestion that the water should be abstracted at Llangollen has been made by a number of bodies including local authorities whose areas are served by Dee water and the question has been examined in a general way on a number of occasions in the past. This note summarises the likely environmental impact of adopting this approach.

A recommendation of this note (q.v.) is that in order to further progress any proposal to significantly modify the Dee regulation scheme, particularly any proposal to greatly affect the residual flow in the river, a full environmental impact assessment would be required. The production of such a report could be

undertaken by the N.R.A. or by consultants working to a contract from the Dee Steering Committee and paid for by that Committee.

This note addresses the general issues and not the detail that such a consultancy report would provide.

2. THE FLOW REGIME OF THE DEE

In order to understand the effects of reduction in flow it is necessary to understand the way in which the regulation system operates.

The Dee flow can be supported by releases of water from any of three reservoirs - Llyn Brenig, Llyn Celyn and Llyn Tegid . The water released from Llyn Tegid is controlled by sluices. When the sluices are open then releases from Celyn can partially refill Tegid as well as supplementing the river flow. Under these conditions, Tegid provides some hydraulic capacitance on the system.

Both Celyn and Brenig are high level reservoirs which are typically drawn down during the summer and re-fill with winter rains. Celyn can be drawn down almost to dryness with an expectation of re-fill during the following winter. Brenig however could take several years to re-fill if severely drawn down and can be regarded as the long-stop resource which ensures adequate capacity in even the driest periods.

3. ABSTRACTIONS FROM THE DEE

The total licensed abstraction from the Dee by the major abstractors is 9.757 cumecs of which 8.208 cumecs is licensed to North West Water plc. Of the remainder, almost all of the 0.5 cumecs licensed to Wrexham and East Denbighshire Water Company is returned as sewage effluent to the river as is a

small proportion of the 0.327 cumecs licensed to Welsh Water. These small amounts aside, the bulk of the abstracted water is lost to the catchment.

Although the volumes quoted above represent licensed amounts, these licenses have never been exploited to the full and the actual take can be significantly less. For ease of presentation, an assumed level of abstraction of 8.4 cumecs has been used to represent the total of all abstractions.

4. PIPING ABSTRACTED WATER FROM LLANGOLLEN DIRECTLY TO ABSTRACTORS

Llangollen lies on the River Dee some 76 kilometres upstream of Chester weir and is upstream of the major tributaries the Ceiriog, Clywedog, Alyn, Aldford Brook and Worthenbury Brook. More importantly it is upstream of Chirk, Ruabon and Wrexham wherein all the major industries on the freshwater Dee lie. The construction of a pipeline from the Llangollen area would pose two questions.

1. Would the existing system of regulation have sufficient capacity to maintain the abstractions without the inflow from the major downstream tributaries ?

2. What would be the effect on the eco-system and the uses made of the river if such a quantity of water were to be removed from the River ?

5. CAPACITY OF THE DEE SYSTEM TO SUPPORT A PIPED SUPPLY

The existing Dee Regulation system is designed to support a greater volume of licensed abstraction than currently exists. The fact that current abstractions are not operating up to licensed volumes gives some further capacity, but this capacity cannot be re-assigned without one of the Water Companies giving up part of its allocated license volume.

The major abstraction points on the regulated Dee are located near Chester. Prior to 1974, the Dee was regulated to provide a fixed maintained flow at Manley Hall (Erbistock). In 1974, advances in hydrometric measurement techniques allowed the point of maintained flow to be moved downstream, to Farndon/Eccleston Ferry. If abstraction was to take place at Llangollen, then the point of regulation would also have to be moved back upstream to Manley Hall.

The proposition of moving the abstraction to Llangollen was considered by Lambert and Weston in June 1985. The following is an abridged extract from their paper with quoted volumes converted from mgd to cumecs.

"The greater the uncontrolled catchments are upstream of the regulation point, the greater (in general) the system yield will be. This is because use is made of the higher than minimum natural flows from the uncontrolled catchment area in Spring, to permit reduced regulation releases. Farndon/Eccleston Ferry uses virtually the whole Dee catchment, and gives the maximum possible yield. Regulation to Manley Hall would provide a lesser yield.

The complex Brenig yield calculations (1969 to 1971) for a 1% drought show that Stage 1 Brenig used conjunctively with Bala and Celyn gives a maintained flow for Eccleston Ferry of 13.39 cumecs. The calculation allows 0.76 cumecs to be abstracted into the Llangollen canal for British Waterways and North West Water plc. The residual flow over Chester Weir is 4.2 cumecs. This leaves 9.19 cumecs available for net abstractions between Manley Hall and Chester Weir. The present licensed Dee abstraction in this reach are 8.82 cumecs gross, 8.35 cumecs net, leaving 0.84 cumecs unlicensed yield (June 1985).

The yield calculations are based on a 2 summer/winter critical drought period. The calculations also showed that regulation to Manley Hall by Bala/Celyn/Brenig would allow a flow of 10.98 cumecs to be maintained at Manley Hall after the 0.76 cumec Canal abstraction. This gives a downstream abstraction of 8.14 cumecs (1.05 cumecs less than regulating to Farndon/ Eccleston). The residual flow over Chester Weir would vary with the natural inflow downstream of Manley Hall, but would generally be in the range 3.68 cumecs to 4.75 cumecs during dry summer periods.

These calculations did not envisage a further major abstraction upstream of Manley Hall. However, these figures can be used to give a reasonable estimate for such a case. It would be reasonable to assume a design residual flow of around 3.15 cumecs at Manley Hall (downstream of any new abstraction). This gives about 7.82 cumecs abstraction upstream of Manley Hall plus the 0.76 cumec Canal abstraction). Downstream of Manley Hall, near Chester, 0.32 cumecs would be available for perhaps non-potable purposes.

Thus, it would be possible to use the existing resources to support an alternative direct abstraction of up to 7.67 cumecs at Llangollen, together with a net abstraction downstream of Manley Hall of 0.31 cumecs.

The total safe abstraction of 7.98 cumecs would represent a reduction of 1.03 cumecs as compared to the present Dee yield regulating to Farndon/Eccleston. The greater the proportion of non-potable below Manley Hall the greater the Manley Hall design residual flow would be.

The calculations also showed that regulation to Manley Hall by Bala/Celyn/Brenig would allow a flow of 10.76 cumecs to be maintained at Manley Hall after the 0.74 cumec Canal abstraction for BW/NWW. This gives a downstream abstraction of 7.98 cumecs (1.03 cumecs less than regulating to Farndon/Eccleston). The residual flow over Chester Weir would vary with the natural inflow downstream of Manley Hall, but would generally be in the range 3.61 cumecs to 4.64 cumecs during dry summer periods.

As a check a quick manual calculation the Dee Design Drought Studies 1979/1982 show a loss of yield by moving the regulation point to Manley Hall of 1.16 cumecs.

At present (excluding the Canal abstraction) the remaining licensed abstractions total 8.32 cumecs which is close enough to 8.14 cumecs for practical purposes, but it would mean that there would be no spare unlicensed yield on the Dee.

To conclude, in terms of existing water resources storage, it would be broadly possible to substitute the bulk of the existing Lower Dee abstractions with an alternative abstraction in the vicinity of Llangollen. However, all the remaining unallocated yield from Llyn Brenig would be lost, and the implication for future resources development on the Dee would need careful consideration. Broadly speaking, if North West Water plc. required no further supplies from the Dee, in excess of their present licence, then it might be possible to meet the relatively minor Welsh Water plc./Water Company future additional needs without major new capital intensive resource development works such as Brenig Stage II."

This report took no heed of the potential environmental consequences of a regulated flow at Manley Hall of 3.15 cumecs and these are addressed below.

If there was a requirement to maintain 4.2 cumecs throughout the downstream stretch, then the volume discharged over Chester weir would rise to 5.8 cumecs. This represents an additional demand of 1.6 cumec days for every day of regulated flow in these conditions. If such conditions persisted from May to September then this would represent an increased demand on the system of approximately 240 cumec days. This must be compared with the expected conservation storage of the system at 1st. May of 1230 cumec days.

If the only effect of piping water from Llangollen was the loss of downstream tributary water to the abstractors, then on the basis of Lambert and Westwood's report, sufficient capacity exists in the system to support such a proposal. If however more than 4.2 cumecs are required in the river at Chester weir (which would equate to approximately 3.15 cumecs below Llangollen) then this represents new, and potentially very large demands on the system.

It is possible to calculate the yield of the complete system under new definitions of the operating rules although there are considerable resources requirements to recalculate the yield of this complex system. Such a calculation would be best addressed in a full environmental impact assessment.

6. ENVIRONMENTAL CONSEQUENCES OF REDUCED FLOW BELOW LLANGOLLEN

The River Dee supports many and diverse interests of which only one is the needs of abstractors. The Dee also supports a very important salmonid fishery and an important coarse fishery in its lower reaches. Fishing is a major recreational use of the river.

The river also supports recreational uses from canoeing and pleasure boating through river-side walking and the enjoyment of natural history to the simple pleasures of watching an aesthetically pleasing water-way.

The river receives, dilutes and carries away effluents from industry and sewage from the local population, some of it discharged directly to the river and some to one or other of the tributaries.

7. EFFECTS ON FISHERIES

Successful salmonid fisheries are dependant on a range of flows in order to migrate through the river, for spawning to be successful and for the young to feed and grow.

Freshets and small spates are particularly important in allowing the movement of fish up river. Without these flow changes fish tend to remain where they are or occasionally fall back to the sea.

Base flow is also important as it defines the wetted area of the river within which fish can set up territories and feed. A smaller wetted area has a lower potential to produce natural food for fish in the form of insects larvae and nymphs.

A low fresh water flow into the Dee estuary could also have a serious impact on the migratory salmonids passing up and down through the estuary as adults on their way to spawning and as smolts moving to the sea . Existing conditions in the Dee estuary have given rise to serious salmonid fish mortalities because of low flow conditions exacerbated by low oxygen levels and elevated ammonia concentrations.

In recent years there has been a considerable growth in interest in acquiring salmon fishing rights whether it be for syndicates, clubs or indeed for time-share. This has meant that the capital values of such fisheries have increased very markedly in recent years with lengths of single bank commanding over £200,000 per mile. The capital value of the salmon fishing below Llangollen could therefore be conservatively assessed at around £10 million.

The revenue derived from such beats is also considerable with some syndicated beats costing over £1000 for a single rod on a day per week during the season. High returns for capital investment are therefore generated. Any changes as dramatic as cutting flows permanently could reduce the quality of the fishing and would immediately lead to legal action and large claims for compensation for capital and amenity losses.

The impact higher up the river cannot be discounted since these fisheries would be dependant upon salmonids ascending the river. If there was any interference in their passage, or reduction in numbers reaching these areas, then claims for damage to the fishery would not be just confined to the lower river.

It is conservatively estimated that claims for damage by fishery owners and fishing interests could exceed £7.5 million

Apart from the impact on salmon fisheries and the resultant damage to local tourism there would also be environmental changes that may be considered to be wholly unacceptable to conservation interests in the river corridor. The impact could be serious because reduction in wetted area would reduce marginal vegetation which is crucial for cover and for breeding for a wide range of animals and birds including swans, ducks, voles and otters.

Flood embankments could also be at greater risk because of drying out causing cracking and leading to increased erosion at flood time. This would be particularly noticeable where trees were affected and roots were starved of water. The increased maintenance costs to the National Rivers Authority could be considerable.

8. EFFECTS ON QUALITY

The Dee, like almost all rivers in England and Wales, receives treated effluents from industry and sewage works. Below Llangollen, most of the significant sewage works discharge to tributaries of the Dee and only some of the smaller works discharge to the main river.

Discharging to relatively small tributaries does however carry a cost penalty since a much greater degree of treatment is required that would be the case if the discharge was to the main river. With an expanding population and a cultural climate insisting that more and more stringent standards be met, there will be very great pressure to move some of the larger discharges to areas of greater dilution. If the flow below Llangollen were to be restricted to the residual flow, then this greater dilution would not be available and the cost of treating sewage in the Dee valley would escalate.

One major industry, Monsanto plc., does discharge into the Dee with a consented volume of 8000 cubic metres per day (0.093 cumecs). At a base river flow of 4.2 cumecs this would provide a dilution of 45:1. At present the ratio is 135.5.

Despite the current high levels of dilution, a number of pollution alerts on the Dee (DEEPOLs) have been raised over the years in response to problems emanating from Monsanto's effluent despite the effluent standard being within the consented parameters. A number of these DEEPOLS related to organic micro-constituents occurring at concentrations of a few parts per billion. Many of these organic species appear to be the product of the biological process used to treat the effluent and not from the principal process streams of the plant.

If water were to be piped from Llangollen, there would no longer be any need to raise DEEPOLs in relation to Monsanto's effluent since it would be down-stream of the abstraction point, but there would still be considerable concern about the impact of organic species in the biota of the river system, tainting of fish etc.

Farm effluents presently exert a considerable impact on the Worthenbury Brook, and other small streams that drain the agricultural Cheshire plain. These streams are typically in NWC Class 2 (moderately good) although they fall into Class 3 (poor) from time to time. Considerable attention is paid to improving the quality of these streams but with the intensity of current farming practices and the number of farm units involved , it is unlikely that great improvements will be made in the foreseeable future. The effects of these stream could lower the quality class of the Dee to NWC Class 2 in its lower reaches.

The reduction in flow would also greatly increase the time of travel down the river and it would take many days for the water passing Llangollen to pass

over Chester weir. During these lengthy periods, river temperatures would be expected to rise during summer months, pHs would rise during daylight and fall at night and dissolved oxygen would follow a rather exaggerated diurnal rhythm. These conditions are typical of slow flowing lowland rivers more often found in the East of England and are atypical of the Dee as it is at present.

As noted above, even at current flows problems have been experienced in the estuary with fish being killed by a combination of low dissolved oxygen, elevated ammonia, elevated pH and high temperature. The much slower passage of water down the river is likely to exacerbate all of these problems and it is possible that fish kills could occur upstream of the weir, particularly if large blooms of algae develop in the slow moving water.

9. EFFECTS ON RECREATION AND OTHER USES

In the lower Dee the river would not be markedly changed in appearance although , as noted above, the water would be more sluggish, warmer in summer and subject to excessive plant growth where this was not inhibited by the passage of boats. Above this level however, the appearance of the river would be very markedly affected with the wetted channel being very seriously reduced in width. The winter flood channel would be unaffected by these regulation changes and as a result the flow of the river would be confined to a very narrow band in a large river bed. As a consequence, the aesthetics of the river would be greatly impoverished and it would no longer be a pleasure to pause by the banks of the Dee and watch the steady flow of water to the sea.

Conclusions and Recommendations.

1. Moving the abstraction point on the Dee to Llangollen would at the very least consume all spare capacity in the regulated system. No new abstractions could be licensed.

2. If a minimum flow in the river of 4.2 cumecs were set then even existing flows could not be supported during the design drought conditions.

3. A flow of 4.2 cumecs would have a seriously detrimental effect on the appearance of the river and its ecology.

4. The salmonid fishery is likely to be seriously affected and salmon fishing would be very seriously damaged.

5. The reduction in worth of the fishing beats could be as much as £7.5 million and fishery owners would seek such recompense from the promoters of the scheme.

6. Visible and invisible earnings from salmonid fishing would be greatly diminished - this would have an effect on general tourist income in the area.

7. It is likely that coarse fishing might improve although some restrictions on boat traffic might be required to maximise this benefit.

8. Dilution available for sewage and trade effluents would be greatly reduced and might require improved standards of effluents from discharges. There could be large cost implications for all dischargers. Future sewage disposal strategy in the area could be rendered far more expensive as populations grow.

9. If despite these issues a decision is taken to further investigate the option of piping the abstracted water, then a full Environmental Impact Appraisal would be required to assess in detail the environmental, aesthetic, conservation, fishery and general amenity effects of such a scheme.

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