

CUMBERLAND RIVER AUTHORITY

MANCHESTER CORPORATION WATERWORKS

AUGMENTATION
OF THE RIVER DERWENT
USING THE RIVER

Report of Joint Working Party

J. S. Keighley, BSc FICE FIWE,
Acting General Manager & Engineer,
Manchester Corporation Waterworks,
P. O. Box 491,
Town Hall,
MANCHESTER - M60 2JU.

C. T. Marshall, BSc PhD MICE MIWA,
Chief Engineer,
Cumberland River Authority,
256 London Road,
CARLISLE - CA1 2QG.

AUGMENTATION OF THE RIVER DERWENT USING THIRLMERE
REPORT OF JOINT WORKING PARTY

Introduction

1. In Chapter 7 of the "Water Resources in the North" report, published in 1970 by the Water Resources Board, "Thirlmere/Bassenthwaite Control Works and Workington tidal sluice" was included in the list of projects which "will be needed in the long term whether or not estuary storage is adopted, and which should therefore be investigated forthwith". In accordance with this recommendation arrangements were made for the project to be investigated by Consulting Engineers retained by the Cumberland River Authority and by Manchester Corporation. The joint report of the Consulting Engineers was received in September 1972 and following consideration by both Authorities, further discussion of the hydrological, administrative and financial implications of a scheme for the augmentation of the River Derwent by a limited discharge from the Thirlmere Reservoir in the short term was authorised. A Working Party of officers from both the Authority and the Corporation was established and experimental releases of water from Thirlmere were made in dry periods in order to assess more clearly their effect upon river flows, and on the level of Bassenthwaite Lake. This report contains the Working Party's evaluations, conclusions and recommendations. The enactment of the Water Act 1973 will result in the vesting of the undertakings of the Cumberland River Authority and the Manchester Corporation in the North West Water Authority as from the 1st April 1974, and this report has therefore been prepared for submission to both the Waterworks Committee and the River Authority and, subject to the approval of both bodies, to the North West Water Authority. Any action to be taken on this report would be a matter for the Water Authority.

Demand for and availability of water

2. The current trend of consumption in the West Cumberland Water Board area is illustrated by the following table of annual average demands.

<u>Year</u>	<u>Potable Supply</u> (mgd)	<u>Industrial Supply</u> (mgd)
1968	5.82	2.61
1969	6.18	2.54
1970	7.22	2.85
1971	7.22	2.41
1972	8.12	2.44
Supplies available	9.04	7.50

3. Whilst the above table shows the industrial demand to be stable at the present time, rapid increases in demand could occur, should further industrial development take place, and there is a steady growth of 'potable' demand to be met. The present industrial supplies are taken from the lower Derwent and further development of this resource could provide the quickest, least expensive and most acceptable solution to these problems. If the scheme adopted were capable of implementation in stages as and when required to meet increasing demand this would be a further advantage. In considering the staging of development the provisions of the West Cumberland Water Order 1966 should be borne in mind. In accordance with this Order the Board are at present licensed to abstract 7.5 million gallons per day (mgd) at all times. The Order also provides for an increased rate of abstraction when the river flow at Camerton gauging station exceeds 42 mgd. In addition to the basic 7.5 mgd the Board would be allowed to abstract half the excess flow over 42 mgd up to a maximum total abstraction rate of 12.5 mgd at a river flow of 52 mgd (2.75 cubic metres per second (cumecs)). The first priority in augmenting the Derwent should therefore be to provide a maintained flow of 2.75 cumecs so that the additional 5 mgd abstraction envisaged in the Water Order could be licensed. The total quantities licensed for abstraction at Workington would then become 1.71 cumecs (32.5 mgd) and the minimum residual flow would be increased from 0.35 cumecs (6.5 mgd) to 1.04 cumecs (19.5 mgd).

Cumberland River Authority : Bassenthwaite Temporary Scheme

4. The River Authority temporary scheme for which powers were obtained in the Cumberland River Authority Act 1971, would involve the construction of a weir, intake and pumping station at the outfall of Bassenthwaite Lake to enable the River Authority to maintain a flow of 3.25 cumecs (62 mgd) in the River Derwent at Camerton, as compared with the minimum recorded natural flow of 1.8 cumecs (34 mgd). The River Authority would have approximately 3200 Megalitres (ML) (700 mg) of storage through the control of the lake levels between 67.7 m (222 ft) and 68.3 m (224 ft) above ordnance datum.

5. The scheme would be of temporary duration as the powers cease on the 31st December 1980. The cost of the scheme in 1969 was estimated at £127 000 plus miscellaneous charges; at the present time the cost is estimated at approximately £220 000. The works have not been carried out because as yet there has been no increased demand for water for industrial supplies, but the scheme could be implemented, if required, within eighteen months.

Joint Consulting Engineers' Report

6. Arising from the Water Resources Board's Report "Water Resources in the North" published in 1970, the Corporation's and the Authority's Consulting Engineers prepared a joint report issued in September 1972 entitled "The Thirlmere Scheme for the Regulation of the River Derwent". The report indicated that 10 000 ML (2200 mg) of Thirlmere storage out of a total of 37 500 ML (8250 mg) could be made available for regulating the River Derwent without diminution of the 218 Megalitres per day (ML/d) (48 mgd) for water supply which under normal circumstances will be conveyed southwards via the Thirlmere aqueduct. This estimate was based on a selected "design drought" period and was subject to the availability of the proposed Shap aqueduct and to the rates of discharge of compensation water at Haweswater remaining unchanged. It was recognised that additional pumping costs from Windermere would be incurred and that part of the Windermere abstraction would be balanced by storage at Haweswater utilising pumping via the Shap aqueduct.

7. The report indicated that the allocation of 10 000 ML (2200 mg) of Thirlmere storage would augment the dry weather flow in the lower reaches of the River Derwent, and enable abstraction for water supplies of up to 237 ML/d (52 mgd). With the provision of works along the river comprising a tidal sluice near the mouth of river at Workington and a pumping installation for improvement of outflow from Bassenthwaite Lake, the quantity could be increased to 347 ML/d (76 mgd). For greater abstractions a larger proportion of the Thirlmere storage would have to be allocated for river regulation, and this would lead to some diminution of water supplies to Manchester.
8. The Joint Consulting Engineers recommended that a scheme based on utilisation of storage at Thirlmere for augmentation of flows in the River Derwent should be implemented in lieu of the River Authority's Bassenthwaite Scheme authorised by Cumberland River Authority Act, 1971.

Proposals for a limited discharge from Thirlmere

9. Whilst the Joint Consulting Engineers report indicated that 10 000 ML of Thirlmere storage could be made available each year to regulate the River Derwent the General Manager and Engineer of the Corporation's Waterworks Undertaking considers that, as a first-stage, the release to the River Derwent should not exceed 7500 ML (1650 mg) over a critical dry period of 19 months. There would be no reduction in the normal quantity of water ie 691 ML/d (152 mgd) which the Waterworks Undertaking will be able to deliver through aqueducts to Manchester on completion of the Shap aqueduct scheme. This allocation would allow up to 3750 ML (825 mg) release in any one year to the River Derwent and in the opinion of the Engineer to the River Authority, based upon observation of experimental releases carried out during the summer of 1973, this is adequate to maintain a flow of 2.75 cumecs (52 mgd) at Camerton, in all normally foreseeable circumstances. Consulting Engineers retained by Manchester Corporation are at present engaged on a study of the conjunctive use of the Corporation's sources of supply and when the results of this work become available it may be found possible to allocate more water for regulation of the Derwent without prejudicing supplies to other areas.

10. It is considered that initially the releases from Thirlmere could be made by operating existing valves, but this will require formal confirmation following consultation with the engineer responsible for inspecting the reservoir under the Reservoirs (Safety Provisions) Act. No additional engineering works are required initially on St. John's Beck, or at Bassenthwaite and although some loss of water may occur, through the discharge without any control arrangements at Bassenthwaite, the opportunity would be taken of observing the behaviour of Bassenthwaite and the River Derwent, gaining operational experience and assessing the suitability of the existing valve installations at Thirlmere before commitment to expenditure on subsequent works. Stage 1 of the scheme involves, therefore, simply the release of water from Thirlmere when necessary to support the abstraction of an additional 23 ML/d (5 mgd) for supply. Such release would be infrequent; the pattern of flows during the years 1961 to 1973 would have required releases in only four periods totalling 49 days, as follows:

<u>Drought</u>		<u>Thirlmere Releases</u>		
		Duration (days)	Maximum Rate (cumecs)	Quantity (ML)
August	1968	5	0.8	346
June	1970	18	1.6	1693
Sept/Oct	1972	17½ + 8	1.5	1871

The effect of these releases on water levels would be significant only in St. John's Beck and details are given in Appendix 'A'.

11. As the demand for water in West Cumberland increases it might be possible to increase the allocation of water from Thirlmere or, to make more effective use of the water released, a gravity pipe-line could be laid as a by-pass to the natural outlet from Bassenthwaite at an estimated cost of £200 000 at 1973 prices. Thus the scheme would be capable of expansion to provide for additional abstractions from the River Derwent. At this stage when the need for additional water from the River Derwent has become fully established improved outlet valve arrangements at Thirlmere would be appropriate; the cost of this work was estimated by the Joint Consulting Engineers as £60 000 at 1967 prices, thus £100 000 would be a more realistic estimate at 1973 prices.

Operating Costs

12. To ensure that 7500 Ml would be available from Thirlmere over a 19 month dry period additional pumping from Windermere would be required over and above that required for the Manchester system, but within the limits imposed by the Manchester (Ullswater and Windermere) Water Order 1966. The General Manager and Engineer of the Manchester Waterworks Undertaking estimates that under the electricity tariff as existing in August 1973 the additional pumping and treatment would cost, on average, about £10 000 per annum. There would be an initial expenditure by the River Authority of some £10 000 in respect of additional instrumentation. The scheme could therefore provide an additional 23 Ml/d (5 mgd) immediately at no substantial capital cost and be capable of expansion.
13. It will be for the North West Water Authority to indicate what costing arrangements are to apply between the respective operational divisions with regard to both repayment of capital expenditure attributable to the Windermere works of the Manchester system, and to pumping costs. Arrangements covering licensed abstraction charges might also be required.

Effect on Thirlmere draw-down

14. The effect of the proposals on the water level in Thirlmere reservoir would be wholly beneficial from the amenity point of view. As a result of the reservation of a quantity of water in Thirlmere for possible release to the River Derwent, the total quantity to be held in storage in Thirlmere at any time of year would be higher than without the reservation. The effect of this would be that except when the reservoir would have overflowed in any case, and for a short period thereafter, the water level would be held significantly higher than without the reservation. In a critical drought period the maximum depletion would be the same as without the reservation.

Statutory Powers

15. The Corporation are required
- (a) to discharge compensation water from Thirlmere into St. John's Beck amounting to 3 mgd in an even and continuous flow throughout the year, and in addition
 - (i) the River Authority can demand 214 million gallons per annum at maximum rates of 4 mgd in October and 3 mgd in November in an even and continuous flow over 24 hours.

(ii) The Millowners Committee which is now defunct can have additional water discharged in certain periods of the year.

The additional quantity of water which can be required by the River Authority for fisheries and by the millowners must not exceed 605 million gallons in any year. This total additional quantity is not being discharged to the river.

- (b) Under the direction of the Engineer of the Corporation and to the extent that he in the exercise of his discretion may sanction the Corporation shall whilst using less than 20 mgd of water from Thirlmere discharge into St. John's Beck in addition to the compensation water provided an additional amount of up to 10 mgd or so much as can be discharged without reducing below 4500 mg the storage of water in Lake Thirlmere available for the use of the Corporation ie for water supply.
- (c) Not to discharge from Thirlmere into St. John's Beck any greater quantity of water than the greatest quantity of flood water which prior to 1879 flowed from the lake down St. John's Beck.
16. There are protective provisions as to settlement of disputes and payment of compensation to persons entitled to compensation water.
17. The present scheme would not vary the minimum flow of 3 mgd (13.6 ML/d) compensation water into St. John's Beck, but it would provide additional flows when required to maintain a given rate of flow in the River Derwent at Camerton.
18. The Corporation and their successors are not debarred by their local Acts from discharging additional water into the River Derwent but they are under a requirement to meet all statutory obligations. The discharge of additional water would not relieve the Corporation from the requirement to discharge additional water at the behest of the Millowners Committee, and it could reasonably be argued that the effect of Section 74 of the Manchester Corporation Act, 1879, is that water should never be discharged if the effect is to lower the storage below 4500 mg.

19. The provisions as to compensation water at Thirlmere are cumbersome and archaic and need to be modified to enable the water authority to make the most effective use of the reservoir having regard to all their obligations including the water supply requirements to Manchester and the North West region via the Manchester aqueduct system.

Recommendations

20. The Working Party recommend that the River Authority and the Waterworks Committee submit this report to the North West Water Authority for consideration; that the proposed discharge of water from Thirlmere as envisaged in this report be implemented in stages as and when augmentation of water resources in West Cumberland is necessary, and that for this purpose the Water Authority be requested to seek such additional powers as may be necessary.

The relative infrequency of operation should first be noted. During the last twelve years releases would have been made on four occasions, for a total of forty-nine days, as detailed in the report. Furthermore, the releases would not be required until the rivers, and Bassenthwaite Lake, have fallen to within a few inches of their lowest recorded levels.

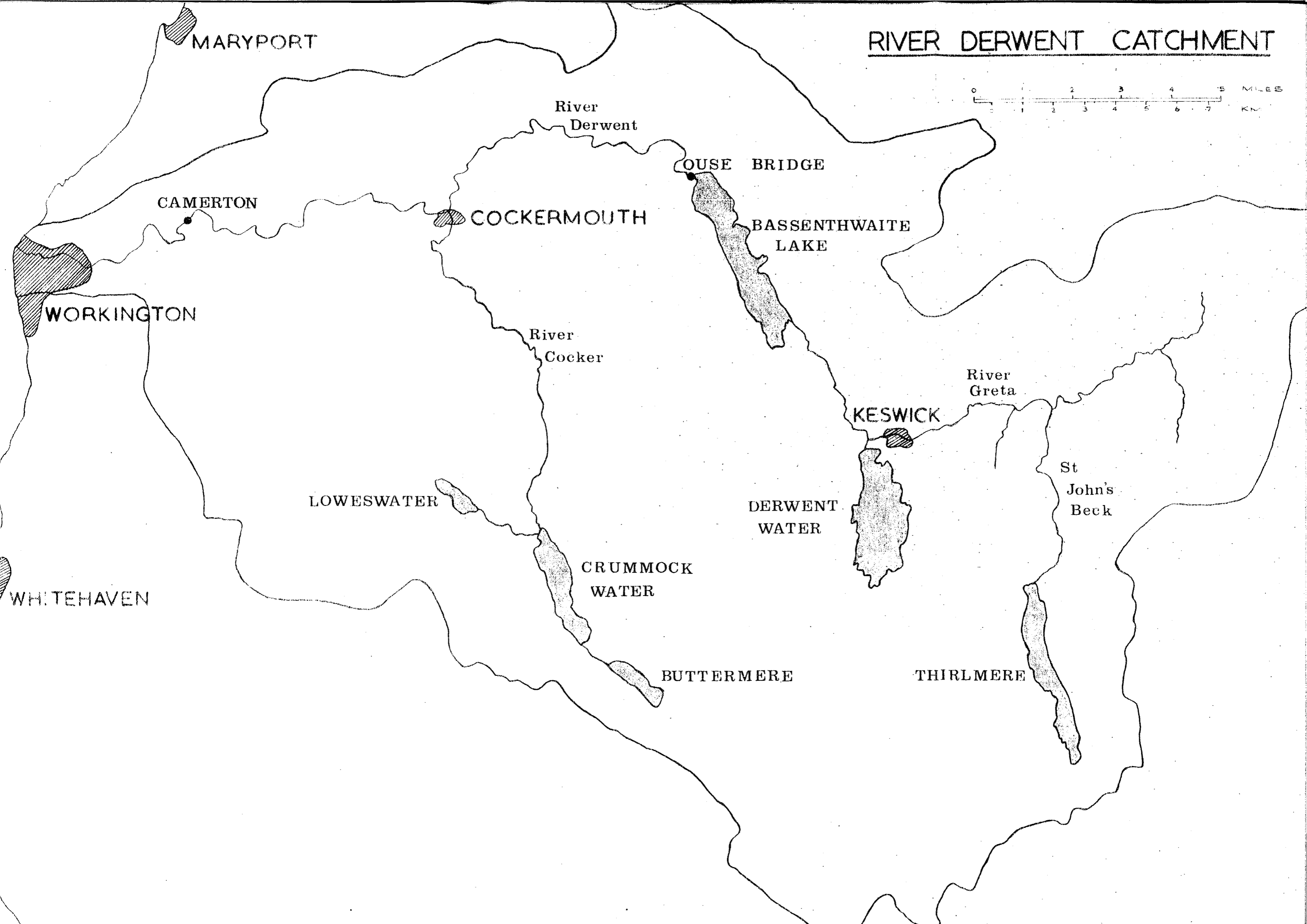
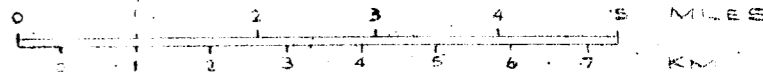
The effect of a release would be most noticeable in St. John's Beck and the River Greta where within a few hours the water level would rise by some 0.18 m (7 in.) and 0.10 m (4 in.) respectively as a result of an initial release of 0.8 cumec. Thereafter there would be only small rises as the rate of release was increased and during the first 1972 drought for example the maximum difference between natural level and the enhanced level would have been approximately 0.28 m (11 in.) in St. John's Beck and 0.17 m (6.7 in.) in the River Greta.

Further downstream the effects will be less noticeable. The effect on Bassenthwaite Lake would be that instead of falling steadily over the period of regulation by some 70 mm (2.75 in.) in a drought similar to that of 1972, or 100 mm (4 in.) in an extreme case, the lake would rise slightly, typically by some 5 mm (0.2 in.) and by up to 25 mm (1.0 in.) in the extreme case. The lake level at the start of the release would be at about 68.3 m (224 ft) A.O.D. This is some 0.15 m (6 in.) below the mean summer level of the lake, and 0.1 m (4 in.) above the lowest recorded lake level.

At Camerton the aim would be to hold the level steady whereas under natural conditions the river would fall slowly by some 55 mm (2.2 in.).

Thus, if under these drought conditions increases in depth can be considered beneficial for all interests, the benefit during a drought such as that of 1972 would be up to 0.28 m (11 in.) in St. John's Beck, 0.17 m (6.7 in.) in the River Greta, and 75 mm (3 in.) at Bassenthwaite. The benefit in the lower Derwent would vary from about 75 mm (3 in.) at Ouse Bridge to 55 mm (2.2 in.) at Camerton.

RIVER DERWENT CATCHMENT

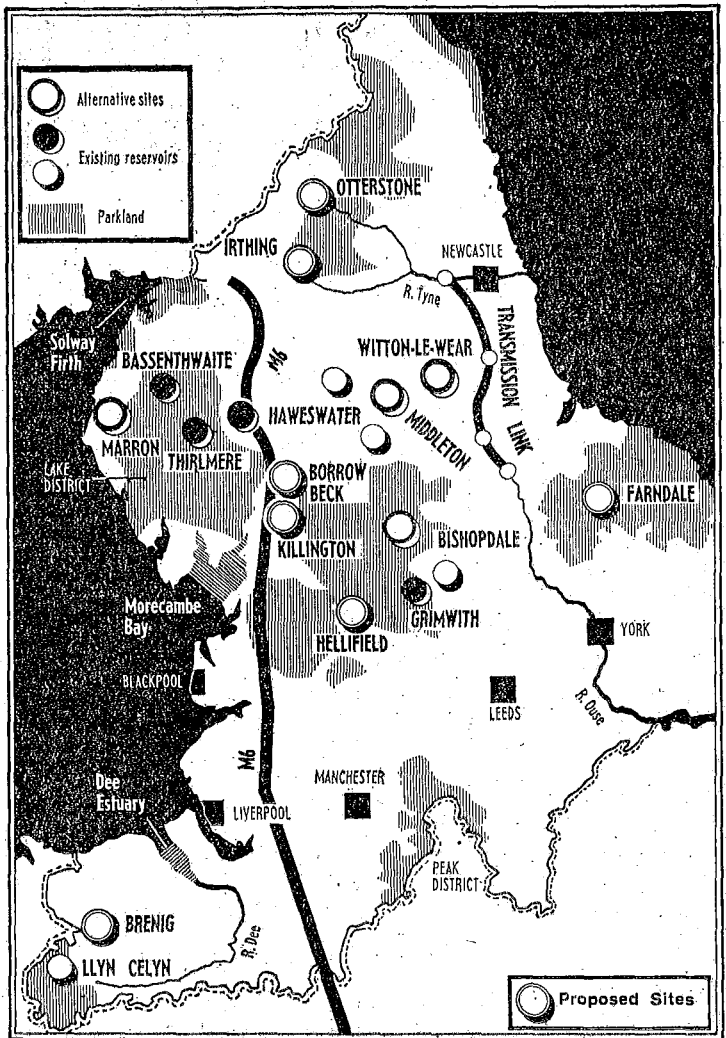


Beauty and the Water Board in battle of the seven reservoirs

By Bryan Silcock
Science Correspondent

A NEW SERIES of battles over reservoirs in national parks and other areas of beauty is being sparked off by the publication a few days ago of a report on water resources for the North by the Water Resources Board.

On Tuesday a Bill for the construction of a reservoir at Farndale in the North Yorkshire Moors National Park will come up for a second reading in the House of Commons, where it will be opposed by a group of MPs who last month had another Yorkshire reservoir scheme thrown out. Tomorrow evening there will be a public meeting to mark the opening of the campaign against a giant



Where the seven would be built

be drastically revised when the results of the barrage investigations become available in 1972 but, according to the report, Brenig, Otterstone and Irthing "will be required whatever is decided about estuary storage."

Farndale, which is intended to regulate the River Derwent so that water more urgently needed can be taken from it for south Yorkshire, Hull and

More water is also urgently needed by the Tyne, Wear and Tees conurbations. The Water Resources Board proposes a giant reservoir at Otterstone on the North Tyne and later a rather smaller reservoir on the river Irthing, with an aqueduct to carry water from the Tyne south to the Wear and the Tees.

Local opposition is growing.