

NATIONAL RIVERS AUTHORITY
AWDURDOD AFONYDD CENEDLAETHOL

WELSH REGION
RHANBARTH CYMRU



NRA

Guardians of the Water Environment
Diogelwyr Amgylchedd Dŵr

RIVER USK BARRAGE

POSITION STATEMENT

18th January 1991



ASiantaeth yr Amgylchedd Cymru
ENVIRONMENT AGENCY WALES

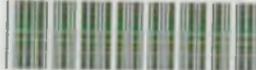
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ENVIRONMENT AGENCY



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1. INTRODUCTION

Newport Borough Council propose to construct a barrage across the river Usk estuary at Newport thereby creating a body of impounded water, with a minimum retained water level. They consider that this will form an important component in the economic regeneration of Newport as it would create an attraction for the redevelopment of areas adjacent to the river.

The proposals indicate that the barrage would be constructed across the river at Spittles Point (NGR ST 32558685) which is situated between the George Street road bridge and the Newport Transporter bridge. Although the proposals indicate the barrage to be of the partial intrusion type, that is one which will allow the controlled ingress of saline water into the impoundment on certain tides, the possibility that the barrage will be operated as a total exclusion type has not been discounted by the promoters.

The existing estuary is a highly dynamic system throughout its entire length, from the tidal limit near Newbridge-On-Usk to the confluence with the Severn estuary at Newport. Because of the high tidal range in the Usk estuary, the fast tidal currents result in a well mixed, non-stratified body of water displaying a gradual change in salinity from the saline water of the Severn to the fresh water of the Usk river.

Following construction of the barrage, the impounded waters will be transformed into a comparatively stable freshwater lake disturbed only by the freshwater river flow, and perhaps by the controlled intrusion of saline water for short periods during certain tides.

Before any construction can proceed, the developers require the consent of Parliament and, as a start of the constitutional process, a private Bill known as The River Usk Barrage Bill was laid before Parliament in November 1990.

The National Rivers Authority, Welsh Region (NRA) has been in discussion with the Barrage promoters, Newport Borough Council and their consultants, Rendel, Palmer and Tritton, for a considerable period of time, but despite many meetings, the Promoters have failed to satisfy the NRA that all its statutory interests are fully protected.

The purpose of this document is to detail the issues that have yet to be resolved, and describe the basis for the lodging of a petition by the NRA against the construction of the Barrage.

2. FLOOD DEFENCE

2.1 The NRA has a statutory duty to undertake a technical audit of the scheme and ensure that the proposed barrage will neither exacerbate the incidence of flooding in the river upstream, nor result in any reduction of the existing flood defence standards. To ensure this can be achieved, the NRA has stipulated design criteria which, in conjunction with the fact that the existing flooding is partly associated with high tide levels, will minimise the flooding risk.

The design criteria are based upon a combination of tide and hydrological events which combine firstly, a mean annual high tide coinciding with a 1 in 100 year peak river flood and secondly, a 1 in 100 year peak high tide coinciding with a mean annual river flood.

During high tides, when moderate river flows are unable to discharge through the barrage, sufficient storage will be available upstream to store the river flows until the tide falls and discharge through the barrage can take place. At higher river flows discharge over the barrage will occur when the available storage has been used and through the barrage when tide levels allow.

The NRA is satisfied that the design criteria required have been incorporated in the Barrage design.

- 2.2 The hydrodynamics model produced by the promoters has not, however, been separately validated by the NRA. Until this validation has been carried out, the NRA is not prepared to give formal approval to the model and acknowledge that its responsibilities in this respect have been satisfied.
- 2.3 An outstanding issue is the accumulation of river sediments in all reaches of the impoundment and in particular in the upper reaches, where large quantities of river gravels would be expected to accumulate relatively quickly, thereby reducing the hydraulic capacity of the river and its tributaries. In order that this aspect can be resolved to the satisfaction of the NRA, the promoters are required to undertake a study to establish the quantity and rate of this material travelling downstream under various flow conditions. Predictions will then be required on the rate of accumulation at the interface with the impounded waters. Furthermore a commitment to remove this material at the promoter's expense, for the 'foreseeable future' is required.
- 2.4 The effect of the accumulated gravels and sediments on river channels, the passage of migratory fish and the effect on water quality when they are in the process of being physically removed has not been investigated to the satisfaction of the NRA.

3. FISHERIES

The NRA has a statutory responsibility to maintain, improve, and develop salmon, trout, coarse and eel fisheries, and in the Severn and Usk estuaries off Newport also has a sea fisheries responsibility.

The River Usk is a noted salmon river, with a small run of sea trout. Twaite shad, a fish species of notable conservation interest, enter the river in significant numbers to spawn, as do smaller numbers of sea lamprey. Eels migrate through the estuary, which is also utilised by a variety of estuarine and coastal marine species.

The protection of these fish species, particularly the salmon stocks with their associated recreational and commercial fishing interests, is an important factor which has to be considered.

3.1 Passage of migratory fish

The barrage will constitute a major obstruction both to the upstream and downstream passage of migratory fish, including salmon, sea trout, shad, eels and lamprey. Migrating fish will have to negotiate the barrage itself, and also pass through the altered tidal zone downstream and the impounded water upstream. Although the success of fish passage through these river reaches will be principally determined by the water quality achieved, it is probable that the changes in flow regime anticipated as a consequence of the barrage, will affect migration rates, with adverse consequences for both fish survival and catchability.

The promoters have not, as yet, provided the NRA with the information on water quality or flow regimes necessary to permit the effect on fish migration to be fully assessed.

3.2 Fish pass

Any fish pass design will require the approval of the Secretary of State and accordingly the NRA has required the promoters to seek such approval for their proposals which must allow fish migration in both an upstream and downstream direction.

3.2.1. Upstream migration

To enable the upstream passage of fish across the barrage structure, the NRA has stipulated that fish passage facilities must be incorporated in the structure. These facilities should permit the unobstructed passage of salmon, shad and eels.

The promoters have agreed in principle to this requirement, but as yet have failed to produce a fish pass design which satisfies the NRA that salmonids and other species will have an unobstructed passage through the barrier.

3.2.2. Downstream migration

Although some downstream migrants will pass the barrage via the navigation lock or the fish pass, it is envisaged that most fish will pass over the sluice gates with the main water flow. The NRA is concerned that at low tide, such migrating fish will have to fall 10 metres onto energy dissipating baffles covered by only 1.5 metres of water.

The promoters have acknowledged this problem, but have not as yet indicated how it might be solved, nor provided detailed information on the proposed operating regime for the barrage sluices.

3.3 Estuarine and marine fish species

Comparatively little is known about the estuarine and marine fish species utilising the Usk estuary and consequently the NRA has asked the promoters to commission a baseline survey to determine the diversity and significance of these species in the area to be affected by the barrage. The promoters have agreed to this and it is hoped that the study will commence shortly.

Until the results of this survey are known, it is not possible to judge the effect of the barrage on the fish populations or whether such effects could be mitigated.

3.4 Monitoring

If the promoters were able to provide information which satisfied the NRA's concerns outlined above, and also include an acceptable fish-pass design within the barrage, there would remain an element of uncertainty regarding the future success of fish migration. It is therefore essential that a comprehensive monitoring programme is instigated to determine:-

- a) the effectiveness of any measures designed to assist the passage of migratory fish.

b) the extent to which the fisheries are affected by the construction and operation of the barrage, and hence the scale of the mitigation required.

c) the mechanism of any detrimental effects on the fisheries and thereby identify any remedial measures that may be required.

Due to the large annual variations evident in historic salmon catch statistics, and the expected improvements in existing Usk salmon stocks as a result of improved water quality in the estuary and reduced illegal fishing in the sea off Newport, the development of a monitoring programme with sufficient sensitivity to determine the extent of any effect of the barrage on salmon stocks would be extremely complex.

The promoters have not satisfied the NRA that a monitoring programme can be developed which has the capability of adequately determining the effect of the barrage on the salmon fishery.

Similar problems exist with regard to any monitoring programme to assess the effect on other fish populations such as shad.

3.5 Mitigation

Notwithstanding the concerns regarding the ability to monitor accurately any detrimental effects, the NRA is also concerned as to how any effect might be mitigated. The size of the natural salmon run in the river Usk is such that even a small reduction caused by the barrage would be difficult to mitigate by restocking; for each 1% decline in the native fish stocks caused by the barrage, in excess of 10,000 hatchery-reared smolts may need to be stocked annually. Such a programme would require strict management to ensure that the genetic composition of the native fish stocks would not be deleteriously affected. It is not clear that mitigation by restocking would be practical if a large reduction in the salmon run occurred or indeed if the shad population were reduced.

In relation to damage to the river Usk fishery, the NRA is particularly concerned about the effect on fish stocks during the period when the extent of the damage is being assessed, and also during any subsequent period during which the barrage structures or modes of operation are altered to try and reduce the damage.

The promoters have not demonstrated to the satisfaction of the NRA that effective mitigation measures could be employed to compensate for any effect of the barrage on fish stocks.

The barrage proposals cause concern for the protection of fisheries in relation to several significant issues itemised above. In view of the NRA'S responsibility to maintain, improve and develop fisheries it has no alternative but to petition against the Barrage Bill until protection of the Usk fisheries is assured.

4. CONSERVATION

Under the Water Act 1989, the NRA assumed the responsibility to further conservation in the riverine environment. The major conservation impact of the barrage proposals is upon fish species and those fish-eating birds and mammals which feed upon migratory fish in the upper reaches of the river.

Unless the promoters have fully addressed the fisheries issues itemised above, the Authority cannot be satisfied that the conservation interests in the river upstream have been adequately protected.

5. WATER QUALITY

The NRA has a responsibility to maintain and improve the quality of the aquatic environment. The proposed barrage will result in a fundamental change in the existing water quality regime of the estuary and in order to ensure that its responsibilities are complied with, the Authority has formulated quality standards to ensure that adequate protection is afforded to the water in both the estuary downstream of the barrage, and the impounded water behind the barrage for both the total exclusion and partial intrusion scenarios.

These quality standards are intended to ensure achievement of the objectives which are generally applied by the NRA to all waters. The key objectives in this instance are:-

- i) **Basic Amenity** - The need to ensure that the waters are visually acceptable to allow man's enjoyment of the aquatic environment.
- ii) **General Ecosystem** - Ensure conditions are such that an ecological balance can be achieved both upstream and downstream of the proposed barrage.
- iii) **Migratory Fish** - To ensure that water quality is maintained to allow the free migration of fish passing both upstream and downstream of the barrage.

5.1 There are many interacting processes which will affect water quality in both the existing estuary and in the changed water regime post-barrage construction. These interacting processes are very complicated and in order to understand them, and predict what are likely to be the water quality conditions after the barrage is constructed computer models are being developed by the promoters.

5.1.1 The mathematical models required to describe the hydrodynamics, sedimentation and water quality aspects of the proposals will each be separately scrutinised by the NRA to ensure that they have been correctly calibrated and properly validated and are therefore able to predict conditions in both the pre- and post- barrage scenarios.

5.1.2 The appropriate modelling techniques and the type of mathematical model that are to be used have both been approved by the NRA, but the first water quality reports issued last year were rejected both by the promoters and the NRA due to unsatisfactory model calibration.

5.2 The models that are being developed must address the processes summarised below in order that solutions can be found to any unacceptable water quality conditions predicted.

5.2.1 Sedimentation - The existing high tidal range produces strong currents throughout the estuary resulting in the regular resuspension of river sediments causing the characteristic muddy appearance of the Estuary. If the barrage is constructed, the reduced current upstream will allow suspended solids to settle and the water will become clearer. However, the smaller volume of water flowing in and out of the estuary downstream of the barrage will result in reduced scouring and increase the potential for a build-up of mud. To prevent this becoming a problem, the Promoters have proposed that sea water be allowed into the barrage and subsequently released to increase the scouring of accumulated silt.

The introduction of saline water into the barrage will lead to stratification in the water body. These conditions could result in the depletion of the dissolved oxygen content of the water which if uncontrolled could result in an anoxic lower water layer.

Furthermore, the effect of the sediments on water quality when they are resuspended below the barrage requires investigation so that water quality standards in the estuary are maintained.

The sedimentation model required to predict both the sedimentation rates and the effect on water quality has not been completed and therefore the NRA has not been assured that problems as described above will not occur.

5.2.2 Algae - Clearer water upstream of the barrage will allow greater light penetration through the water and, with a supply of nutrients from the river, upstream effluent discharges and other sources, there may be the opportunity for algal blooms to develop. During a bloom the water may become green blue or brown and very turbid. Some species of algae float and can produce thick scum. Some blue green species can produce toxins when they decay.

Although the NRA has not set quality objectives to control this aspect, the promoters have as yet been unable to supply sufficient information to indicate whether conditions are such that any algal blooms can be controlled.

The potential for the generation of algal blooms is, in part, dependent upon the quantities of nutrient present. Until such time that the NRA has been provided with predictions relating to the quality of the waters behind the barrage, it is unable to determine whether any mitigation measures are necessary.

5.2.3 Dissolved Oxygen - Oxygen, which is dissolved in the water column, originates from atmospheric input, the river and from the seawater. It must be maintained above a certain critical level to support the passage of migratory fish through the estuary and to sustain the resident fish populations. At very low oxygen levels the estuary would support few living organisms and could even become a nuisance because of smell.

The degradation of organic substances dissolved or suspended in the water, originating mainly from the sewage effluent inputs, the river, the seawater, and resuspended muds all exert a demand on the dissolved oxygen.

If the barrage is built, the comparatively still water upstream may experience lower dissolved oxygen levels because of the reduced mixing and increased residence time behind the barrage. Even when the crude sewage inputs are removed, oxygen demands will still be experienced from the remaining treated sewage effluents, the river and the sea water. Additional demands may also arise from time to time from dying algae in the bottom waters of the impoundment and nocturnal respiration of algae in the surface waters. The NRA will have to be satisfied that the stipulated dissolved oxygen levels will be maintained at all times.

The mathematical model required to describe the existing estuary and predict water quality conditions upstream and downstream of the barrage is heavily dependent upon inputs from the hydrodynamics and sedimentation models.

Because these models have not yet been calibrated and validated, the NRA has not been convinced that the quality standards required in both the upstream impoundment and the estuary downstream of the barrage can be achieved and maintained.

5.2.4 Sewage - the NRA is responsible for consenting all discharges to the estuary and has insisted that the existing crude sewage discharges above the proposed barrage will have to be removed to prevent aesthetic and water quality problems developing. Their removal is essential to ensure the achievement of specified water quality standards. The current proposal involves collecting the crude sewage discharges and conveying them through a new sewerage system to the Nash STW where they will receive the necessary degree of treatment. The NRA will stipulate consent conditions such that the quality of the receiving waters, upstream and downstream of the barrage, are safeguarded.

The existing sewage effluent discharge from Ponthir sewage works will continue, but may require improved treatment.

Storm sewage outlets may remain upstream and downstream of the barrage. It is envisaged that these discharges will occur relatively infrequently, and will only discharge dilute, fully screened sewage effluent during storm conditions. However the NRA has stipulated that an hydraulic analysis of the sewerage network will be required in order to assess the impact of these intermittent overflows. This work has not been presented to or approved by the NRA.

5.2.5 Salinity - The existing estuary is well mixed, due to the high current velocities, and there is a gradual change from saltwater to freshwater conditions moving up the estuary. If the barrage is constructed there will be an abrupt change from salt to freshwater at the barrage. This change may be modified both by the intrusion of sea water to facilitate downstream flushing, and when the lock gates are operated. Freshwater river flows will also affect the degree of mixing. Saltwater, being more dense than freshwater, will tend to sink to the bottom upstream of the barrage and may produce stratification. As mentioned earlier, this can result in anoxic conditions in the lower layer if the saltwater is not flushed out from behind the barrage quickly.

The ecology of the upstream impoundment will be highly sensitive to sudden changes in salinity. It will therefore be essential, if a partial exclusion option is preferred, that conditions behind the barrage are maintained within tolerable limits so that a balanced ecosystem can develop.

5.2.6 Microbiological Quality - Bacteria and other microbiological organisms of natural and sewage origin exist in the river, estuary and seawater. The die-off rate is governed by three main factors, suspended solids, salinity and ultra-violet rays from the sun. They will survive longer in freshwater but the increased penetration of sunlight expected upstream of the barrage could offset this.

The bacteriological quality of the waters behind the barrage will partly determine the recreational and other uses to which these waters can be put. The NRA has no statutory responsibility in matters relating to public health and it will be for the Environmental Health Department of Newport Borough Council to determine the significance of the microbiological concentrations expected behind the barrage in relation to the proposed uses of the water.

5.2.7 Other Effluents - Several other effluents discharge to the estuary downstream of the proposed barrage and because of the reduced volume of seawater which will flow in and out of the estuary, the NRA may require improvements to the degree of treatment given to these discharges.

5.3 Although further investigation and modelling work has been carried out by the promoters to refine the various models, the completed versions are not available and therefore cannot be separately validated by the NRA.

5.3.1 The following information is required in order to assess the barrage proposal.

5.3.1.1. Pre-barrage (Hydrodynamic Model)

Validation of the existing situation and post-barrage confirmation that preset design criteria can be achieved.

5.3.1.2. Pre-barrage (Water quality/sediments)

The NRA require detailed information on all inputs collated for the model and be satisfied that it is fully calibrated and validated such that it can accurately predict existing conditions in the estuary. All assumptions made in this consultation/validation process must be capable of scientific and technical justification.

5.3.1.3. Post-Barrage (Upstream)

The NRA require full details of the model used to predict post-barrage conditions.

The difficulty in validating the model is recognised, but supporting information must be presented to justify the physics and the processes used in the model to predict those parameters of concern to the NRA.

5.3.1.4. Post-Barrage (Downstream)

Downstream conditions post-barrage are of equal concern to the NRA.

The impact on the tidal Usk must be fully assessed and the techniques used to predict conditions downstream of the barrage fully justified.

- 5.4 The NRA require to view summary and technical reports presenting the information requested above on a staged basis, i.e. no approval for later stages can be given until each stage has been fully assessed and approved in turn.

Because of the lack of technical information from the promoters, none of the models has received approval and therefore at present the NRA has not been assured that the water quality standards that have been stipulated can be achieved and that all its concerns have been effectively addressed.

6. CONCLUSIONS

The promoters have so far failed to demonstrate, on a number of fundamental issues, that the construction of a barrage across the Usk estuary will not adversely affect the statutory responsibilities of the NRA in respect of both the protection of the environment and the uses made of the waters affected by the proposals.

In view of this it is recommended that the NRA petitions against the Usk Barrage Bill and maintains opposition until such time that its statutory interests are shown to be adequately protected and its concerns satisfied.