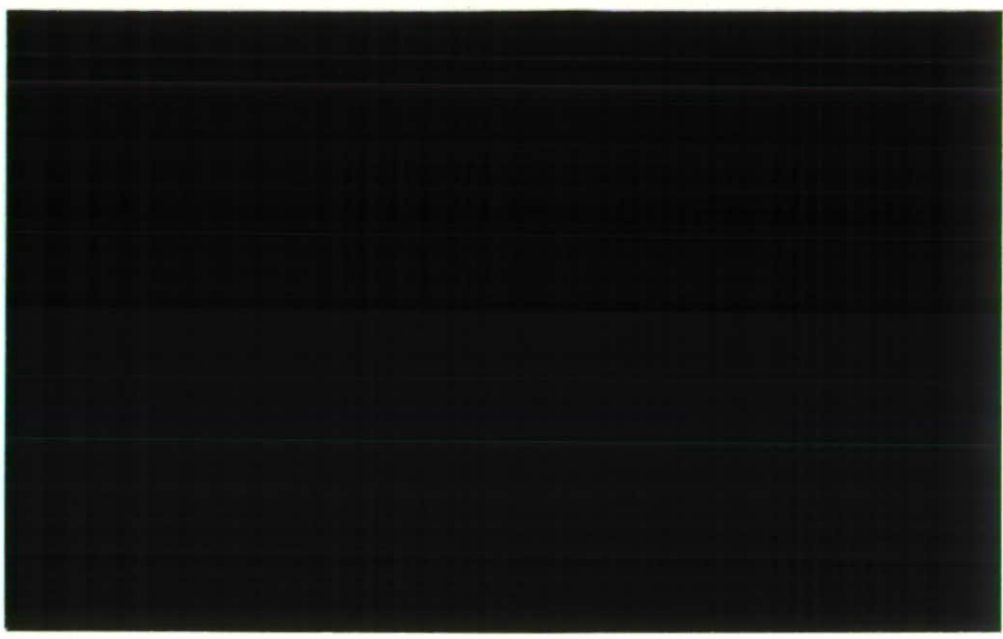


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**HYDROLOGICAL IMPACTS OF  
PROPOSED DRAINAGE IMPROVEMENT  
AT ARTHOG BOG SSSI, GWYNEDD**

**Report to Countryside Council For Wales**

**CCW Contract Report No. 45**

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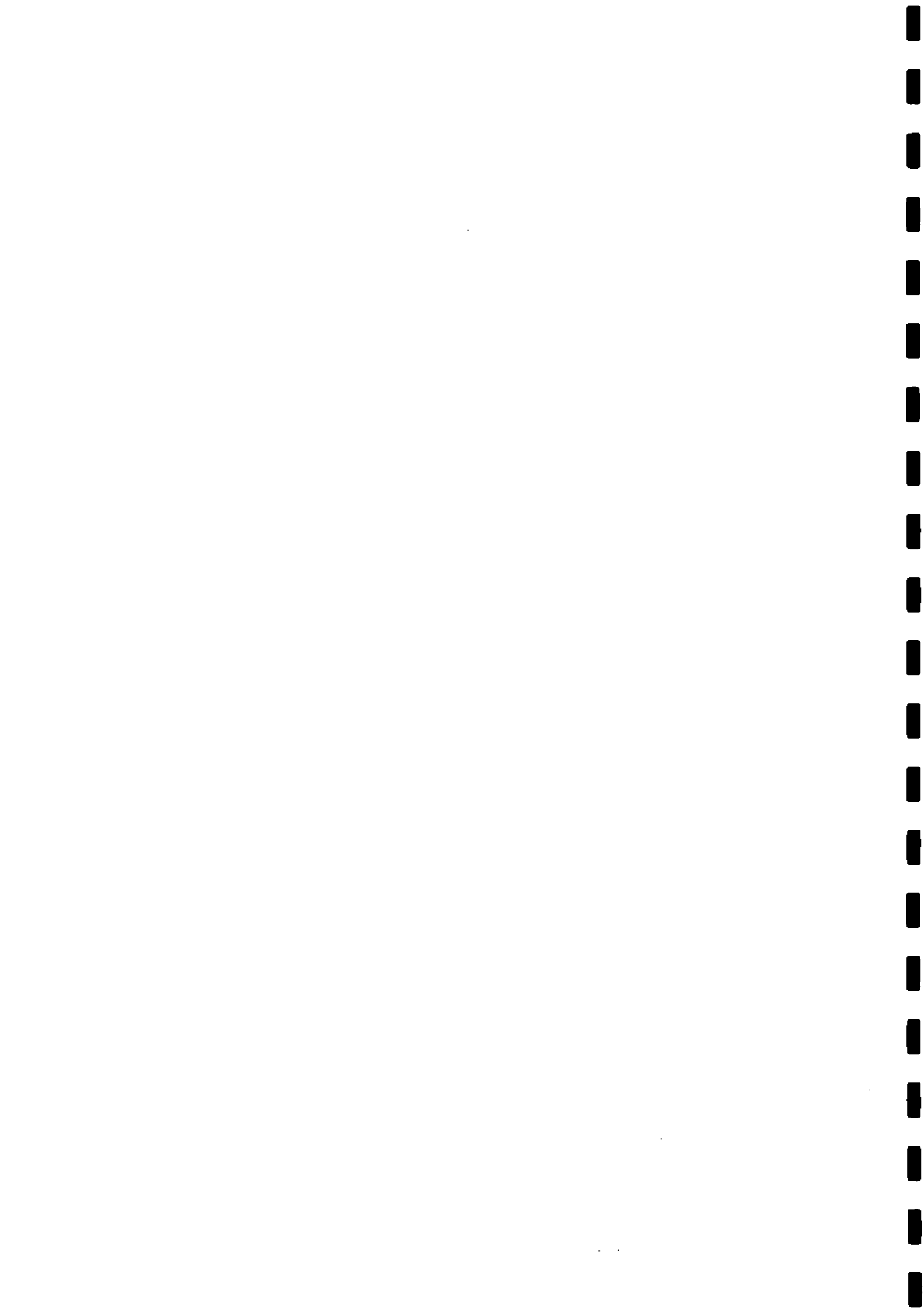
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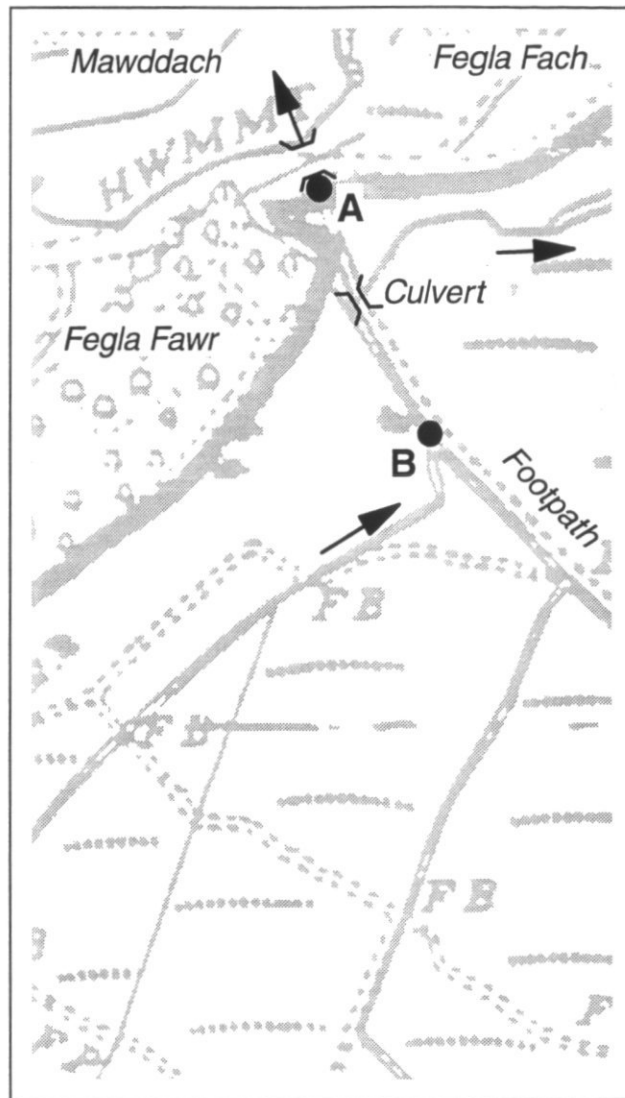
**January 1995**



## Background

Arthog Bog SSSI (SH 633145) is a remnant of a formerly more extensive raised mire on flat land adjoining the Mawddach estuary. The bog has been much modified by the construction of the now disused Morfa Mawddach to Dolgellau railway, by peat cutting and by partially successful attempts at drainage for agricultural improvement. Some areas of peat cuttings, and residual, possibly uncut, parts of the core of the raised mire retain bog vegetation.

The drainage of the mire is complicated, relating at least partly to its division into four landholdings, and it is suspected that the direction of flow of ditches depends to a degree on their state of maintenance. The main outfall point is at the north-eastern corner of the SSSI, near the site of Arthog railway station, where there is a large tidal flap structure leading into the Afon Arthog, but there is a small outfall into the Mawddach between the rocky hillocks Fegla Fawr and Fegla Fach (Figure 1).

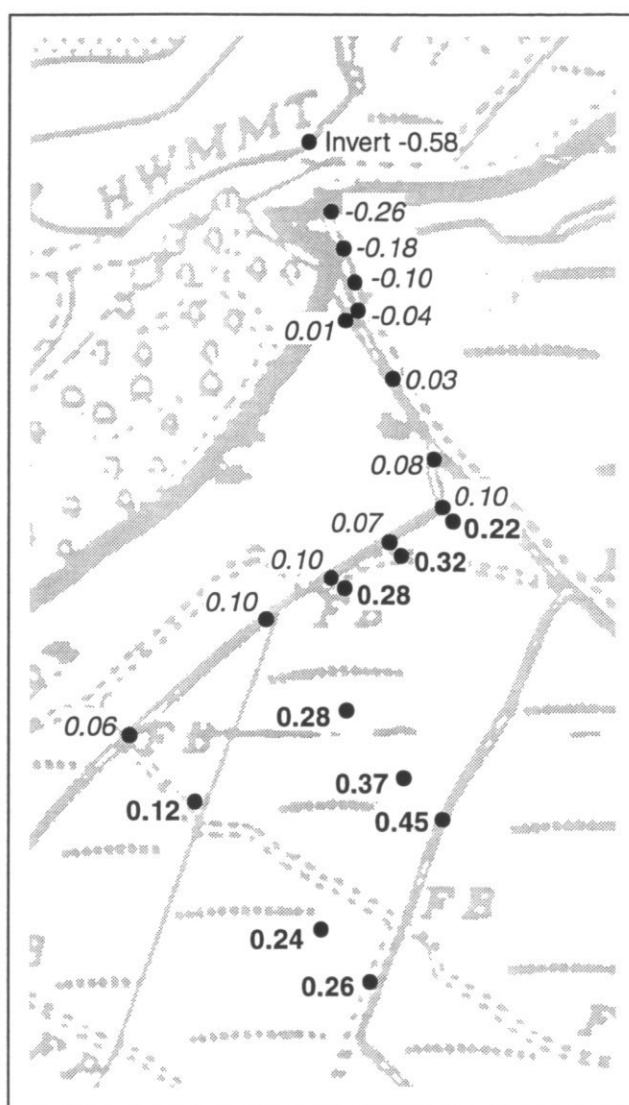


**Figure 1** Arthog Bog in the vicinity of the Mawddach outfall. The SSSI boundary (bold line) follows the edge of Fegla Fawr and Fegla Fach, and the outfall is at grid reference SH 63331494. The ditch apparently draining from the culvert to the east is no longer in operation, having been superseded by the connection to the outfall.

The largest single landholding belongs to Miss Roberts of Fegla Fawr, and the Mawddach outfall drains an area of pasture immediately to the east of Fegla Fawr farm. A proposal has been made to deepen a length of ditch leading to the outfall, between points A and B (Figure 1). A levelling survey was carried out by the Institute of Hydrology on 11 and 14 October 1994, to determine the impact of this work on the core interest of the SSSI.

### Drainage upstream of the Mawddach outfall

The ditch AB runs alongside the public footpath crossing the bog, and roughly half way between A and B there is a culvert beneath the footpath taking flow from the west side of the path to the east. The Mawddach outfall, which passes through the sea wall, mostly drains land to the south and west of the path: at a distance of less than 50 m to the east of the footpath, drainage is towards an arterial ditch leading eastwards towards the Afon Arthog tidal flap.



*Figure 2* Levelling survey - bold text indicates ground levels, italics indicate water levels, and all levels are in m relative to an arbitrary datum 0.50 m below the top of the roof slab of the footpath culvert.

The survey, carried out using Electronic Distance Measurement equipment mounted on a theodolite, indicated that there was no measurable fall for 170 m upstream of point B, as far as the footbridge, a fall of 5 cm through the culvert and a fall of 54 cm between the eastern end of the culvert and the invert of the tidal flap outfall at point A (Figure 2). The reasons for the steepness of section AB are not difficult to determine: the ditch downstream of the culvert is narrow and crowded by salallows, and immediately downstream of the culvert silt deposition in a channel choked by growth of vegetation has caused the ditch to spread over the ground surface.

It was not possible to make a detailed examination of the condition of the culvert beneath the path, but it appears to be roofed with large flat stones, and may be of stone or concrete. The construction of the stone bed of the footpath suggests that the culvert is well-built and ought not to be disturbed by any ditch maintenance. The upper end of the outfall through the sea wall (which is taken to be point A) is a control point limiting any deepening of the ditch AB, and the proposed works would lower the water level at point B by at most 36 cm. This lower water level would obtain at conditions of low flow and low tide: immediately upstream of the sea wall, silt marks indicate that the drainage ditch has a range of water levels of about 40 cm, possibly owing to leakage of seawater through the tidal flap, build-up of freshwater at high tide, and high flows in response to rainfall events on the bog.

A visual inspection of the southern and western perimeter of the SSSI confirmed that the largest flow of drainage water, which also presumably includes runoff from the hills above the main road, was along the south arterial drain on the landward side of the railway towards the Arthog Station tidal flap. At SH 635142 there is a large well-maintained ditch draining southwards under the railway into the arterial drain. The northern extension of this ditch, at SH 33143, is recorded on the 1:10560 map as flowing northwards, but it was mapped by Newson (1982) as south-flowing (towards the railway). The inclusion of this ditch in the catchment of the south arterial drain confirms the southern boundary of the possible drainage area of the Mawddach outfall, and another of Newson's southward-flowing drains, along the western edge of the SSSI at SH 631143, due east of Barmouth Junction Station, indicates that the southernmost point draining towards the Mawddach outfall is around 100 m south of Fegla Fawr Farm, or about 400 m upstream of point B.

## **Conclusions**

Viewed from the position of the landowner, the proposed drainage improvement between points A and B amounts to overdue maintenance of an existing drain, removing the build-up of silt and vegetation that has reduced the efficiency of the system. There are two points which probably limit the extent of any resulting fall in water levels: the outfall pipe through the sea wall, whose invert acts as a base level for the system, and the culvert under the footpath. Because of tide-locking, there is almost certainly no reason to change the invert level of the estuary outfall. The culvert under the path could probably be cleaned out or reconstructed to provide an invert level about 30 cm below the present water level, and this, combined with the cleaning of section AB of the ditch, would lower the summer water level at B by up to 36 cm. Winter water levels would be controlled by rainfall on the bog, tide-locking and high freshwater flows in the Mawddach, but some improvement of soil conditions in the pasture adjoining the drains upstream could be expected, and the obvious flooding in the north-eastern corner of the field near to the culvert would be removed.

The raised mire in the core of the SSSI is protected from dehydration by the poor condition and low gradient of drains across the mire, and drainage improvement does constitute a threat. Nevertheless, if the ditch is left to silt up there will be flooding of the land to the west of the footpath and eventually across the footpath, and it is probable that a limited lowering of the drain water levels upstream of point B would have little direct impact on the core area of the mire. The present condition of the ditch AB is not suitable for water level control within the SSSI, either for conservation or for pastoral use, and it should not be allowed to deteriorate further. It is therefore recommended that

- (1) a limited amount of maintenance should be carried out, i.e. cleaning out the section AB to a depth of up to 75 cm below the present water level, with the footpath culvert being cleared either to 50 cm below water level or to its invert.

Upstream of point B the drain is reasonably well-defined but partially blocked by vegetation. In the event of deepening of section AB, and without further clearance of the drain upstream of B, the lowering of water levels would probably be dissipated over a length of 100 m or so except in summer. It is to be expected therefore that a proposal to carry out maintenance of this section would follow closely behind the works on section AB. The greatest danger to the central mire area is excessive lowering of water levels in summer, which would be a consequence of an extensive improvement of the drainage system. It is recommended that:

- (2) any improvement of the channel capacity of the drain upstream of point B to cope with winter flows should be mitigated in summer by the installation of a stoplog weir at or near to the footpath culvert, which would retain water levels no lower than 20 cm below present levels in the summer and be sufficiently wide (2 m or more) to permit free movement of stormwater in winter.

The longer term implications of Miss Roberts' proposal depend largely on whether there is any intention to extend the benefits of lower water levels along the south-eastern edge of Fegla Fawr into the core of the SSSI. The straight ditch upstream of point B, if cleared of vegetation and discharging to an improved section AB, would provide a suitable outfall for improved drainage in the core area to the south, subject to the limited capacity of the estuary outfall, and there would inevitably be some lowering of the water table within cutover areas or areas drained by shallow grips. It is recommended that:

- (3) in the interests of the conservation of the central core of the bog, proposals for the maintenance or deepening of ditches draining into the section upstream of point B, up to a distance of 300 m from B, should be examined critically and considered likely to cause damage to the remnant mire communities. In particular, any connection between drains and the core area of the mire, whether through old grips, natural water tracks or ditches, should be closed off by tipping and compacting ditch spoil to create a raised bank between the drain and the centre of the mire.

## Reference

Newson, M.D. (1982) Arthog Bog SSSI - hydrological comments on the drainage threat, Report to Nature Conservancy Council.