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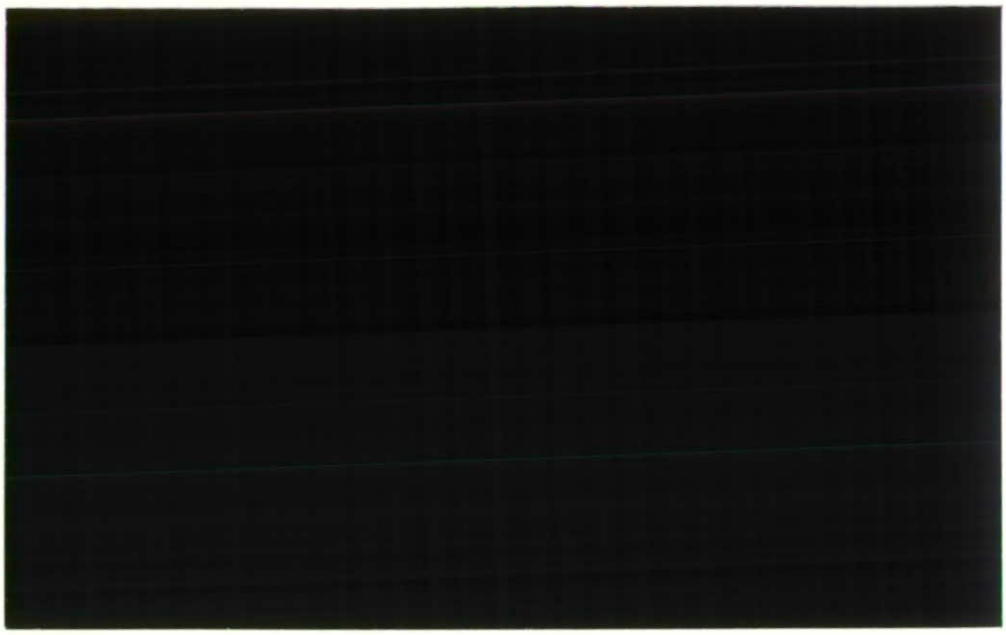

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Natural Environment Research Council

Terrestrial and Freshwater Sciences

ASSESSMENT OF HYDROLOGICAL IMPACTS OF PROPOSED BORROW PIT AT SALBRI MIRE, ANGLESEY

Report to S G S Environment

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Background

The mire at Salbri (OS grid reference SH 373888), in the north-west tip of Anglesey, occupies a basin near the interfluve between northward-flowing tributaries of the Afon Wygyr and southwest-flowing tributaries of the Afon Alaw. Salbri Mire was designated by the Nature Conservancy Council as a Site of Special Scientific Interest (SSSI), as one of very few unmodified basin mires in the region. Although improvements to the outlet channel have taken place, the mire does not appear to have been dewatered, and there is some evidence to suggest that water levels have risen within the last century.

It is proposed to use stone from the ridge of South Stack Series pre-Cambrian sedimentary rocks, which forms the southern boundary of the site, in the production of road material. The proposed borrow pit, of an areal extent of about 0.82 ha and a depth of 5 m, would approach to about 20 m from the edge of the SSSI.

The Institute of Hydrology (IH) was approached to provide a hydrological assessment of the likely impact of the development on the mire, and a site visit was made on 29 November 1994.

The hydrology of Salbri Mire

The oligotrophic community present in the centre of the mire suggests that direct rainfall is an important contributor to the water budget of the site, with catchment runoff playing a minor part in the water budget but a possibly major role in maintaining high water levels throughout the year, thus preventing excessive drawdown in dry summers. The vegetation community is not consistent with a large input of groundwater to the site.

The topographic catchment of the mire (Figure 1) is defined by a series of rocky bosses that surround the site to the south and east, but it also includes a relatively large area of pasture land rising towards the west, reaching its highest point near Creigiau Mawr. The hour-glass shape of the topographic catchment derived from close examination of the contour map was confirmed by visual examination, and by walking part of the boundary on the site visit. The total catchment area of the outlet from the mire is 11.4 ha, which should be compared with the SSSI area of 3 ha.

The annual rainfall (1941-1970 average) at Llwydiarth Esgob, 7.5 km to the south-east of the site, is 1016 mm. Llwydiarth Esgob is at a similar altitude (61 m) to Salbri, but there is an increase in rainfall from west to east owing to orographic effects, and the rainfall at Salbri could be as low as 950 mm. The long-term average of potential evaporation, taken from the Meteorological Office's MORECS estimate from 1961 to 1992 for 40-km square 102, is 617 mm. There is thus a healthy excess of rainfall over evaporation on an annual timescale, though the behaviour of the water table in the mire during any given summer will depend on the seasonal pattern of rainfall as well as the annual total.

The central part of the mire consists of a floating mat of vegetation, and this will exert a further stabilising influence on water availability to the plant community, in that any temporary decline in the absolute water level will be accompanied by a change in "ground" level, so that there will be little or no change in the water level relative to the vegetation mat.

The floating mat also helps to eliminate competition from woody species, and is a feature of the site that should be preserved by careful monitoring and maintenance of the water level.

At the extreme north of the site there is a stone wall crossing the mire, and this and the remnants of another wall extending out into the mire to the vicinity of sampling station 6 suggest that water levels in the mire may have risen over time, perhaps as a consequence of the declining condition of the artificial outlet ditch. The site may have a history of significant changes in water level: a lowering of levels caused by the excavation of the ditch, followed by the enclosure of marginal land, which then reverted to peripheral marsh as the ditch silted up.

On the site visit, pH and electrical conductivity of standing and running water were determined at 13 points around the edge of the mire (see Figure 1 for numbered sampling stations). The values obtained are presented in the Table.

Table 1 *pH and conductivity measurements, 29 November 1994*

Station	Easting	Northing	pH	Conductivity µS/cm
1	3735	8892	4.80	166
2	3741	8896	5.02	147
3	3742	8894	5.23	220
4	3740	8889	5.16	275
5	3740	8886	5.17	319
6	3740	8883	5.10	278
7	3744	8900	5.03	148
8	3745	8880	5.54	383
9	3727	8884	5.04	173
10	3725	8889	5.32	186
11	3734	8881	4.85	135
12	3736	8881	3.61	144
13	3740	8879	4.45	112

Both conductivity and pH data support the initial classification of Salbri as an acidic mire, with no obvious point groundwater input. Figure 2 shows contour plots of both determinands, with sampling stations and the SSSI boundary also plotted. It should be noted that the lack of sampling stations in the centre of the mire gives little control of contours in the central region, but it is possible to draw two interesting conclusions from the results:

i) there is an area of low pH near the southern margin of the SSSI, and areas of quite high pH to the east and west of the site

ii) the low pH area is also picked out by conductivity measurement, and there is water of higher conductivity along the eastern edge of the site.

The higher conductivity water is probably associated with grazing and poaching by cattle which approach the mire from the higher ground here. There is no high conductivity water along the southern edge that might indicate significant groundwater inputs.

Landform of the surface water catchment

The proposed borrow pit is intended to lie outside the topographic catchment area, but it lies within the region of very irregular land surface defined by rock bosses, and it was important to make a careful examination of the landform, and any other signs of water movement, in this area.

The vertical rockface overlooking the mire from the south is dissected by a number of southwest-northeast dry valleys, floored with soil of the brown-earth type. Each of these channels has a humped profile, sloping towards the mire from a line between 18 and 30 m from the edge of the SSSI. On the day of the visit, water standing in hoofmarks in poached soil at the foot of the rock face and at the northern end of two of the dry valleys showed a consistent tendency to fall in level towards the mire, suggesting that there might be some flow of water from the upland area towards the mire through the loamy soil, but there was no sign of the development of channelised flow along the valleys.

Examination of rock faces throughout the borrow pit area failed to disclose any significant groundwater flow, though there were a couple of instances of local seepage emerging from vertical fissures.

Impact of proposed borrow pit

The hydrological impacts of the borrow pit operation could be:

i) disturbance of the topographic catchment, resulting in a loss of water supply to the southern edge of the site

ii) derogation of the quality of water reaching the site by seepage and runoff from the quarried area or disturbed soils

iii) interception of groundwater flow towards the site, or in extreme cases the dewatering of the site by induced groundwater flow towards the quarry

iv) disturbance of hydrogeological units (e.g. less permeable silts underlying the peat) by blasting.

It is considered that groundwater flow through the bedrock is not an important feature of this site, and that the excess surface water reaching the site from the topographic catchment to east and west of the mire is adequate to maintain water levels if there were any loss of groundwater to the quarry.

The mire is not perched, i.e. it is not isolated by an impermeable or slowly permeable horizon from an underlying aquifer with a lower piezometric head. It is also understood that the floor of the borrow pit will remain above the level of the mire. The risk of disturbance of the hydrology of the site by the effects of blasting is therefore minimal, though of course the

oligotrophic plant communities of the mire would be affected by the deposition of airborne dust from quarrying or crushing operations.

The first two impacts must be taken seriously, and the borrow pit carefully positioned to avoid impinging on the topographic catchment. Loss of a small part of the catchment area is not considered important to the water budget, though flows of water across the mire could be changed by alteration of the water budget on a very local scale: the more significant impact of excavation within the catchment would be the release of silt and bases into the more acidic and base-poor area of the mire close to the southern boundary.

Recommendations

The borrow pit as indicated on the map dated November 1994 (see Figure 1) appears to cross the catchment boundary at its north-eastern corner. The pit should be re-positioned so that its northern edge falls at least 10 m outside the topographic catchment of the mire. This is particularly important in the dry valleys, and it is recommended that the delineation of the catchment boundary carried out as part of this study should be confirmed for each of the dry valleys by a levelling survey to find the highest point in the profile of each valley and mark it on the ground before the final outline for the borrow pit is decided.

This study has shown that the mire is in receipt of surface water from agricultural land, and inputs of nutrients are especially to be expected at the eastern edge, where cattle were seen to be grazing in close proximity to standing water in hydraulic connection with the mire. An area of about 5 ha to the west of the site also drains into the mire, and this area of shallow soils appears to carry improved pasture grazed by sheep. It is recommended that, in the long term, the mire should be watched for changes in flora brought about by nutrient enrichment.

The water level of the mire is controlled by the condition of the outlet drain. Although the maintenance or deepening of this ditch is included in the list of potentially damaging operations for the SSSI, it is recommended that the measurements of water level on the staff gauge at the northern end of the mire should be kept under regular review, and that in the event of a non-seasonal decline in water levels, steps should be taken to safeguard the mire by installing a control structure on the drain.

Figure 1

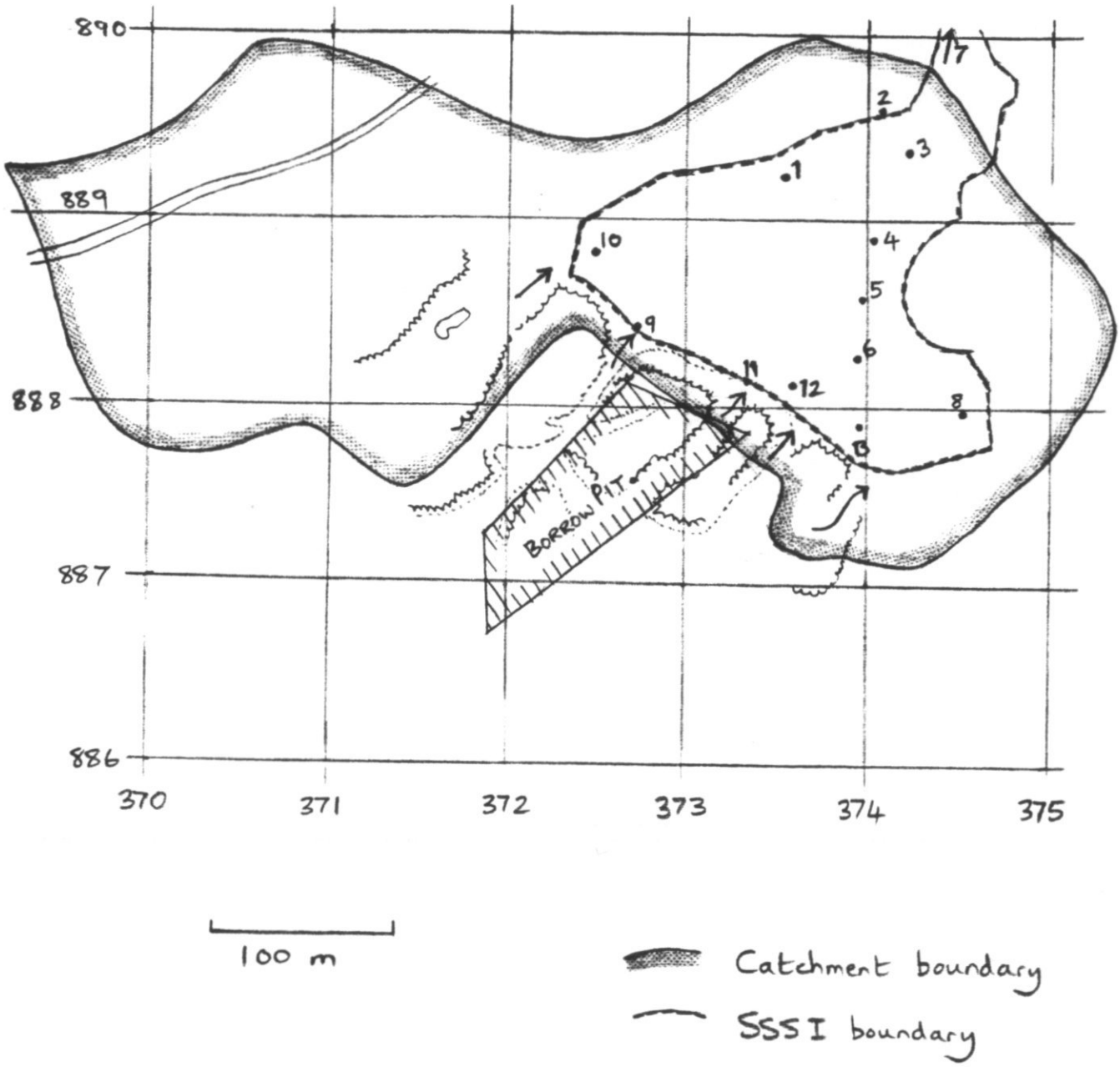
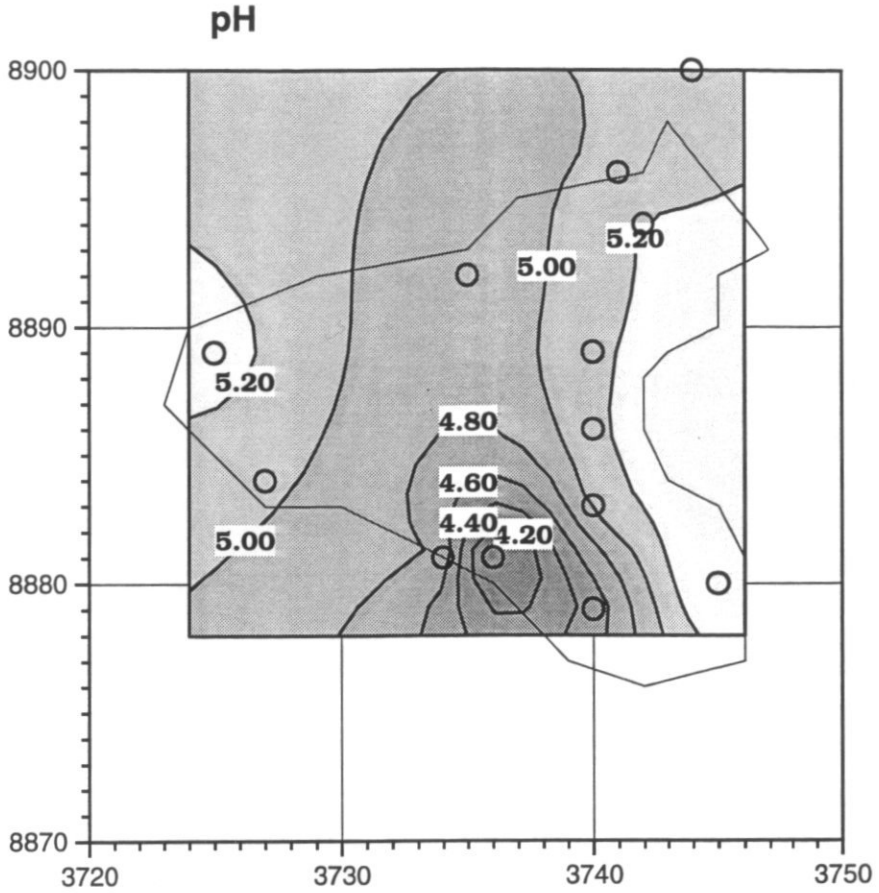
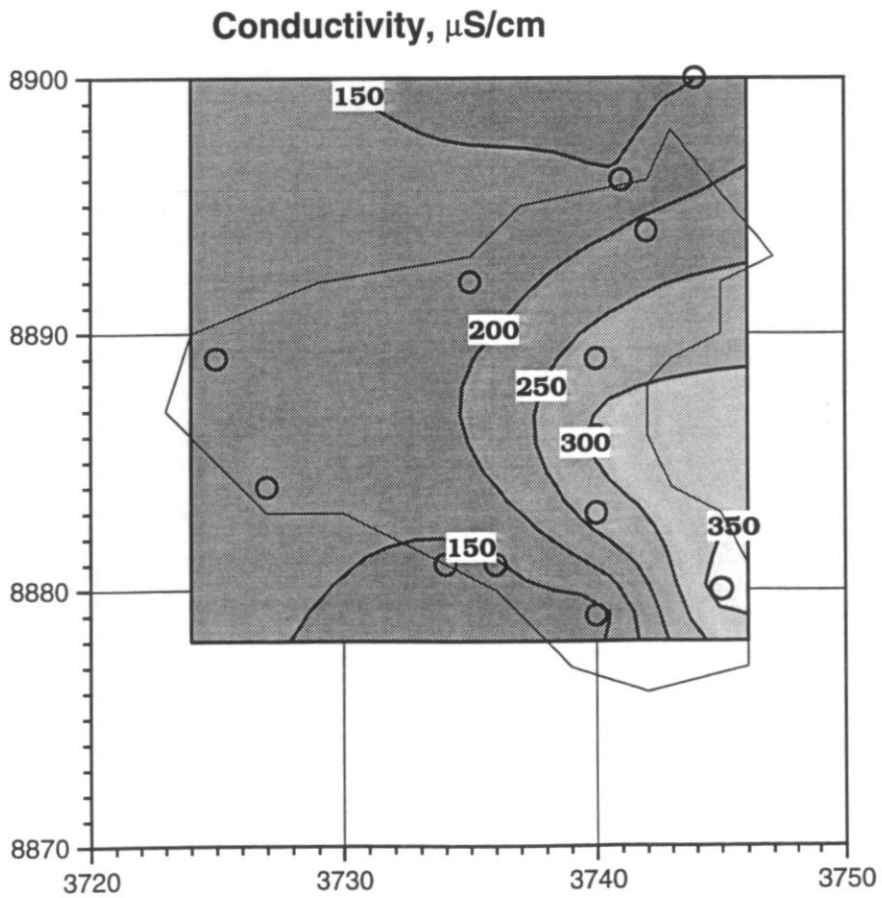


Figure 1 *Location plan. Five dry valleys draining towards the southern edge of the mire are indicated by arrows.*

Figure 2



(a)



(b)

Figure 2 *(a) pH and (b) conductivity measurements. Circles indicate sample stations.*