LOWLAND RAISED MIRE SURVEY AND MONITORING - STARTING FROM SCRATCH

A case study from Fenn's and Whixall and Bettisfield Mosses

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1. Principles for survey and monitoring any site

Any management plan for the site should define, in its management plan objectives, exactly what is going to be done to the site; this is likely to be standard for most lowland raised mire rehabilitation sites, viz. unsuitable vegetation off, water up, visitors to a defined level. Defining which important changes are expected for the site will inform the manager of what will have to be surveyed and monitored in order to know the degree to which management has been successful. Substantial re-examination and updating of the plan in the light of further site knowledge should be carried out when determining survey and monitoring priorities.

1.1 Why do any surveys or monitoring at all ? - *the ammunition theory.*

There are three main reasons for collecting data: LEGAL ORGANISATIONAL PR

a) LEGAL - to counter prosecutions, evidence for Agricultural Land Tribunals, or for refuting allegations that you are breaking terms of your lease or management agreement.

b) ORGANISATIONAL - to show you have given value for money (particularly when asking for more resources). Clearly this will vary, dependent upon the nature of the organisation. Are birds, dragonflies, or number of school parties the most important item to monitor?

c) PR - manipulating water-levels is a very emotive subject with neighbouring communities. Managers must be well informed to be able to counter inevitable flack, that will arise from '*killing trees and drowning butterflies*'. The will to communicate achievements also falls here.

1.2 Degree of survey or monitoring.

To gather ammunition for any of the above reasons, a choice must be made as to the intensity of work.

MINIMAL what you must be able to say.

AVERAGE what you should be able to say.

MAXIMAL what you would like to be able to say.

1.3 Planning the work.

List out all of the questions that will require answers and the potential answers. This will illustrate the data required. No data should be collected unless the storage and analysis systems have been determined to ensure that the manager can continually and easily analyse what the data is demonstrating.

Do not confuse what to do with how to do it -' what' is a matter of requirement, 'how' - is a matter of resources.

1.4 Base-line surveys are invaluable.

Don't miss them - you only get one chance to do them.

There is always a conflict between building up a good record of base-line data and having to rush ahead with management before resources disappear or the site deteriorates even more. However such surveys are essential to proving the effectiveness of management works. Bear in mind that, management works can take longer than expected to cover the whole site, giving unexpected survey time .

2. Survey and monitoring work at Fenn's and Whixall Mosses

The management plan objectives for the site require that the following aspects of the site should be assessed:

2.1 Hardware audit

Annual and more regular documented checks of all paths, signs, route markers, boundary structure, dangerous trees etc.

2.2 Plant and machinery service records

Daily and long-term service records are essential for HSE requirements together with routine updates on Reserve Safety Statements and Risk Assessments

2.3 Extents of habitats

Various photographic methods are being employed including vertical black and white 1:10 000 surveys and fixed point ground stereo photographic pairs and colour transparency pairs. The most useful has proved to be oblique colour aerial photographs as the Moss is very accurately gridded out by the previous peat cutting patterns. The aerial photographs require contemporaneous ground verification: the ground photography only conveys the structure of major vegetation components.

A base-line ground survey of subjective percentage cover of major vegetation components has proved to be very useful in determining management priorities and verifying vertical aerial photographs. The results are currently only expressed as a series of maps of distribution of different cover percentages of individual species but they convey management issues well.

2.4 Floristic assessments

Higher plants have been monitored in replicated 1 x 1 m permanent quadrats, established in two replicated areas of each of the four peat-cutting types present on the Moss: uncut, hand-cut, recent commercially cut and old commercial cuttings. They cover different aspects of the cut structure, such as ditches, low areas and peat baulks. 0.5 m quadrats divided into 10 x 10 cm portions, as used on less damaged sites, were not used because of the scale of current vegetation, particularly Molinia and Betula. Stereo photographic coverage of the quadrats was taken but no analysis has yet been made.

This has given a detailed base-line survey from which subsequent monitoring can be chosen. Some repeat monitoring will have to be deferred for many years where flooding has occurred.

Mosses have been monitored using a base-line survey of subjective cover percentages of mosses and liverworts. This was carried out by an expert at identified locations across the SSSI specified by the Site Manager. This has proved very useful already in site renotification and justification of management works and further acquisitions.

2.5 Fauna

2.5.1 Invertebrates

Many of the known records of rare insects for the Reserve are old. Updating is required because of the recent intensive peat cutting and drought. As a result, lists of past records with locations were obtained from known visiting entomologists. A very useful base-line survey was obtained by repeated visits by a contracted group of up to 8 entomological specialists of differing expertise from Liverpool Museum. They were marshalled around the site by EN staff to cover as much of the site at specified locations as possible. They also conducted a desk study of past records. Again this location specific information has been similarly useful in renotification, justification and acquisition.

Detailed monitoring of ground and flying invertebrates has been carried out over three seasons, using standard pitfall and water trap techniques, with replicates at two locations in each of the four peat cutting types. A student project has investigated more marginal areas. Problems of too few entomologists and too little funding to identify the specimens has diminished the immediate usefulness of such an approach.

Three extensive transects are being recorded annually for dragonflies and butterflies using standard BMS techniques. Emphasis is placed on two indicator species - the Large Heath butterfly and the White-faced Darter. Reliance on placement labour has caused problems in one instance as has unsuitable weather conditions - raised mires being exposed sites. Similarly reliance on volunteer labour could cause problems.

Visits by experts to locate and subjectively monitor extremely rare species has proved the only method of assessing effects of management on RDB species.

Student projects on dragonfly behaviour and a contract on the Large Heath butterfly have provided useful base information and illustrated how little is known of species behaviour.

2.5.2 Birds

A breeding bird survey was carried out in 1988 and will be repeated in 1995, together with 200m interval transect wader monitoring.

2.6 Water

2.6.1 Water levels: ditches

An initial mapping of all drains on the site by the ex-Moss foreman has proved to be invaluable in planning sequences of damming. This was extended to cover the drainage network in the entire SSSI and surrounding agricultural area. The water level visible in the drains and, if flooded, on the peat surface is recorded twice yearly in winter and summer. Levels are represented in colour on a site map and give a very easily comprehended picture of the effects of damming. Peak events such as backflooding from the arterial drains onto the flats are recorded by repeating the permanent photographic record for specific flats.

2.6.2 Water-levels: peat

80 3\8" diameter dipwells, sunk to the base of the peat and levelled in to Ordnance Datum are monitored fortnightly. They form a large cross across the whole site with a smaller cross in an area of uncut peat. Recorded using a blow-pipe, the results are tabulated on Quatro-pro so graphs can be drawn up of the water levels across the site etc. After this initial survey with one or two more years, monitoring will be reduced to certain critical dipwells. Two continuous water-level recorders have been installed, one on an uncut area and one on commercially damaged undammed ground.

2.6.3 Precipitation, evaporation & evapotranspiration.

Two tipping bucket rain gauges, one evaporation pan and two lysimeters have been installed, but on many sites data from adjacent rain-gauges could be purchased or Morecs data for the surrounding 40km square could be obtained.

2.6.4 Water heads, outflows, and peat shrinkage \ expansion

A photogrammetric mapping survey was carried out to 0.5m contour interval for the site and surrounding SSSI and agricultural land. This, together with a survey mapping the extent of the peat body and the drainage network surveys, has been very useful in determining effects of raising heads of water on water levels in surrounding land. The movement of the peat surface is monitored at 7 locations with metal plates set against peat anchors, but these have shown minimal change, and a smaller number would have sufficed.

The levels of the main arterial drainage system were surveyed to determine the effects of weirs at various locations on back-flooding into other parts of the site. This proved very useful where cutting has altered the profile of the site and additional ownerships adjoin.

Several piezometer tubes have been inserted by M.Sc students into the sand beneath the peat to determine flows from peat to sand and vice-versa and the permeability of peat at various depths has been investigated to determine consequences of raised heads of water in the rehabilitated Moss on surrounding ownerships.

The quantity of outflow water leaving the site have not as yet been monitored but are of great interest to adjacent farmers and may be investigated in 1995 using thin plate weirs and continuous water-level recorders.

3. Conclusion

There are many different aspects of mire rehabilitation which are inconclusively known. Large quantities of water are being impounded and heads of water are being raised. Sites may have nationally important species particularly of invertebrate which may not be favoured by the rehabilitation work. Changes in response to raised water levels are very rapid. Sites are very different in their initial fauna and flora and climatic conditions.

Consequently it is important to collect as much data as resources allow , with HSE audits and water level recording taking priority over flora then fauna. The selection of key locations and key species may become progressively easier as more detailed studies emerge from previously rehabilitated sites.

A MONITORING SCHEME FOR *DRUMSHANGIE MOSS*

Rob Stoneman, Scottish Wildlife Trust

1 Introduction

In the late 1980's, British Coal Opencast proposed a large open cast mining operation to the east of the A73 Airdrie-Cumberland road. The proposed area, which lies to the NE of Airdrie, has been subject to a long history of deep mining and is adjacent to the location of the Stanrigg mining disaster. More recently extensive open cast mining both on and adjacent to the site have left widespread dereliction including deep water and unstable ground. Local people exploit exposed coal in abandoned open cast pits by digging small pits to extract coal. These activities are highly dangerous and have claimed one fatality already.

Given widespread dereliction and its associated dangers, Monklands District Council have welcomed British Coal Opencast plans to open-cast and restore the area.

However, despite the dereliction, the Drumshangie area has high wildlife value. Subsidence pools, wet acid grassland, scrub woodland and particularly the Drumshangie Mosses combine to make this area highly important for wildlife. The Drumshangie Mosses are composed of 5 main units (see map: P1, P2, P3a, P3b and P3c). It is difficult to gauge the natural extent and setting of the mosses because of mining dereliction. However, the bogs almost certainly developed on saturated glacial tills, which cap the underlying carboniferous rocks, and were surrounded by wet fen areas. Units P1, P2 and P3a are characterised by *S. magellanicum/S. papillosum* lawns of exceptional quality. P3c is comprised of regenerating cutover bog whilst unit P3b is highly degrade primary bog. They may well have formed one continuous unit before mining; all are now remnants and have been modified to varying extents. As a result, the Scottish Wildlife Trust, Scottish Natural Heritage and the Central Scotland Countryside Trust voiced concern about the open-cast mining proposals on environmental grounds paying particular attention to the destruction of the raised/intermediate mosses.

A compromise solution was agreed upon whereby the majority of the peatland areas are to be retained. At least as important though, are plans for restoring the site. In contrast to past open cast activities where mines are restored to farmland, the restoration plans for Drumshangie lay the emphasis on restoration for nature conservation purposes including forestry, peatland, scrub, open water as well as pasture land.

Clearly, for these plans to be effective, a properly worked out scheme to protect the peatlands will be necessary. Indeed, the planning permission specifically entails British Coal Opencast, or superseding bodies, to suitably safeguard the peatlands prior to excavation works.

Since there is a degree of knowledge currently concentrated in the Scottish Wildlife Trust's (SWT) Scottish Raised Bog Conservation Project, it was felt it would be useful for SWT to start discussions on the matter.

2 Management

Given the ecohydrology of raised bogs, the continuing survival of these mosses will depend upon external constraints (in particular adjacent hydrological conditions) and internal (i.e. on the bog itself) factors. The key objective of measures taken at Drumshangie is to maintain or, where possible, improve the acid raised bog vegetation communities via hydrological control. This will require:

1 the creation or maintenance of waterlogged conditions adjacent to the mosses (i.e. external measures) and;

2 the creation or maintenance of near-natural drainage condition on the mosses themselves (i.e. internal measures).

2.1 External Measures

Peatland conservation requires adjacent land management. Preferably land should be inundated with shallow water to form a wet fen which would then act a lagg fen to the remaining peatland areas. Naturally, raised bogs are surrounded by lagg fens. Fens could be created by bordering the mosses with low bunds to allow inundation between the moss and the bund thus creating a fen area (see Figure 1). Obviously, detailed topographical mapping would be required to decide upon height and location of bunds. Also it would be important to be able to control water-levels via sluices. The actual water-level in the fen areas could be set according to ground water mound theory.

The creation of fen areas has a double benefit for wildlife. These areas will not only protect the peatlands but also create an important wildlife habitat. Fens contain many rare species but are now rather uncommon because of agricultural drainage. The size of the fen areas adjacent to the peatland does not affect the peatland although, perhaps, the larger the fen, the greater its effect. Accordingly, it may be useful to incorporate fen areas into the restoration plan thereby creating a mix of wetland habitats on the site.

2.2 Internal Measures

Many of the peatland areas are suffering because of drainage of the bog surface. Reversing, the effects of this drainage is relatively simple. Dams made of plywood, elm-board, plastic or peat (dependent upon local factors) can be constructed across ditches. Water-levels are thus returned to near the surface. In time, the ditch infills with *Sphagnum* to become virtually unrecognisable.

More serious, are the effects of block cutting of area P3c. Here peat has been removed by cutting peat out of small drained "fields". The peat was dried on surrounding baulks. This form of exploitation is common. Restoration relies on inundating the fields to allow the establishment of a floating vegetation mat to establish. In addition, this re-wets the adjacent baulks promoting *Sphagnum* growth.

Whilst block-cutting and drainage on the bogs in unconnected to British Coal Opencast operations, it is strongly advised that a small amount of the restoration budget is allocated to peatland rehabilitation of this nature. Without solving internal hydrological problems, external measures (as required in the planning permission) would be ineffective and pointless. The costs of such measures would be small, probably involving 2-4 weeks work using one low ground pressure digger vehicle.

Another internal problem will be created where open cast operations impinge directly onto the bog creating a peat wall. Apart from obvious safety considerations, as waterlogged peat will inevitably slump or "burst" into the mine workings, the creation of such walls will have a number of deleterious effects:

1 Alteration of the shape and, therefore, the hydrology of the peat dome.

2 Steepening of hydrological gradients resulting in increased flow and drainage of the bog.

There are no easy solutions to these problems and where possible it should be avoided. Certainly, shoring up the exposed peat wall with a clay bund would make a bad situation worse by introducing nutrients onto the bog surface and completely altering the natural hydrology of the bog. Slow seepage, in the upper decimetres, from the centre to the edges of raised bogs is a natural feature which should be preserved. Perhaps the only solution is to artificially create a slope (see Figure 2). This proposal is highly tentative and requires further consultations.

3 Monitoring Objectives

In order to assess the effects and success of the management, monitoring is required in 3 main stages:

1 Pre-operation monitoring: A necessary pre-requisite for any management would be to establish a baseline of information concerning the site conditions. Given that management objectives are to maintain or, preferably, improve conditions on the bogs, the baseline information becomes a minimum standard to which the site must not be allowed to fall below. This data could also be used for publicity and interpretation purposes dependent upon the final outcome of the site; i.e. in anticipation that the site may eventually be used for the public benefit (as a nature reserve for example).

2 Monitoring during operations: During this phase, management measures and their effects should be monitored to ensure the site stays above the minimum standard as set by the baseline survey.

3 Post-operations monitoring: A full re-survey of the site should be undertaken to comprehensively assess the effects of mining and management measures on the site. This monitoring should also establish the new status of the site following restoration to effectively act as new baseline dataset for preparation of a new management plan.

4. Monitoring Prescriptions

4.1 Pre-operations

The baseline information should include: vegetation survey, topographic survey, photographic survey, hydrological characterisation and archaeological survey. This would be best achieved through the following methods and techniques:

4.1.1 Aerial photography

Low-level, false colour aerial photographs are used extensively for bog management planning in Holland and Switzerland. Careful analysis of the images allied to ground truthing provides accurate vegetation maps including hydrological features (drain, peat cuts etc.). In addition, photometric analysis of the pictures allows accurate topographic maps to be constructed to a precision of ± 30 cm. Oblique aerial photographs should also be taken at this stage.

4.1.2 Fixed-point photography

As part of the baseline information gathering exercise it is important to gather as much data on the present state of the site. Fixed point stereo photographs are a cheap way to document a site. It is suggested a series of photographs are taken with a particular emphasis on areas which are likely to experience the greatest changes.

4.1.3 Water-level monitoring

Water-level monitoring will be essential to determine the site's present status. Dip wells have the disadvantage of being time-consuming to read and do not show minima and maxima. This is partly alleviated by using WALRAGs which record minimum and maximum levels. An alternative is to employ automatic water-level measurers which only need reading every 6 months or so. These are much more expensive so it is suggested they are sparsely used. One should be placed on the mire expanse, 2 on the edges of the bog adjacent to severe management impacts with another placed in an area which will form a new lagg fen.

4.1.4 Meteorological Data

The water-level information should be allied to climatological information. It is suggested that this data is bought from a local meteorological station.

4.1.5 Archaeological Survey

Peat-bogs are a rich archive of environmental and cultural history. This should be assessed before mining operations commence.

4.2 During Operations

The current British Coal plan for Drumshangie envisages that mining operations will last for 10 years. Bunding would have to occur prior to the main mining phase, i.e. at the beginning of the 10 year period.

Monitoring during this phase would entail:

1 Detailed photographic survey of all management measure e.g. bund construction and lagg fen creation.

2 Where peat is removed or cut into during mining operations or as a result of bog management, a watching brief should be allocated to local archaeologists so that archaeological or palaeoenvironmental information is not overlooked.

3 Bunds, created as part of the management operations, should be monitored to check their efficiency. This can be carried out by walking the structures visually checking for faults and also by monitoring lagg water-levels. WALRAGs or continuous data loggers should be installed in newly created lagg fens to allow levels to be checked once a month.

4 Hydrological monitoring on the mire expanse should be continued. Data should be checked once a month to check for unexpected variability or water-level crashes below the prescribed minimum.

4.3 Post-Operations

As a result of restoration works to the peatlands and the whole site, the site characteristics will have altered from the original baseline. It is, therefore, envisioned that the site is subjected to a repeat baseline survey as described above.

5 Resource Implications and Data Collection

The management and monitoring costs of the aforementioned works entail significant expenditure. However, when put into the context of the total costs of the Drumshangie mining operations, the expenditure is, relatively, extremely small.

The monitoring operations conveniently divide into 3 tasks:

1 Pre-operations baseline survey - this could be let as a single contract with cost absorbed into the site preparation (for mining) budget.

Cost: £10,000

2 Monitoring during operations would entail one day per month's work. Funding, by the mining operator, aimed at the local Wildlife Trust would allow them to add this work to the work programme of existing reserve managers.

Cost: £1,000 per year for 5 years.

3 Post operations survey could be re-let as a single contract with the cost absorbed into the site restoration budget.

Cost: £10,000

6 Data Storage, Analysis and Use

The initial survey should be collated on computer, where possible or filed appropriately. This could be stored with the local Trust to allow the reserves manager (see above) to use the data for on-going monitoring. During operations, analysis would be rather cursory mainly concentrating on whether water-levels were falling below the prescribed minima. If water-levels did fall below these minima, then the mining company and reserves manager would investigate the reasons for this so that remedial actions can be initiated.

A full assessment would be made in the second (post-operations) contract. This analysis would contribute to a new management plan. The conclusions of which would heavily rest on the future status - both eco-hydrological and political - of the site.

7 Present Monitoring

The Drumshangie area has been subjected to detailed geological survey for the past 15 years. Phase One (equivalent) vegetation survey data is also available.

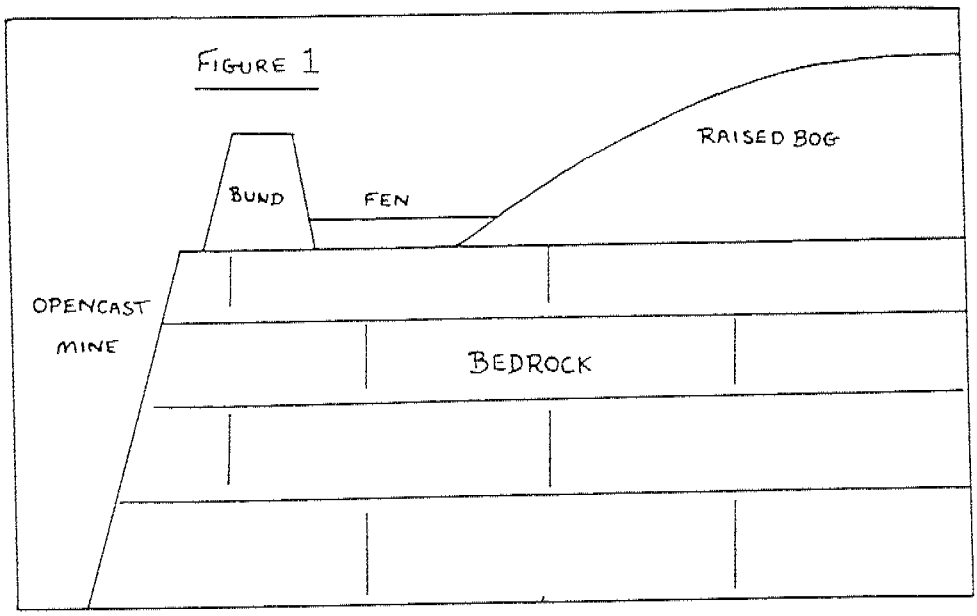


FIGURE 1
RAISED BOG
BUND
FEN
OPENCAST
MINE
BEDROCK

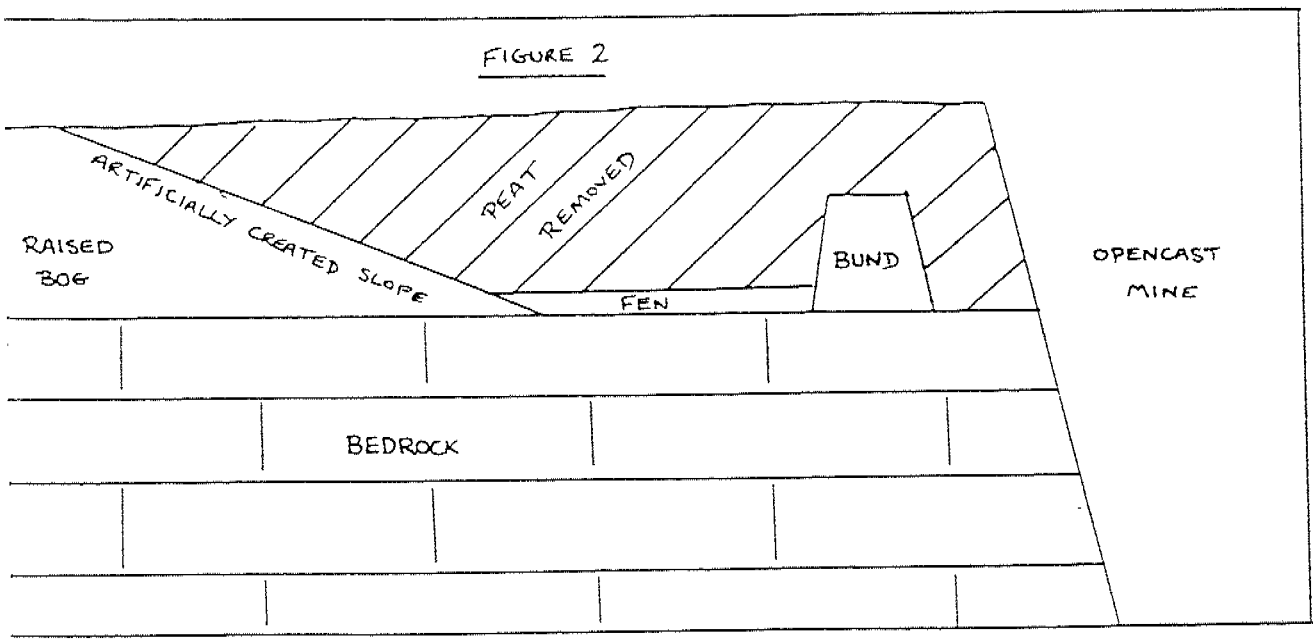


FIGURE 2
ARTIFICIALLY CREATED SLOPE
PEAT
REMOVED
RAISED
BOG
BUND
FEN
OPENCAST
MINE
BEDROCK

SHAPWICK HEATH NATIONAL NATURE RESERVE, SOMERSET REHABILITATION PROJECT

Mervyn Yeandle, English Nature

1. Introduction

Shapwick Heath is a 1200 acre NNR site situated in the Brue Valley on the Somerset Levels. The Brue Valley is also known under its ancient name as the Vale of Avalon (Map 1).

Over the centuries, the wetland landscape has been completely transformed, first by drainage and land reclamation to create wet pastures and then by commercial peat cutting. The peat industry has dominated this landscape for the last century. Now changes in this industry provide a unique opportunity to recreate something of the former wetland character of the Vale of Avalon.

Shapwick Heath NNR consists of many different habitats which over the years have suffered greatly through effects of drainage from the adjacent peat workings. This has resulted in the loss of some important species; notably the Large Marsh Grasshopper which has occurred despite the efforts of English Nature to stop water loss from the site. Now English Nature have managed to secure a hydrological unit which isolates the NNR from surrounding land, through major engineering work. This has been made possible by the donation of ex-peat workings from Levington and other bodies, and sufficient funding for the project from English Nature's Lowland Peatland Programme.

We estimate that by summer 1995 we should have control of the hydrology of the NNR and be able to address the problems of drying which have seriously degraded the nature conservation interest over the whole of the site.

2. Site Description

The main habitats (prior to the Levington deal) are:.

2.1 Acid Grassland (M.25, 60 acres)

This habitat, once the home of the Large Marsh Grasshopper and Marsh Fritillary, has suffered through drying, reducing the area of M.25 to just 10% due to the invasion of *Molinia caerulea* and *Betula/Myrica* scrub.

2.2 Neutral Hay Meadows (140 acres)

These are the best examples of neutral hay meadows on the Somerset Levels and Moors, and seem to be the least affected by drainage. Because of subtle differences in land height due to efforts of the old turf diggers, each field has its own character. These produce stunning displays of colour in late May and June with uncountable numbers of butterflies particularly Meadow Brown, Ringlet and Marbled White. With four different orchids and vast amounts of Scabious, Knapweed and Betony, the meadows are the second biggest attraction to the public after the birds.

2.3 Rhynes and Ditches

These effectively divide the reserve into approximately 5 acre fields and have great botanical and invertebrate interest i.e. Lesser Silver Water Beetle (*Hydrochara caraboides*), Hairy Dragonfly (*Brachytron pratense*), Bladderwort (*Utricularia spp.*), Bogbean (*Menyanthes trifoliata*) and Water-violet (*Hottonia palustris*).

2.4 Woodland and Scrub

To the peat purists, trees are not acceptable on peat due to the effects of evapotranspiration but these wet birch woodlands provide habitat for a variety of wildlife, such as one of the only two colonies of White Admirals in Somerset. There are also nationally important fern communities that require the damp, shady conditions that these woods provide. Breeding birds include Nightingale (*Luscinia megarhynchos*), Woodpecker and occasionally Nightjar (*Caprimulgus europaeus*) and Willow Tit.

2.5 Ashcott Plot (16 acres)

This is one of the last remnants of mire vegetation on the Levels and has suffered the same fate as the acid grasslands. Through years of drainage the area of *Sphagnum* has been reduced to approximately 5%. A pump was installed in 1991 to pump water from the peat workings into the site, but because the water from Levington's drainage channels is 1-2 ms into the mineral-rich clay, the feared vegetation change due to eutrophication has started to happen (e.g. an invasion of *Typha*).

2.6 Old peat workings previously managed by Fisons (Levington) and Wessex Water plc

The management of approximately 650 acres of old peat workings in Shapwick Heath has been passed from Fisons (Levington) and Wessex Water to English Nature. Unfortunately only 80 acres has any peat left on it, on the rest of the land the peat has been totally exhausted exposing the marine clay.

3. Management Objectives and Measures

3.1 Acid Grassland

Management objectives:

- Manage as species-rich *Molinia caerulea/Potentilla erecta* community with target species such as: *Cirsium dissectum, Succisa pratensis, Salix repens, Lysimachia nummularia, Filipendula ulmaria, Carex paricea, C. hostiana, Erica tetralix.*

- Maintain small percentage of *Betula/Myrica* scrub for birds and invertebrates.

Measures

- Raise water levels and avoid fluctuations.

- Remove scrub.

- Arrange grazing at correct density to maintain species-rich community.

3.2 Neutral Hay Meadows

Objectives

- To maintain as species-rich damp hay meadows.

Measures

- Late hay cut (July) with aftermath grazing by cattle. Once in every 5 years graze meadows early (April/May) in rotation to check invasive species (*Juncus*). Once every 5-10 years omit hay cut and graze late in the year, again in rotation to benefit invertebrates.

3.3 Ditches and Rhynes

Objectives

- To maintain a diverse mosaic and range watercourses from open water with emergent fringes to channels almost choked with vegetation.

Measures

- Traditional management of rhynes for conservation consists of clearing mechanically every 3-5 years on the reserve.

- Where cost is not such an important factor, they are selectively cleared of choking vegetation (*Glyceria fluitans*) by hand annually and only cleared mechanically when necessary and then only one half rhyne and one bank in any one year.

3.4 Woodland and Scrub

Objectives

- To create more suitable nesting habitat for Nightjar (*Caprimulgus europaeus*) and Nightingale (*Luscinia megarhynchos*).

- Create as much edge as possible in scrub areas, for feeding Nightjar (*Caprimulgus europaeus*) and bare peat with dead vegetation for nest sites.

Measures

- Fell selected areas to allow dense undergrowth to develop. This is not only important for nest sites for Nightingales, it is also a vital nectaring point for invertebrates, such as White Admiral and Silver-washed Fritillary. Bare ground for Nightjars can occur naturally, under scrubby trees, if not, this can be achieved by mulching with black polythene and covering with rotted wood chips.

3.5 Ashcott Plot

Objectives

- Increase *Sphagnum* areas and reduce need for pumping.

- Maintain high water levels.

Measures

- Remove all trees and scrub.

- Insert polythene membrane vertically around the whole of the site.

- Arrange grazing at correct density.

3.6 Old peat workings previously managed by Fisons (Levington) and Wessex Water plc (peat voids)

Objectives

- Create new wetland habitats e.g. reed swamp, rich fen, wet heath, *Sphagnum* mires.

Measures

- Stop pumping and allow water to rise to summer pen. Culverts will allow surplus water to drain, preventing levels rising above summer pen. Because most of the land has been worked-down to the clay, water depths are likely to be in the order of 0.5 - 1.5 ms deep. The water areas will be colonised by reed swamp with carr woodland developing on the fringes.
- On the land where peat has been left, level-out peat baulks and make area hydrologically secure.
- Install control system to allow water either into or out of the site.
- Maintain high water level all year round.
- If necessary, introduce target species. The precise management requirements for the levelled area will become clearer as the vegetation community develops objectives.

4. Monitoring Objectives

4.1 Acid Grassland

Objectives

- Monitor vegetation changes to determine the optimum water table and grazing management required to maintain wet acid grassland and important invertebrate communities and target species (e.g. Marsh Fritillary, *Euphydryas aurinia*).

Methods

- Vegetation - nested quadrats, fixed point photography.
- Water levels - dip wells.
- Invertebrates - butterfly transects - general invertebrate surveys. Intense monitoring of Marsh Fritillary (*Euphydryas aurinia*) e.g. adults'-larvae - survival rate of larvae.

4.2 Neutral Hay meadows

Objectives

- To monitor vegetation changes to determine optimum grazing/cutting regime for the varied hay meadow communities and associated invertebrate assemblages.

Methods

- Vegetation - nested quadrats - fixed point photography.
- Grazing - stocking numbers - type - seasons.

- Hay cutting - dates.
- Invertebrate - butterfly transect - general invertebrate survey.

4.3 Rhynes and Ditches

Objectives

- Monitor structure of ditch vegetation to maintain variety of ditch habitats from open water to choked. for benefit to aquatic plants and invertebrates.

Methods

- Assess ditch maintenance annually e.g. percentage of open water.
- Record annual maintenance programme.
- Counts of dragonflies and RDB species e.g. Lesser Silver Diving Beetle (*Hydrochara caraboides*).

4.4 Woodland and Scrub

Objectives

- Monitor woodland conditions required to support important populations; e.g. ferns - White Admiral (*Ladoga camilla*), Nightjar (*Caprimulgus europaeus*) and Nightingale (*Luscinia megarhynchos*).

Methods

- Trial mapping of Royal Fern (*Osmunda regalis*) and Marsh Fern (*Thelypteris thelypteroides*) (e.g. number of plants per 10m x 10m quadrat).
- Butterfly counts annually (target sp. - White Admiral).
- Breeding bird census.
- Record of woodland management.

4.5 Ashcott Plot

Objectives

- Monitor vegetation changes to determine the optimum grazing and water table management regimes which promote an increase in distribution and growth of *Sphagnum* spp.

Methods

- Vegetation - nested quadrats.
- Selectively map locations and distributions/extent of *Sphagnum* species.

4.6 Old peat workings previously managed by Fisons (Levington) and Wessex Water plc

Objectives

- Monitor vegetation changes to determine optimum conditions for target wetland communities (breeding birds - wintering - passage birds - invertebrates and otters - reedbed and open water).
- Monitor water table to determine extent of summer deficit.
- Monitor vegetation changes on levelled land to see what happens.

Methods

- Vegetation - aerial and fixed-point photography and mapping. Nested quadrats in levelled areas.
- Breeding bird census of target species (RDB and schedule 1) - annually.
- Census of all breeding birds (5 yearly).
- Winter WEBS count.
- Water levels monthly - gauge boards.
- Record and map otter spraints.
- Dragonfly transects.

5. Resource Implications

- Vegetation monitoring: first year let to contract: £2500. After first year 5 days EN staff.
- Fern mapping - first year let to contract: £300. After first year, 1 day EN staff.
- Breeding bird census - 5 yearly: £500
- Invertebrate work done by volunteers and reserve staff.
- Aerial photography - 3 yearly: £1500
- Fixed point photography - reserve staff.
- Water quality and levels - reserve staff. Total days reserve staff - 60 days.

6. Data Collection, Storage and Use

6.1 Data Collection

This is an area in need of review. At present, data collection from volunteers is rather unorganised.

6.2 Data Storage

This is an area also in need of review and is at present very fragmented. Information can be stored at various points: i.e. volunteers' homes, reserve workbase, Site Manager's office or regional office. An effort must be made to centralise data.

6.3 Use

Monitoring provides valuable information important to the management of the NNR. Information is also passed-on to other interested bodies. Because of the close proximity of other conservation organisations i.e. RSPB and the Somerset Wildlife Trust, information is readily passed at 'ground level' between the three organisations.

7. Present Monitoring

7.1 Vegetation

At present, monitoring (changes resulting from management) is a very non-scientific procedure, but this does not imply that present monitoring is not effective. Monitoring vegetation changes due to English Nature management consists of walking field, ditch or wood and observing the changes/expected results. For example, acid grasslands after grazing, look to see if *Molinia* is retreating, benefiting target vegetation species i.e. Meadow Thistle (*Cirsium dissectum*) and Ivy-leaved Bell-flower (*Wahlenbergia hederacea*).

7.2 Invertebrates

This is mainly carried out by volunteers, except Marsh Fritillary (*Euphydryas aurinia*) and White Admiral (*Ladoga camilla*) which are monitored by reserve staff and monitoring by volunteers includes:

- moths, - monthly through summer
- dragonflies - weekly through summer
- butterflies - weekly transect (reserve staff)
- rare species i.e. Lesser Silver Diving Beetle (*Hydrocara caraboides*)

7.3 Water Management

A water test is carried out monthly by reserve staff measuring - temperature, pH, oxygen content and conductivity. Water levels are not measured, simply observed. For example, if water levels are down in the ditch system the irrigation pump is turned on and levels raised to optimum level.

7.4 Birds

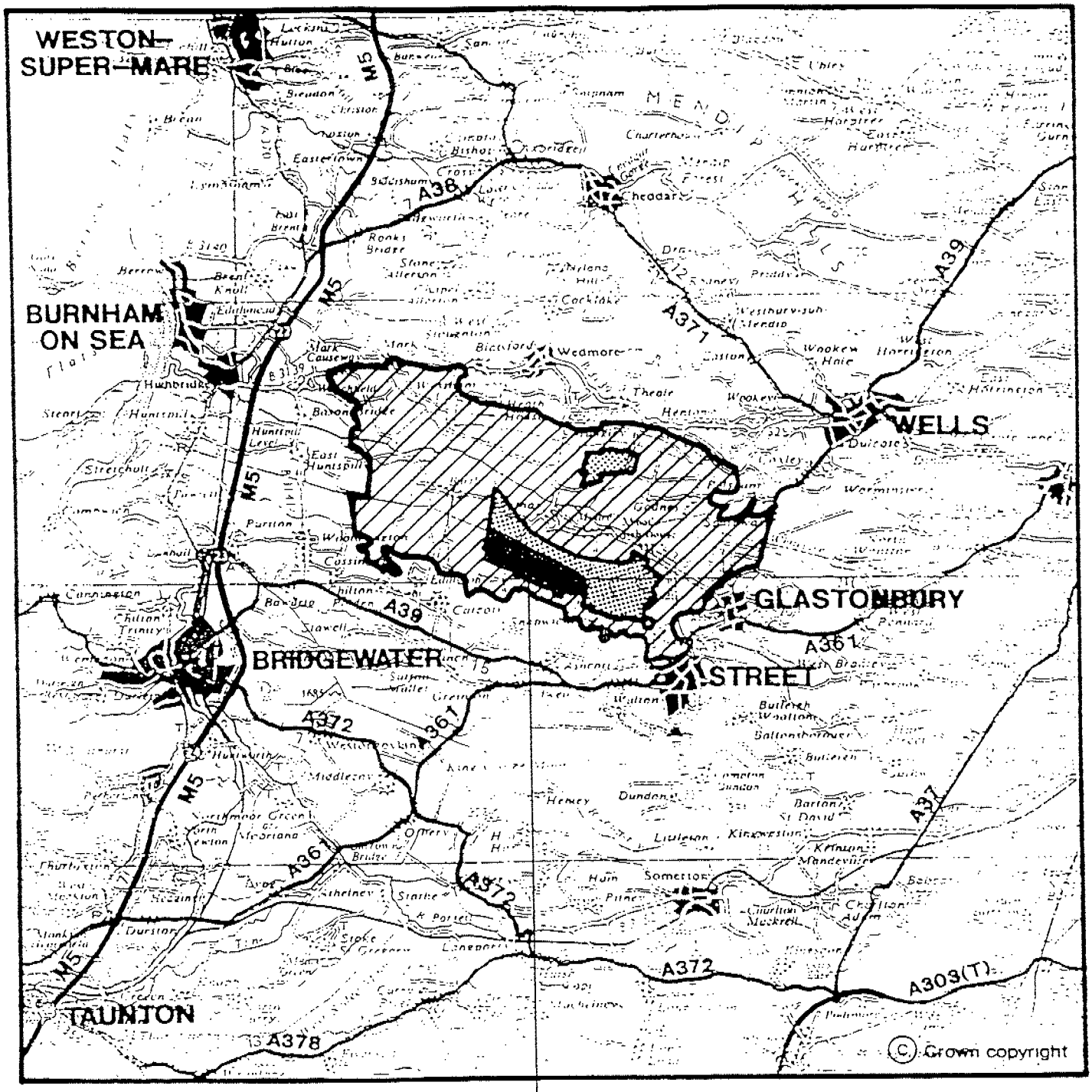
Because of the wide interest in this subject from the general public, voluntary organisations and reserve staff, birds are comprehensively monitored i.e. breeding census, WEBS counts and BTO counts.

7.5 Otters

Spraints are recorded and mapped.

7.6 Projects

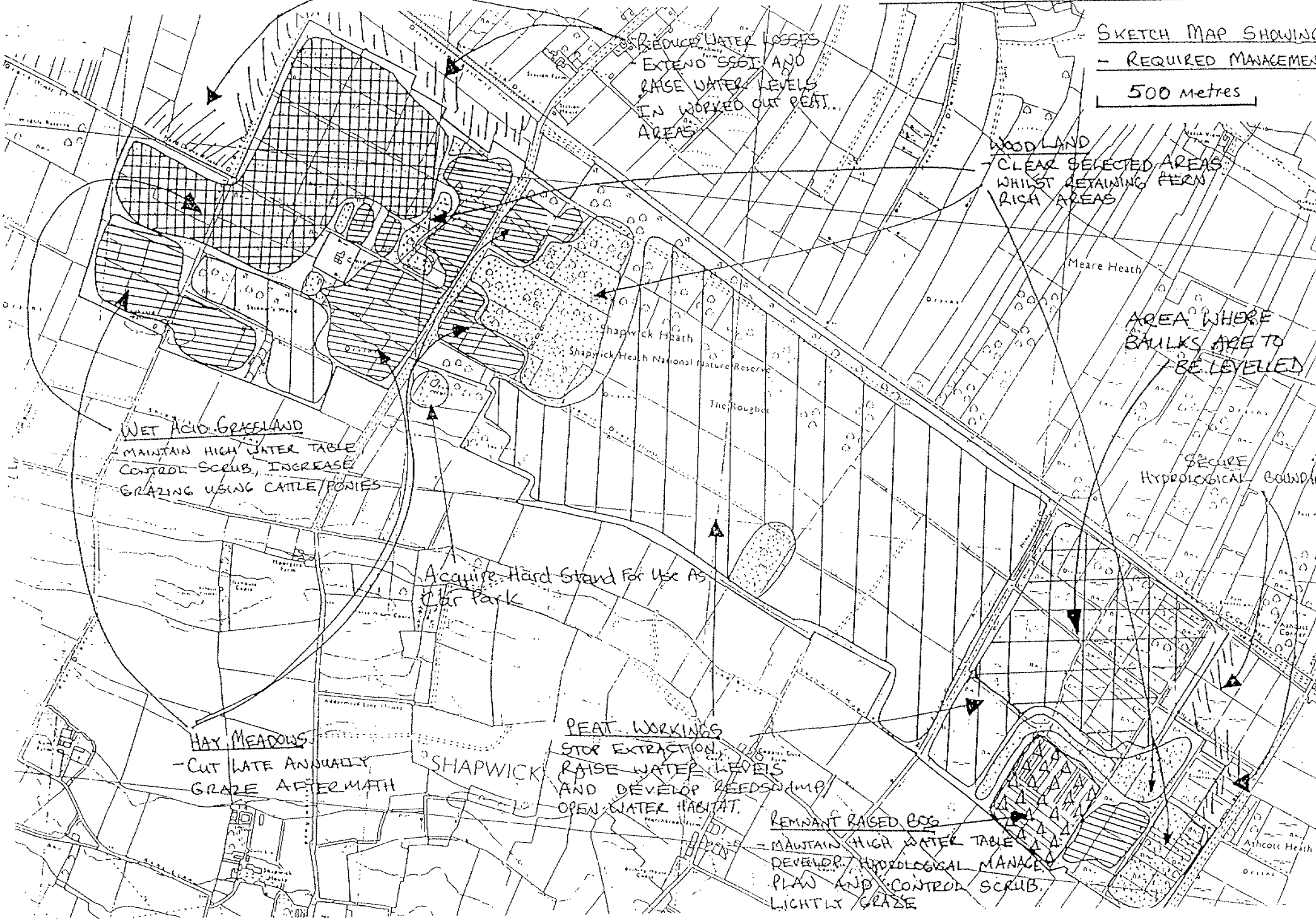
There are several specific management and monitoring projects on-going. These are done by volunteers, instigated and overseen by reserve staff. These projects are designed to safeguard and increase some of the rare invertebrates and breeding birds. For example, Emerald Damselfly (*Lestes sponsa*) and Nightjars (*Caprimulgus europaeus*). The management and monitoring is organised and carried out by the individual volunteer who liaises as often as possible with reserve staff.



Study Area

Peat Production Zones

SHAPWICK HEATH NNR


SKETCH MAP SHOWING
- REQUIRED MANAGEMEN
500 metres
REDUCE WATER LOSSES
- EXTEND SSSI AND
RAISE WATER LEVELS
IN WORKED OUT PEAT
AREAS
WOODLAND
- CLEAR SELECTED AREAS
WHILST RETAINING FERN
RICH AREAS
Meare Heath
AREA WHERE
BAULKS ARE TO
BE LEVELLED
Shapwick Heath
Shapwick Heath National Nature Reserve
The Roughes
SECURE
HYDROLOGICAL BOUND
WET ACID GRASSLAND
- MAINTAIN HIGH WATER TABLE,
CONTROL SCRUB, INCREASE
GRAZING USING CATTLE/PONIES
Acquire Hard Stand for Use As
Car Park
HAY MEADOWS
- CUT LATE ANNUALLY
GRAZE AFTERMATH
SHAPWICK
PEAT WORKINGS
STOP EXTRACTION,
RAISE WATER LEVELS
AND DEVELOP REEDSWAMP/
OPEN WATER HABITAT.
REMNANT RAISED BOG
- MAINTAIN HIGH WATER TABLE
DEVELOP HYDROLOGICAL MANAGE
PLAN AND CONTROL SCRUB.
LIGHTLY GRAZE
Ashcott Heath