CHAT MOSS DIPWELL STUDY

Report on a dipwell study carried out on Chat Moss, Greater Manchester

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1. INTRODUCTION

1.1 Agricultural Land Classification

The determination of soil wetness class is an important factor in grading the quality of agricultural land. Soil wetness class is determined by the depth and duration of water logging in the soil profile and this is best established by the use of quantitative data recorded over a period of many years using dipwells. In the absence of such data an interpretative method of field assessment is used to determine soil wetness class in the field.

In peat soils where a slowly permeable layer is not encountered within 80 cm of the surface, wetness class is determined solely on the basis of the Field Capacity Days (FCD) at the site. Where FCD exceed 150 the present Agricultural Land Classification Guidelines (MAFF, 1988) do not place peat soils into a specific wetness class but provide a range of wetness classes II-IV. In the absence of other site limitations the grading of agricultural land quality may rely solely on the determination of soil wetness class. The resource planner is thus faced with the problem of which wetness class is most appropriate for the land being classified.

1.2 Chat Moss

Chat Moss is an area of peat soils on the western outskirts of Greater Manchester. An Agricultural Land Classification (ALC) survey carried out in 1966 showed much of the area to be peat soils of the Turbary, Ridley, Altcar and Westhay series and the land was classified as ALC Grades 1 and 2 using the methodology given in Technical Report No. 11 (MAFF, 1966). Some mineral soils in the north of the Moss were classified as Grades 2 and 3. The average annual rainfall at the site is 922 mm and the accumulated temperature for the period January to June is 1421 degrees C, giving a climatic grade of 1. The FCD vary between 206 and 214.

Following a request from the Local Planning Authority, the Wolverhampton Resource Planning Group undertook an ALC survey of 2,880 ha of Chat Moss in 1989 using the ALC Revised Guidelines. The survey identified soil wetness as the major limitation to the agricultural use of the land. Chat Moss falls within the FCD range of 201-225 which, using table 12, of the ALC revised guidelines gives a wetness class of II-IV and hence wetness Grades of 1, 2 or Subgrade 3a. In order to provide more detailed information on the depth and duration of waterlogging, and thus enable a more accurate determination of soil wetness class, it was decided to undertake a dipwell study on Chat Moss. This was also taken as an opportunity to investigate other aspects of the ALC Revised Guidelines relevant to the classification of peat soils. The study had four objectives:

i) To establish the wetness class of peat soils on Chat Moss;

ii) To compare the wetness class of peat soils with the agricultural land class as defined in the ALC revised guidelines;

iii) To identify areas in England and Wales where lowland peat soils are associated with high rainfall;

iv) To identify other issues relating to the classification of peat soils where further guidance in the ALC guidelines would be useful.

2. TO ESTABLISH THE WETNESS CLASS OF PEAT SOILS ON CHAT MOSS

2.1 Methodology

Two dipwell studies were carried out. Initially a six month pilot study was undertaken between January and April 1989, followed by an eighteen month study between February 1990 and July 1991.

2.2.1 Materials

Each dipwell consisted of a 1 metre length of 2 inch diameter plastic pipe. In one half of each pipe 22 holes of 1 cm diameter were drilled to allow lateral movement of water at depth, (fig. 1). The height of the water within each dipwell was measured using a steel tape.

2.1.2 Dipwell Installation

Dipwells were installed to 100 cm depth in holes bored using a 5 cm peat auger. The dipwell tubes were pushed into the holes leaving about 2 cm above the surface. To prevent the entry of litter and small mammals a piece of gauze was secured over the top of each tube with a rubber band.

2.1.3 Location of Dipwells

For the six month pilot study 32 dipwells were installed at four locations. At each location two plots were established, each consisting of a row of four dipwells with a spacing of five metres between each dipwell.

For the second study 72 dipwells were installed at eighteen plot locations, (fig. 2) with one plot of four dipwells at each location. One plot was sited on non-agricultural land as a control. In deciding on the location of the dipwells a number of factors were taken into consideration: co-operation of the farmers; ease of access to dipwell plots; the variety of land use on Chat Moss, (table 1).

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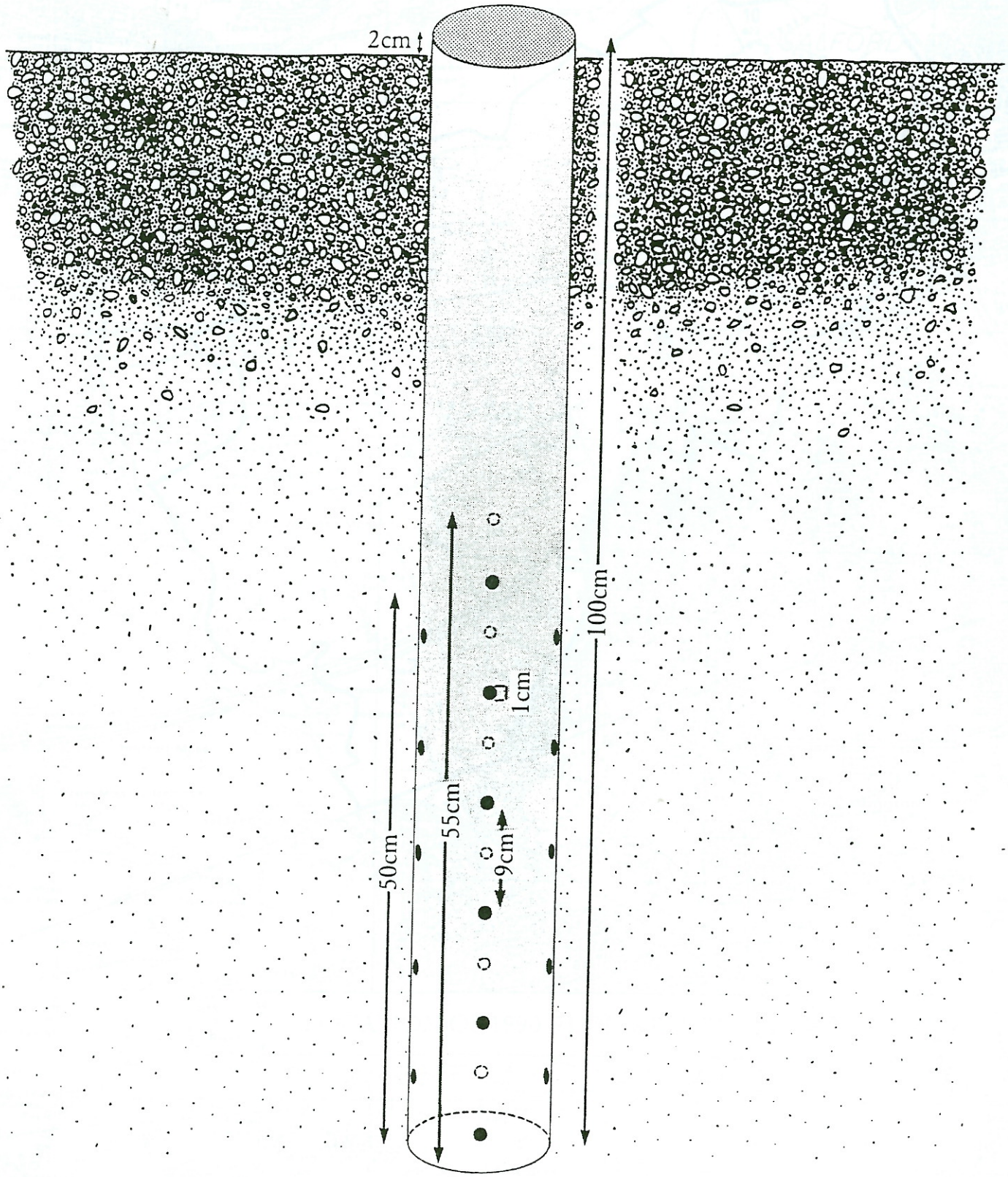
EXAMPLE OF DIPWELLS USED



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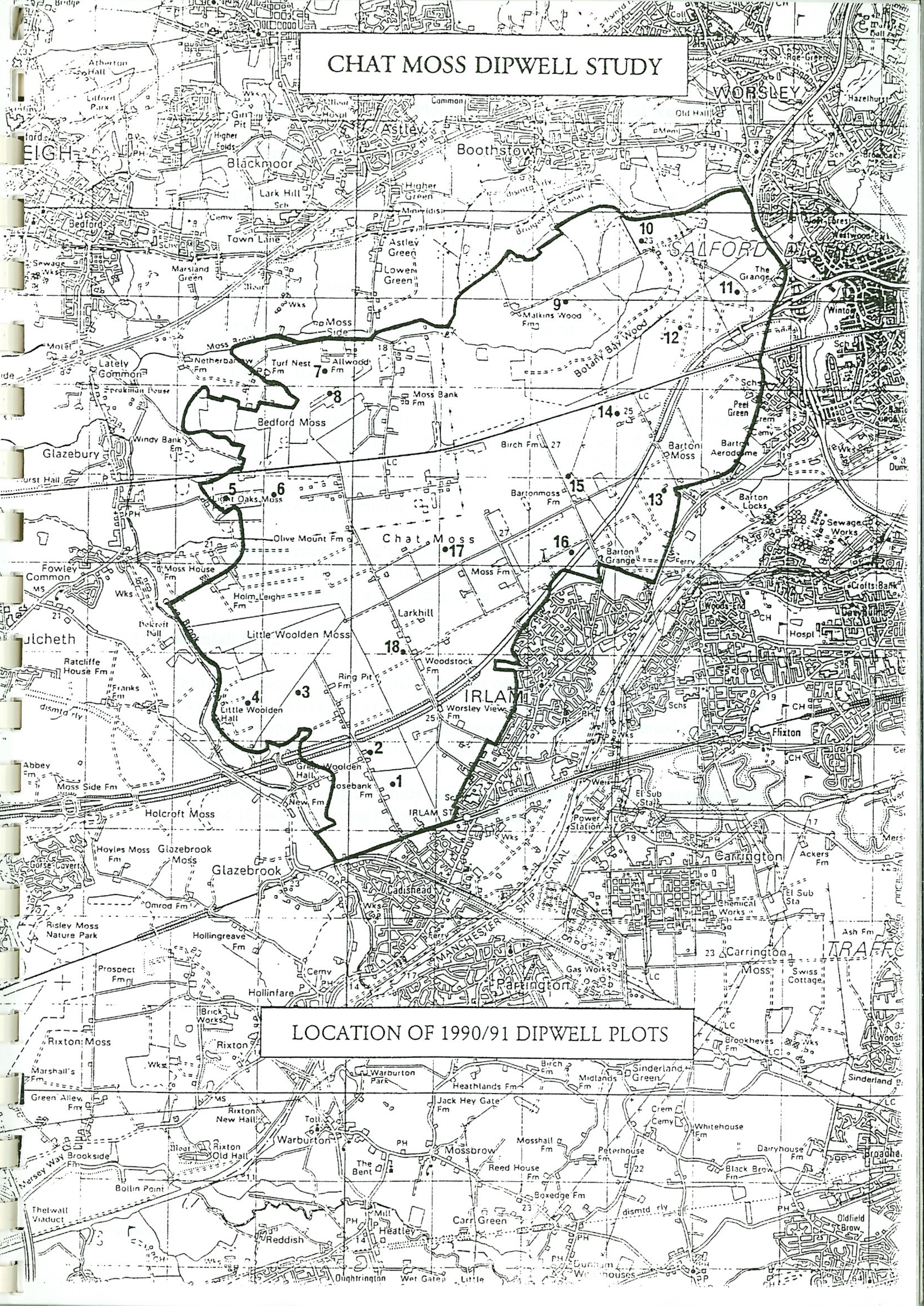


LOCATION OF 1990/91 DIPWELL PLOTS

Land Use	Plot Nos.	Total No. of Plots
Horticulture	1, 2, 13, 14, 15	5
Cereals	4, 11, 12, 16, 18	5
Grass	3, 5, 6, 7, 9, 10, 17	7
Non-agricultural	8	1

Table 1. Land use at dipwell plots on Chat Moss

2.1.4 Dipwell Readings

During the pilot study readings were taken twice weekly between January and April 1989. From mid-April until the end of June readings were taken once a week. During the main study readings were taken once a week throughout the study period as limited resources prevented more frequent sampling.

Measurements were taken by lowering a steel tape into the dipwell and measuring the height of the water table. Measurements were recorded in centimetres on a recording sheet.

2.2 Rainfall Data

During the second study rainfall data was obtained from two weather stations; Daveyhulme Sewage Works and Leigh Bedford Power Station, the latter having incomplete records. Rainfall figures for the study period along with those for the period 1964-1990 are shown in table 2.

It is notable that during the study period rainfall was 8.4% below average, with 8 out of 12 months having below average rainfall.

Table 1: Rainfall Data for Chat Moss

	Average Monthly Rainfall 1964-90 (mm)	Total Monthly Rainfall 1990-91 (mm)	% Difference
February	84.1	90.7	7.8
March	90.7	31.3	-49.3
April	70.6	44.2	-37.4
May	53	39.7	-25.1
June	65.9	93.3	41.5
July	70.9	31.1	-56.2
August	68.8	76.0	10.5
September	82.2	79.0	-3.9
October	83	135.5	63.2
November	92.8	83.4	-10.1
December	95.3	84.4	-11.5
January	93.8	55.6	-40.7
Average Monthly Rainfall (mm)	76.8	70.3	-8.4
Total Rainfall (mm)	922.1	844.2	-8.4

2.3 Data Collection

2.3.1 Pilot Study

More than half the dipwells were lost during the study period, mainly due to agricultural practices. The results were thus inconclusive and will not be discussed further. However important lessons were learned in terms of locating dipwells and the overall planning of the study.

2.3.2 Main Study

The 18 month study period has been divided into two 12 month periods and two sets of results compiled; these are referred to as data sets 1 and 2. Data set 1 covers the period February 1990 - January 1991 when the soil wetness cycle was wet - dry - wet, and data set 2 covers the period July 1990 - June 1991 when the soil wetness cycle was dry - wet - dry.

Soil wetness classes are defined in table 11 of the ALC guidelines on the basis of the number of days in most years when the soil is wet within a given depth. In order to place the dipwell results into a soil wetness class the results have been multiplied by 7 to give 364 days records. This extrapolation maintains the proportion of the recording period when the water table was within each depth class.

2.4 Results

The results for data sets 1 and 2 showed some slight variation in the derived ALC grades of individual dipwells but overall the ALC grades of the dipwell plots in each data set are the same, showing that the soil wetness class remains

the same throughout the "wetting cycle". The results of the two data sets have been combined and are presented in table 3.

2.5 Discussion

Using the revised guidelines the 1989 ALC survey placed the majority of the peat soils into wetness class II - IV; the surveyors then used their professional judgement to classify the land as Grade 1, (fig. 3.). The results of the dipwell study show that eleven of the plots maintain the ALC grades allocated by the ALC survey. This supports the ALC survey results and thus supports the present ALC system for classifying peat soils.

2.6 Limitations

The dipwell study had two major limitations which should be borne in mind when considering the results. Data was collected once a week over a 12 month period and then extrapolated to give a comparison with the ALC wetness class definitions. The results are thus not as complete a record of the depth and duration of waterlogging as would normally be required for wetness class definition. The short duration of the study also meant that the data was affected by short term rainfall averages. During the study period rainfall was 8.4% below the thirty year average and thus the depth and duration of waterlogging is likely to have been affected.

2.7 Dipwell Results and Wetness Class Definitions

Certain depth/duration combinations obtained by dipwell measurements were found not to meet any of the definitions of Soil Wetness Classes as given in Table 11 of the ALC guidelines. Two examples of this are as follows:

Table 3: Soil Wetness Classes and ALC Grades

Dipwell No.	Wetness Class	Dipwell ALC Grade	Survey ALC Grade
1	2	1	1
2	1	1	1
3	2	1	1
4	2	1	1
5	4	3a	1
6	3	2	1
7	2	1	1
8	4	non-ag	non-ag
9	2	1	1
10	2	1	1
11	4	3a	1
12	2	1	1
13	2	1	1
14	4	3a	1
15	1	1	1
16	3	2	1
17	2	1	1
18	2	1	1

1. The profile is wet within 70 cm for 63 days and wet within 40 cm for 7 days and there is no slowly permeable layer. Thus the profile is wet within 70 cm for more than 30 days but less than 90 days and so does not meet the criteria for Wetness Class I or II.

2. The profile is wet within 70 cm for 119 days and wet within 40 cm for 56 days. The profile is wet within 70 cm for between 90 and 180 days but is wet within 40 cm for more than 30 days and so does not meet the criteria for either Wetness Class II or III.

Combinations of depth and duration of waterlogging not covered by the present system include the following:

1. The soil profile is wet within 70 cm for 30 days or less and wet within 40 cm for 30 days or less but when combined they amount to between 31 and 60 days in total.

2. The soil profile is wet within 70 cm for between 31 and 90 days and wet within 40 cm for 30 days or less.

3. The soil is wet within 70 cm for up to 180 days but only wet within 40 cm for between 31 and 90 days.

4. The soil profile is wet within 70 cm for more than 181 days and wet within 40 cm for 30 days or less.

A flow diagram (figure 4) has been drawn up which includes the above combinations, and it is hoped covers all the possible permutations of depth and duration of waterlogging.

3. COMPARE THE WETNESS CLASS OF PEAT SOILS WITH THEIR AGRICULTURAL LAND QUALITY IN RELATION TO THE ALC REVISED GUIDELINES

3.1 Table 7 of the revised guidelines provides a means of establishing the wetness grade of peaty soils from wetness class and field capacity days. There is a gradual increase in wetness grade (from 1-4) as wetness class increases (from I-IV). However in wetness class V there is a significant step in the grading of the peaty and lighter textured soils, going from Sub-grade 3a in wetness class IV to Grade 4 in wetness class V.

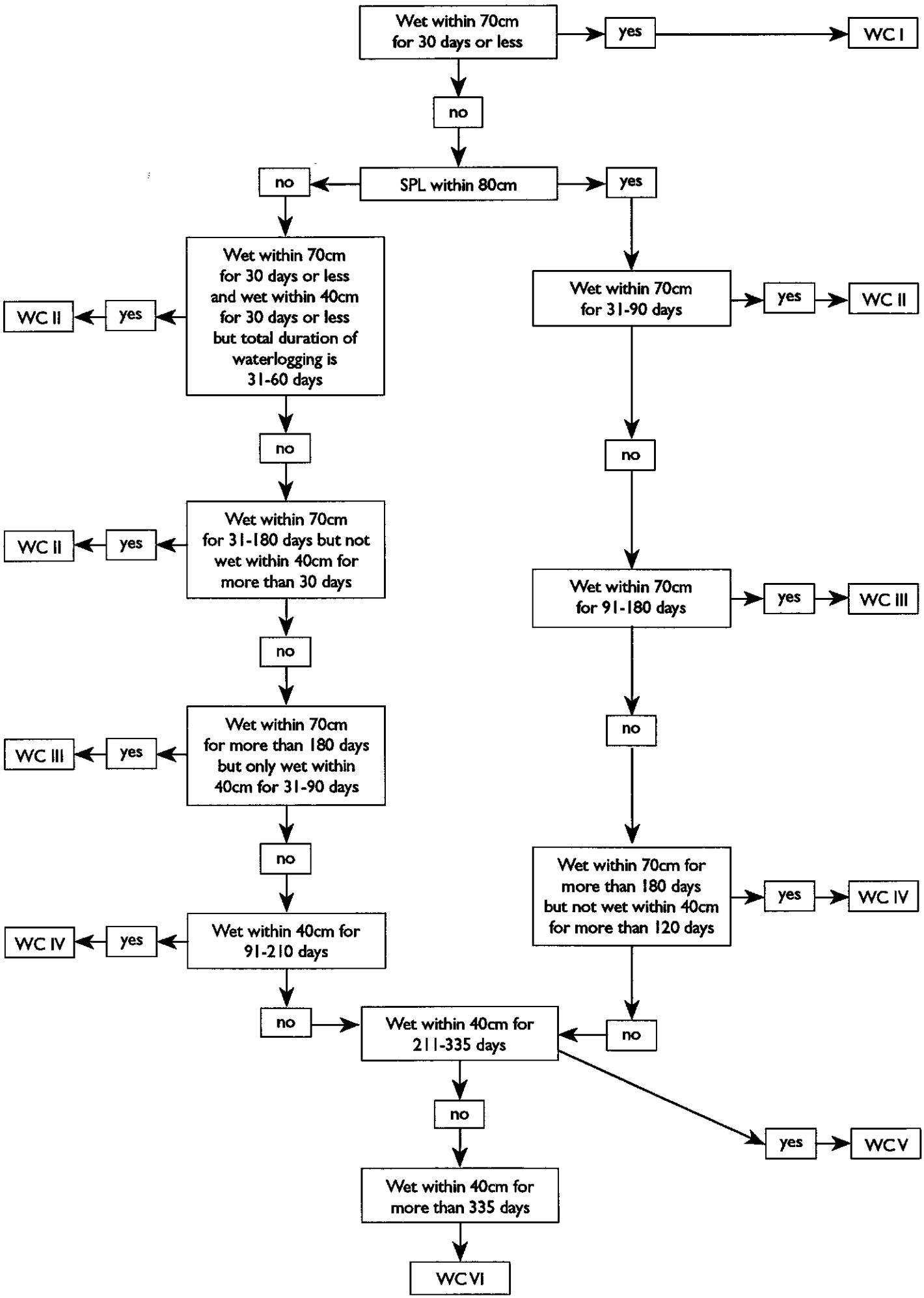
This jump of one sub-grade seems somewhat harsh and a need for a revision of this grading was recognised by Reading Agricultural Consultants in their report on Ashton Moss, Greater Manchester (Appendix 1). This site has 228 Field Capacity Days and a climatic Grade of 2. Following the ALC guidelines the soils would be placed into wetness class V and consequently into Grade 5. As much of the land is in intensive horticulture such a grading would seem unreasonable, (on the Provisional ALC Sheet 101 the Moss is shown as Grade 2), and the Consultants suggested that Sub-grade 3b would be more suitable. Further testing would be required but an amendment to the grading of peaty and light textured soils in wetness class V would seem necessary.

4. IDENTIFY OTHER ISSUES RELATING TO PEAT SOILS WHERE FURTHER GUIDANCE IS REQUIRED WITHIN THE REVISED GUIDELINES

In the process of carrying out the dipwell study reference to the Revised Guidelines has revealed areas where information on the agricultural classification of peat soils is limited. This was also highlighted by Reading Agricultural Consultants in their report on Ashton Moss. Areas where further guidance is required in the Revised Guidelines include: subsoil acidity caused by ochre formation following underdrainage and the need for relatively heavy lime applications; the need for re-drainage as the peat settles, and possibly the eventual need for pumping; the low load-bearing capacity because of general waterlogging.

At present no guidance is given to the surveyor on how to take account of such limitations when classifying peat soils.

Fig. 4: Flow Diagram for Wetness Class Determination



5. IDENTIFY AREAS WITHIN ENGLAND AND WALES WHERE LOWLAND PEAT SOILS ARE ASSOCIATED WITH A RELATIVELY HIGH RAINFALL

Lowland peat soils have been defined by the Soil Survey (Burton, Hodgson, 1988) as land below 200 metres OD where the peat is at least 40 cm thick and covered by less than 30 cm of non-organic material. For the purpose of this study, high rainfall has been defined as land with field capacity days in excess of 150. This meets the wetness class II-IV range in table 12 of the Revised Guidelines.

Figure 4 shows the principal areas of peat within England and Wales which meet these two conditions and table 4 gives a breakdown by county of the agricultural area of lowland peat soils in relation to their total area. The lowland peats are described here under the headings of the three field capacity day ranges above 150 which are used in the Revised Guidelines.

1. 151-200 Field Capacity Days

Northumberland	Prestwick Carrs
Durham	Bradbury and Ricknall Carrs
North Yorkshire	Hutton Buscel and Hertford River Carrs, Crakehill, Ings, Snape Mires
Lancashire	Hesketh, Tarleton, Martin Mere and Halsall Mosses
Cheshire	Woolston, Rixton, Appleton, Stretton and Cole Mosses
Shropshire	Fen and Whixall Mosses, Baggy Moor
Staffordshire	Aqualate Mere, Tibberton Moor
Hampshire	Test and Itchen Valleys, New Forest
Avon	Gordano Valley, Nailsea and Kenn Moors
Somerset	Brue Basin, Queens Sedge, Kings Sedge, West Sedge, North Moors, Parrett and Tone Valley

The total area of lowland peat soils within this FCD range is 33,502 hectares. Nearly 90% of these soils are in agricultural use, with arable and horticultural use concentrated in Lancashire and grassland more common in Cheshire, Hampshire and Somerset.

2. 201-225 Field Capacity Days

Cumbria	Bowness Common, Solway, Drumburgh and Rockliffe Mosses
Lancashire	Over Wyre, Lower Wyre, Fylde Lowlands, White Moss, Holland Moss, Rainford Moss, Simonswood Moss, Knowsley Moss
Gt. Manchester	Chat Moss, Holcroft Moss, Glazebrook Moss
Cheshire	Danes Moss
Gwynedd	Borth Bog

The total area of lowland peats within this FCD range is 15,046 hectares. Nearly 70% of these soils are in agriculture with arable and horticultural use concentrated in Greater Manchester, whilst the mosses in Cumbria and Gwynedd are more commonly used for nature conservation.

3. Greater than 225 Field Capacity Days

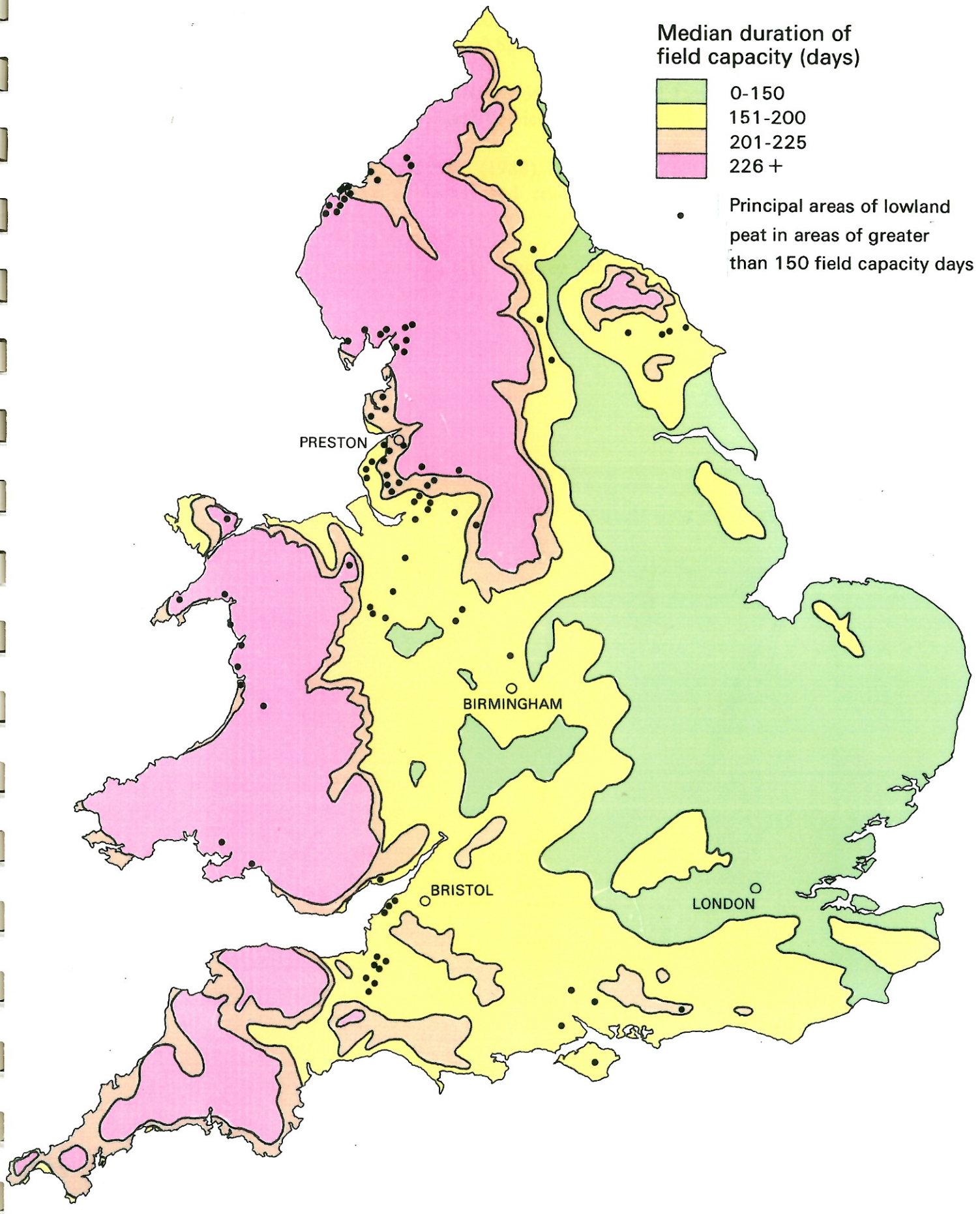
Cumbria	Allonby, Abbeytown, Black and Leven Estuary Mosses
Lancashire	Leighton, White Hale Moss, Burton Moss
Gt. Manchester	Ashton Moss
Gwynedd	Llanbedr Bog, Dyffryn Bog, Dysynni Bog, Arthur Bog, Tregaron Bog
Dyfed	Crymbyn Bog

The total area of lowland peat soils within this FCD range is 10,325 hectares. Nearly 70% of this area is in some form of nature conservation, mire reedswamp or semi natural vegetation. About 30% of the area is in some form of agricultural production, principally rough grazing and permanent pasture with limited arable farming and only Ashton Moss in Greater Manchester supporting intensive horticulture.

Table 4: Lowland peats in England and Wales

	>225 FCD			200-225 FCD			150-199 FCD		
County	Total area of peat soils (ha)	Area of peat in agriculture (ha)	% Of peat soils in agriculture	Total area of peat soils (ha)	Area of peat in agriculture (ha)	% Of peat soils in agriculture	Total area of peat soils (ha)	Area of peat in agriculture (ha)	% Of peat soils in agriculture
Northumberland							478	365	76
Durham							495	495	100
Cumbria	5992	1700	28	3117	195	6			
North Yorks							2246	2200	98
West Yorks							29	0	0
Lancashire	763	480	63	5920	5195	88	5845	5845	100
Merseyside				1266	1110	88			
Gt.Manchester	315	205	65	2735	2550	93	895	400	45
Cheshire				282	76	27	965	566	59
Shropshire							2509	1431	57
Staffordshire							704	467	66
West Midlands							39	20	51
Warwickshire							45	30	67
Hereford & Worcs							138	102	74
Gwynedd	1658	660	40	421	340	81			
Clwyd	100	0	0	10	0	0			
Powys				16	0	0	40	0	0
Dyfed	1195	319	27	1078	360	33	50	0	0
West Glamorgan	295	20	7	10	0	0			
South Glamorgan				50	10	20			
Gwent							148	112	76
Hampshire							1409	850	60
Sussex				100	100	100			
Kent							60	40	67
Isle of Wight							140	120	86
Dorset				0	0	0	248	20	8
Wiltshire							115	115	100
Avon							561	484	86
Somerset							16343	15568	95
Cornwall	7	7	100	13	0	0			

LOWLAND PEAT AND CRITICAL FIELD CAPACITY



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