ADAS
Environment Modelling
and GIS Group

Met Office

Development of a System for the Forecasting of Risk from Fire on Access Land in England and Wales

STAGE 1 – PROJECT REPORT

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1. INTRODUCTION

1.1 Stage 1 of the Project

This Stage 1 report sets out the work undertaken by the Met Office and ADAS Consulting Ltd. (ADAS) between 20 February 2002 and March 15 2002. The work represents the formal Stage 1 of the project (as completed by 15 March 2002) to "develop a system for the forecasting of fire risk on Access land in England and Wales".

Stage 1 of the project is to include:

- background research into fires and fire risk including:
  - the cause and frequency of fires on all types of Access land
  - damage resulting from fires
  - collate existing good practice and relevant guidance material on fire risk management
  - current procedures for fire risk management, including the role of local fire panels and any headline advice these bodies give to the public
- an interview with a representative group of relevant authorities namely :
  - the Countryside Agency
  - Countryside Council for Wales
  - Forestry Commission
  - Peak District National Park
- proposals for a prototype system to be implemented during Stage 2 of the project, and
- a wider consultation with a range of relevant authorities and other stakeholders.

In particular Stage 1 has tried to separate the interdependent, and constraining factors that affect the management and forecasting of fire on Access land currently. These include:

- current practice
- national and local policy
- available data and technology

1.2 Background to the Project

In November 2000 the Countryside and Rights of Way (CROW) Act received royal assent. Part I of this Act introduces means to create a qualified right of area-wide access on foot for open-air recreation to 'open country' (mountain, moor, heath and down) and to registered common land (together known as 'access land'). Means are also provided for land to be voluntarily dedicated for access, and any land so dedicated will be included in the term 'access land'.

The Act gives the Countryside Agency a key role in bringing the new access rights into effect in England (the Countryside Council for Wales has a parallel duty in Wales). Government is committed to implementing the new access rights across England by 2005.

There is a long history of informal public access to open country. It is not envisaged that creation of formal public access rights over this land will normally produce significant changes in visitor numbers. There will, however, be circumstances under which access will require management to avoid any conflict with other land management interests, for safety purposes or for the prevention of fire.

In the majority of cases informal management (e.g. use of notices asking the public to avoid an area or promoting awareness of safety issues or fire risk) will be sufficient. Where more stringent measures are considered necessary, the Act gives discretionary powers to the landowner or tenant to formally exclude or restrict access to their land for a limited number of days per year. Persons with a legal interest in the land may also apply for additional restrictions that are necessary for the purposes of land management, in the event of exceptional fire risk, or to protect the public from dangerous operations etc. This may take the form of complete exclusion of the public, restriction to linear routes, confining entry to specified access points, or other limitations on access.

The Act gives the Agency power to issue guidance to the 'relevant authorities' that will manage the new rights (which are National Park Authorities within national parks, Forestry Commission for dedicated woodland, and the Countryside Agency for other areas in England). It is important that the relevant authorities are consistent in reaching decisions on where exclusion or restriction of access is appropriate.

The access rights to be introduced under the CROW Act will be subject to national limitations. These are listed at Schedule 2 of the Act, paragraph 1 (e) of which states that the entitlement to be on the land does not include any person whom "lights or tends a fire or does any act which is likely to cause a fire".

Section 25 (1)(a) of the Act gives the relevant authorities legal powers to impose fire-related access restrictions. These powers may only be exercised when the relevant authority is satisfied that "by reason of any exceptional conditions of weather or any exceptional change in the condition of the land" restriction of access is necessary for the purpose of fire prevention. Ministers have stated that where high fire risk occurs independently of these conditions - some types of vegetation are flammable even in ordinary conditions, for example - this is not a reason to restrict access to the land, and the powers granted under section 25 (1)(a) would not apply (See Appendix N for the Hansard Transcription of the debate held in the House of Lords on 5 October 2000).

Ministers also made clear during the passage of the Bill through Parliament that land managers would not be expected to use their allowance of discretionary restrictions to manage access at times of high fire risk. So in situations where informal management of access is insufficient to meet the need, the powers given to the relevant authorities under section 25 (1)(a) will be the principal mechanism through which any necessary formal restriction on access for fire prevention will be made. The relevant authorities may give a direction either following application by the land manager, or without any application being made.

Access land will include a wide variety of land and vegetation types, which will vary in their susceptibility to fire. Where the nature of the land suggests that it is susceptible to fire, the local authority may give informal guidance to land managers on the steps they could take to manage the land to reduce fire risk. These may include pre-emptive measures such as maintenance of fire

breaks or controlled burning of vegetation, and ways to increase public awareness of fire risk and of what do to on discovering a fire.

1.3 Meetings Held to Date

A series of five meetings has taken place with the aim of establishing current fire risk management practices undertaken, specific requirements and aspirations of pilot stakeholders from the system and what datasets currently exist that could be incorporated into the fire risk management system. The meetings held were:

- Forestry Commission and Forest Enterprise, Thursday 21st February 2002,
- Peak District National Park Authority and Derbyshire Fire and Rescue Service, Monday 4th March 2002,
- Countryside Council for Wales, Monday 4th March 2002,
- Binnie, Black and Veatch, Thursday 7th March 2002,
- Countryside Agency, Tuesday 12th March 2002.

A summary of each meeting can be found in Appendices A to E respectively.

1.4 Wider Consultation - UK

As well as conducting meetings with the pilot stakeholders, ADAS has also contacted all of the National Park Authorities, or similar, in England and Wales to request information about current practice and existing datasets that may be of use to the fire forecasting system. A copy of the letter that was sent out to the National Parks (and equivalent) can be found in Appendix F, and a copy of the letter sent to the organisations contacted during the wider consultation exercise can be found in Appendix G. A summary of the responses received from the National Parks is given in Table 1 and from the other organisations who manage land in Table 2.

The organisations contacted were:

- Snowdonia National Park Authority
- Sussex Downs Conservation Board
- North York Moors National Park Authority
- Northumberland National Park Authority
- New Forest Committee
- Pembrokeshire Coast National Park Authority
- Broads Authority
- Brecon Beacons National Park Authority
- Exmoor National Park Authority
- Dartmoor National Park Authority
- Yorkshire Dales National Park Authority
- Lake District National Park Authority

The wider consultation process involved the following organisations:

- RSPB UK Headquarters

- Country Land and Business Association
- The Moorland Association
- The National Trust
- National Farmers Union
- United Utilities Water Plc
- Severn Trent Water Ltd
- South West Water Ltd
- Health and Safety Executive
- Hampshire County Council
- Countryside Management Service
- Dorset County Council,
- Cotswold District Council
- Cornwall County Council
- Timber Growers Association
- The Crown Estate
- English Heritage
- Defence Estates
- English Nature
- Countryside Management Association
- The Wildfowl & Wetlands Trust
- The Wildlife Trusts
- The Game Conservancy Trust
- The National Gamekeepers Association
- Farmers Union of Wales
- British Association for Shooting and Conservation Ltd

Not all of the organisations contacted have been able to provide a response at the time of writing.

Organisation	Risk Assessment Procedures	Fire Records	Periods at most risk	Vegetation at most risk	Actions taken during periods of high risk	Fire Liaison group?
Broads Authority	None for accidental fires - only for prescribed burning	Yes - paper	Summer	Reedbeds/peat, commons with gorse and broom, riverbanks - moorings	Fire warning signs places along dry footpaths or commons, temporary footpath closure or diversions	
Brecon Beacons National Park Authority	No formal risk assessment procedures - common sense approach	No	Not specified	All	Notices, press releases, radio interviews, liaison with the National Trust, CCW, other major landowners and the fire service	
Yorkshire Dales National Park Authority	No formal risk assessment procedures - common sense approach. On one estate a system is used based on 2 weeks without significant rainfall with by strong winds.	Not specified	Not specified	Moorland and dry heath areas - peat	Fire hazard/moor closed signs placed at access points, information centres and information points. If closed, articles also placed in local press and bulletins made on local radio. Patrols made.	Only for one estate - estate managers, Fire Service and Yorkshire Dales National Park Authority
North York Moors National Park Authority	MORECS data received monthly together with weekly forecasts for weather. Thresholds defined for trigger of actions	Records kept by Fire Service	Spring /Summer		Warning notices, volunteers placed at vantage points. If risk worsens, press releases and media bulletins. Substitution of steam trains with diesel. Closure of walks.	Yes - Fire Service, Forestry Commission, North Yorkshire Moors Railway, moorland land owners, North York Moors National Park Authority
Exmoor National Park Authority	MORECS received weekly. Thresholds defined to indicate risk.	Yes - MapInfo database	Summer	Grass (molinia), heather and gorse, scrub	Other land owners/managers informed of the risk. Fire warning signs placed at vantage points. Fire watch patrols.	Information exchanged during high risk period, but not specified as a Fire Liaison Group
Dartmoor National Park Authority	None specified for accidental fires – only for prescribed burning	Yes - GIS based	Not specified	Not specified	Fire plans drawn up and distributed to Fire Service, English Nature, DEFRA, Dartmoor Commoners Council	Yes
Sussex Down Conservation Board	No formal risk assessment procedures - common sense approach	Not specified	Not specified	Heathland	Highway Authorities requested to put out warning signs for motorists, barbecues banned, information given to public via website, local press and onsite signing and ranger presence.	
Peak District National Park Authority	MORECS received weekly. Soil moisture readings taken to validate MORECS data.	Yes – National Trust developed	Spring / Summer	Heather, deep peat	Fire warning signs, press releases, developing fire management plans, mobilising or relocating fire fighting equipment.	Yes – Peak District National Park Authority, National Trust, Derbyshire Fire and Rescue Service, Water companies, Independent landowners, Ramblers Association, Peak Park Moorland Owners and Tenants Association, English Nature and the British Mountaineering Council
Lake District National Park Authority	None	No	Summer	Heather moorland, deep peat, woodlands	Patrols undertaken. Advice may be posted on site and given to visitors. Fire beaters may be located at strategic points	

Table 1. Summary of Responses from National Park Consultation

Organisation	Risk Assessment Procedures	Fire History Records?	Periods at most risk	Vegetation at most risk	Actions taken during periods of high risk	Fire Liaison group?
The Crown Estate – Windsor Estate	Only for Woodlands. No formal procedure - periods without rain for 2 weeks predispose a high fire risk.	Yes	March to October	Woodlands and heathland understorey. Thicket plantations, heather and grass.	Fire plans ratified – contain contact numbers, rendezvous points, water bodies, main access points, hydrants, forest roads. Ranger patrols undertaken. Agreements with golf courses to ban smoking. Waymarker signs in forests showing quickest routes out. Fire risk signs NOT displayed. Forests closed as last resort.	Unofficial – Fire and Rescue, Local Authority & Crown Estate
The Crown Estate – Dunster Estate	Not specified	Not specified	Not specified	Heaths and young plantations	Posters displayed in visitor areas when vegetation in a dry state. Fire plans used.	Yes – Somerset Fire and Rescue Service, Exmoor National Park Authority, The Quantock Hills AONB, English Nature, The Forestry Commission, The Crown Estate, The National Trust. Annual meetings.
Defence Estates	Not specified	Not specified	Summer	Heather / peat	Fire maps produced showing water supplies and rendezvous points. Special clearance required for pyrotechnics. Fire danger rating boards placed at training camp gates and prominent places in the training areas. A ban on fires in woods and on ground where peat exists is implemented.	
Forestry and Timber Association	Forestry Commission Fire Danger Rating System	Yes	Not specified	Young forests	Not specified	Yes
Dorset County Council	Yes – based on on-site meteorological measurements	Yes – Dorset Fire and Rescue Service, Dorset County Council, Dorset Environmental Records Centre, GIS based	April to October		Distribution of fire plans. Visitor exclusion if not common practice, fire risk signs NOT displayed – was thought to be counterproductive in 1976. All fires strictly forbidden.	Yes – Borough of Poole, Bournemouth Borough Council, Christchurch Borough Council, Dorset County Council, Dorset Fire and Rescue Service, Dorset Police, Dorset Wildlife Trust, East Dorset District Council, English Nature and the Herpetological Conservation Trust
The National Trust	No nationally consistent formal fire risk assessment procedures	No	Not specified	Not known	Fire warning signs placed around grounds.	
Peak Park Moorland Owners and Tenants Association	Fire risk assessment procedure as for Peak District National Park Authority	Not specified	Summer	Peat, long vegetation alongside footpaths and roads	Procedure as for Peak District National Park Authority	Yes

Table 2. Summary of Responses from Wider Consultation

1.5 Wider Consultation – Abroad

ADAS has been in contact with many of the fire authorities, fire researchers and foresters abroad that have been undertaking research into fire risk forecasting and implement indices of fire risk. As well as providing documentation about their country's particular index of fire risk, many have offered advice for this project and for fire risk management in general.

The Canadian Forest Service expressed concern that the Canadian Forest Fire Danger Rating System may not be wholly applicable to England and Wales because of differences in fuel type (vegetation), topography, fire climate, values-at-stake and unique ignition factors. Advice was offered that the proposed system should be aimed at assessing the size of fire that the rural fire services can handle as a threshold for possible excluding access to land.

The Experimental Climate Prediction Center (ECPC) in California produce global daily estimates of fire risk based on their Fire Weather Index. In the U.S., this index would then be combined with an estimate of the vegetation status provided by the interpretation of satellite imagery. Although the ECPC believe that there would be some applicability of their index to England and Wales, the index alone lacks information about the fuel moisture and so becomes very variable throughout the day.

The U.S. Forest Service (USFS) uses a variety of indices of both fire weather and fire danger to asses the risk of wildland fire. The USFS recommend that for a full Fire Danger Rating System for England and Wales, background research in the following areas would be needed:

- Historical fire return regimes and fire ecology for all fuel types in England and Wales
- The production of fuel maps
- The production of smoke sensitive zone maps
- Estimates of average fuel consumption by fires during flaming and smouldering phases
- Average fire intensity estimates by fire type (small, large, duff or crown fires)
- Estimates of annual emissions for planned and unplanned fires
- The use of AVHRR satellite imagery for fuel moisture estimates (improving the resolution of fire risk to 1km scale).

2. RESULTS OF RESEARCH AND CONSULTATION PROCESS

2.1 The Cause and Frequency of Fires on all Types of Access Land

The Met Office has carried out a literature review of the causes of wildfires in the UK and the summary report is included as Appendix H.

There are many causes of fires on Access Land, including:

- intentional arson,
- discarded cigarettes and matches,
- out of control camp fires,
- discarded glass,
- fallen power lines,
- steam engines,
- weapon fire,
- lightning,
- out-of-control prescribed burning.

It is widely accepted that in the UK the majority of countryside fires are caused by arsonists or are accidental and that most are associated with the presence of people.[3],[4] In France, the causes have been estimated as 42% attributable to negligence, 27% accidental and 11% arson.[5] In contrast, lightning is an important factor in the ignition of wildfires in other countries, particularly in North America and Mexico.[6],[7] Dry lightning is a rare occurrence in the UK (refer to Appendix).

Table 3 contains the Forest Enterprise records for fires between 1991 and 1999, and this data is also displayed visually in Figure 4. The largest number of fires occurred in Wales, followed by South and West England, and the yearly total of recorded fires varied from just 17 fires in the 1998/9 period to 883 fires in the 1995/6 period.[1]

Region	1991/2	1992/3	1993/4	1994/5	1995/6	1996/7	1997/8	1998/9
N&E England	6	88	2	4	24	4	3	
S&W England		78	13	7	176	44	54	4
Wales	26	368	27	28	666	383	305	11
N Scotland		8		3	6	5	3	0
S Scotland	3	23	4	13	11	34	4	2
Great Britain	35	565	46	55	883	470	369	17

Table 3. Number of Fires in Forest Enterprise Woodlands Between 1991 and 1999. (Taken from Entec, 2000)[1]

Hampshire Fire and Rescue Service have attended about 4150 heath fires a year on average over the period 1976 to 1999, as detailed in Figure 1. The county split of grassland/heath fire attended by Fire Services is given in Figure 5, for 1995, one of the worst recent years for outdoor fires due to the hot summer. As can be seen from this figure, there is a strong correlation between the number of fires and the presence of population, with the largest cities in Greater London, West Midlands, Greater Manchester and Merseyside experiencing more than 10,000 fires in 1995, and West Yorkshire and South Yorkshire not far behind. The UK as a whole experienced on average 2.5 times as many fires in 1995 than 1997, which experienced a relatively average summer. Figure 2 charts the total number of grass/heath/woodland and crop fires attended by Fire Services in the UK over the period 1985 to 2000, which range from 30,000 to 172,000 fires per year. The daily rate of fires per month for 2000 is shown in Figure 3, from which it can be seen that in the peak fire seasons of Spring and Summer, some 300 fires per day are occurring throughout the country.

The former Department of the Environment, Transport and the Regions commissioned TERRA to undertake a series of independent reviews into records of heathland fires in Dorset.[10] 3333 records covering the period 1993 to 1998 were obtained from the following organisations:

- Dorset Fire and Rescue Service
- Dorset Wildlife Trust
- East Dorset District Council
- English Nature
- Forest Enterprise
- Herpetological Conservation Trust
- Poole Borough Council
- Royal Society for the Protection of Birds

From these heath fire records, the following summaries were made:

- the largest number of fires occurred in 1995,
- the month with the most fires was April, followed by August (except in 1995 when August had more fires than April)
- 24% of the fires occurred in Winter (January to March and October to December).
- fires occurred on all days, but there were 17.5% more fires at weekends than weekdays on average.
- fires also occurred at all times of day, but the lowest numbers occurred between 02:00 and 06:00 and the highest between 13:00 and 20:00, with a peak at 16:00 to 17:00 that was more pronounced during school term-time than school holidays.
- the fires were clustered predominantly around the urban fringes of the Dorset study area
- 61% of them were as a result of suspected arson, campfires were attributed to 18% of the fires and out of control prescribed burning to 7% of the fires.
- 42% of the records referred to areas of less than 0.025ha and 73% of areas less than 0.5ha. Only 7 fires were over 15ha and the largest fire recorded was 44ha.
- for fires larger than 2ha, the frequency was greatest in January and July, with most occurring further away from urban areas.

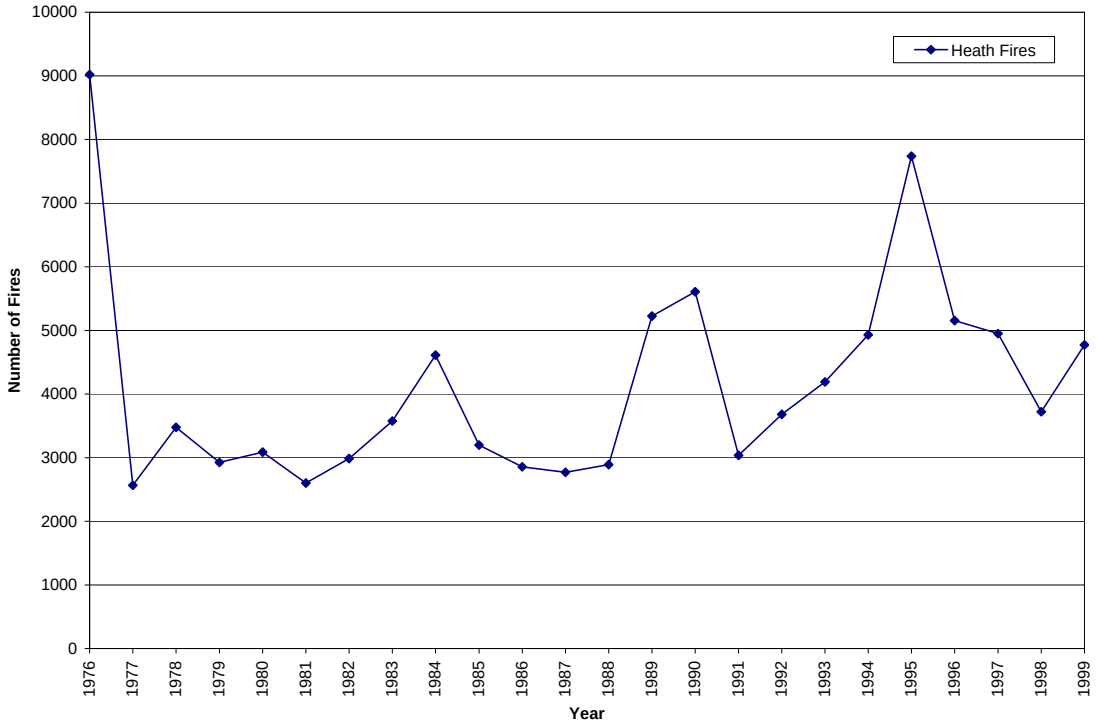


Figure 1. Number of Heath Fires Attended by Hampshire Fire and Rescue Service, 1976-1999

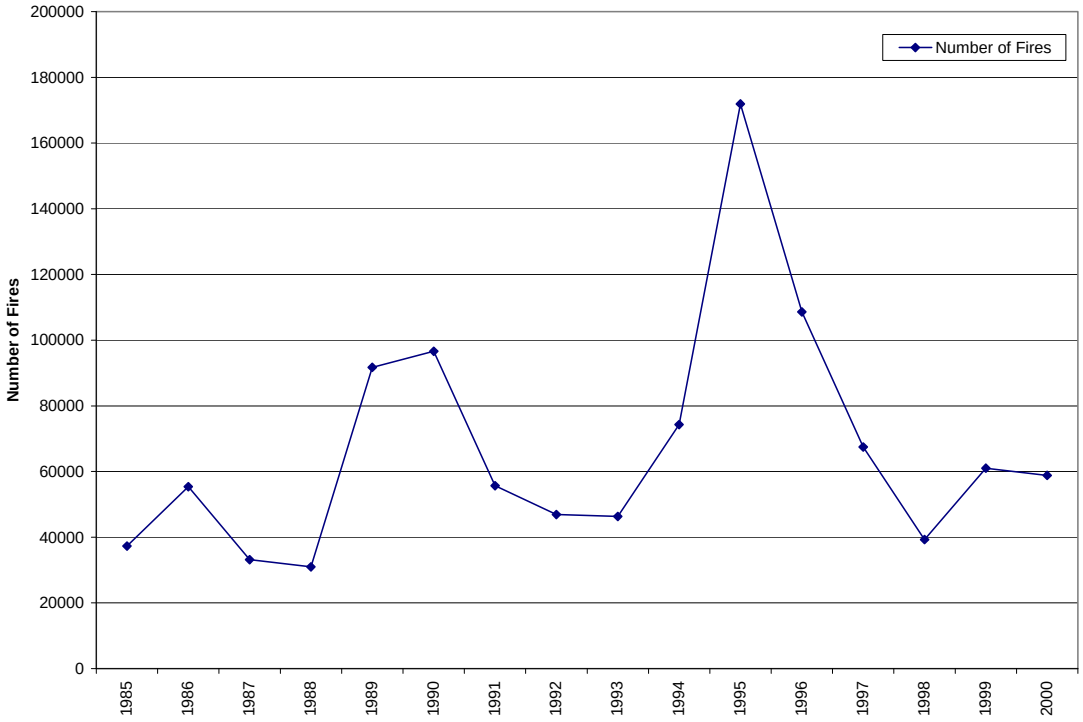


Figure 2. Number of Grassland/Heath/Woodland/Crop Fires Attended by the UK Fire and Rescue Services, 1985-2000

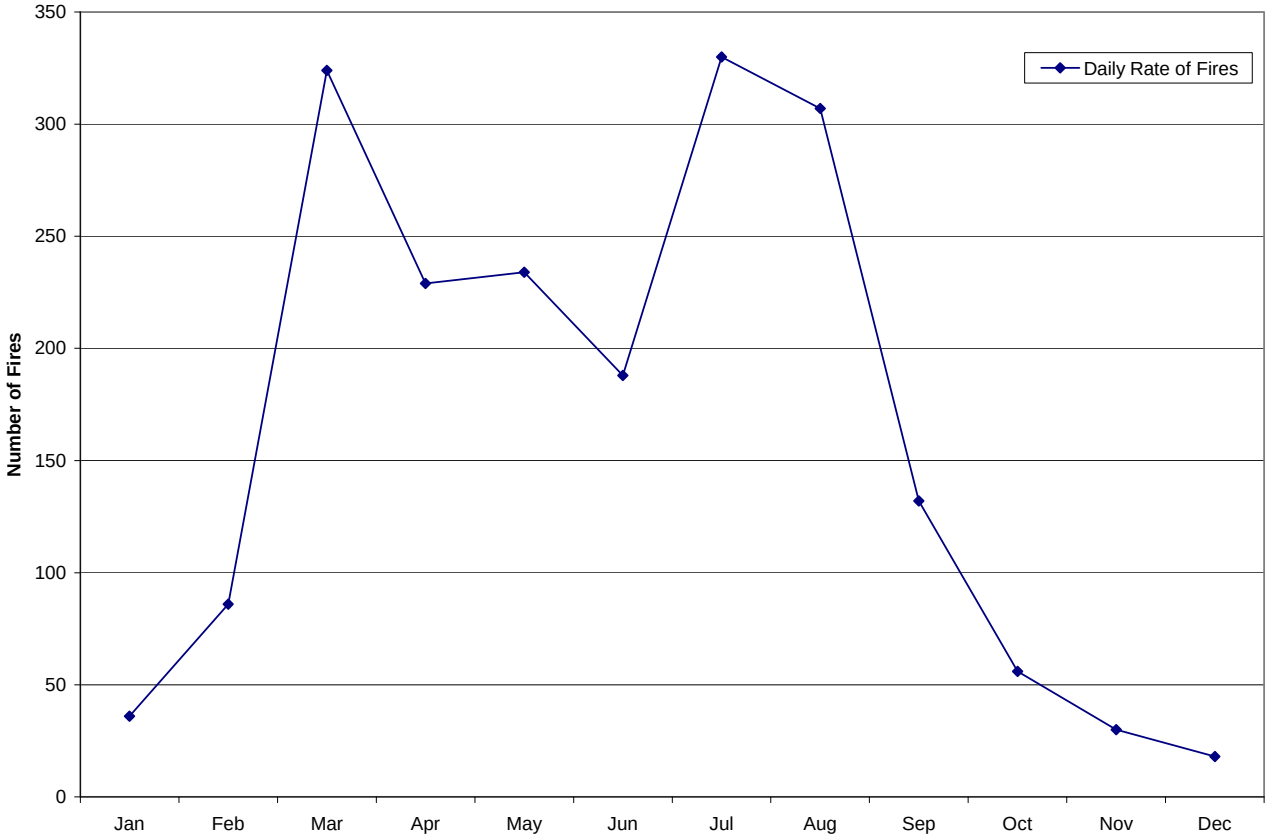
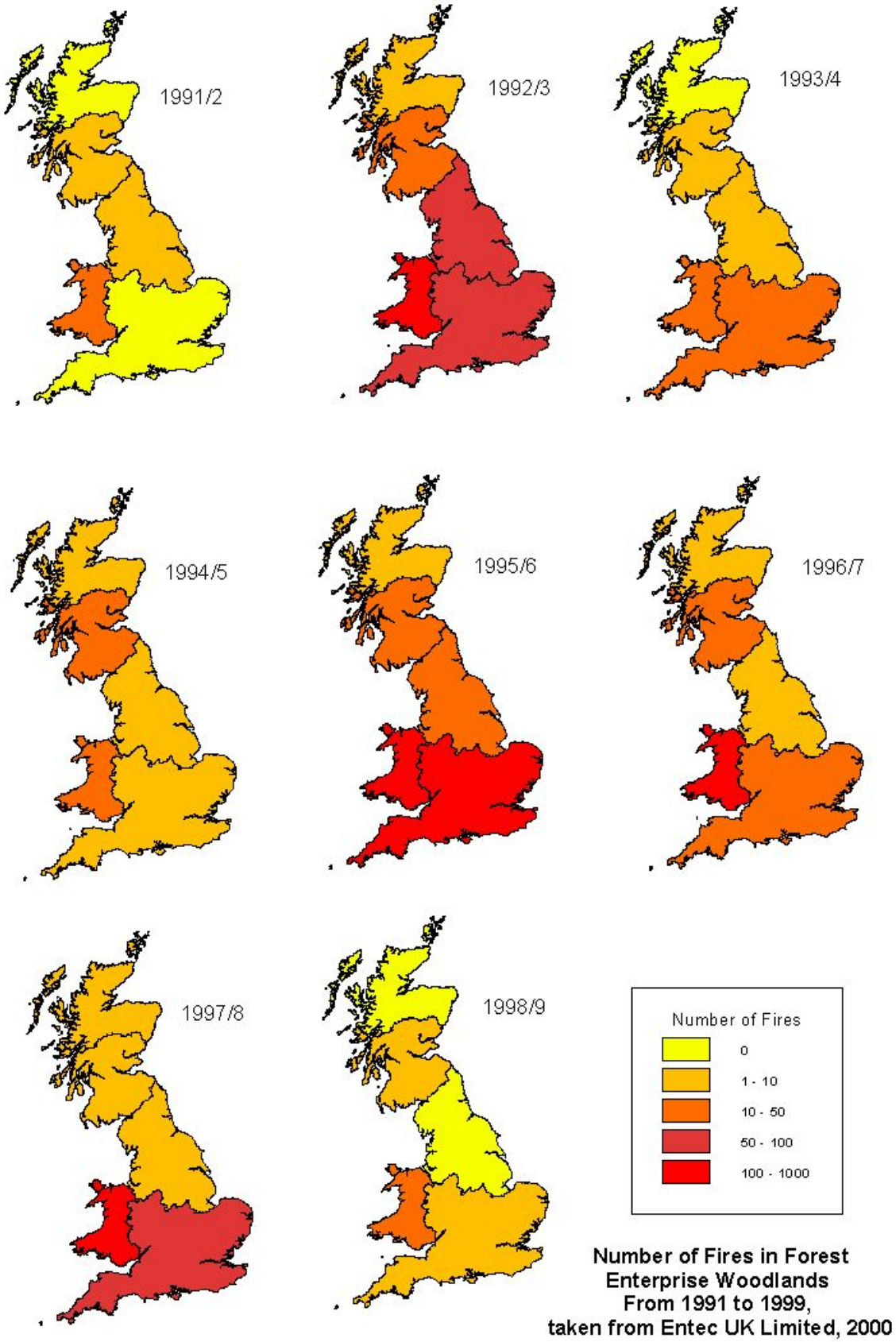


Figure 3. Daily Rate of Fires in the UK,2000



Number of Fires in Forest Enterprise Woodlands From 1991 to 1999, taken from Entec UK Limited, 2000

Figure 4

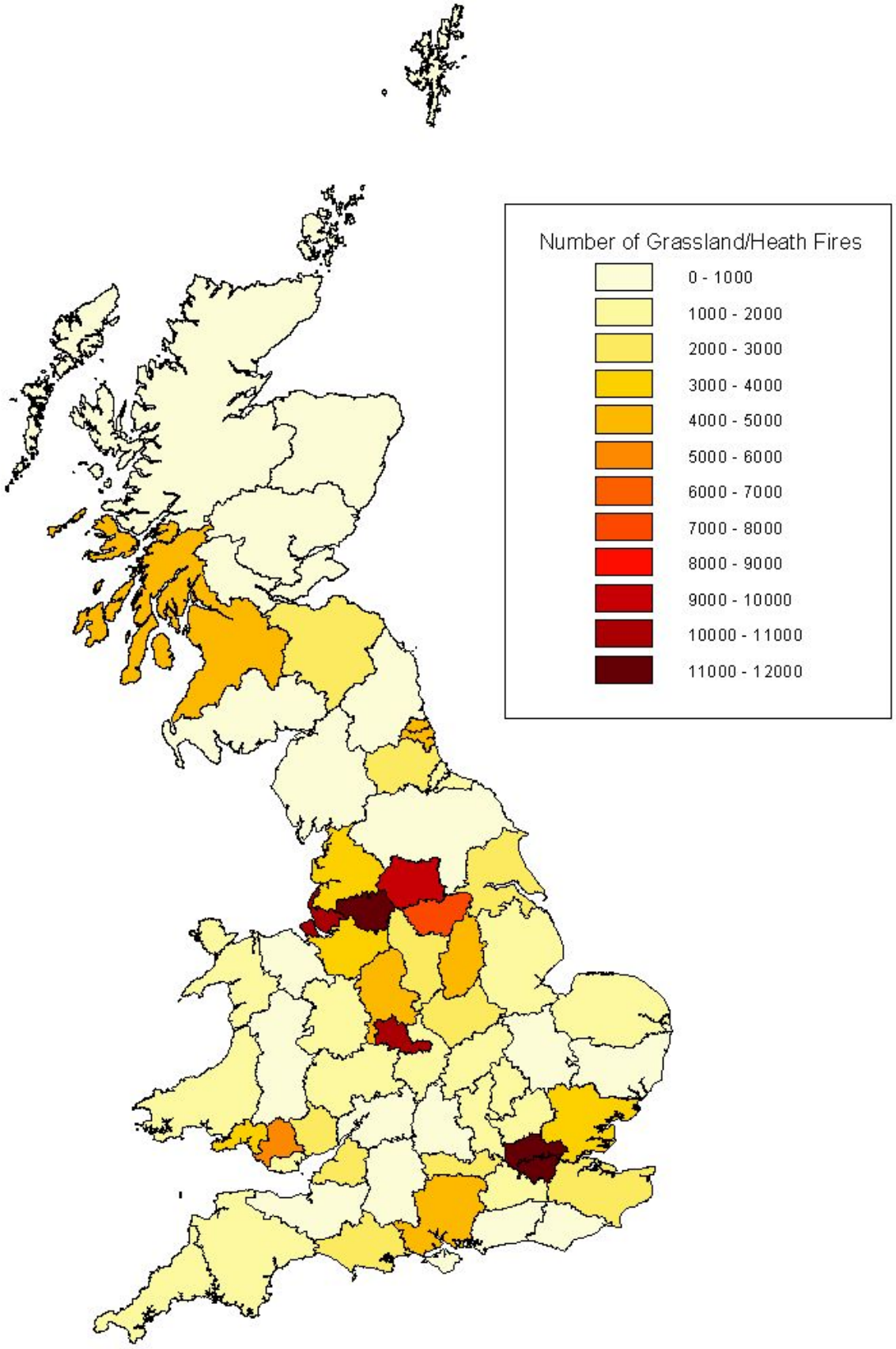


Figure 5. Grassland and Heath Fires Attended by Fire Services, 1995, from HOSB 08/97

2.2 Damage Resulting from Fires

The distribution of the area of land burnt in Forest Enterprise woodlands between 1991 and 1999 is demonstrated in Figure 6. The greatest area affected by fires was in the 1995/6 year, which coincides with the year of the largest number of fires, but the following year of 1996/7 suffered almost the same area of fires although the actual number of fires in Great Britain was almost half that of the previous year (refer to Table 3 and Table 4).

Region	1991/2	1992/3	1993/4	1994/5	1995/6	1996/7	1997/8	1998/9
N&E England	9.15	2.2	16	7.3	59.6	14.4	18.5	
S&W England		40.6	3.9	86.7	90.4	41	54.3	7.1
Wales	81.7	149	86.9	114	233	189	148.3	33.4
N Scotland		1.6		170	3.38	41.4	45.4	0
S Scotland	19.2	1.4	16.5	615	79.8	164	43.5	1.5
Great Britain	110.05	194.8	123.3	1023	466.18	449.8	310	42

Table 4. Area (ha) of Fires in Forest Enterprise Woodlands Between 1991 and 1999. (Taken from Entec, 2000)[1]

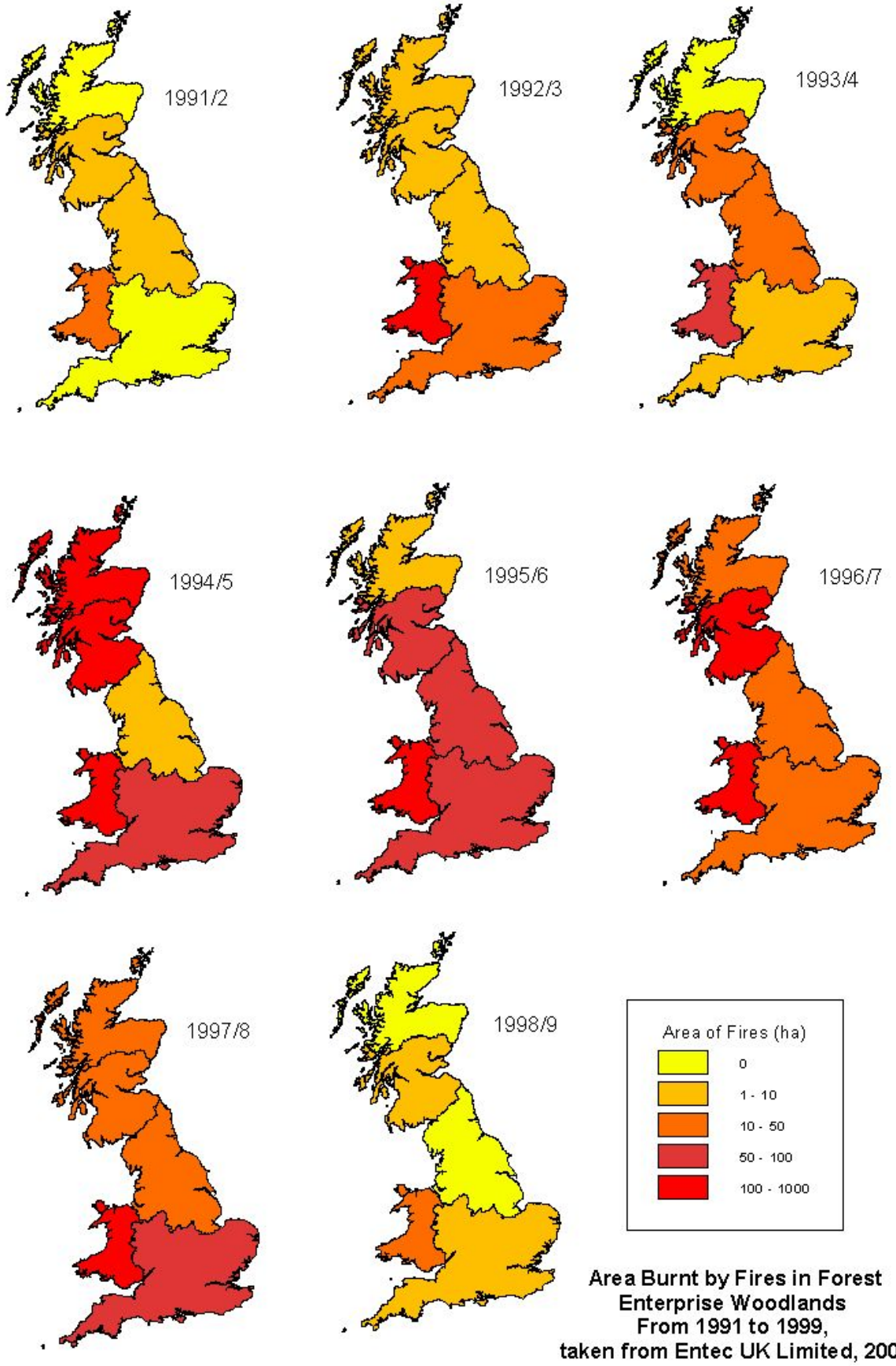
The average area of Forestry Commission forest burnt between 1973 and 1983 has been estimated at 710ha per year, and between 1985 and 1989 at 497ha per year, and it is also estimated that the area of privately owned forest burnt each year exceeds these figures.[2]

Although fire can be a normal part of the ecology of an area, uncontrolled fires can result in significant changes to the flora and fauna found in an area. During the fires on the Dorset heaths in 1976, about 11% of the county's heathland was burnt, and about 25-30% of older heaths (which are more susceptible to fire) were lost. Several species require older stands of heath, particularly reptiles, and as a result of the fires in 1976 many lost their habitat. The heath vegetation itself is estimated to take 20 years to re-establish to full maturity, and in the meantime is likely to be invaded by bracken and grasses which can lead to the complete elimination of heath.[8]

Significant adverse affects on the ecology of an area can occur as a result of not only large fires, but also frequent small fires. Fires in the wrong season can also be particularly damaging, for example to ground nesting birds. Re-colonisation is rapid where a large area of heath is concerned, but less rapid where small patches of heath are surrounded by modern urban landscapes that do not support the species that prefer a heathland habitat. A single fire that affects a significant proportion of an isolated heath may never recover fully it's former wildlife interest.[9]

Controlled burns are usually carried out in spring and should be small fast and of low intensity. Uncontrolled fires tend to occur in spring and summer and may be large, intense and burn for a long time. Uncontrolled fires can destroy all above-ground vegetation, burn into the organic matter in the soil and kill off roots, buds and seeds, and cause excessive nutrient loss, as well as destroying fauna in an area.[13]

TERRA (1999) point out that a relatively small heath may be able to support a large number of small fires, but because of a lack of data on the exact fire location and burn size it is difficult to determine the actual burn frequency on an area of heath. Although the frequency of burn on average may be less than that recommended for land conservation practices, the frequency of burning in some locations is likely to be much higher.[10]



Area Burnt by Fires in Forest Enterprise Woodlands From 1991 to 1999, taken from Entec UK Limited, 2000

Figure 6

2.3 Procedures for Fire Risk Management

2.3.1 Historical Information

A report by the World Meteorological Organization summarises the state of fire risk forecasting in 1961 [24]. Methods for assessing fire risk are summarised:

In 1943, Byram and Jemison found that:

$$Tf - Ta = I/(0.015V + 0.026)$$
$$Hf/Ha = e(-0.033(Tf-Ta))$$

Where

Tf = surface temperature of oak litter in deg F
Ta = air temperature in deg F
I = Intensity of radiation in calories / cm2 / min
V = windspeed at surface in mph
Hf = relative humidity at surface of litter
Ha = relative humidity at standard shelter value

Constants used in this formula will probably vary by fuel type.

A relative humidity value of 40% was taken to be significant in Canada, Germany and the USA, as the level at which forestry workers stop working because insurance policies become invalid if operations are carried on while humidity is below this level. This is the simplest form of fire danger rating.

In Korea, the difference between the air temperature and the dew point depression was used, with a threshold of 15°C being significant. This is not too dissimilar to the relative humidity threshold of 40%.

In Cyprus and Israel, an index based on saturation deficit was used with the following categories of risk:

30.4-40g/kg = very high
22.4-30g/kg = high
14.4-22g/kg = moderate

The Swedish Meteorological and Hydrological Institute uses a system developed by Angstrom (1942):

$$B = 5R - 0.1\,(t-27)$$

Where

R = relative humidity,
T = temperature (deg C)
Fire risk = B< 2.5

An early Australian index was developed by Cromer for use in New South Wales (Foley 1947):

$$D = \sum_{I=1}^{n} (0.6T - 0.3H - 30)$$

Where measures are taken at noon and

n = number of days since rain
T = temperature (deg f)
H = relative humidity

And when I=0, D = 2 (0.6T – 0.3R – 30).

Nesterov's index used in the former USSR is:

$$G = \sum_{i-1}^{n} (d \times t)$$

where

n = number of days with no rain (<2.5mm)
d = humidity deficiency (in millibars) at 1.00pm
t = temperature (deg C) at 1.00pm

There are 3 resulting fire risk categories:

I – 0 to 300 units
Ii – 301 to 1000 units
Iii – above 1000 units

The Polish State Hydrological and Meteorological Institute modified the Nesterov index as follows:

a) rainfall <= 2.0mm is not taken into consideration
b) rainfall between 2.1mm and 5mm reduces the previous G value by 25% before adding the current value of (dxt)
c) rainfall between 5.1 and 8mm reduces the previous day's G value by 50% before adding the current days value
d) rain between 8.1mm and 10mm means that G restarts on the day with rain
e) rainfall > 10mm means that the G value restarts on the day after the day with rain.

The resulting risk categories are as follows:

G	Degree of fire danger
<=300	no danger
301-500	small danger
501-1000	average danger
1001 – 4000	great danger
>4000	exceptionally great danger

The former Federal Republic of Germany and the North Western USSR used a soil moisture deficit index to assist in indicating the degree of danger of bog and heath fires – similar to the MORECS readings used in some of the National Parks in the UK.

The Japan Meteorological Agency issued an index relating to the fire risk for wooden buildings:

$$(He)i = (1-r)Hi + r(He)i-1$$

where

He = effective humidity
Hi = humidity on day I
R = constant, less than one that indicates the proportion of the effect of the humidity of the previous day.

Fire warnings will be issued when:

a) an effective humidity of 60% or less and a forecast humidity of 40% or less, together with a maximum windspeed of of 7mph or more
b) winds of mean windspeed of 10 m/s or more will continue to an hour or more, in the absence of precipitation.

All of these indices are measures of the fuel moisture content and give an indication of the ease of inflammability. Other systems take account of wind and long-period drying to attempt to provide an estimate of burning intensity and ease of control. Many of these systems however require some

degree of visual estimate of the condition of the fuel, and/or measurement of fuel moisture directly by weighing specially designed fuel indicator sticks.

2.3.2 Forestry Commission Fire Danger Rating System

In the UK, the Meteorological Office issued fire warnings to farmers during World War II to indicate the level of risk associated with enemy attacks on crops[25]. These warnings covered quite large areas, for example Cornwall, Devon, Somerset, Wiltshire and Gloucester were one area. At the request of the Forestry Commission, the Meteorological Office altered the form of the warnings slightly to make them more applicable to forest conditions and the Forestry Commission received these warnings from March 1942 to July 1943. The Meteorological Office index was compared to the index used in Canada in the 1940's. Peace reports that the Meteorological Office index of that time was too variable, being too sensitive to slight changes in windspeed and slight rainfall. He also found that although the Canadian index was less variable than the Meteorological Office index, there was no allowance for dew and so in September when heavy dews form, the Canadian index gave too high a danger reading. Peace found good correlation between foresters estimates of fire danger and the Canadian index of the time and the UK Forestry Commission Fire Danger Rating System was borne from principles learnt from Canada. It is recommended that the maximum area for one weather station to cover is 100 square miles.

The Forest Enterprise estate within England and Wales is split into Forest Districts, and procedures vary between the Districts. In general though the Forestry Commission's Fire Danger Rating System is comprised of a fire hazard component and a fire risk component, and there are two methods used to calculate the risk and hazard of a forest on a particular day. The standard method is to be used in a subjective assessment of the fire danger in diverse and scattered blocks of trees where there is variable hazard and little risk, and little or no history of fires. The fire hazard component is determined from four constituents: the type and condition of the dominant vegetation, the relative humidity and the wind speed. Values assigned to each of these variables are given in Table 5 and Table 6. The way that the fire hazard rating and the fire risk rating are combined is shown in Table 7.

Factor	Description	Value
Type of Ground Vegetation	Molinia	+3
	Bracken	+2
	Grass	+1
	Heather	+1
	Gorse	+1
	Brash	0
Condition of Ground Vegetation	Dead-dry (e.g. hot period in Spring)	+3
	Yellow-drying (e.g. hot Summer drought)	+2
	Lush-green (e.g. later Spring growth)	-2
	Dead-moist (e.g. wet Winter time)	-2
Relative Humidity	Under 40%	+3
	40%-50%	+1
	50%-60%	0
	60%-80%	-1
	Over 80%	-2
Wind Speed	Force 5 and over (17 knots and over)	+1
	Force 4 (11-16 knots)	+1
	Force 3 (7-10 knots)	+1
	Force 2 (4-6 knots)	0
	Force 1 (0-3 knots)	-1

Table 5. Standard Method of Calculating the Fire Hazard Index

Factor	Description	Value
Season	Spring (March to May)	+2
	Summer (June to August)	+1
	Autumn (September to October)	+1
	Winter (November to February)	0
Day	Sunday or Bank Holiday	+3
	Saturday	+2
	Weekday	+1
Time	Afternoon (Midday to Sunset)	+3
	Morning (Sunrise to Midday)	+1
	Night (Sunset to Sunrise)	-1
Weather	Warm (Warm and sunny)	+2
	Cool (Bright but cool)	+1
	Cloudy (Dull but dry and not cold)	0
	Showery (Cool with frequent showers)	-2
	Cold (Dull and cold, but dry)	-2
	Wet (Wet and overcast)	-4

Table 6. Standard Method of Calculating the Fire Risk Index

Hazard Rating	Risk Rating				
	1 or 2	3 or 4	5 or 6	7 or 8	9 or 10
1 or 2	Nil	Nil	Nil	Nil	Nil
3 or 4	Nil	Nil	Nil	Low	Low
5 or 6	Nil	Low	Low	Moderate	Moderate
7 or 8	Low	Low	Moderate	High	High
9 or 10	Low	Moderate	High	High	Extreme

Table 7. Standard Method of Combining Fire Hazard and Fire Risk Ratings to Obtain Fire Danger Rating

The special method of calculating the fire danger rating is to be used at forests where there are large concentrated areas with uniform environmental conditions, above average hazard and risk and a history of fires. This method is more complicated and requires meteorological readings to be taken for rainfall, temperature, relative humidity, and wind speed as well as an assessment of the ground vegetation condition. The special method of fire danger assessment also incorporates a memory of the conditions the day before into the calculation. The tables used to calculate the special method of fire danger rating are given in Appendix .

The TERRA environmental consultancy was commissioned by the Department of the Environment, Transport and the Regions to undertake a review of the ability for the Forestry Commission Fire Danger Rating System to predict the frequency of fire events. It was found that there was considerable variation in the ability of the danger rating system to predict a fire event, with only 1996 producing a strong relationship. Over most of the years of fire history data that TERRA had collated, the Forestry Commission Fire Danger Rating System Hazard Index was most strongly correlated to the occurrence of fires in the months of May, August and September. They did find that there was a strong tendency for the number of recorded fires to increase with the severity of the Danger Rating Index.[11]

2.3.3 The Peak District National Park Fire Risk Assessment Procedure

Between April and September, the Peak District National Park Authority receive the MORECS model data from the Met Office at a resolution of 40 square kilometre cells, of which only 4 overlap with the Peak District National Park. These data are received weekly and plotted against a map of actual fire occurrence (developed by the National Trust in 2000). If the MORECS data is predicting a “high” risk, Peak District National Park Ranger Service personnel will take soil moisture readings in vulnerable areas (as determined from the map showing actual fires and from personnel experience). These readings are used to validate the outputs from the MORECS data and if a “high” risk is also indicated from the soil moisture readings, the Fire Advisory Panel will be called in to assess the data, along with future predictions for rainfall, and advise appropriate actions to be taken. The soil moisture readings consider the condition of the surface vegetation (dead, dry or green), the condition of the surface peat (dry, damp or wet), the depth of moisture (to 0.5”, 1.0”, 1.5” or 2.0”) and the flow rate of plateau water (nil, poor or good).

2.3.4 TERRA Environmental Consultancy’s Review of the Impact of the Weather on Fire Risk

TERRA were commissioned by the Department of the Environment, Transport and the Regions to undertake an assessment of the impact of the weather on fire risk on Dorset heathland. Fire history data was collated and meteorological data obtained for Bournemouth International Airport – the nearest weather station to the heaths. Meteorological variables considered were the daily minimum and maximum air temperatures, the daily sunshine hours, daily rainfall, relative humidity at 12:00

GMT, the daily mean wind speed and the wind direction at 12:00 GMT. It was found that the strongest relationships occur between the weather variables on the actual day of the fire event rather than after a time lag. When average conditions over a 10/11-day period were examined, only relative humidity was found to have a significant relationship. For summed conditions the mean and minimum temperatures, the number of sunshine hours and the relative humidity were found to have a relationship with fire occurrences. The number of cumulative sunshine hours was found to have a positive relationship with the number of fires, and the rainfall, wind speed and relative humidity all had negative relationships with the number of fires. They conclude that the number of fires was increased when the total rainfall in a 10/11-day period was less than 10mm and the cumulative relative humidity was less than 600. The also conclude that winds with a direction from the north or the east on an individual day resulted in more fires than winds from other directions.[11]

2.3.5 Canadian Forest Fire Danger Rating System

The Canadian Forest Fire Danger Rating System has been developing since 1968 with the most recent improvements added in 1992. It consists of two components, the Canadian Fire Weather Index (CFWI) incorporating a daily severity rating and the Fire Behaviour Prediction (FBP) System. The CFWI provides numerical ratings of relative fire potential based on weather variables and is schematically represented in Figure 7. Weather readings are taken at noon on a daily basis and used as inputs to the CFWI to form 6 sub-components, defined as:

- Fine Fuel Moisture Code (FFMC) – A numerical rating of the moisture content of litter and other cured fine fuels. This code is an indicator of the relative ease of ignition and flammability of the fine fuel.
- Duff Moisture Code (DMC) – A numerical rating of the average moisture content of loosely compacted organic layers of moderate depth. This code gives an indication of fuel consumption in moderate duff layers and medium sized woody material.
- Drought Code (DC) – A numerical rating of the average moisture content of deep, compact organic layers. This code is a useful indicator of seasonal drought effects on forest fuels and the amount of smouldering in deep duff layers and large logs.
- Initial Spread Index (ISI) – A numerical rating of the expected rate of fire spread. It combines the effects of the wind and the FFMC on the rate of spread, without the influence of variable quantities of fuel.
- Buildup Index (BUI) – A numerical rating of the total amount of fuel available for combustion that combines DMC and DC.
- Canadian Fire Weather Index (CFWI) – A numerical rating of the fire intensity that combines ISI and BUI. It is suitable as an index of fire danger.
- Daily Severity Rating (DSR) – A numerical rating of the difficulty of controlling fires which is based on the FWI but more accurately reflects the expected efforts required for fire suppression.

Although the weather readings are taken at noon, the data were correlated with fine fuel moisture content and test-fire results taken later in the afternoon at about 16:00. The Fire Behaviour Prediction system predicts the rate and direction of spread of fire in different fuels and is expressed diagrammatically in Figure 8. These two components combine with other subsystems, still under development, to form the Canadian Forest Fire Danger Rating System as shown in Figure 9. The Canadian Fire Danger Rating System is designed for a standard pine fuel type, and subsequent indices have evolved for other fuel types.

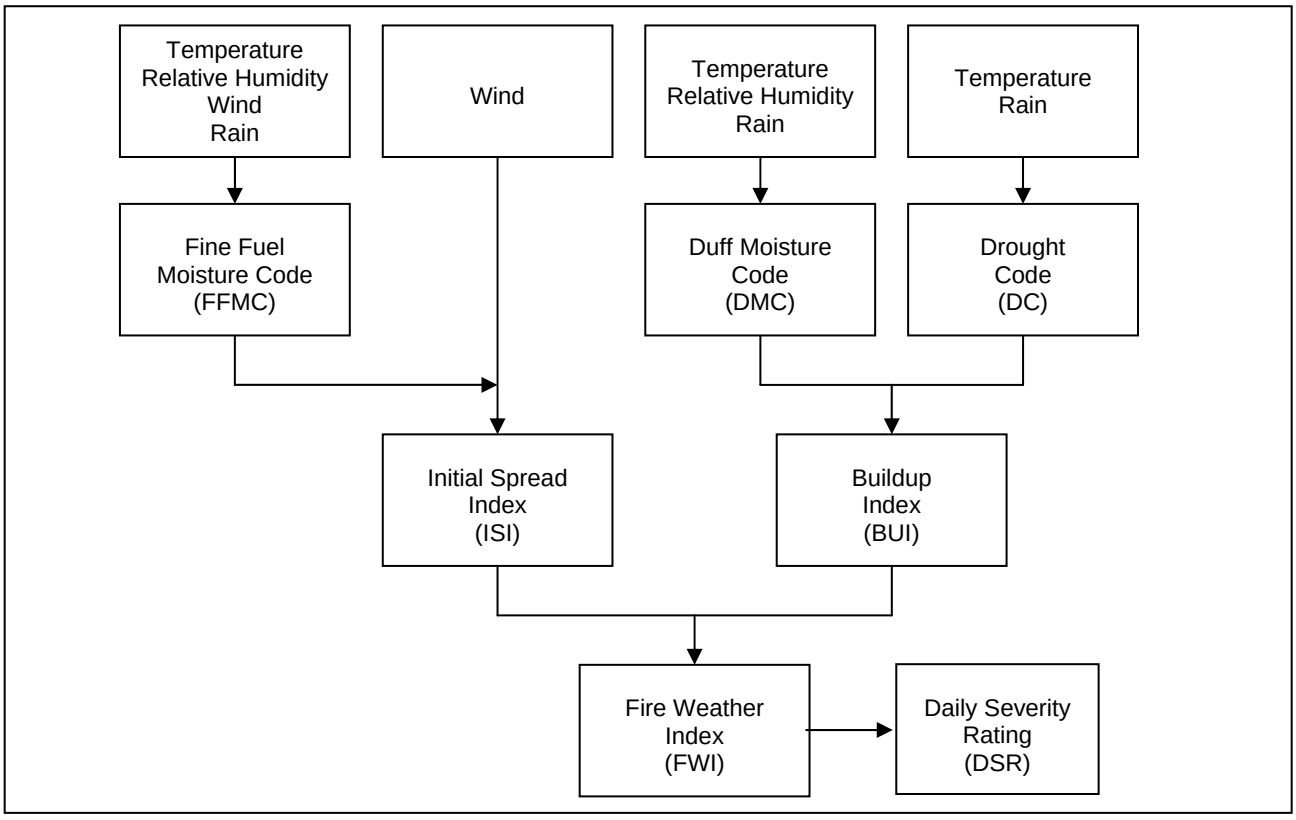


Figure 7. Structure of the Canadian Fire Weather Index

The midafternoon moisture content of fast drying fuels represented in the FFMC are less dependent on the day length than the two slower reacting moisture codes, DMC and DC. The DMC and the DC, representing slower drying fuels, will be dependent upon the length of time for drying, which will vary according to the season. The Canadian Fire Weather Index was designed to be fuel-independent and provide uniform results across Canada. The question of how fire varies with fuel type was considered to be a separate problem, to be solved independently.

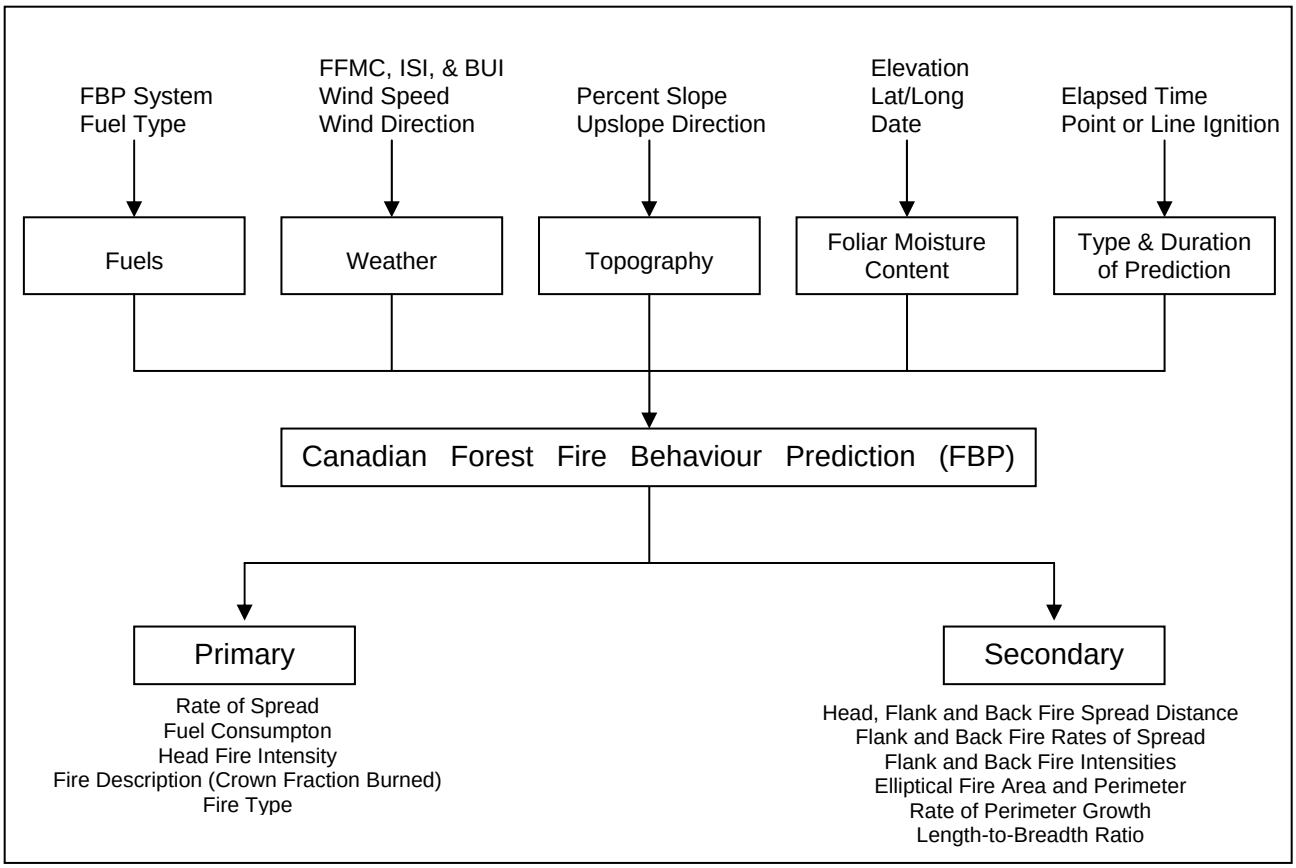


Figure 8. Structure of the Fire Behaviour Prediction System

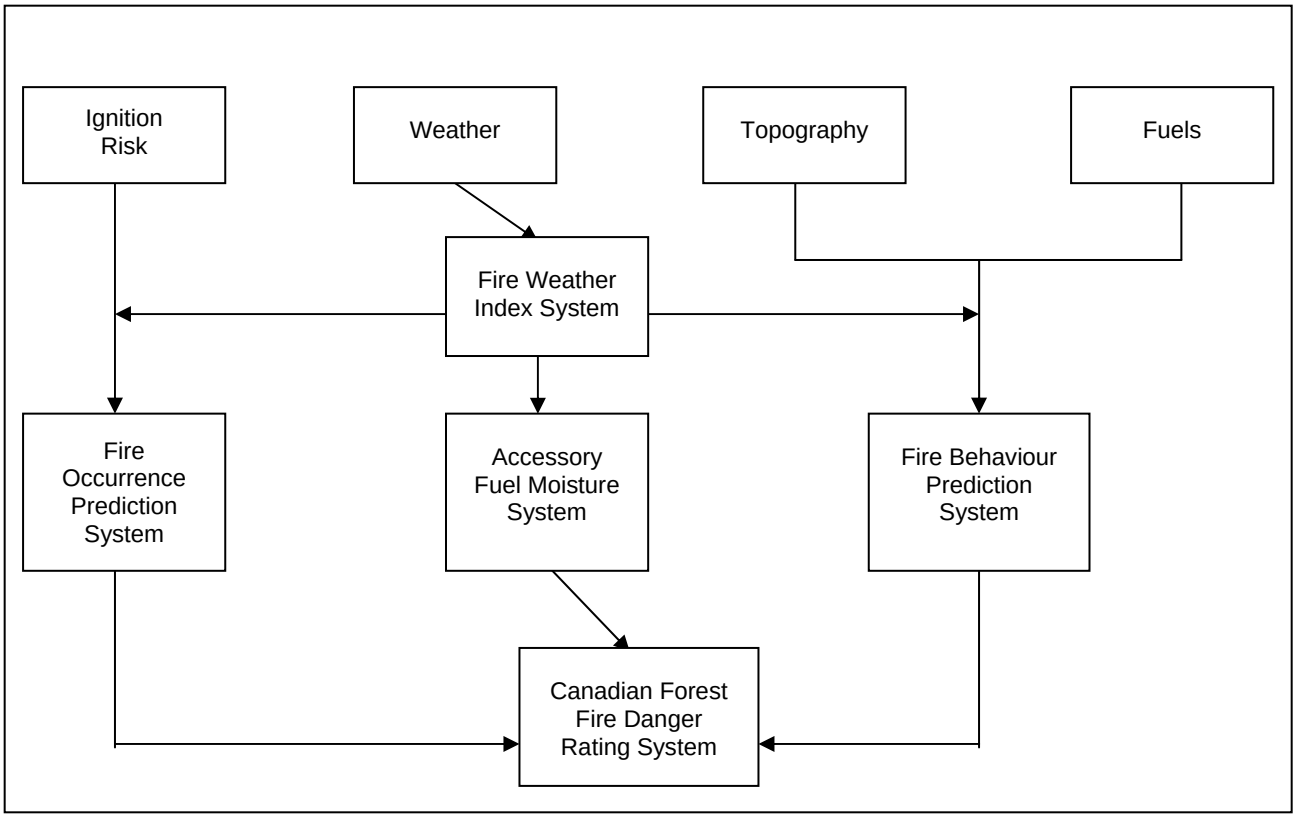


Figure 9. Simplified Canadian Forest Fire Danger Rating System Schematic

2.3.6 U.S. National Fire Danger Rating System

The U.S. National Fire Danger Rating System consists of three components, defined as:

- Ignition Component, which relates the probability that a fire will result when a firebrand is introduced to a fine fuel;
- Spread Component, which integrates the effects of the wind and the slope with the fuelbed properties to calculate the predicted rate of spread of a fire;
- Energy Component, which is defined as the potential available energy per unit area of fire.

These three components combine with other submodels to generate fire danger related indices:

- The Lightning Caused Fire Occurrence Index considers potential fire incidence caused by lightening strikes and is built up from fire history data.
- The Man-Caused Fire Occurrence Index considers potential fire incidence caused by human presence and is built up from fire history data.
- The Burning Index is a numerical value that indicates the predicted amount of effort needed to contain a single fire of a particular fuel type and is calculated from the Spread Component and the Energy Release Component.
- The Fire Load Index is a numerical rating of the amount of effort required to contain all probable fires within a specified period of time and is comprised of the Occurrence Indices and the Burning Index.

Figure 10 shows a schematic of the National Fire Danger Rating System.

Fuel models are used to describe the fuel loads in terms of the time required for particular a vegetation type to dry out. For example, short grass is estimated at 0.74 tons/acre of which all of it is considered to be a 1-hour fuel. A 1-hour fuel would take a 1-hour timelag period to lose (or gain) 63% of the difference between the current level of moisture within the fuel and the equilibrium moisture content (assuming constant atmospheric conditions for a period of time).

Fosberg (1978) (cited in Roads et al, 1991[26]) developed a simplification of the National Fire Danger Rating System that assumes constant fuel properties whereby,

$$a = m/30$$

Where:

$$m = 0.03229 + 0.281073R - 0.000578RT \quad \text{for } R < 10\%$$
$$m = 2.22749 + 0.160107R - 0.014784T \quad \text{for } 11 < R < 50\%$$
$$m = 21.0606 + 0.005565R^2 - 0.00035RT - 0.483199R \quad \text{for } R > 50\%$$

and

$$FWI = (1 + W^2)^{½}(1 - 2a + 1.5a^2 - 0.5a^3)/0.3002$$

Where

FWI = Fire Weather Index
W = Windspeed (statute mph)
a = Normalised equilibrium moisture content
R = Relative Humidity (%)
T = Temperature (°F)

Source: Roads et al, 1991[26]

However, as this simplification assumes uniform fuel characteristics, a separate analysis of the state of the fuel would be required in order to use this index in an assessment of the necessary to restrict access under the CROW Act.

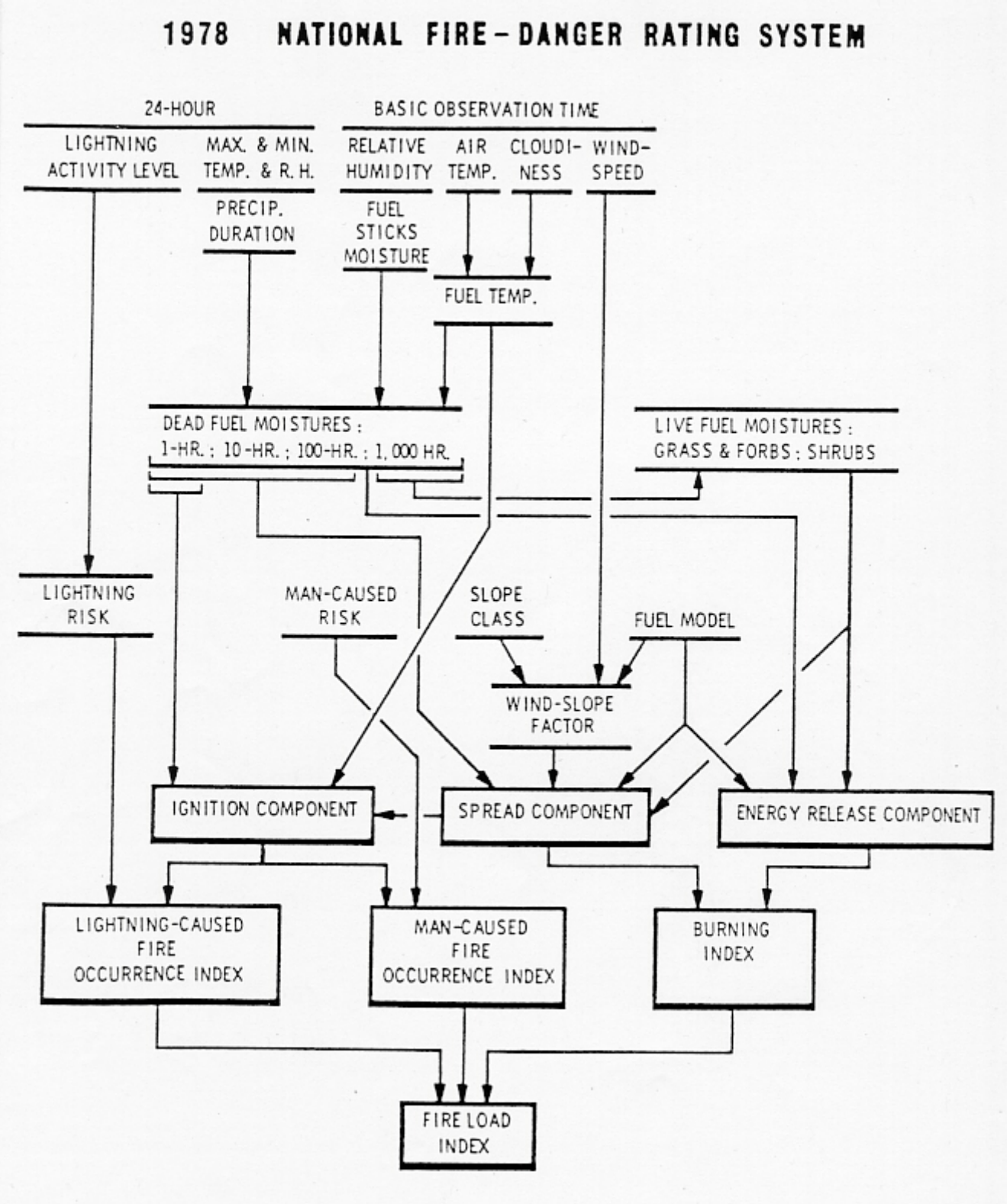


Figure 10. Schematic of the U.S. National Fire Danger Rating System. Taken from U.S. National Weather Service (http://www.seawfo.noaa.gov/fire/Nfdrs.jpg)

2.3.7 Australian Fire Danger Rating Systems

The most widely used Fire Danger Rating Systems in Australia are the McArthur Forest and Grassland Fire Danger Rating Systems, which were devised by Alan McArthur in the early 1960's. These fire danger rating systems are based on fire danger meters, as shown in Figure 11 and Figure 12 for forests and grasslands respectively. These meters give an indication of the difficulty of suppression in either forests or grasslands. In Australia, the term fire danger is widely accepted as reflecting the severity of weather conditions affecting fire behaviour in a standard fuel type rather than other definitions such as risk of ignition, and potential for damage. General forecasts of fire danger in Australia are kept separate from models of predicted rate of spread and fire behaviour because of the local variability in these models.

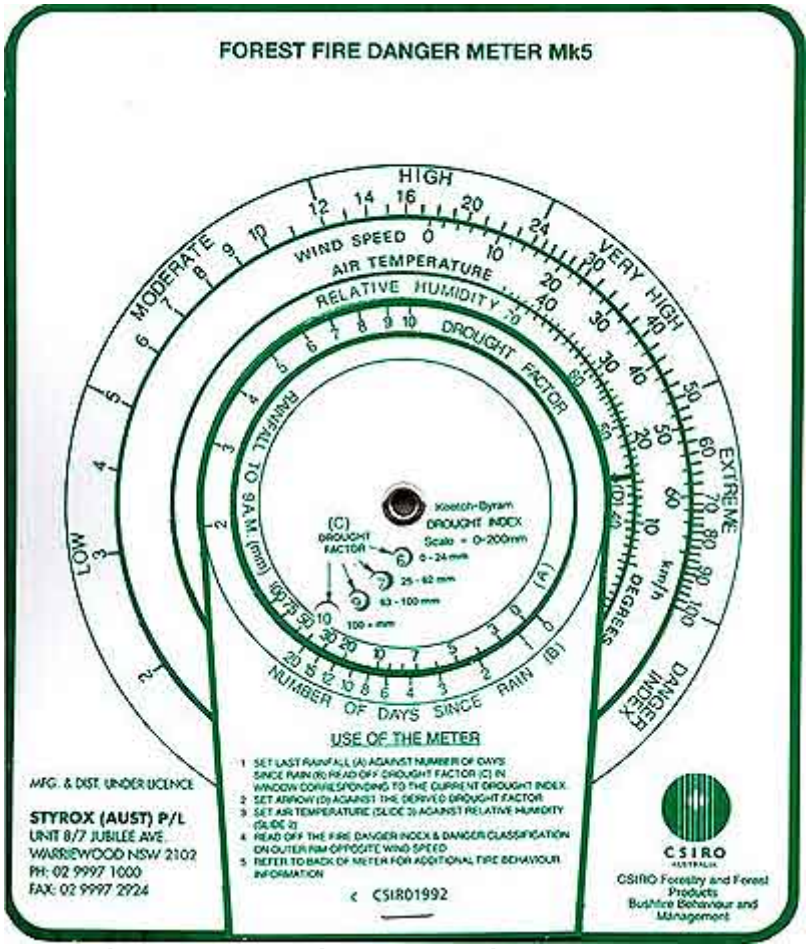


Figure 11. McArthur Forest Fire Danger Meter
(Taken from CSIRO, http://www.ffp.csiro.au/nfm/fbm/meters/ffdm.html)

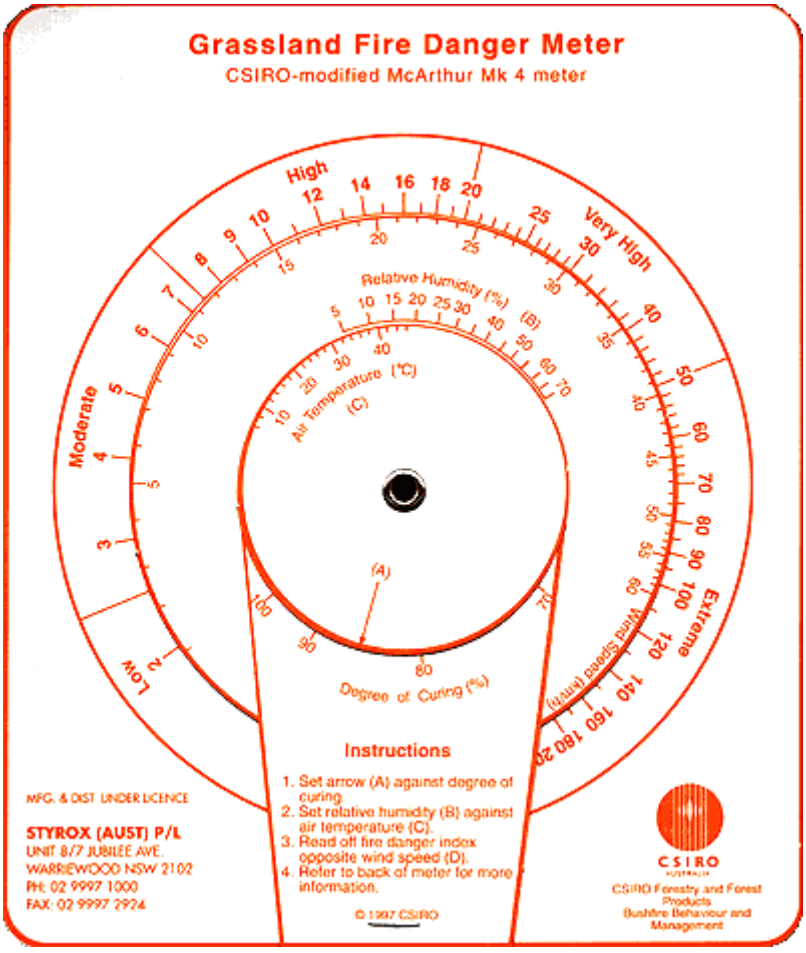


Figure 12. McArthur Grassland Fire Danger Meter
(Taken from CSIRO, http://www.ffp.csiro.au/nfm/fbm/meters/ffdm.html)

The meters are used to calculate the Fire Danger Index (FDI), as described in Table 8 and Table 9. An index of 1 means that a fire will not burn, or burn so slowly that control presents little difficulty. An index of 100 means that fires will burn so fast and hot that control is virtually impossible. The index is divided into five fire danger ratings (Low, Moderate, High, Very High, and Extreme) that represent the degree of difficulty of suppression.

FIRE DANGER INDEX	RATE OF SPREAD (km/h)	DIFFICULTY OF SUPPRESSION	MAXIMUM AREA AT VARIOUS TIMES FROM START (hectares)**				AVERAGE FINAL SIZE OF FIRE (hectares)	FLAME HEIGHT (Meters) IN		
			½ hr	1 hr	2hr	4hr		Sparse Pasture	Average Pasture	Heavy Pasture
2	0.3	Low. Headfire stopped by road and tracks	3	20	80	320	3	0.3	1	3
5	0.6	Moderate. Head attack easy with water.	6	40	160	640	16	0.6	2	3.5
10	1.3	High. Head attack generally successful with water	15	90	360	1440	65	1	3	5.5
20	2.6	Very High. Head attack will generally succeed at this Index	35	210	840	3360	450	2	3.5	7
40	5.2	Very High. Head attack may fail except in favourable circumstances and close back burning to the head may be necessary	80	480	2000	8000	2400	2.5	5	9
50	6.4	Extreme. Direct attack will generally fail. Backburn from a secure good line with adequate manpower and equipment. Flanks must be held at all costs.	105	630	2500	10000	4000		5.5	10
70	9		170	1000	4000	16000	10000		6	11
100	12.8		300	1800	7000	28000	32000		7	13

Table 8. McArthur Fire Danger Index for Grasslands

FUEL QUANTITY (tonnes per hectares)	FIRE BEHAVIOUR	FIRE DANGER INDEX												
		5	10	15	20	25	30	40	50	60	70	80	90	100
5	R(km/hr)	0.03	0.06	0.09	0.12	0.14	0.17	0.23	0.28	0.34	0.39	0.45	0.5	0.56
	H(m)	0.3	0.6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
	S(km)	-	-	-	0.1	0.2	0.3	0.6	0.8	1	1.2	1.4	1.7	1.9
10	R(km/hr)	0.06	0.12	0.18	0.23	0.29	0.34	0.45	0.56	0.67	0.78	0.89	1	1.11
	H(m)	1	2	3	4	5	5.5	7	8.5	10	11	12	13	14
	S(km)	-	-	0.2	0.4	0.6	0.8	1.2	1.7	2.1	2.5	3	3.4	3.8
15	R(km/hr)	0.09	0.18	0.26	0.35	0.43	0.51	0.68	0.85	1.02	1.18	1.35	1.52	1.68
	H(m)	2	3.5	5	7	8	9.5	12	14	**	**	**	**	**
	S(km)	-	0.2	0.6	0.9	1.2	1.5	2.2	2.8	3.4	4.1	4.8	5.4	6
20	R(km/hr)	0.12	0.24	0.36	0.48	0.6	0.72	0.96	1.2	1.44	1.68	1.82	2.16	2.39
	H(m)	2.5	5	7	9	11	13	**	**	**	**	**	**	**
	S(km)	0.1	0.5	0.9	1.3	1.7	2.2	3	3.8	4.7	5.6	6.4	7.2	8.1
25	R(km/hr)	0.14	0.3	0.45	0.6	0.75	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3
	H(m)	3	7	10	12	14	**	**	**	**	**	**	**	**
	S(km)	0.1	0.6	1.1	1.6	2.1	2.6	3.6	4.6	5.6	6.6	7.6	8.6	9.6

R = Rate of Spread (km/hr)
H = Flame height (meters)
S = Average spotting Distance (km)

Table 9. McArthur Fire Danger Index for Forests

The drought factor is a key component of the McArthur Fire Danger Meter, calculated originally as shown in Figure 13, although in recent years the derivation of the drought factor has been considered in a variety of ways. The most recent revised method for calculating the drought factor is given as:

P = rainfall in mm during an event,
N = time since the rain event in days,
I = soil dryness in mm equivalent (Keetch and Byram 1968; Mount 1972),
D = Drought Factor.

Each rain event is assigned a nominal 24 hour period in which it is deemed to have occurred. If the rain event occurred in the 24 hours to 9am on the current day then *N*=1. If the rain occurred since 9am then *N*=0. The measure of significance of a rain event, *y*, is given by:

$$y = \begin{cases} (P-2)/N^{1.3}, & \text{if } N \geq 1 \ \& \ P > 2, \\ (P-2)/0.8^{1.3}, & \text{if } N = 0 \ \& \ P > 2, \\ 0, & \text{if } P \leq 2. \end{cases} \qquad (1)$$

The most significant rain event *(P, N)* is that event in the last 20 days which maximises *y* or, equivalently, minimises the Drought Factor, *D*.
The proposed function for the Drought Factor is:

$$D = \min\left(10.5\left(1 - \exp\frac{-(I+30)}{40}\right)\frac{y+42}{y^2+3y+42},\ 10\right) \qquad (2)$$

where *y* is defined by Equation 1 using the most significant rain event.

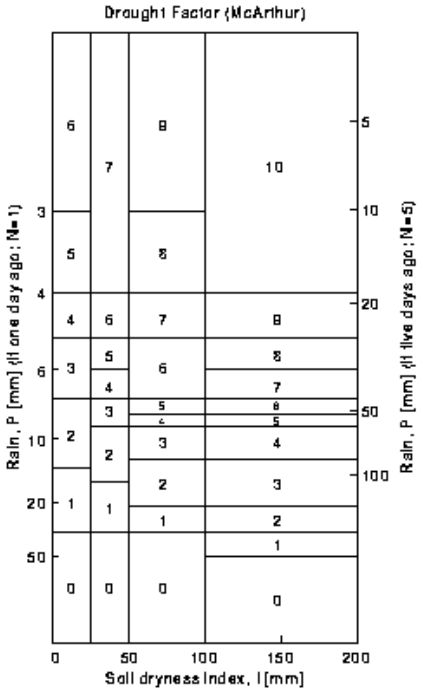


Figure 13. Drought Factor as given by the McArthur Forest Fire Danger Meter. (Taken from Australian Bushfire Conference Proceedings, 1999, http://life.csu.edu.au/bushfire99/papers/griffith)

2.3.8 Fire Advisory Panels

The role of Fire Advisory Panels or Liaison Groups varies. In the Peak District National Park, the Fire Advisory Panel plays an advisory role in the assessment of fire risk measurements and would be notified in every "high" risk period. Exmoor National Park also involve a wide range of organisations during every "high" risk period. Other Fire Liaison groups will only meet once or twice a year to review and plan for the fire seasons, as is the case in the North York Moors National Park and Dartmoor National Park. Table 1 gives the details of the types of organisations involved in Fire Advisory Panels or Liaison Groups.

The general aims of the groups are to:[2]

- Improve labour and equipment availability at short notice,
- Improve the effectiveness, efficiency and communication on the fire ground,
- Improve safety, training, cost sharing and general mutual assistance.

A crucial part of the group meetings is to develop fire plans that indicate access points, rendezvous points, water resources, fire breaks and contact numbers for all relevant organisations.

2.4 Existing Good Practice and Guidance Material on Fire Risk Management

There is very little good practice guidance issued relating to fire risk management by those organisations who are not directly responsible for the management of land, other than that relating to prescribed burning. The Health and Safety Executive, the British Association for Shooting and Conservation, the National Gamekeepers Association, the National Farmers Union and the Moorland Association do not issue good practice guidance to their members.

Good practice guidance is issued by Dartmoor National Park Authority in respect of prescribed burning.

2.4.1 Fire Plans

Many organisations are working together to develop fire plans that contain contact details for all relevant organisations, access and rendezvous points, water resources and roads, fire breaks and areas of important ecological significance. These plans are usually produced in a map format and distributed to all stakeholder organisations with the aim of concentrating resources in areas that are most important. These could be in terms of ecological value, or areas where a fire could be more likely to get out of control as a result of a particular vegetation cover (e.g. young plantation) or distance from a road/equivalent track that a fire tender could traverse.

Combined with fire plans for some groups are standard operating procedures that define actions that should be taken in the event of a fire and the command structure that is vital to maintain control of an incident. Included in Appendix are the standard operating procedures for the South Grampian Forest Fire Protection Group, provided by Michael Bruce of the Forestry and Timber Association.

2.4.2 Fire History Data Quality and Storage[10]

In their assessment of fire history data for Dorset heaths, TERRA (1999) conclude that fire history data was variable in terms of quantity and quality. Only 8 of the 15 organisations that they contacted for fire history records were able to provide records. In most of the records, the time of day of the fire, the extent and cause of the burn were estimated rather than measured, and the time that the

fires were extinguished was never recorded. Spatial analysis of the records was hindered by poor geo-referencing, often to the centroid of the site rather than the location of the fire, and some records were indicating fires occurring in the Solent.

The extent of misinterpretation of the fire records is difficult to estimate. For example, of the 3333 records obtained, 1300 occurred in 1995, but it is known than Poole Borough Council intensified their fire recording during this period. In light of the review undertaken by the TERRA environmental consultancy in 1999, they recommend that more comprehensive and accurate data on burn sizes and location is gathered in order to fully assess the long-term impacts of high frequency burning, and to help identify fire characteristics with variables such as vegetation type and slope.

TERRA contacted a number of different organisations for fire history records, and found that over half of the organisations had not adopted heathland habitat identification standards and all of the organisations did not distinguish between different types of heath – wet, humid or dry. TERRA considers that this could lead to fire history records that did not occur on heathland at all but some other vegetation type. In addition, many organisations overlap in their jurisdiction but heath names had not been standardised between the organisations and it was therefore not clear whether the different organisations were referring to the same area of land in the fire records.

Distribution of fire records between the relevant organisations varied with some not distributing their records to any other organisations and others freely distributing theirs, albeit as summary records. The Dorset Fire and Rescue Service is the only organisation with a statutory duty to report heathland fires, but the largest fires are reported in the most detail. Data storage methods was also variable between the different organisations, with some not even recording electronically, and only half of the organisations contacted used standard terms for data entry.

The recommendations that TERRA have made are for closer collaboration and information sharing between all organisations involved in the management of Dorset's heathlands. A system is proposed whereby participants gather standard fire event data and log to a central repository. Once verified by site managers, the fire records are collated in a database that is accessible to all relevant organisations through the central repository. The complete outline of the proposed model of data collection and storage is included in Appendix , although has not been fully adopted to date (John Day, RSPB, personal communication).

A copy of the Heath Warden Incident Report form provided by Dorset County Council is included in Appendix M.

2.4.3 Fire Fighting

Advice given by the Defence Estates for fire fighting moorland fires is:[14]

- Backburn downwind of the fire,
- Use beaters to "rub out" the fire as "beating" can spread the flames
- Because of the intense heat, have 2 people to each beater
- Peat must be thoroughly wetted and/or dug up in order to extinguish the fire

2.4.4 Good Practice Guidance from Dorset and Surrey Naturalists' Trusts and the Royal Society for the Protection of Birds[8],[9]

Fire brigades were under extreme pressure to control wildfires in the hot summer of 1976. They generally experienced difficulties gaining access to the fires because of the lack of tracks, or tracks

that were not suitable for fire appliances to traverse. Fire control measures such as fire breaks were deemed to have been inadequate in terms of maintenance and width, and the height of vegetation alongside the firebreaks was said to be too high and allowed firebrands to cross the breaks. The recommendations that the Dorset Naturalists' Trust, the Surrey Naturalists' Trust and the Royal Society for the Protection of Birds made following the fires of 1976 were that:

- Comprehensive Fire Plans should be drawn up and implemented for all sensitive areas. These Fire Plans should be the product of consultation between landowners, the Nature Conservancy Council (now English Nature) and the County Fire Service. The Fire Plans should cover:
  - Location of the most important biological value so that fire-fighting efforts can be concentrated where most needed,
  - Creation and maintenance of fire breaks,
  - Provision of suitable access tracks onto heathlands,
  - Provision of firebeaters,
  - Provision of water points and water tenders
- The Fire Plans should be circulated to all who might be involved in the event of a wildfire, and there should be regular liaison between all these stakeholders.
- There should be public campaigns to highlight the danger, destruction and cost of heath fires.
- On MOD land, genuine danger areas should be clearly distinguishable to fire-fighters from those where they may freely operate.
- Consideration should be given to training fire service personnel in fighting heath fires.
- The increased use of all-terrain fire fighting vehicles and earth moving equipment should be encouraged.
- Procedures should be established and periodically tested that allow greater use of MOD resources, both troops and equipment, for wildfire fighting, particularly when the Fire Service are fully stretched.

2.5 Periods for Fire Risk Assessment

As temperatures increase in the period following winter, heath vegetation will be relatively dry and therefore springtime, before new growth increases vegetation moisture content, is a high risk period for heath fires. As the vegetation grows and the moisture content increases the risk reduces, but in summer after the growth stage is over, ambient temperatures are able to dry the vegetation once more and so summer also becomes a risk period for heath.[10]

Early Spring is also a high fire risk period for woodlands, particularly young plantations, because a covered canopy will not have developed until later in Spring thereby exposing the ground vegetation. Summer and Autumn have also been defined as a periods of risk by the Forestry Commission, though to a lesser extent.

The most likely periods of high fire risk identified extend from early Spring to Autumn for all vegetation types. It is worth noting however that prescribed burning must take place between 1 October and 15 April for upland areas. It may be that some of the potential end users of the fire weather index and the condition of land index may wish to use the information to help determine the best times for prescribed burning. The RSPB suggest that burning be carried out in winds up to Force 3 in dry weather when the standing crop and surface of the litter layer is dry, but the soil and litter layer are damp (ideally in February and March), in order to protect the rootstock and the seed

bank from being over-heated. It is considered that the fire weather index and the condition of land index could be used to identify these conditions.

It is recommended that fire risk assessments are carried out from at least March to October.

3. DEVELOPMENT OF FIRE RISK INDICES

3.1 The Countryside and Rights of Way Act

Section 25(a) of the Countryside and Rights of Way Act defines the conditions under which a landowner may be granted a temporary closure for fire prevention. The exact wording of the Act is:

" 25. (1) The relevant authority may by direction exclude or restrict access by virtue of section 2(1) in relation to any land during a specified period if the authority are satisfied-

> "that, by reason of any exceptional conditions of weather or any exceptional change in the condition of the land, the exclusion or restriction under this section of access to the land by virtue of section 2(1) to the extent provided by the direction is necessary for the purpose of fire prevention . . ."

The inclusion of the weather as a condition for fire risk was easy to understand but the reference to an exceptional change in the condition of the land was more difficult to define. ADAS undertook a review of the debate in the House of Lords on 5 October 2000 that was the driver for the inclusion of this reference. It is assumed from the debate that the inclusion of reference to the condition of the land refers to how dry the soil and vegetation are and therefore the extent of fuel moisture for a fire. It was included to cover particularly the period immediately following a period of exceptional weather in which the weather may no longer be classed as exceptional, but the soil and ground vegetation could still be exceptionally dry. The Hansard transcription can be found in Appendix N.

3.2 The Science of Fire

For a fire to ignite and be sustained, there are three components required: heat, oxygen and fuel. Without any one of these components, the fire will go out, as demonstrated in Figure 14. In a woodland or moorland fire, the ignition will normally take place in the dead material as live material reduces the efficiency of ignition. For most plants, the critical temperature for ignition is about 300°C[16]. More important that the temperature is the fuel moisture as more energy is required to raise the temperature of a liquid so that it changes to a gas. Until water is entirely evaporated from a portion of the fuel, the temperature will not be able to exceed 100°C and the fire will not ignite. [16]

Fuels can be described by physical characteristics such as the loading (weight per unit area), size (particle diameter) and bulk density (weight per unit volume). Shrubs can be described as flashy fuels as they are likely to contain natural oils within their foliage, and the heat of a fire will draw this oil out of the leaves and create outbursts of intense fire behaviour and sudden changes in flame lengths. The more flammable a species is, the higher the moisture content that will sustain a fire. Deciduous plants with fresh green foliage may have moisture contents of up to 300% of the dry weight of vegetation and will be very difficult to ignite. Coniferous vegetation such as heather and conifers generally have a much lower moisture content, but higher contents of natural oils. The proportion of heather in an area can often be used as a guide to the intensity and likely temperature of a fire. [16]

The rate at which moisture is absorbed into a fuel will depend upon the fuel size and is dependent upon the recent weather conditions – air temperature, precipitation, relative humidity. The drier and

warmer the fuel is, the more likely it is that the fire will be sustained once ignited. Moisture absorption rates are a property of fuels used in the National Fire Danger Rating System in the U.S.A, and are expressed in terms of timelag. One timelag period is defined as the amount of time necessary for a fuel component to lose (or gain) 63% of the difference between the current level of moisture and the equilibrium moisture content, assuming constant atmospheric conditions. As the response is related to fuel size, a 10 hour fuel will respond more quickly to changes in the weather than a 100 or 1000 hour fuel.[15]

The spread of the fire is a complex process involving the components of wind, slope, and fuelbed properties (particularly moisture related properties). The fire will spread forwards in the direction of the wind (the head fire), sideways in accordance with the changing direction of the wind, which will depend upon its speed, (the flank fire) and backwards if on a slope and burning material rolls down a slope (the back fire). The fire can also spread upwards if there is continuous vegetation able to support the fire from the ground to the canopy. Figure 15 shows the different types of fires and the way that fire can spread and Figure 16 shows the spread of a fire as viewed from above.

The effects of both the wind and the slope are important considerations for fire risk assessment. The flames of a fire will bend forwards with the wind and lean over unburnt vegetation and dry/preheat it. This will increase the speed of ignition of the unburnt vegetation and therefore the rate of spread of a fire. Slopes have a similar effect to the wind – vegetation upslope of the flames will be dried and preheated. It is estimated that the rate of spread of a fire is likely to double for every 10º increase in slope and therefore on a 20º slope (about 1 in 3) a fire burning uphill is likely to move 4 times as fast as on level ground. [16]

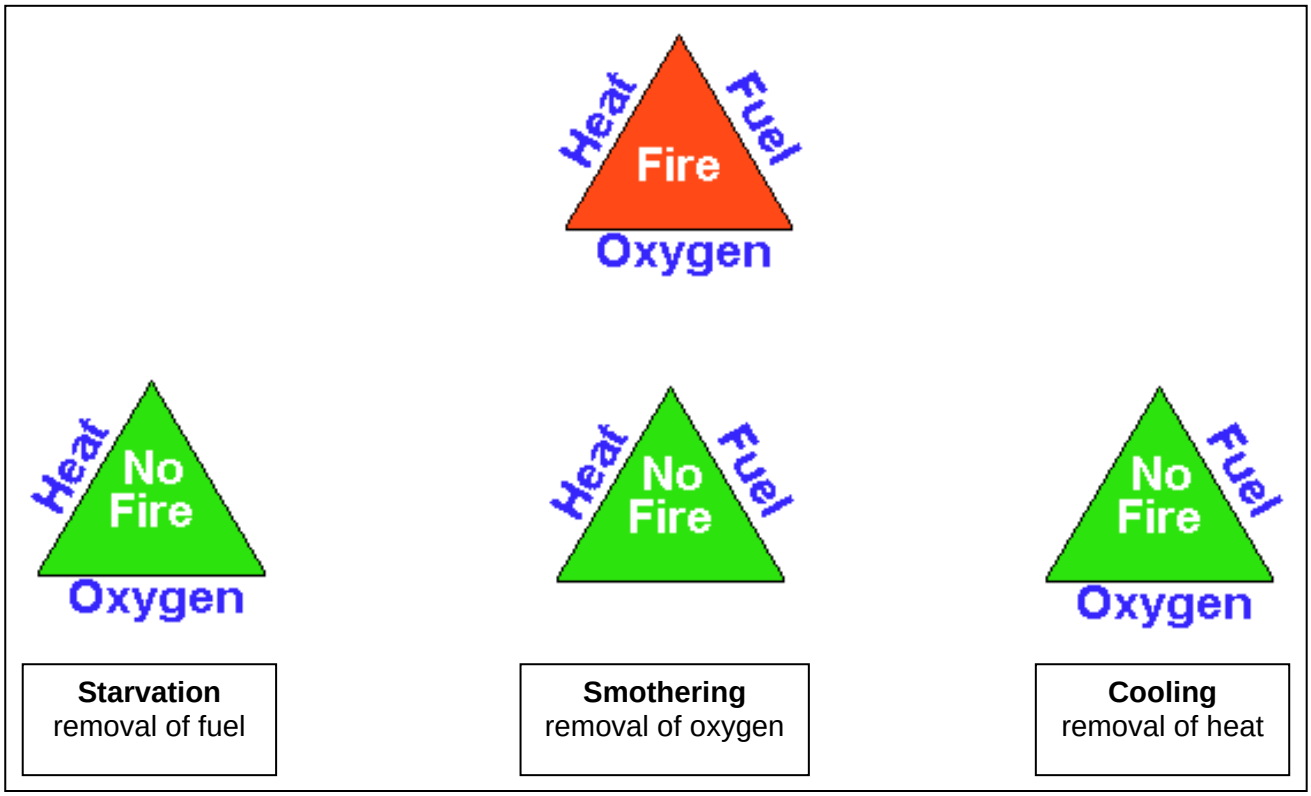


Figure 14. The Fire Triangle
(Taken from Herriott Watt University, http://www.civ.hw.ac.uk/research/fire/information/)

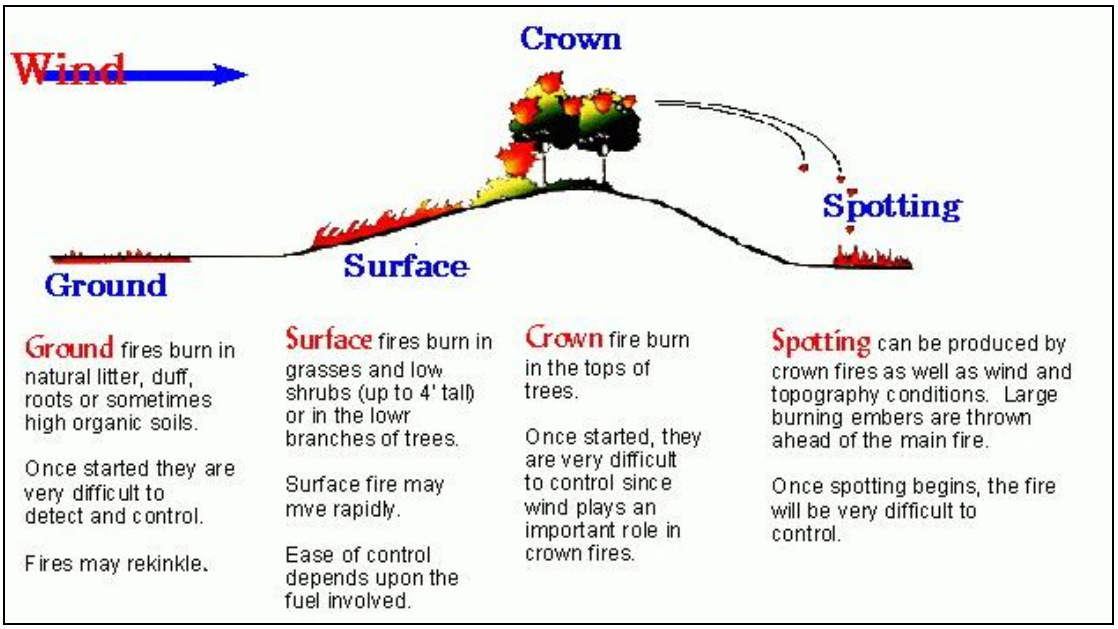


Figure 15. Types of Fires.
(Taken from the National Weather Service, http://www.seawfo.noaa.gov/fire/olm/firetype.htm)

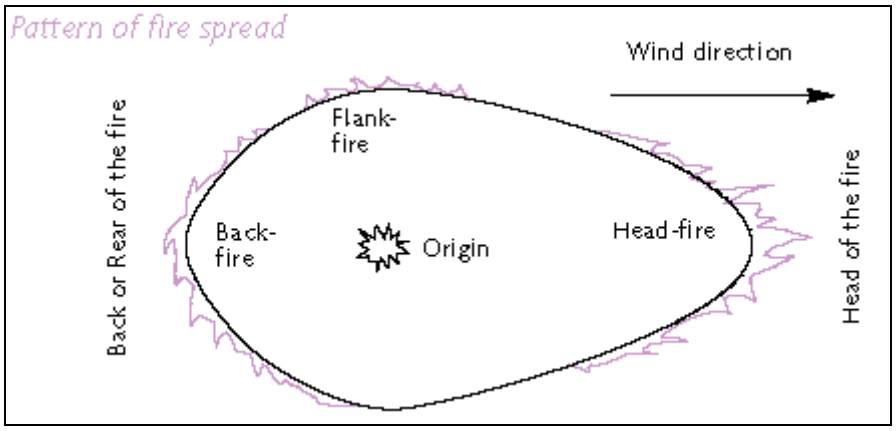


Figure 16. Pattern of Fire Spread[16]

3.3 Fire Weather Index (FWI)

Climate Correction Layer

The Act allows for restriction of access to land if there is a high fire risk as a result of exceptional weather. In some contexts, exceptionality is judged according to the typical weather of a specific location and time of year but this approach is not well suited to this application. Exceptionally dry and warm weather in, say, North Wales, is a lot wetter and cooler than exceptional weather in, say, the South East. For example, given weather hot and dry weather of the same rarity in the North West and the South East, assuming all other environmental factors are the same, then significantly more fires may be expected in the South East than in the North West. Therefore, to allow the system to provide sound advice, a geographical correction factor may need to be applied which was based on the average weather conditions for each region.

Description of the Met Office model

This section gives a brief overview of a suggested model for the Met Office to develop.

Forecasting fire risk in the UK

The scoping study suggested that an appropriate method of calculating the fire risk in the UK would be based on the US National Fire Danger Rating System and a Fire Weather Index (FWI) developed by the National Centers for Environmental Prediction and the Scripps Institute (NCEP).

The FWI algorithm

The FWI is calculated as follows:

$$FWI=(1+W^2)^{1/2}(1-2a+1.5a^2-.5a^3)/.3002,$$

where

$a = m/30$

$m = 0.03229+0.281073R -0.000578RT$ R<10%

$m=2.22749+0.160107R -0.014784T$ 10%<R<50%

$m=21.0606+0.005565R2-0.00035RT-0.483199R$ 50%<R.

a is the ratio of equilibrium moisture content to a moisture of extinction of 30. The second quantity in parentheses is called the moisture damping coefficient. The normalised equilibrium moisture content, a, is determined from dry-bulb temperature T (degrees Fahrenheit) and relative humidity R (percent). W is the wind speed (statute mph). The required meteorological data for the FWI come from NCEP's forecasts of 10 metre winds and 2 metre temperature and relative humidity.

Although simple, this is a modern method. It does not depend directly on the condition of vegetation, but this is not such a drawback as one might imagine, as the daily conditions are strongly correlated with the risk of fire ignition. The way in which a fire develops once it has started has a dependency on the dryness of the vegetation, so a measure of dryness from the MOSES system could also be incorporated (e.g. by multiplying by a factor derived from the soil moisture deficit or potential evaporation), or the risk at a particular location could be judged by local personnel, given their knowledge of the vegetation conditions and a forecast of a fire weather index from the Met Office. An alternative approach would be to use the index in conjunction with an index specifically incorporating an assessment of the condition of land as considered in section 3.4.

Figure 17 shows a simple schematic of the FWI. As forecasts are required for 5 days ahead, the Met Office's global model would be used to determine certain parameters. This operates on a global 432*325 (0.83*0.55 degrees) grid, which at UK latitudes gives a horizontal resolution of approximately 60 km. The daily fire weather forecasts from our global model will be reliable for 3 to 5 days ahead. The index would be on a nominal scale of 1 to 5 (5 being the highest) with fire risk most likely to fall within the lower end of the scale and band 5 values used to define exceptional conditions.

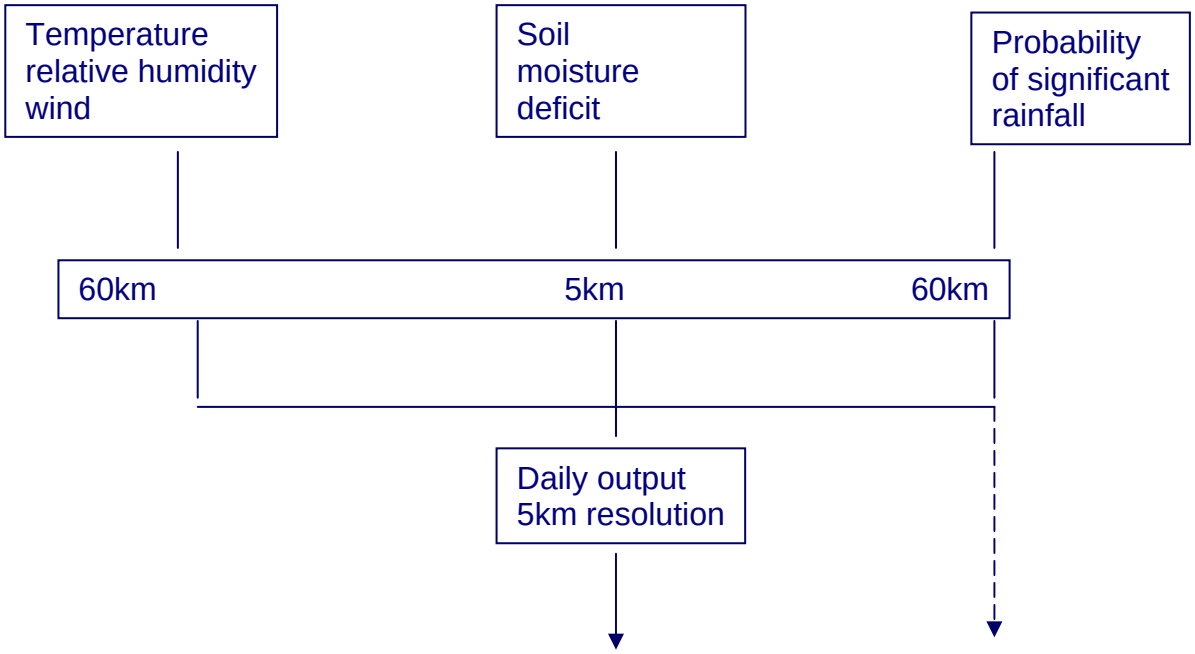


Figure 17. Simple Schematic of FWI

3.4 Condition of the Land Index (CLI)

As included in the wording of the CROW Act, it is necessary to consider the change in dryness of the soil and vegetation as well as the overall weather in the assessment of the risk of fire. In effect, the change in condition of the land can be considered as a reference to the fire risk – the likelihood of ignition, whilst the weather is a reference to the fire hazard – the behaviour of a fire. The two indices will be closely related as the weather determines the level of drying of soils and vegetation.

The fuel moisture will vary considerably throughout the plant, with the largest moisture being retained in the soil and litter layers underneath the plant and the least moisture being retained in the canopy. It is estimated that the litter layer under heather may have a moisture content of 200 – 300 % whilst the dead material supported among the shoots of the canopy may have a moisture content of only 25%. The moisture content of the heather canopy itself is likely to be in the range 50% - 100% during the prescribed burning season. On dry, well-drained ground, moisture contents of the vegetation and litter may become less than 50%. Dead plant material dries out more quickly than living material, and the moisture content of dead grass leaves can change from 90% to 20% in less than half an hour under drying conditions.[16]

Multiple regression analyses of fire history records in Dorset found that the number of fires on the heathland was greater with increased temperatures and sunshine, and with low relative humidity. Each of these variables will contribute to the drying of the land and the vegetation thereby lowering the moisture content of the vegetative fuel. Winds from the north or east in Dorset are colder and drier and will also contribute to the drying of the vegetative fuel moisture, and from the fire history records considered, the wind blew from the north or east for only 40% of the time, but on 60% of the days with more than 10 fires occurring.[11]

If a CLI is considered separately, it should be based as far as possible on systems already in use either in the UK or abroad to avoid the need for significant additional research. It is also proposed that the index should allow for the expansion of this project into a complete fire danger rating system and fire behaviour model in the future. In the more sophisticated methods of fire risk assessment described in Section 2.3, the two indices are combined as an overall fire danger rating, for example in the Canadian system the Fine Fuel Moisture Code, Duff Moisture Code and Drought Code give values of moisture content at different fuel depths. Many of the systems presented in Section 2.3 have already been adapted for use in other countries, for example, the Canadian system has been adapted for use in parts of the U.S.A., South East Asia and in New Zealand.

4. DEFINITION OF EXCEPTIONAL

For completeness, definitions of weather, climate and exceptional follow.

- Weather as defined in the Oxford English Dictionary:

  > "atmospheric conditions prevailing at a place and time, combination produced by heat or cold, clearness or cloudiness, dryness or moisture, wind or calm, high or low pressure, and electrical state of local air and sky;"

- Climate:
  - Average weather conditions of a place or region throughout a particular season, where 'Averages' are normally taken over tens of years
  - Governed by latitude, position relative to continents, oceans and local topography

- Exceptional:
  - Conditions likely to occur fewer than once every 10 years

It must be noted that by accepting the definition of "exceptional" outlined above, relevant authorities must be prepared for fires to occur on land outside of "exceptional "conditions. This means that applications for land closure under section 25(1)a of the CROW Act could be refused as exceptional conditions do not prevail, but that fires on that land could still occur.

5. SYSTEM OPTIONS

5.1 Fire Threat Analysis System

A Fire Threat Analysis System encompasses all factors relating to the threat of wildfires – the potential for ignition of a fire, fire behaviour predictions, the ability to suppress a fire once started and an assessment of the potential damage that could result from a fire. Figure 18 shows a schematic of the fire threat analysis system.

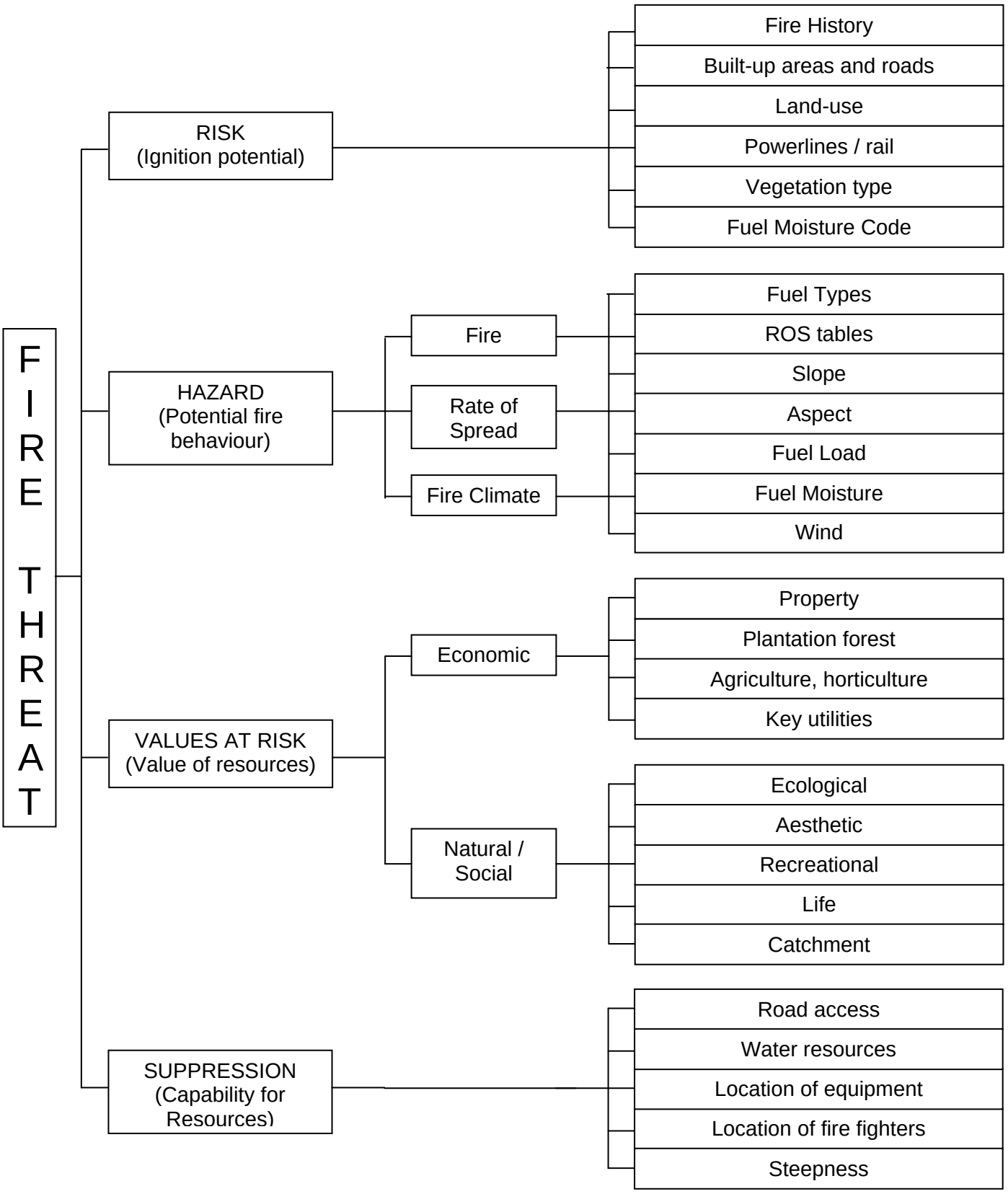


Figure 18. Fire Threat Analysis System Schematic

There are examples of a full wildfire threat analysis system being implemented, such as for the McGregor Model Forest in Canada. In New Zealand, the development of a fire threat analysis system is being undertaken, with the adaptation of the Canadian Forest Fire Danger Rating System forming a component.

It is considered that a full fire threat analysis system would require a significant amount of research for use in the UK. It would be data intensive, requiring information including: landcover and vegetation types, location of roads, tracks and firebreaks, slope and aspect information, population data, location of fire stations and/or fire fighting equipment, and water resources. Much of this data would be difficult and/or expensive to obtain and would require regular updating for the most effective model. Although this model represents perhaps the ideal solution for identifying and managing the threat of fire, it would be difficult to fully implement. It would also go beyond the scope of the CROW Act Section 25(1)a and the identification of fire severity and hence exceptional conditions.

Each of the components shown in Figure 18 are weighted independently, and then weighted together to form the threat index as demonstrated in Figure 19. Identification of the appropriate weights to be applied, where not available as a physical quantity, is something that could only be done by experts in the field of fire risk assessment and management.

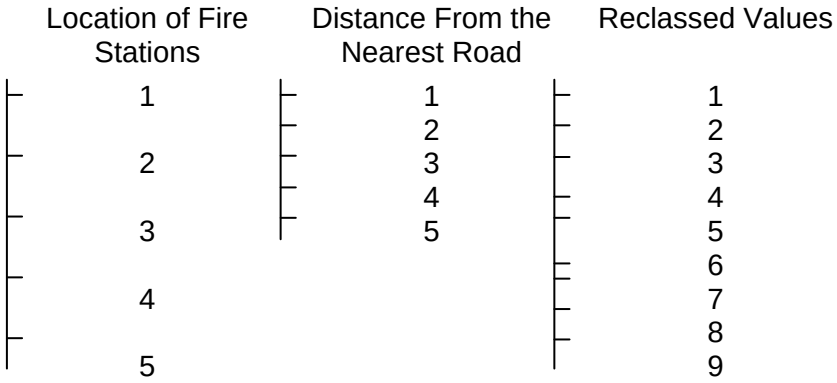


Figure 19. Ranking of Different Datasets

Table 10 provides details of the fire threat analysis system components, and indicates which could be weighted according to some scientific relationship and which would require expert opinion.

It is thought that the essence of a fire threat analysis system, if desired, could be captured at a later stage of this project. These stages of the project are designed to identify best practice in relation to fire risk management and should identify the importance and interrelationships of the fire threat analysis system components.

Dataset	Coverage	Potential Usage	Scientific or Intuitive Basis
Risk – Probability of Ignition			
Fire History	Partial	Depends on the cause of fire: Prescribed burning = less likely to burn again for a period of time, Arson = more likely to be a target again in the future.	Intuitive
Roads	National	Weight the distance from a road	Intuitive
Rights of Way	Partial	Weight the distance from a right of way	Intuitive
Urban Areas	National	Weight the distance from an urban area	Intuitive
Vegetation	National	Weight the flammability of vegetation – probably not possible with current knowledge of UK vegetation	Scientific
Aspect	National	Weight the aspect according to amount of solar radiation received	Scientific
Values at Risk – Value of Resources			
Economics	National	Calculate the value of the land based on landcover	Intuitive / Scientific
Ecological	National	Weight the land according to any special designations it owns	Intuitive
Recreational	Partial	Weight the land based on the number of visitors it receives	Intuitive
Life	National	Weight the land according to the nearby population that could be at risk if a fire broke out	Intuitive
Catchment	National	Weight the distance from a source of drinking water	Intuitive
Suppression – Capability for Resources			
Roads	National	Weight the distance from the nearest road as a proxy for the time needed for fire service personnel to reach the scene of a fire	Intuitive / Scientific
Water Resources	National	Weight the distance to the nearest water supply needed to help extinguish the fire	Intuitive
Location of Fire-fighters and Equipment	National	Weight the distance from the nearest resources as a proxy for the time needed for fire service personnel and equipment to reach the scene of a fire	Intuitive / Scientific
Steepness	National	Weight the steepness of the land in accordance with the ease of access for fire-fighters to reach the scene of a fire	Intuitive
Hazard – Potential Fire Behaviour			
Vegetation	National	Determine likely rate of spread of a fire based on vegetation type and moisture content	Scientific
Slope	National	Apply a slope correction factor to the rate of spread based on the principle that fires spread more easily upslope.	Scientific
Fire Intensity	National	Weight the combined the rate of spread prediction and slope correction to obtain a prediction of fire intensity and the ease with which the fire could be controlled.	Scientific

Table 10. Components of the Fire Threat Analysis System

5.2 Fire Danger Rating System

Without detailed ground validation of the different fire danger rating systems, it is difficult at present to determine which system would be most appropriate for use in England and Wales. The choice of which system to implement would be greatly informed by some form of ground validation to ensure that the fire danger rating system was appropriate for UK vegetation types and climate. The exception may be the Forestry Commission's Fire Danger Rating System, which could perhaps be adapted to accommodate non-woodland vegetation, but incorporates human-presence factors that would need validating against fire history records. Most of the fire danger rating systems incorporate

a fire behaviour prediction which is built upon understanding of vegetation characteristics and burning behaviour.

5.3 The Proposed System

There are strengths and weaknesses with all of the fire danger rating systems. The Forestry Commission Fire Danger Rating System has the benefit of being developed for UK vegetation types and climate, although in terms of future project expansion it lacks any detailed fire behaviour prediction. It is a practical tool designed to be used by forest managers on the ground, and for this reason it may be that certain aspects could not be easily transferable to a remote situation. The foreign systems are based on foreign vegetation types and climate and may not be equivalent to UK vegetation and climate. However, they are grounded in the science of fire, are the result of many years of study, and have already been adapted for use in countries other than those where they were developed. Extraction of the relevant condition of land components from these systems would not preclude the extension of this project into a full fire assessment tool.

The proposals for the project at this stage are to examine in more detail all of the fire danger rating systems, where input data and system explanation allows. Components relating to the condition of the land would be extracted from the systems and validated independently against fire records to determine which would be the most appropriate for use in the UK. How appropriate a system is would be assessed in terms of suitability to UK vegetation types and climate, and also in terms of ease of use and understanding by the fire risk assessors.

6. PILOTS

A full pilot of the system will not be possible until the CROW Act is implemented, however index values could be produced to assess whether severe fire events are being captured as part of a test trial. Prior to the implementation of the Act, there will not be any landowners requesting for closure of their land and therefore no point having personnel waiting for a phone call to make a decision on. It would be possible to develop example scenarios to test the system and calibrate it to the decision making process. If these scenarios were developed, they would not be tied to any particular time period of the year, and could be considered in a relatively short time period. It is thought that this would probably be a beneficial exercise, but perhaps not until a later stage of the project.

It is therefore proposed that the period between June 2002 and April 2003 should be used as a data collection exercise to build up a database of fire history. This data collection exercise should include as many of the different organisations listed in Section 1.4 as is possible and deemed practical. The data can then be used to validate the different indices for fire risk outlined in Section 5.3, and to calibrate the chosen indices.

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Appendix A – Summary of Meeting Held with the Forestry Commission

ADAS

Environment Modelling
and GIS Group

Met Office

Forestry Commission and Forest Enterprise

The Forestry Commission (FC) are the government body responsible for forestry throughout Great Britain. The FC come under the direction of Westminster Ministers in England and the National Assembly for Wales in Wales. Forest Enterprise is an executive agency of the FC, established in 1996 and is responsible for the management of 800,000 hectares of woodland owned by Great Britain.

During the Fire Danger Season (March to June), meteorological readings will be taken daily by dedicated Forest Enterprise staff. Fire risk assessment is then based upon the fire danger rating, which is a combination of fire hazard and fire risk. The fire hazard is assessed using four variables: type of predominant vegetation, condition of the ground vegetation, relative humidity and wind speed. The fire risk is also assessed using four variables: the season, the day of the week, the time of day and the weather conditions. Both the fire hazard and the fire risk are graded independently on an index system, and are then combined to derive the fire danger rating.

For woodland, young plantations will be most at risk of fire because there will not be a closed canopy and therefore abundant understorey vegetation is likely. Fire management becomes a low priority once a crop is about 15 years old.

For the NE Forest Enterprise region, the main causes of fire are:

Boundary burning that has gone out of control (e.g. prescribed heather burns)
Military training related fires (e.g. bomb disposal exercises)
Unplanned arson (e.g. a discarded cigarette)
Planned arson (e.g. fires started by children)

The bigger fires tend to be boundary related as they are generally sited further from urban areas and therefore the Fire Services. Arson fires tend to be sited close to urban areas and probably start nearer main roads.

Factors affecting the fire risk from a forestry point of view are:

- Season – spring is the peak season for fire risk in woodlands because of the greater presence of fire loads. Summer and autumn are also lesser fire risk seasons.
- Day of the week – fire risk is greatest at weekends and bank holidays when there are more people about, but mid week fires tend to be more significant because of the nature and inaccessible location in which they start (i.e. military training exercise related fires).
- Species of tree – Larch or thinned Fir plantations may pose a greater risk of fire than other species, because they support greater understorey vegetation.
- Location of the woodland in the country – more favourable lowland conditions in the south of the country yield a greater abundance of understorey vegetation than the northern uplands.

The only example of a wooded area being closed for fire prevention is Cannock Chase AONB (north of Birmingham), which was closed after weather conditions are considered to have caused an “extreme” fire risk for 5 consecutive days. The FC have a general policy of keeping the forests open to access as much as possible, even during periods of high fire risk, as it is considered that the presence of people will ensure a quicker response to any fires.

Aspirations for a fire management process would be:

- A tool developed specifically to meet the policy requirements of the FC rather than to meet any forest management needs of the Forest Enterprise and private woodland owners.
- A system that would enable scientific decision making (science making up 80% of the decision process) in order to respond to private landowner requests for directions for exclusion of access.
- The system must take account of changes to the land that may allow a closure to be granted (i.e. substantial areas of clearfell and re-planting).
- If there is inadequate woodland data available then the system must be built upon a question based decision making tree.
- CCW will be using a different system in Wales to that used by their English counterparts, therefore there should be a seamless system between both the England and Wales regions.
- The system would ideally but not essentially operate using ArcView.

Datasets that the FC have access to are digital inventories for all Forest Enterprise managed land, the National Inventory and maps showing areas for which felling licences have been granted. Private woodland landowners would not necessarily have any comparable datasets regarding the age and types of trees on their land.

Key Points

1. **The season in which wooded land is most at risk of fire is Spring. The system must therefore take account of "exceptional" weather in relation to seasonality and for changes in land condition, which is likely to be extremely relevant for wooded land.**

2. **It is unlikely that a map showing the fire risk based on science and a map of actual fire occurrence would correlate because most fires are as a result of human intervention, however it should be able to highlight areas at greater risk of sustaining and spreading a fire.**

3. **Any proposed system must be able to operate seamlessly through the two countries of England and Wales.**

Appendix B – Summary of Meeting Held with the Peak District National Park Authority

Peak District National Park Authority and Derbyshire Fire and Rescue Service

The Peak District was set up as a National Park in 1951. The Peak District National Park Authority (PDNPA) works in partnership with private landowners and local authorities to manage this land.

The PDNPA base their initial assessment of fire risk in the National Park on the Met Office Rainfall and Evaporation Calculation System (MORECS) output. MORECS calculates evaporation and soil moisture on a 40km by 40km grid on a weekly basis. Between April and September, the PDNPA receive the MORECS grid for which four squares overlap with the National Park boundary, and plot it over a map showing the actual occurrence of fires (a map developed by the National Trust in 2000). If the MORECS output is predicting a "high" fire risk, the Peak District National Park Ranger Service personnel will take soil moisture readings in "vulnerable" areas (including recording the state of surface vegetation, condition of surface peat, depth of moisture and the flow rate of plateau water). If the Park Rangers soil moisture readings also indicate a "high" fire risk then the PDNPA will notify the Fire Advisory Panel, who will consider the data and make recommendations for actions to be taken. Any final decision to close the land lies with the National Park Authority, must be sanctioned at Board level and will be based on a high fire risk for a period of weeks. The National Park Authority has not closed any part of the moor for a perceived risk of fire since 1994.

Current fire management practice is designed to determine threshold markers to trigger decisions for actions to be taken. These actions could include putting out fire warning signs, issuing press releases, developing fire management plans and mobilising or re-locating fire fighting equipment – the decision is not exclusively (and very rarely) for closure.

It was highlighted that a land closure would only mean the restriction of new access rights under the CROW Act. It is not possible to divert or close a public right of way without due legal procedure under the Highways Act 1980.

The National Park's Dark Peak area is divided into 4 regions that are currently assessed as discrete blocks in terms of fire management, and could be closed independently. Only a whole moorland block would be closed, as a closure would have to relate to some physical boundary and they would not allow piecemeal closure for landowners. If the Park Authority allowed one block to close, it would be very difficult for them not to sanction closure for other blocks too.

Factors affecting the fire risk from the National Park Authority's point of view were:

- Soil type – deep peat can burn for weeks and the fire will not spread outwards but downwards making it difficult to extinguish. Peat will also burn quite easily under a "medium" fire risk. A fire on thin topsoil on top of limestone would pose less of a risk.
- Location – if the fire risk is near a road then people could probably extinguish it on foot with beaters. If the fire risk was further from a road, such as the deep peat areas, then helicopters could be required to extinguish any fire.
- The unique relationship between the National Park Authority and the Fire and Rescue Service – investment in terms of time, resources and equipment and the undertaking of contingency planning and desk-top exercises mean that the Peak District National Park is prepared to manage a fire risk.

It was highlighted that resources are not available to police a closure, other than to put out closure signs, and that actually advertising a fire risk may make the risk of fire greater due to the encouragement of malicious fires.

Aspirations for a fire management system would be:

- A system that is proactive and auditable.
- A system that operates through DAMS whilst maintaining the ability to manipulate and query the data as necessary.
- A spatial resolution that is fine enough to take account of the rain shadow effect over the park and enable the National Park Authority to develop more zones for management as discrete blocks.
- A system that follows the same procedures that are currently in operation for fire risk management within the park, including a series of triggers for recommending actions such as putting out fire warning signs.
- A system that operates through MapInfo.

The only spatial dataset that the National Park Authority have that could be incorporated into the system is the map showing actual fire occurrences produced by the National Trust.

Key Points

1. **The months in which the Peak District National Park land is most at risk of fire are April to September.**
2. **The Peak District National Park Authority would like to see a system that supports their current fire management practices, including a series of triggers to make decisions about certain actions that could be taken before complete closure of land, e.g. to put out fire warning signs.**
3. **The system must be flexible enough to allow data manipulation and analysis.**
4. **The decision to close land will be based upon a "high" fire risk for a period of weeks and it is unlikely that a decision to close an area of the park will be based on 1 day of a "high" fire risk.**

Appendix C – Summary of Meeting Held with the Countryside Council for Wales

Countryside Council for Wales

The Countryside Council for Wales (CCW) is the government body charged with advising the government on ways to sustain, and opportunities to enjoy, the outdoor environment of Wales. The CCW take on the role of both the Countryside Agency and English Nature, in Wales. CCW will be the relevant authority in Wales for exclusions and restrictions on access land outside the National Parks, except in woodland dedicated as access land under section 16 of the CROW Act. The CROW Act also gives CCW powers to issue advice to the other relevant authorities in Wales about excluding or restricting access.

CCW is only directly responsible for managing National Nature Reserves. However, CCW also has a management planning and regulatory role for SSSIs, which cover large areas of open country and registered common land in Wales. Thus, CCW only actively manages fire risk on NNRs and does not have staff to implement fire management planning elsewhere. Outside the National Parks and NNRs, fire management will depend on action by owners and occupiers and local authorities. There are currently contingency plans drawn up for Nature Reserves, together with a warden service, but contingency plans will need to be drawn up for all other land that is likely to be considered for closure. It was considered however, that any "exceptional" weather conditions that would suggest closure for land parcels would be likely to cover the whole of Wales simultaneously and not just small parts.

Aspirations for the system:

- A tool that delivers prediction data outside the DAMS system. The data or output would be incorporated by the CCW into the database management system that is being developed in-house.
- Assesses latent fire risk for Wales, potentially based on Phase 1 Habitat mapping that the CCW have in digital format for the whole of Wales.
- A system that relates fire risk to latent fire risk – precautions for a "high" fire risk on vegetation which does not burn easily could just waste time.

The CCW do not keep records of actual fire occurrence, although such records may be kept for Nature Reserves. It was highlighted that only those fires that are reported could be recorded.

Key Points

1. **The Countryside Council for Wales currently only mange fire risk on National Nature Reserves and, to a more limited extent, on SSSIs. They would therefore like to see a reactive system that provides them with a risk assessment that they can incorporate into their own Access Database System.**

2. **An initial assessment of latent fire risk could be based on the Welsh Phase 1 Habitat mapping and an assessment of vegetation fire load as part of the overall fire risk assessment.**

3. **If the system were to provide any sort of advice, it will need to operate at different levels to accommodate different policies.**

4. **The Countryside Council for Wales has to publicise all closures, for whatever reason, on a website. They would like to publicise the day's fire risk on the website for private landowners and other land managers, including local authorities and National Parks.**

Appendix D – Summary of Meeting Held with Binnie, Black and Veatch

Binnie Black and Veatch

The purpose of this meeting was to provide ADAS and the Met Office with a better understanding of the Desktop Access Mapping System (DAMS) that is being produced for the Countryside Agency by Binnie Black and Veatch consultants.

DAMS contains Ordnance Survey map products, draft areas of designated Access Land mapping (using the Topographic Identifier (TOID) structure of land parcel identification), vegetation and land cover mapping, Section 4 maps and aerial photography. Data is served from a local server to client terminals.

It is important that a relevant authority be able to report closures to other relevant authorities, ideally through DAMS, in order to maintain a consistent approach to land closure decisions for fire prevention purposes. It is not clear that DAMS will be able to provide this functionality in real time, or just via an upload to the central database once a day.

DAMS is designed to provide non-expert users with a basic GIS interface to the management of Access Land. The core functionality is intended to give users the ability to track and maintain an audit trail of decisions of the designation of Access Land areas, subsequent appeals and future ad-hoc closures and restrictions.

DAMS will be available by licence to the relevant authorities who have a responsibility to manage Access Land but it is not yet confirmed whether all of these authorities will subscribe.

DAMS and the fire forecasting system must be able to support integration, but DAMS will not be available as a product within the life-cycle of the current fire forecasting project and so any pilot studies will be external to DAMS. This may mean that it will be necessary to produce a ‘dummy’ DAMS in the meantime, with example data in order to demonstrate the fire risk assessment system.

Appendix E – Summary of Meeting held with the Countryside Agency

Countryside Agency

The Countryside Agency (CA) is the body resulting from the merger of the Countryside Commission and the Rural Development Commission in 1999. Their role under the CROW Act is to manage restrictions on Access Land that is not in a National Park or woodland dedicated for access under section 16 of the CROW Act. Day to day land management is a new role and the CA has not in the past had extensive contact with private landowners on routine land management issues.

The CA does not have rangers and would not have the resources available to manage a "high" fire risk in the same way that may be available to National Park Authorities. The Agency will not have the resources to police any restrictions, or provide wardens or rangers. The CROW Act allows for them to be provided by the local highway authorities, but the extent to which they will be appointed is unclear.

The CA will have the duty to publicise any closures or restrictions to Access Land on behalf of all the relevant authorities in England on a website. How long the Agency will have to make a decision on an application is not yet known.

As the CA currently have no practical role in land management, they have very little spatial data, and all datasets that they do have are with Binnie Black and Veatch. They are interested in some method of incorporating visitation levels if possible in a future system.

Aspirations for the system are:

- A tool that operates through existing CA IT and mapping systems - how this integration should work is not yet confirmed.
- A system for decision making, also providing an audit trail.
- Prompts for factors to be taken into consideration in reaching a decision where further local information is required.

Key Points

1. **The Countryside Agency does not currently undertake any fire management practices on land. They currently have no practical role in land management. They will not have the resources to undertake proactive management, though limited resources may be made available through government.**

2. **The system must operate through DAMS.**

3. **Any process for managing fire risk needs to incorporate prompts for factors to be considered in the decision making process, and keep an audit trail as conditions leading to exceptional fire risk develop.**

Appendix F – Copy of Letter Sent to National Park Authorities

ADAS
Environment Modelling
and GIS Group

Met Office

1 March 2002
Mark Eccles
Lake District National Park Authority
Murley Moss
Oxenholme Road
Kendal, Cumbria
LA9 7RL

Dear Mr Eccles,

Re: Countryside and Rights of Way Act 2000 and Fire Risk Management

The Countryside Agency has commissioned the Met Office to undertake a study into the management of the risk of fire on Access Land. ADAS have been contracted by the Met Office to assist with the development of a proposed Geographical Information System-based tool to support the decision making process for the temporary exclusion of the public to Access Land under sections 25.1.a of the Countryside and Rights of Way Act 2000.

As part of our involvement in this project, The Countryside Agency has commissioned ADAS to undertake a review of the current fire risk management practices of relevant stakeholder authorities, and to ascertain what spatial datasets exist that could be incorporated with a climatological model of fire risk to aid decision making.

It would be appreciated if the Lake District National Park Authority could provide ADAS with information regarding the following:

- Current fire risk assessment procedures: methodology, frequency, grading system etc.
- Details of any records kept of actual occurrences of fires on Lake District National Park Authority land including details of cause of fire, where known and the type of land affected,
- Factors affecting the fire risk on Lake District National Park Authority land,
- Areas within Lake District National Park Authority land that are at most risk of fire, and the reasons why: e.g. specific vegetation types, high visitation areas.
- Times of day, day of week, season etc that Lake District National Park Authority land is perceived to be at most risk from fire,
- Details of action that is taken during periods of high fire risk,
- Details of any good practice guidance provided, either for staff, for land managers or for the public,
- Details of any spatial datasets (either hardcopy or in GIS compatable format) that Lake District National Park Authority have that may be of use for this project, e.g. land cover within Lake District National Park Authority land, visitor numbers and locations.

Environment Modelling
and GIS Group

The timetable for this project is very tight. ADAS and the Met Office have been asked to report on this initial review by Monday 18th March, and therefore we would appreciate your comments and information as soon as possible, and before Wednesday 13th March.

Thank you for your time, we look forward to hearing from you soon.

Yours faithfully,

Appendix G – Copy of Letter Sent Out for Further Consultation

ADAS
Environment Modelling
and GIS Group

Met Office

9 April 2002

RSPB UK Headquarters
The Lodge
Sandy
Bedfordshire SG19 2DL

Dear Sirs,

Re: Countryside and Rights of Way Act 2000 and Fire Risk Management

The Countryside Agency has commissioned the Met Office to undertake a study into the management of the risk of fire on Access Land. ADAS have been contracted by the Met Office to assist with the development of a proposed Geographical Information System-based tool to support the decision making process for the temporary exclusion of the public to Access Land under sections 25.1.a of the Countryside and Rights of Way Act 2000.

As part of our involvement in this project, The Countryside Agency has commissioned ADAS to undertake a review of the current fire risk management practices undertaken, or guidelines issued by relevant stakeholder authorities, and to ascertain what spatial datasets exist that could, or should, be incorporated with a climatological model of fire risk to aid decision making.

It would be appreciated if ADAS could be provided with information regarding the following, where appropriate:

- Details of any good practice guidance provided, either for staff, for land managers or for the public,
- Details of any current fire risk assessment procedures: methodology, frequency, grading system etc, and details of action that is taken during periods of high fire risk,
- A description of any records kept of actual occurences of fires including details of cause of fire, where known and the type of land affected,
- Factors known to affect the fire risk, areas that are at most risk of fire, and the reasons why: e.g. specific vegetation types, high visitation areas, times of day, day of week, season etc. that Access Land is perceived to be at most risk from fire,

The timescale for this project is quite tight, and therefore we would appreciate your comments and information as soon as possible, and before Monday 6th May.

Thank you for your time, we look forward to hearing from you soon.

Yours faithfully,

Appendix H – Causes of UK Countryside Fires: A Literature Review carried out by the Met Office

Causes of UK countryside fires: A Literature Review

prepared for the Countryside Agency project "Forecasting the risk of fire"

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Date: 5 April 2002

Reviewed by: Jack Hopkins
Date: 8 April 2002

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Causes of UK countryside fires; a literature review

1. Overview

1.1 This literature review was carried out on behalf of the Countryside Agency. It looks at the causes of countryside fires.

1.2 There is surprisingly little published work on countryside fires in the UK, let alone causes of them, but a few published sources of information were found. The world wide web proved useful for general information, but lacked information that could be attributed to individual authors.

2. Causes of countryside fires in the UK

2.1 Possible causes of countryside fires are arson, careless disposal of cigarettes and matches, accidents involving camp fires, bonfires and barbecues, prescribed fires getting out of control, the magnifying-lens effect of discarded bottles, trees falling into power lines, weapons fired on military firing ranges and lightning, especially when there is no accompanying rainfall (dry lightning). It is obvious that most of the causes are associated with the presence of people. Some other causes are mentioned below.

2.2 It has been reported that in the UK, most countryside fires are due to arson or negligence (Sinclair 1991). It has also been reported by an assistant chief fire officer of an English fire and rescue service, in a personal communication with the author of this review, that in his opinion the majority of countryside fires in the UK are started deliberately by people. Other sources say that in the UK, accidental fires are common with peaks in their numbers during holiday periods in April and August, and that most of the accidental fires occur near the urban areas (Webb, 1998). The Hampshire Fire & Rescue Service website, in its section on heath and woodland fires, says "Generally, these fires are caused by people either unintentionally or wilfully setting fire to elements of the countryside. This may be due to carelessly discarded cigarettes or smoking materials, uncontrolled bonfires and barbecues or children deliberately setting fires during the school holidays, etc. Electric arcing from the large areas of railway network is also a common cause."

2.3 Dry lightning occurs when a thunderstorm has a high cloud base, which allows the rain to evaporate before it reaches the ground. It is rare in the UK, but is not unknown. During the evening of 2 July 1999 over southern England, scattered thunderstorms produced mostly only moderate or light precipitation but a significant amount of lightning. (Holt et al,2001)

2.4 Several cases of large countryside fires with an attributed cause were found during the course of this research. From 4 to 9 July 2001 there was a severe fire in the Peak District National Park, at Robinson's Moss, Arnfield Moor. Two helicopters and scores of personnel fought the fire, which burnt about 2 square miles of moorland. Terry Tallis, a principal ranger, was quoted on the BBC news website saying "These fires do not start by themselves. The main holiday season is approaching and I must appeal to everyone visiting the Peak District, especially the moorlands, to be alert to the dangers they inadvertently bring." A 14-year-old boy from Salford in Greater Manchester was arrested on suspicion of starting the fire.

2.5 On the first weekend of May 2001, which was a bank holiday weekend, the Hampshire Fire & Rescue Service were called to 73 woodland, heath and grass fires. On the following weekend they were called to 63. Their press release on 14 May said that many of these incidents were caused by the carelessness of people using the countryside or by children and teenagers deliberately starting fires.

2.6 On 7 April 1997 at Yarner Wood & Trendlebere Down Nature Reserve, Devon, a fire burnt 1.7 square km of heathland. It followed a long period of dry weather, and moved swiftly upslope and downwind in a moderate wind (Blackford, 2000). It was attributed to arson (Brear, 1999). Another Devon heath fire in recent years was caused by a model aircraft igniting after crashing on the heath (Devon County Council, 1998).

2.7 On Friday 5 May 1995 fire burnt 24 hectares of heathland with stands of pine and birch trees in the Frensham Common Country Park near Tilford in Surrey (Scott et al, 2000). Although no cause was given in the reference, the date of the fire was close to the early May bank holiday, so human involvement seems likely.

2.8 Another fire which occurred close to a bank holiday was on Wednesday 28 May 1997 (only two days after the late May holiday) when at least 15 hectares of Lightwater Country Park in Surrey were burnt, affecting both sides of the M3 motorway, requiring it to be closed for nearly 4 hours (Surrey Advertiser, 1997).

3. Countryside fires overseas

3.1 In France, the main causes of wildland fires are thought to be negligence (42%), accidents (27%) especially during forest utilization and agricultural activities, and arson (11%) (Teusan, 1995). Those percentages add up to 80, leaving 20% of fires with unknown or natural (e.g. lightning) causes. It should be noted that France experiences more lightning strikes than the UK, so it is likely that a greater percentage of wildland fires in the UK are caused by people. In 1989 10% of Austria's forest fires were reported to be caused by lightning (Federal Forest Research Station of Austria, 1990) although that was mostly due to a relatively high proportion of lightning fires in the state of Vorarlberg.

A significant proportion of wildfires in North America are caused by lightning, although the proportion varies with the location, and different authors ascribe differing shares of responsibility to people and lightning. In northern Baja California, Mexico, the high frequency of burns has been attributed to deliberate burning. However, lightning from summer thunderstorms are a frequent source of natural ignitions (Minnich et al, 1993). Lightning is the primary cause of fire in the forested regions of the Pacific Northwest, especially when it occurs without significant precipitation at the surface (Rorig, Ferguson, 1999).

4. Conclusions

4.1 The overwhelming majority of countryside fires in the UK are due to the presence of people, and of those fires, a large number are caused by carelessness or arson. Some documented cases of large heath fires have occurred a few days either side of a bank holiday weekend: these could have been caused by people taking additional leave from work in order to have a whole week off. No instances of countryside fires caused by lightning in the UK were found in the course of this research, although it is a well-known cause of fires in other parts of the world, including other European countries. Despite the lack of known causes in some of the UK cases listed, a prior spell without rain was often mentioned in the articles and news releases. If thunderstorms had occurred, with or without significant rainfall, presumably they would have been mentioned, so lightning is not a significant cause in the UK.

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Appendix I – Forestry Commission's Special Method of Calculating Fire Hazard and Fire Risk for use in a Fire Danger Rating System

FIRE PROTECTION MEMORANDUM NO 6

ASSESSMENT OF FIRE DANGER

a Introduction

General

1. An assessment of current fire danger, that is, a combination of fire hazard and fire risk, provides the basis for prescriptions in the Fire Plan. Fire danger is expressed as a rating with 5 degrees: nil, low, moderate, high and extreme.

Methods

2. Assessment requires a systematic consideration of all the relevant factors of hazard and risk. The method to be employed in each forest will depend upon the overall danger from fire and will be prescribed in the Fire Plan.

3. A reasonably precise and objective assessment based on careful meteorological and other observations will be required at forests where there are large concentrated areas with uniform environmental conditions, above average hazard and above average risk, and with a history of frequent fires. On the other hand, in forests composed of diverse and scattered blocks with variable hazard and little risk, and with little or no history of fires, special methods are unlikely to be justified and a subjective assessment by an experienced Chief or Head Forester may be considered sufficient. Many forests will fall somewhere between these 2 extremes and the most useful method may be one combining objective and subjective observations or judgement supported by simple measurements.

4. Such a method for assessing a Hazard Rating and a Risk Rating and thus the Fire Danger Rating is described in subsection b (and Appendix I). A more detailed method of assessing the fire hazard component based on readings of meteorological instruments is described in subsection c (and Appendix II). Whatever method is adopted, it is important that the weightings in the assessment tables should be adjusted where necessary to fit local conditions.

Recording

5. All assessments of fire hazard and fire risk and the Fire Danger Rating should be recorded. The record sheet in Appendix I - 4 may be used for this.

c. Special Hazard Rating

General

1. The special method for assessing fire hazard objectively depends on the careful determination of 4 main factors in the weather conditions affecting the start of forest fires. These are rainfall, temperature, relative humidity and wind speed.

Instruments

2. Regular readings are taken from a small set of meteorological instruments.

a. One rain gauge (funnel, bottle and measuring cylinder).

b. One maximum registering thermometer graduated in degrees Celsius.

c. One wet and dry bulb hygrometer.

3. In certain cases a small climatological station may be installed under the direction of the Meteorological Office. A higher standard of instrumentation and reporting will be required than for the assessment of fire hazard alone, but precise environmental data will be valuable for silvicultural and research purposes.

Location

4. The correct siting of the instruments is of the utmost importance. Details for the proper installation of each instrument are given below. In general, they should be sited where regular readings can conveniently be taken and reported; at the same time it is desirable that the site should be representative of the locality and should bear a known relationship to the plantations at risk.

Readings

5. During the fire danger season (or as prescribed in the Fire Plan) readings should be taken daily, preferably at 0900 hours, although for fire hazard purposes it does not matter greatly so long as they are taken between 0800 and 1000 hours. Under certain conditions it will be desirable to take second readings at about midday.

6. Taking and recording the readings is not difficult, but it is important that they are reported and the Hazard Rating calculated without delay, using the working sheets and tables 1-10 Appendix II.

Rain Fall

7. The rain gauge consists of a funnel with a bottle or other suitable container protected from evaporation underneath. Rain collected since the previous reading is measured in a graduated cylinder. The funnel and the measuring cylinder will be calibrated in either inches or millimetres. It is important the the same system of measurement shall be used throughout the calculation.

8. The rain gauge must be installed carefully as follows.

a. The rim of the funnel should be horizontal and should be approximately 0.3 m (1 ft) above ground level.

15. The maximum temperature should be read to the nearest 1°C and the index on the thermometer thereafter drawn down to the mercury using the magnet provided.

16. The maximum temperature during the previous 24 hours should be recorded in Col 5 of the record sheet to the nearest 1°C against the date on which the reading is taken.

17. It is assumed that the mean maximum shade temperature for the previous 5 days or for the number of days since heavy rain (over 6.5 mm or 0.25 inches) last fell - whichever is the lesser - bears a direct relationship to the temperature of combustible material on the forest floor.

18. Therefore the maximum temperatures (Col 5) for the last 5 days, or for such lesser number of days since 6.5 mm (0.25 inches) or rain last fell (Col 4), will be added up and the total entered in Col 6 on the record sheet.

19. The mean daily maximum temperature will be calculated by dividing the total in Col 6 by the number of days involved (5 or less) and recording the result in Col 7 of the record sheet.

20. The Corrected Basic Hazard Rating (Appendix II - 3) is derived from the Basic Hazard Rating for the current day (Col 3) and the mean daily maximum temperature (Col 7), and should be entered in Col 8 of the record sheet.

Relative Humidity

21. Relative humidity is an expression of the dampness of the air (and thus of its drying capacity). It means the amount of water vapour actually present expressed as a percentage of the possible vapour content of the air if it was saturated. (Completely dry air = 0%; saturated air = 100% relative humidity). It will be measured with a hygrometer.

22. The hygrometer consists of a pair of identical thermometers, the bulb of one of which is covered and kept moist by a wick dipping into a small vessel of water. When the air is unsaturated, evaporation from the wick causes cooling of the wet bulb thermometer. If the air is saturated, there is no evaporation and cooling, and both thermometers give the same reading.

23. The hygrometer must be installed in similar conditions and adjacent to the maximum registering thermometer. Great care must be taken to ensure that the reservoir is kept full of clean water and that the wick and bulk are kept free of slime and dirt.

24. The wet and dry bulb temperatures should be read and entered on the Estimated Minimum Relative Humidity working sheet (Appendix II - 4) in Col 2 and Col 3 respectively. The wet bulk depression is the difference between the 2 temperatures and this should be entered in Col 4.

25. The lower the relative humidity, the lower the moisture content of potential fuels and the more likely are fires to start. Warm air can hold more moisture than cold air and it is therefore important to estimate the minimum relative humidity to be expected at the warmest time of the day (usually the early afternoon). To do this, it is necessary to know the probable maximum temperature and the dew point.

26. The dew point is the temperature at which the moisture in the air begins to condense out (as dew or mist). It can be read from the Dewpoint Table (Appendix II - 5) against the dry bulb temperature (Col 3) and the wet bulb depression (Col 4), and should be entered in Col 5 of the working sheet.

b. Yellow-drying

This condition is usually associated with high summer temperatures and low rainfall. It is characterised by the browning of short grass on lawns, pastures and south-facing grazed hillsides. It can be particularly hazardous, but may not occur at all in wet summers.

c. Lush-green

This condition usually occurs after the spring flush and continues until the heat or drought of the summer starts to dry out the young growth. However, in certain predominantly grass areas, the condition may recur in a mild, moist autumn.

d. Dead-moist

This condition usually starts when the first autumn frosts cut down the bracken and it persists during the autumn and winter rains until drying east winds come (or a protracted period of sharp frosts brings on a premature Dead-dry condition.

36. The appropriate condition of the vegetation should be entered in Col 13 of the record sheet.

Hazard Rating

37. The Hazard Rating (Appendix II - 10) can now be derived from the Hazard Rating Index (Col 12) and Condition of Vegetation (Col 13), and should be entered in Col 14 of the record sheet.

38. While the content and arrangement of the tables should not be altered, it is important that the weightings should be adjusted where necessary to make the system fit local conditions.

FPM 6 APPENDIX 1-4

STANDARD/SPECIAL METHOD: FIRE DANGER RATING RECORD SHEET

FOREST: MONTH: YEAR:

Date	C° Dry Bulb	C° Wet Bulb	Depres-sion	Dew Point	C° Fore-cast Max Temp	Relative Humidity	Wind Force	HAZARD INDICES				Total Hazard Index	Hazard Rating	RISK INDICES				Total Risk Index	Risk Rating	Danger Rating	REMARKS (inc actual max Temp etc if needed)
								Ground Veg	Cond Of Veg	Rel Humdty	Wind Force			Season	Day	Time	Weather				
1																					
2																					
3																					
4																					
5																					
6																					
7																					
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10																					
11																					
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28																					
29																					
30																					
31																					

HAZARD RATING RECORD SHEET

Month _____ Year _____ Forest _____

Conservancy

Date (1)	Rainfall Recorded at 09.00 mm/ins (2)	Basic Hazard Rating from Table 2 (3)	No of days since 6.5mm/0.25in rain fell (4)	Maximum temperature recorded at 9.00 °C (5)	Cumulative Maximum Temperature °C (6)	Mean Daily Maximum Temp °C (7)	Corrected Basic Hazard Rating from Table 3 (8)	Estimated Minimum Relative Humidity % (9)	Estimated Wind Force Beaufort Scale (10)	Diurnal Variable from Table 8 (11)	Hazard Rating Index from Table 9 (12)	Condition of vegetation (13)	Hazard Rating from Table 10 (14)	Remarks (Check figures or fires) (15)
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
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28														
29														
30														
31														

BASIC HAZARD RATING

For all vegetational Types except Molinia

Basic Hazard Rating on Previous Day	Rainfall recorded on current day											
	0 or trace	ins .01 to .05	mm 0.25 to 1.4	ins .06 to .10	mm 1.5 to 2.6	ins .11 to .15	mm 2.7 to 3.9	ins .16 to .20	mm 4.0 to 5.2	ins .21 to .25	mm 5.3 to 6.5	over ins .25	over mm 6.5
0	30		25		20		10		5		0		0
5	35		30		25		15		5		0		0
10	40		35		30		15		5		0		0
15	40		35		30		20		10		0		0
20	45		40		35		25		10		0		0
25	45		40		35		25		15		5		0
30	50		45		40		30		15		5		0
35	50		45		40		35		15		5		0
40	55		50		45		35		20		5		0
45	55		50		45		40		20		5		0
50	60		55		50		40		25		10		0
55	65		60		55		45		25		10		0
60	70		65		60		50		30		10		0
65	75		70		65		50		30		10		0
70	80		75		70		55		35		15		0
75	85		80		75		60		35		15		0
80	90		85		75		60		40		15		0
85	95		90		80		65		40		20		0
90	95		95		85		70		45		20		0
95	100		100		90		70		50		25		5
100	100		100		95		75		55		30		15

BASIC HAZARD RATING

For use during period January to April in areas where the dominant vegetation is

Molinia

Basic Hazard Rating on Previous Day	Rainfall Recorded on Current Day				
	ins 0 to 0.05 / mm 0 to 1.4	ins 0.06 to 0.15 / mm 1.5 to 3.9	ins 0.16 to 0.25 / mm 4.0 to 6.5	mm 0.26 to 0.50 / mm 6.6 to 12.7	over ins 0.50 / mm 12.7
0	40	30	20	10	0
10	50	40	30	20	0
20	50	50	40	20	10
30	60	60	50	30	10
40	70	60	50	30	10
50	70	70	50	30	20
60	80	70	60	40	20
70	90	80	60	40	20
80	90	80	60	40	30
90	100	90	70	50	30
100	100	90	70	50	30

CORRECTED BASIC HAZARD RATING

Basic Hazard Rating on Current Day	Mean Daily Maximum Temperature (°C)						
	under 15.5°	15.5°- 17.5°	18°- 20°	20.5°- 22.5°	23°- 25°	over 25°	
0	0	0	0	0	0	0	
5	5	5	5	5	5	5	
10	10	10	10	10	10	10	
15	15	15	15	15	20	20	
20	20	20	20	25	25	25	
25	25	25	25	30	30	30	
30	30	30	35	35	35	35	
35	35	35	40	40	40	45	
40	40	40	45	45	50	50	
45	45	45	50	50	55	55	
50	50	55	55	55	60	60	
55	55	60	60	65	65	70	
60	60	65	65	70	70	75	
65	65	70	70	75	80	80	
70	70	75	75	80	85	90	
75	75	80	80	85	90	95	
80	80	85	90	90	95	100	
85	85	90	95	100	100	105	
90	90	95	100	105	110	115	
95	95	100	105	110	115	120	
100	100	105	110	115	120	125	

CORRECTED BASIC HAZARD RATING

Basic Hazard Rating on Current Day	Mean Daily Maximum Temperature (°C)					
	under 15.5°	15.5°- 17.5°	18°- 20°	20.5°- 22.5°	23°- 25°	over 25°
0	0	0	0	0	0	0
5	5	5	5	5	5	5
10	10	10	10	10	10	10
15	15	15	15	15	20	20
20	20	20	20	25	25	25
25	25	25	25	30	30	30
30	30	30	35	35	35	35
35	35	35	40	40	40	45
40	40	40	45	45	50	50
45	45	45	50	50	55	55
50	50	55	55	55	60	60
55	55	60	60	65	65	70
60	60	65	65	70	70	75
65	65	70	70	75	80	80
70	70	75	75	80	85	90
75	75	80	80	85	90	95
80	80	85	90	90	95	100
85	85	90	95	100	100	105
90	90	95	100	105	110	115
95	95	100	105	110	115	120
100	100	105	110	115	120	125

HAZARD RATING: ESTIMATED MINIMUM RELATIVE HUMIDITY WORKING SHEET

Month _____ Year _____ Forest _____

Date (1)	Wet Bulb at 09.00 °C (2)	Dry Bulb at 09.00 °C (3)	Wet Bulb Depression (Col 3 minus Col 2) °C (4)	Dew Point at 09.00 (from Table 5) °C (5)	BBC forecast Max temp °C (6)	Adjusted forecast Max Temp °C (7)	Estimated Min RH % (from Table 6) °C (8)	Wet Bulb at 14-15.00 °C (9)	Dry Bulb at 14-15.00 °C (10)	Depression °C (11)	Actual RH % at 14-15.00 (met Table No 265) (12)
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											
31											

Notes a. Columns 1 to 8 may be used to calculate the estimated Minimum Relative Humidity % for Col 9 of the Hazard Rating Index record sheet.
b. Columns 9 to 12 may be used on days when conditions are dangerous to check the estimate (Col 8) against the actual (Col 12).
c. Columns 12: Met Table No 265 is supplied with the Hygrometer.

DEW POINT (°C)

Dry Bulb (°C)	Depression of the Wet Bulb (°C)										
	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
29	29	28	26	25	23	22	20	18	16	14	12
28	28	27	25	24	22	20	19	17	15	13	10
27	27	26	24	23	21	19	18	16	14	11	9
26	26	25	23	21	20	18	16	14	12	10	7
25	25	23	22	20	19	17	15	13	11	8	5
24	24	22	21	19	18	16	14	12	9	7	4
23	23	21	20	18	16	15	13	10	8	5	2
22	22	20	19	17	15	13	11	9	6	3	0
21	21	19	18	16	14	12	10	7	5	1	-2
20	20	18	17	15	13	11	9	6	3	0	-5
19	19	17	16	14	12	10	7	4	1	-3	-8
18	18	16	15	13	11	8	6	3	-1	-5	
17	17	15	13	11	9	7	4	1	-3	-7	
16	16	14	12	10	8	6	3	-1	-5		
15	15	13	11	9	7	4	1	-2	-7		
14	14	12	10	8	6	3	0	-4			
13	13	11	9	7	4	1	-2	-7			
12	12	10	8	6	3	0	-4				
11	11	9	7	4	1	-2	-6				
10	10	8	6	3	0	-4	-8				
9	9	7	4	2	-1	-5					
8	8	6	3	0	-3	-7					
7	7	5	2	-1	-5						
6	6	4	1	-2	-6						
5	5	2	0	-4	-8						
4	4	1	-2	-5							
3	3	0	-3	-7							
2	2	-1	-4	-8							
1	1	-2	-5	-8							
0	0	-3	-7								
-1.0	-1	-4	-8								
-2.0	-2	-6									
-3.0	-3	-7									
-4.0	-5	-8									
-5.0	-6										

RELATIVE HUMIDITY (%)

Dew Pt (ºC)	Forecast Maximum Temperature (ºC)																														Dew Pt (ºC)
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
29																														100	29
28																													100	95	28
27																												100	95	90	27
26																											100	94	90	85	26
25																										100	94	89	85	80	25
24																									100	94	89	84	80	75	24
23																								100	94	89	84	79	75	71	23
22																							100	94	89	84	79	74	70	67	22
21																						100	94	89	84	79	74	70	66	63	21
20																					100	94	89	84	79	74	69	66	62	59	20
19																				100	94	88	84	79	74	69	65	62	58	55	19
18																			100	94	88	83	79	74	69	65	61	58	55	52	18
17																		100	94	88	83	78	74	69	65	61	57	54	52	49	17
16																	100	94	88	83	78	73	69	65	61	58	54	51	49	46	16
15																100	94	88	83	78	73	68	65	61	57	54	51	48	46	43	15
14															100	94	88	83	78	73	68	64	61	57	53	51	48	45	43	40	14
13														100	94	88	83	78	73	68	64	60	57	53	50	48	45	42	40		13
12													100	94	88	83	78	73	68	64	60	56	53	50	47	45	42	39			12
11												100	94	88	82	78	73	68	63	60	56	53	50	47	44	42	39				11
10											100	94	88	82	77	73	68	63	59	56	52	50	47	44	41	39					10
9										100	93	88	82	77	72	68	63	59	55	52	49	47	44	41	38						9
8									100	93	87	82	76	72	67	63	59	55	51	49	46	44	41	38							8
7								100	93	87	81	76	71	67	63	59	55	51	48	46	43	41	38								7
6							100	93	87	81	76	71	66	62	59	55	51	48	45	43	40	38									6
5						100	93	87	81	76	71	66	62	58	55	51	48	45	42	40											5
4					100	93	87	81	76	71	66	62	58	54	51	48	45	42	40												4
3				100	93	87	81	76	71	66	62	58	54	50	47	45	42	40													3
2			100	93	87	81	75	71	66	62	58	54	50	47	44	42	39														2
1		100	93	87	81	75	70	66	62	58	54	50	47	44	41	39															1
0	100	93	87	81	75	70	65	61	58	54	50	46	44	41	38																0
-1	93	87	81	75	70	65	61	57	54	50	46	43	41	38																	-1
-2	86	81	75	70	65	60	57	53	50	46	43	40	38																		-2
-3	80	75	69	65	60	56	53	49	46	43	40																				-3
-4	74	69	64	60	56	52	49	45	43	40																					-4
-5	69	64	60	56	52	48	45	42	40																						-5
-6	64	60	56	52	48	45	42	39																							-6
-7	59	56	52	48	44	42	39																								-7
-8	55	51	48	44	41	39																									-8
Dew Pt (ºC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Dew Pt (ºC)
	Forecast Maximum Temperature (ºC)																														

BEAUFORT SCALE OF WIND FORCE

Beaufort No	Description of Wind	Specification of Beaufort Scale for use Inland	Wind Stretch in Knots
0	Calm	Calm; smoke rises vertically	Under 1
1	Light air	Direction of wind indicated by smoke drift, but not by wind vanes	1- 3
2	Light breeze	Wind felt on face; leaves rustle; wind vane moved.	4- 6
3	Gentle breeze	Leaves and small twigs in constant motion; light flags extended.	7-11
4	Moderate breeze	Raises dust and loose paper; small branches moved.	11-16
5	Fresh breeze	Small trees in leaf begins to sway, wavelets form on inland waters.	17-21
6	Strong breeze	Large branches in motion; whistling heard in telegraph wires; unbrellas used with difficulty.	22-27
7	Moderate gale	Whole trees in motion; inconveniences felt when walking against wind.	28-33
8	Fresh gale	Breaks twigs off trees. Generally impedes progress.	34-40
9	Strong gale	Slight structural damage occurs (chimney-pots and slates removed).	41-47
10	Whole gale	Seldom experienced inland; trees uprooted; considerable structural damage occurs.	48-55
11	Storm	Very rarely experienced; accompanied by widespread damage.	56-63
12	Hurricane		64+

DIURNAL VARIABLE

Relative Humidity %	Estimated Wind Force: Beaufort Scale Number					
	0	1	2	3	4	over 4
under 40	75	85	95	95	100	100
40-44	70	80	90	95	100	100
45-49	65	75	85	90	95	95
50-54	60	70	75	85	90	90
55-59	50	60	65	70	75	80
60-64	40	45	50	55	60	65
65-69	20	25	30	35	40	45
70-79	5	10	15	20	25	30
80-89	0	5	5	10	10	15
90-100	0	0	0	0	0	0

HAZARD RATING INDEX

Correct Basic Hazard Rating	Diurnal Variable																				
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4
10	0	0	1	1	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	8
15	0	1	1	2	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	11	12
20	0	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16
25	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
30	0	1	2	4	5	6	7	8	10	11	12	13	14	16	17	18	19	20	22	23	24
35	0	1	3	4	6	7	8	10	11	13	14	15	17	18	20	21	22	24	25	27	28
40	0	2	3	5	6	8	10	11	13	14	16	18	19	21	22	24	26	27	29	30	32
45	0	2	4	5	7	9	11	13	14	16	18	20	22	23	25	27	29	31	32	34	36
50	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
55	0	2	5	7	9	11	13	16	18	20	22	24	26	29	31	33	35	37	40	42	44
60	0	2	5	7	10	12	14	17	19	22	24	26	29	31	34	36	38	41	43	46	48
65	0	2	5	8	10	13	16	18	20	23	26	29	31	33	36	39	42	44	46	49	52
70	0	3	6	8	11	14	17	20	22	25	28	31	34	36	39	42	45	48	50	53	56
75	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
80	0	3	6	10	13	16	19	22	26	29	32	35	38	42	45	48	51	54	58	61	64
85	0	3	7	10	14	17	20	24	27	31	34	37	41	44	48	51	54	58	61	65	68
90	0	4	7	11	14	18	22	25	29	32	36	40	43	47	50	54	58	61	65	68	72
95	0	4	8	11	15	19	23	27	30	34	38	42	46	49	53	57	61	65	68	72	76
100	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
105	0	4	8	13	17	21	25	29	34	38	42	46	50	55	59	63	67	71	76	80	84
110	0	4	9	13	18	22	26	31	35	40	44	48	53	57	62	66	70	75	79	84	88
115	0	5	9	14	18	23	28	32	37	41	46	51	55	60	64	69	74	78	83	87	92
120	0	5	10	14	19	24	29	34	38	43	48	53	58	62	67	72	77	82	86	91	96
125	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100

HAZARD RATING

Hazard Rating Index	Conditions of Vegetation			
	Dead - dry	Yellow - drying	Lush - green	Dead - moist
0	A	A	A	A
4	A	A	A	A
5	A	A	A	A
9	A	A	A	A
10	B	B	A	A
14	B	B	A	A
15	B	B	B	A
19	B	B	B	A
20	B	B	B	B
24	B	B	B	B
25	B	C	B	B
29	B	C	B	B
30	C	C	B	B
34	C	C	B	B
35	C	C	C	B
39	C	C	C	B
40	C	C	C	C
44	C	C	C	C
45	C	C	C	C
49	C	C	C	C
50	D	D	C	C
54	D	D	C	C
55	D	D	C	C
59	D	D	C	C
60	D	D	C	C
64	D	D	C	C
65	D	D	D	C
69	D	D	D	C
70	E	D	D	D
74	E	D	D	D
75	E	E	D	D
79	E	E	D	D
80	E	E	D	D
84	E	E	D	D
85	E	E	D	D
89	E	E	D	D
90	E	E	E	D
Over 90	E	E	E	D

Appendix J – Good Practice Guidance for Prescribed Burning, Issued by Dartmoor National Park Authority

Firebreaks
- Use firebreaks, choosing natural boundaries for the burn wherever possible.

Control
- Have sufficient manpower and equipment.
- Appoint one person to be in charge.

Landscape and Wildlife
- Take account of wildlife habitats.
- Avoid spoiling the landscape and environment.

Neighbours
- Keep them informed and take account of their property and interests.

Public Safety
- Avoid creating hazards to road users and the public.

Prosecution
- A breach of the *Heather and Grass etc (Burning) Regulations 1986* may on conviction result in a fine of up to £1000.
- For SSSIs failure to give written notice to English Nature can result in a fine up to £2500 under the *Wildlife and Countryside Act 1981*.

Insurance
- Dartmoor Commoners' Council insurance will not cover public liability for damage to property arising out of swaling unless the Fire Service is advised in advance of each instance of swaling.

716.2/162/swaling checklist/mac

SWALING CHECKLIST

DARTMOOR COMMONERS' COUNCIL · ENGLISH NATURE · DEFRA Department for Environment, Food & Rural Affairs

Before burning you must telephone:

1. **Police**
   08705 777444
   Ask for the Force Enquiry Centre
2. **Devon Fire and Rescue Service**
   01392 872200
   Ask for the Control Room
3. **English Nature**
   01392 889770
   If the burn is to take place in a Site of Special Scientific Interest
4. **Dartmoor National Park Authority**
   01626 832093

Making these phone calls will help to ensure that no officers are sent to put your fire out.

The Legal Requirements

The burning, not only of heather and grass, but also gorse, bracken and bilberry, is controlled by the *Heather and Grass, etc (Burning) Regulations 1986.*

- Burning is allowed only between:
  1 October - 15 April in upland areas. The National Park Authority recommends no burning after 31 March to prevent harm to nesting birds.
- Outside these dates burning is allowed only under licence issued by the Department for Environment, Food & Rural Affairs (DEFRA).
- Permission of the owner must be gained.
- At least 24 hours but not more than 7 days notice of intent to burn must be given in writing to the owners and occupiers of the land concerned and persons in charge of adjacent land.
- You must not start burning heather, grass, gorse, bracken or bilberry between sunset and sunrise.
- You must ensure that sufficient people and equipment are on hand to control the burn.
- You must take all reasonable precautions to prevent injury or damage.
- You must not cause a nuisance through the creation of smoke. This is an offence under the *Clean Air Act 1956*.
- You must contact English Nature if burning on a Site of Special Scientific Interest.
- Under the Dartmoor Commoners' Council's Regulations, arising from the *Dartmoor Commons Act 1985*, no person or local Commoners' Association shall burn moorland where heather is present on the commons exceeding an area of 9000 square metres at intervals of less than 12 years, nor where the distance between burns in any one year is less than 150 metres. No person or local Commoners' Association shall burn moorland where dead grass, bracken or gorse is present on any common land unit over an area exceeding 50 acres (20 hectares) or 25% of the area of that common land unit whichever shall be the less and such burning shall take place at intervals of no less than 3 years.

Points to Remember

Planning
- Burn in accordance with an approved long-term Fire Plan for your area, drawn up to meet agricultural and environmental objectives.
- The Fire Plan should include a programme of essential burning on a sound rotation basis and include the creation of firebreaks where necessary.
- Plan individual burns sensibly by relating size of area to manpower availability, safety requirements and forecasted weather conditions.
- Plan to avoid burning at weekends or public holidays if possible.

Timing
- Burn when there is a gentle breeze.
- Make an early start.
- Stop and re-assess if conditions change.

Place
- Choose with care the best spot to start the fire, to ensure the fire doesn't spread too quickly.
- Burn small areas at a time, paying particular attention to the optimum width of the burn.

(cont.)

Appendix K – Standard Operating Procedures of the South Grampian Forest Fire Protection Group

SOUTH GRAMPIAN FOREST FIRE PROTECTION GROUP (SGFFPG)

STANDARD OPERATING PROCEDURES (S.O.P.'s)

1. Background:

The South Grampian Rural Fire Group is a mutual aid organisation covering the estates on upper Deeside and upper Donside. The purpose of the group is to give practical assistance to each other in the event of a serious forest or moorland wildfire.

Group members will always work in support of Grampian Fire Brigade but it is recognised that the skilled personnel and specialised equipment based on estates can improve the effectiveness and efficiency of wildfire suppression efforts.

2. CALLOUT PROCEDURES:

2.1. Action on receipt of initial call: **from Fire Brigade or neighbour:**

2.1.1. Confirm details of incident:

• Location of fire (grid ref.).	• People/assets threatened
• Size of fire front (width).	• Location Fire Support Office
• Wind direction and speed.	• Location Assembly/Staging Area/RVP
• Flame height (m),	• Access route
• Forward rate of spread (km/hr).	• Personnel/equipment required

2.1. Put staff on STANDBY, start preparing equipment

B. Put radios on to COMMON FREQUENCY

C. Give details of fire to other members of the group.

D. On CALLOUT move personnel and equipment to: Assembly Area / Staging Area / RVP as instructed

E. Give Fire Support Office ETA & info on resources coming.

F. Senior staff member then:

1. Make contact on radio when near area

2. Report to Fire Brigade Incident Controller and/or senior estate manager at Forward Control Point.

3. Obtain briefing on Incident Action Plan including: fire suppression objective, strategies, tactics & tasks.

4. Brief staff & fight fire without taking personal risks.

III. COMMAND, CONTROL & CO-ORDINATION

A. Grampian Fire Brigade in overall command of fireground when attending fire.
B. Each Estate must retain own chain of command at all times, especially to ensure: safety, health and welfare of own staff.
C. Wildfire suppression activities will be conducted by Fire Brigade Incident Controller supported by an Incident Management Team.
D. Incident Management Team will include senior manager from estate with fire.
E. Senior estate manager acts as liaison between Fire Group and Fire Brigade.
F. Tasks for fire group teams should come from Fire Brigade.
G. All fire group personnel must work in a team under their own supervisor, with radio.
H. Maximum number of people per supervisor 7 to 1.
I. In the event of there being no senior manager attending fire from receiving Estate. A senior manager, with radio, from group will be appointed to liaison position.

IV. ADMINISTRATION

A. The Estate receiving assistance will provide food, water, fuel and resting facilities. Fire Brigade facilities may be available.
B. The Estate receiving aid will pay for all the costs of group members attending: labour, vehicles, equipment, transport, subsistence, materials used; at annually agreed rates.
C. Each Estate providing assistance accepts liability (through insurance) for: own actions, damage to third parties, injuries to own employees, and damage to own vehicles and equipment.
D. Each Estate reserves the right to give priority to the protection of their own employees, equipment or assets (forest).

V. COMMUNICATIONS PLAN

A. Radio discipline is essential at all stages
B. Fire group team leaders take as many spare radios & batteries to fire as possible.
C. Make sure Fire Brigade Incident Controller has a radio on the common frequency. Provide a spare battery.
D. Collect Fire Brigade radio & spare battery, if appointed to liaison position.
E. All use common group frequency initially.
F. At a large complex incident, only fire group team leaders to use common frequency. Each estate attending use own channel for internal communications. Instruction to change frequencies will come from Fire Group liaison manager.
G. When frequency change made; all Fire group team leaders must have access to 2 radios, one set to common emergency frequency the other to their own frequency.

Appendix L – A Model for the Development of an Integrated System of Data Exchange for the Assessment of the Impact of Fires on Heathland.

Taken from:

[12] Tantram, D. A. S., Boobyer, M. G. & Kirby, J. S., 1999, "Monitoring heathland Fires in Dorset: Phase 2. ", Report to Department of the Environment Transport and Regions. Wildlife and Countryside Directorate. Terra Environmental Consultancy Northampton

7 A MODEL FOR THE DEVELOPMENT OF AN INTEGRATED SYSTEM OF DATA EXCHANGE FOR THE ASSESSMENT OF THE IMPACT OF FIRES ON HEATHLAND

7.1 General

A model has been constructed to address the need for a co-ordinated system of data and information exchange. The need for such a system has been identified by DETR and the conclusions of work conducted for this research project. Currently, one of the main limitations to the assessment of the impact of fires on heathland is the dispersed nature of the information required as a basis for such analysis. At present several organisations have statutory, voluntary and commercial interest in the maintenance of the favourable status of heathland and the monitoring of the impact of fires. Each of these organisations and in some cases individuals holds a portion of the 'key' to the question 'how is heathland affected by fires?'.

Closer collaboration and agreement for data sharing is likely to benefit each of the various interest groups and reduce significantly the resources required for comprehensive analysis and monitoring of the heathland resource as a whole.

In order to be able to assess the impact of fires on heathland a number of activities are required that collect, collate and manage the data necessary for analysis. A variety of organisations have a range of interests in the identification of fires, their control, management and prevention in addition to the monitoring and surveillance of their effects on heathland. In proposing a system of co-ordinated information exchange it is necessary to abstract the various roles, sources of information and reporting obligations of all interested parties. A model of how information can be collected and managed is proposed that addresses the requirements of the DETR, as well as the aspirations of many of the local organisations to see improved data collection, in implementing a system that enables long term monitoring of the effects of fires on heathland. Such a system should be extensible and compatible with other initiatives so that data collection and storage is not duplicated across systems and so those roles are clearly delineated.

The proposed system is designed to allow participants to gather standard fire event data. These data are posted to a central repository where fire event records are logged and sent out to site managers for additional information and verification. The verified records are returned to the central repository where they are collated in a database. The central repository manages the fire records and the verification process and stores ecological information on Dorset's heathland and its condition. The central repository provides access to both fire event data and ecological data that together will enable the assessment of fire impact on heathland.

The identification of the various roles within the proposed model has been undertaken independently of existing roles and organisations.

The following 'Roles' are identified:

- A Central Repository
- The fire service
- Site managers
- National data centre

The description, role and remit of each are described in the following sections.

7.2 A Central Repository

7.2.1 Description

At present one of the most significant barriers to any assessment of the effects of fire on heathland habitat is the dispersed nature of relevant data across a number of organisations. These data where they exist are managed in a variety of formats for specific purposes and require bespoke negotiation for access. Many of the organisations that currently collect such data would benefit from additional information and access to collaborative data analyses. It is proposed that a central repository be defined that has the remit of managing data on behalf of the community of organisations.

This repository is likely to be hosted by an organisation with existing responsibilities or interest in the collection and use of data regarding heathland. The repository should act as a location for an information system that is administered by dedicated staff. These staff should be responsible for the data collection, collation and storage and should be able to furnish requests for data and organise provision of access to the data.

The role the repository should be defined to account for the collection, storage and management of data and should necessarily not include the analysis of these data. Such analyses as may be required to fulfil reporting obligations should be the responsibility of the relevant commissioning body (i.e. DETR or EN as its statutory advisor).

7.2.2 Objectives

The proposal for a central repository has the following aims:

- To enable the collection of heathland fire information for the assessment of impact and analysis.
- To increase the use of information for the purposes of maintaining the favourable condition of heathland.
- To reduce significantly the overall cost of data collection, collation, storage and provision of access.
- To increase the value of existing initiatives by collaboration and synergy.
- To reduce the duplication of data collection regarding heathland biodiversity and the incidence of fire.
- To avoid the need for case by case bespoke negotiation for data access.
- To minimise the potential for inconsistencies in data analyses regarding the effects of fire on heathland.

The central repository should have the following objectives:

- **To maintain objective independence**
  The central repository should be seen to be independent to ensure that data are collected without bias and access is granted without prejudice. The role of 'data broker' should be on



behalf of all collaborating organisations (a community that should be wide enough to ensure impartiality of remit).

- **To collect data to an agreed, consistent format**

  The collection of data of relevance to the effect of fires on heathland should employ standards agreed by a representative group of organisations. This standard should be compatible with the full range of information required by the full range of uses to which it may be put. The standard should be clear, public and should not impose onerous overheads to those responsible for data collection.

- **To store data of relevance to fires on heathland**

  The central repository, in addition to storing information related to incidents of fires on heathland, could as a secondary function, store and/or provide access to data of relevance to heathland biodiversity.

- **To administrate regular data collection to an agreed time table**

  Responsibilities regarding data provision are linked to the data provider roles in the model. The central repository should have a responsibility for administration of these channels of data flow to ensure the integrity of the data resource.

- **To store data in a standard and accessible format**

  The data relating to fires on heathland should be stored in a publicly documented format to enable analysis by bodies/individuals outside of the repository.

- **To allow open access to the stored data for analysis**

  The data repository should allow access to the data resources by external bodies for the purposes of analysis.

The implications and implementation of these objectives are outlined in later sub-sections.

7.2.3 Remit

The definition of the processes required to be supported by the central repository is outlined in Figure 7.2 "Top level Data flow and process diagram: 'Central Repository'".

The processes required to manage information of relevance to heathland fire are identified as being:

- Receipt of fire records.
- Notification of the incidence of fire on heathland.
- Forwarding records to site managers.
- Fire Record validation.
- Gathering Heathland ecological information.

For further discussion about these and the various elements identified in the model as outlined in the Data Flow Diagrams (DFDs), see sections 7.7 – 7.11.

7.2.4 Notification of the incidence of fire on heathland

In certain cases the site manger requests notification of the incidence of fire immediately to enable them to respond and possibly assist in the control of the fire. We propose that the fire service undertakes to inform all such site managers in the event of fire by group paging. This process is outside the control of the model described here but is supported by it. Since the central repository will not provide 24hr, seven days a week cover the fire service will be the first in many cases to inform the site manager. However, at the same time the fire service will inform the central repository by faxing a fire incident record. On receipt of this information a

fire record is created and forwarded to the site manager for validation. Therefore the site manager may have been informed prior to the receipt of the fire record but the process converges when the fire record is validated and returned to the repository (as illustrated by the dotted line on the diagram).

7.3 The fire service

7.3.1 Description

At present the fire service undertakes to inform certain parties of the incidence of fire on heathland. They store, in their own information system, information of relevance to fire incidents and provide access to these data on request.

7.3.2 Objectives

The fire service currently informs people with a stated interest in heathland of the incidence of fire. In most cases they are currently the originators of the basic data recorded about fires on heathland. In the model they are defined as the major originator of the minimum fire record and as the first informers of site managers of the incidence of fire.

In addition to their own duties they have the following role in the model:

- Initiate the creation of the Fire Incident Record.

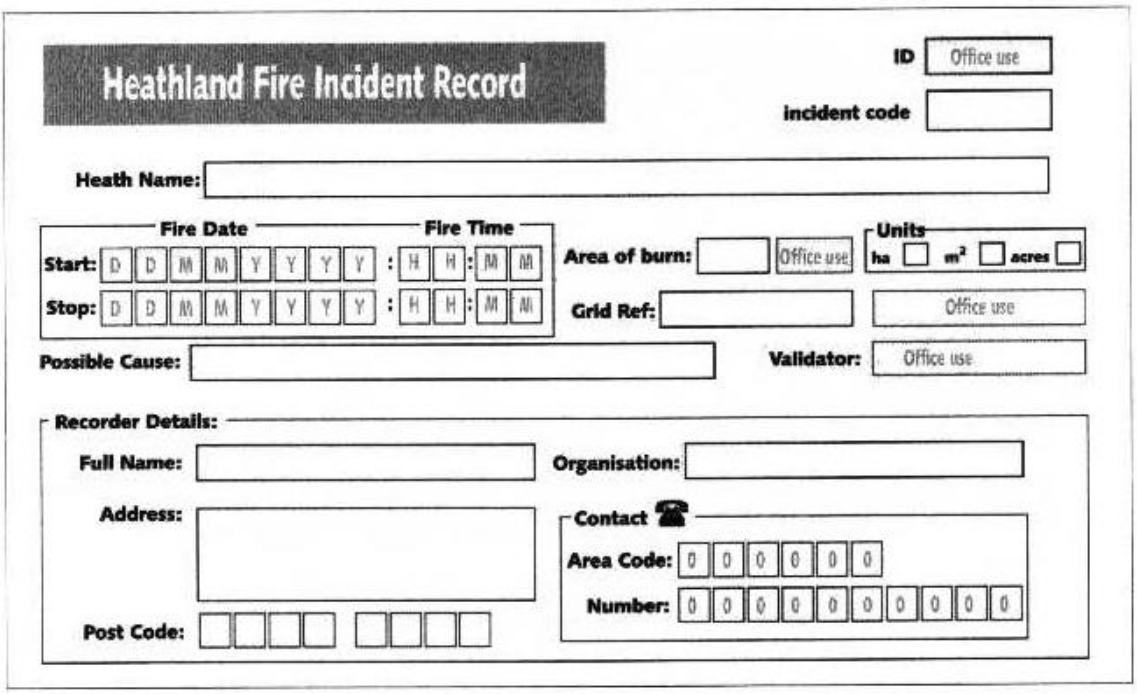
They are the first to be notified in most cases of the incidence of fire. They are able to determine if the fire location is 'heathland' in the broadest sense and as such inform the central repository of the incident. This step is the first to be taken in the creation of the fire record. The central repository should provide the fire service with maps indicating the location of heathland parcels.

7.3.3 Remit

The model outlined in this document does not increase greatly the overheads of the fire service. The processes required to provide information of relevance to heathland fire are identified as being:

- Inform site managers of the incidents of fire.
- This is carried out currently and represents a list of pager numbers that automatically get called with the details of the fire. The list of people informed is not determined by fire location but is a static list of all who may wish to be informed. The individuals decide if the fire is related to their site or not.
- Complete and return a 'Fire Incident Record'.
- A fax template (see Figure 7.1) is completed and sent to the central repository, this can be done electronically from a suitable computer or 'manually'.

Figure 7.1: Fax template for Fire Incident Record.



7.4 Site managers

7.4.1 Description

The definition of a site manager varies from site to site. In essence it is anybody with a formal responsibility for a heathland site. Each heathland site should have one or more people who are contactable in the event of a fire. In some cases this will be a site warden in other cases it may be one of several volunteers who is nominated to be 'on-call' during particular periods.

7.4.2 Objectives

Site managers are external to the model and as such no attempt is made to define their remit. However, in terms of the model a generic 'site manager' is seen as having certain duties with regard to the processes required to maintain the system. As such this generic site manager role can be seen as having objectives. The definition and conformation of these objectives and consequent duties require agreement with the full range of site managers as they exist in the real world.

The objectives of a site manager with regard to the model are:

- **To limit the damage caused by fire**
  This may be immediate where they aim to assist in the control of the fire and the setting of priorities in targeting fire control.
- **To maintain the site in favourable condition and to report condition**
  To manage the site and to survey, monitor and maintain biodiversity of the site.
- **To survey the site**
  To collect physical and ecological data of relevance to the site.

7.4.3 Remit

The model aims not to increase significantly the duties of the site manager with regard to the recording of information relevant to fire incidents. The model aims to streamline the interaction with site managers and to devolve responsibility of the validation of fire records to them. Record validation should not be onerous and should be combined with existing site visits following fire incidents. The information collected should be compatible with information they require for their own records and the submitted information should be readily accessible to them. The collaborating parties should regard the process of record validation in the spirit of collective ownership of the data.

The main duties they have with regard to the model are:

- Record validation.
- Site detail information

7.5 External Data Centres

7.5.1 Description

In order to be able to provide comprehensive information, to facilitate the analysis of the effects of fire on heathland, the repository should have and provide access to national, regional and local data centres that manage information additional to that collected and stored by the repository. The repository should aim to be a node of the National Biodiversity Network (NBN) and as such provide access to resources available through the network. The collection of standard lists of information required to manage the heathland fire data should also be facilitated through the network of partners of the NBN. The 'Site Catalogue' (see Section 7.7) for example, should be collated from sources of geographical, habitat and statutory site designation information. This will ensure that the appropriate authority maintains such standard sources of data and thereby assure their quality.

The definition of the External Data Centre in the model is therefore a 'placeholder' for interaction with the NBN and its resources; the definition of such interaction will progress in parallel with the identification and development of the NBN and its resources themselves.

7.5.2 Objectives

To provide data on request and, where possible, provide access to network resources. The development of the central repository should be informed by developments of the 'Local Record Centre' network of the NBN and should draw on available resources and experiences as appropriate.

The objectives of the national data centres will vary according to their individual character, but are generally:

- To provide access to the best information available of relevance.
- To be an authority for standard terms and invariant data.

7.5.3 Remit

The duties of external data centres are in many respects outside of the influence of this model. However, broadly speaking the generic duties of a national data centre as they relate to the model are:

- To supply the source information for the Site Catalogue.
- To provide access to biodiversity information of relevance to heathland.

7.6 The Model

The model is presented in figures 7.2-7.6 in the form of data flow diagrams (DFDs). These diagrams represent a standard tool of Structured Systems Analysis and Design Methodology (SSADM) and illustrate how information flows across the system boundary and within the system. They depict external sources and recipients of information and the internal stores and processes that hold and change the information.

Note: In the DFDs the numbering of the various elements does not imply sequence.

7.7 Level 0 – The Central Repository

This depicts the activities of the Central Repository and separates these into processes. The processes (the numbered closed boxes on the diagram, see the legend) are each further detailed in the subsequent diagrams.

The following processes are identified:

- Receive Fire Record
- Forward to site manager
- Validate record
- Augment heathland data

Each of these processes obtains information from either an external or an internal source of data and processes these data. The data are then stored internally or passed to an external source. The full details of the processes indicated on the diagram are given in the following sections.

The following external sources are defined:

- Fire Service
- Site Manager
- National Data Centre

These have been detailed in sections 7.3, 7.4 and 7.5 above.

Several internal stores of information are identified:

D1 **Fire Records**

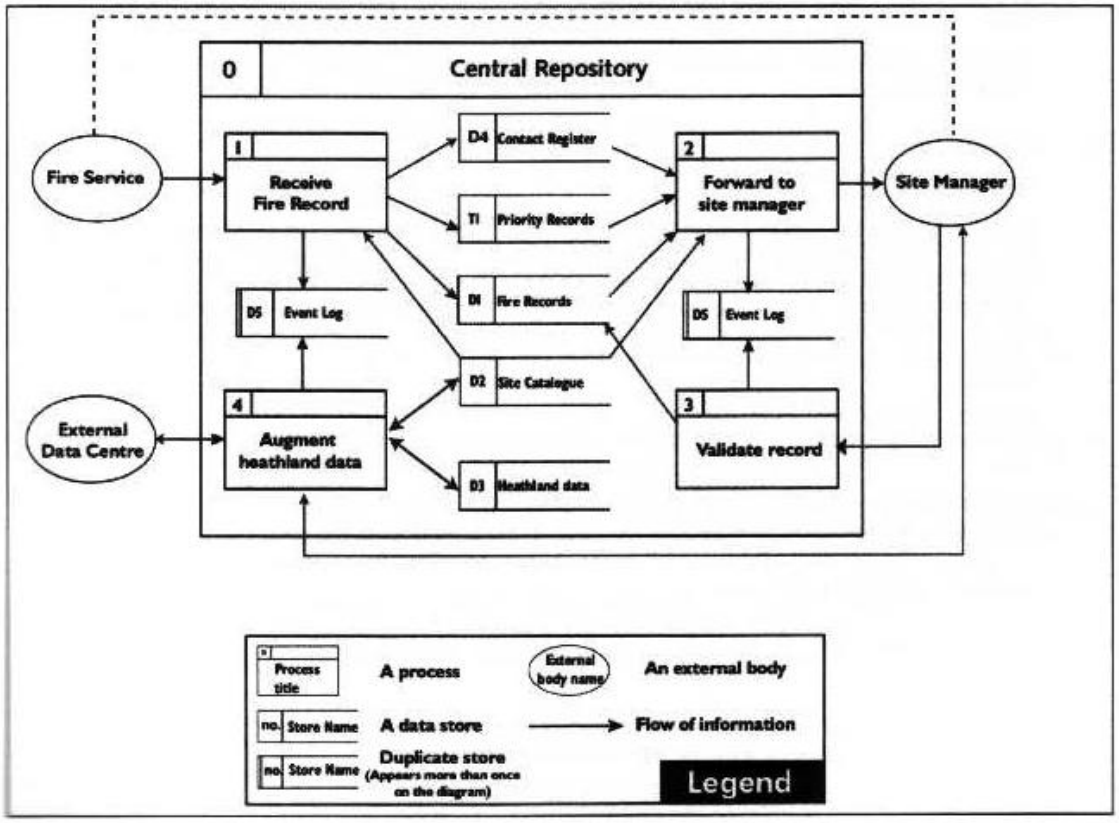
Description:

This is the central store that manages the fire incident information. It is the central store of data regarding fire on heathland and is the 'authority' for such information.

Source:

The primary source for these data is the fire service that provides information about the incidence of fire. This incident record forms the basis of the fire record, which throughout its life obtains information from a number of processes that interact with external and internal sources of information.

Figure 7.2: 'Top level' data flow and process diagram: 'Central Repository'.



Use:

This is the heathland fire data and will be used by all analyses of heathland fires.

Priority Records

Description:

As indicated on the diagram this represents a temporary store or 'priority marker' of fire records for immediate attention of site managers. For full details of this process see level 1: Receive Fire Record.

Source:

The fire service.

Use:

This store is used to inform site managers immediately of the incidents of fire.

Heathland data

Description:

This store represents a collection of information regarding biodiversity and heathland. Ideally it would represent access to national data centre resources for fauna, flora and physical data. These data are required for contextual purposes for the evaluation of fire impact, and should be acquired as they become available and according to need.

The store will provide access to lists of species and physical features and provide information about them such as their status, distribution. Current monitoring and survey data should also be accessible.

Source:

National and regional data centres of the NBN.

Use:

The data represented by this store will be used in providing context to analyses of the fire data and general heathland information.

Site Catalogue

Description:

The site catalogue represents an inventory of the heathland resource. It should be spatially based (ideally on a GIS system) and represent the authority on the identification of heathland parcels and vegetation types. Each parcel should have an official invariant identifier and a proper name (with a list of synonyms). It should be linked to other sources of data (e.g. such as favourable condition information) to provide information about heathland sites.

Source:

SSSI/SNCI registers and habitat maps.

Use:

This is a central data resource providing unequivocal identification and links to the ownership of each parcel of heathland. It will be used in determination of responsibility for each heathland site and providing standard definitive names and physical character of parcels of heathland (dimensions, boundaries, statutory designation information, ownership, etc.).

Contact Register

Description:

A resource that manages addresses and other contact information. The store will contain as a minimum the contact information for all participating organisations, all site managers and will be linked to the site catalogue.

Source:

Information will be provided by the participants and will be cleared for use by all people whose details are held within the store. Strict guidelines should be defined as to access to this information and security should be implemented to ensure confidentiality and appropriate use. The store will fall under the Data Protection Act and all people with information in the system must be made aware of the use and conditions of use to which the information is put.

Use:

The contacts information is the reference for site manager details and all other interpersonal communication regarding information held in the repository.

Event log

Description:

The central repository is not the source of any of the data managed by it. As such the generation and augmentation of the data managed by the system is undertaken by external bodies. The interaction with these bodies for these purposes should be logged to ensure correct data management procedures are maintained. It is likely that the logging of events will be an automated element of the 'system' and will reflect events such as when the data where last modified and by whom, when the fire incident record was first received, when it was validated, etc.

Source:

Every time an interaction is made with an external source of information and when internal data are transformed, that event should be logged.

Use:

Such information provides an audit trail within the system. It provides management control of the data life history. Obvious questions that can be answered by such information are:

- What records are currently 'out' for validation?
- How many fire incidents were reported?
- When was the national context data last updated?

7.8 Process 1: Receive Fire Record

The initial creation of a fire record in response to receiving notification of a fire incident (usually but not always from the fire service). Judgement as to whether site is heathland made by the central repository.

1.1 When a fire incident occurs on heathland the fire service send the Central Repository a 'fire incident record' by fax. The original fax is stored in a physical store or archive (M1: Fax store).

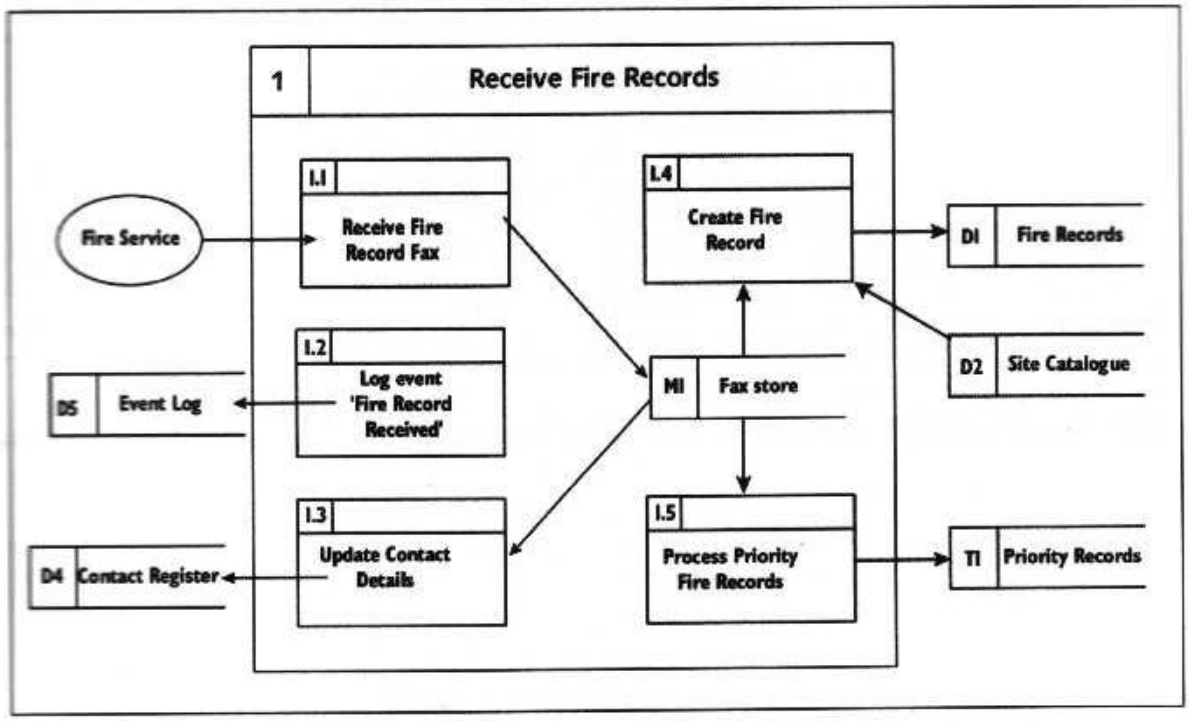
1.2 The 'event' is logged (D5).

1.3 Any contact details are updated/added to the Contact Register (D4) (not all fire records originate from the fire service and as such may contain new contact details).

1.4 The fire incident record is checked against the site catalogue to determine the site identifier from the catalogue and to determine if the fire is on a 'heathland' site. A fire record (D1) is created from the incident record and linked to the site catalogue information (D2).

1.5 If the fire site is one that requires immediate notification of the site manager then the record is marked as a priority for forwarding to the site manager. In most cases the site manager will have been informed of the fire by the fire service directly, through the group paging system.

Figure 7.3: Process 1 – Receive fire record.



7.9 Process 2: Forward to site manager

Once a fire record has been created it requires validation and additional information as a result of a visit to the site after the fire by the site manager. A copy of the full record is sent to the site manager for updating.

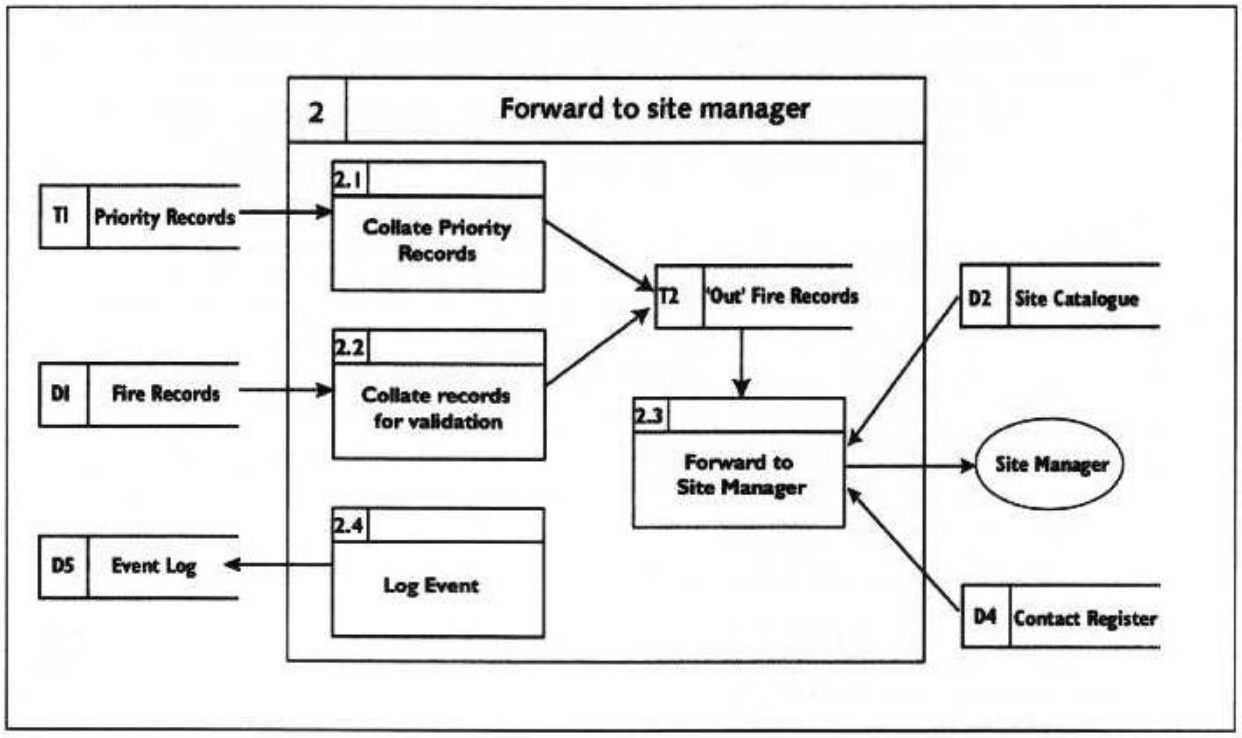
2.1 Priority records (T1) are collated for forwarding to site managers and added to list of records for sending out (T2: temporary store – "out' fire records').

2.2 Unvalidated Fire records (D1) are collated for forwarding to site managers and added to list of records for sending out (T2: temporary store – "out' fire records').

2.3 The list of records for forwarding to site managers (T2) is sent out. This process refers to the site catalogue (D2) to determine which site manager and the Contact Register (D4) for their current contact details.

2.4 The action of sending out records is logged as an event (D5). This enables the system to determine which records are currently 'logged' out.

Figure 7.4: Process 2 – Forward to site manager.



7.10 Process 3: Validate record

The site manager on receiving a record undertakes to complete the record with information about the fire and to validate the grid reference, area of burn, etc. (See the Fire Record later in this section). The site manager then returns the copy of the record to the central repository.

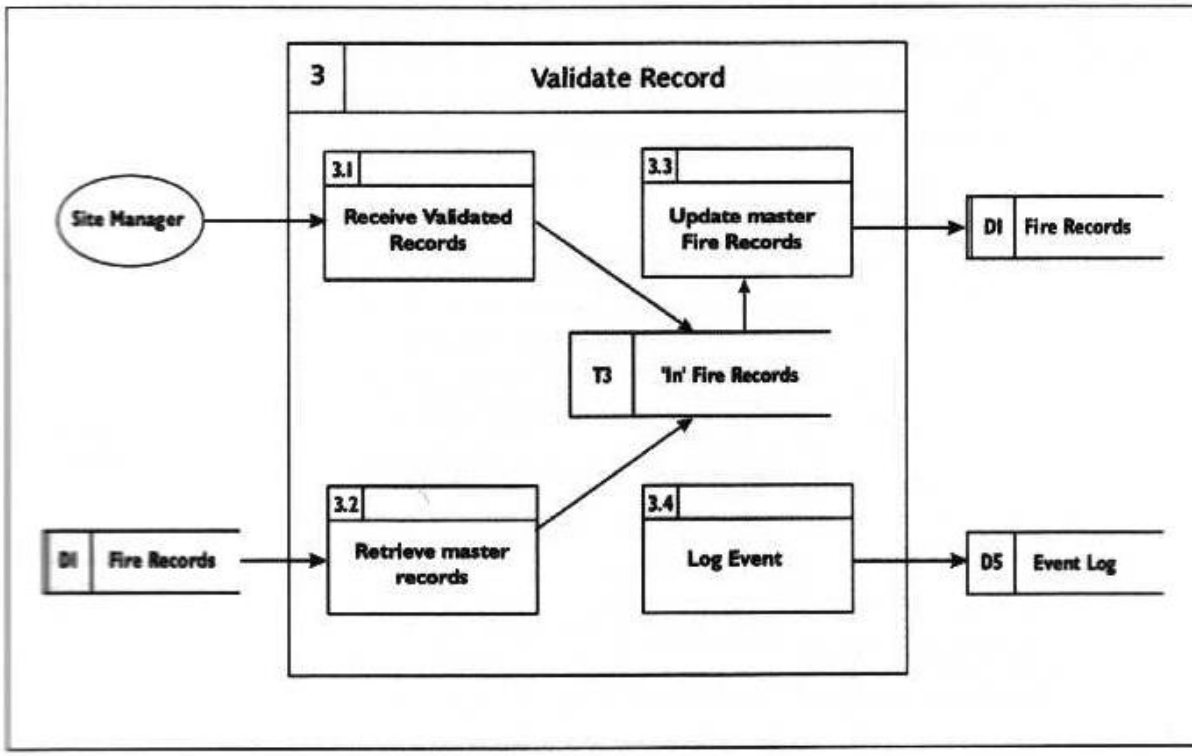
3.1 A Validated record is received from the site manager and placed in a temporary store of 'in' records.

3.2 The master record to which the copy in the store relates is retrieved.

3.3 The new information from the incoming copy of a fire record (T3) is added to the master record (D1).

3.4 The return of the validated record is logged (D5).

Figure 7.5: Process 3 – Validate record.



7.11 Process 4: Augment heathland data

There is an ongoing process of updating the resources of heathland data. This is especially important for critical stores such as the site catalogue (D2). The purpose of this process is to ensure that the best available information required to provide context to the fire records is made available. The exact nature of the storage of such data and which data have access to them provided from a remote location is dependant on agreements between external data centres and the development of the NBN.

Site dimension, favourable condition and other information relating to individual sites should be returned by the site manager at regular intervals (e.g. annually).

4.1 Data deficiencies are identified in the heathland data store (D3) and a request made to the appropriate national data centre

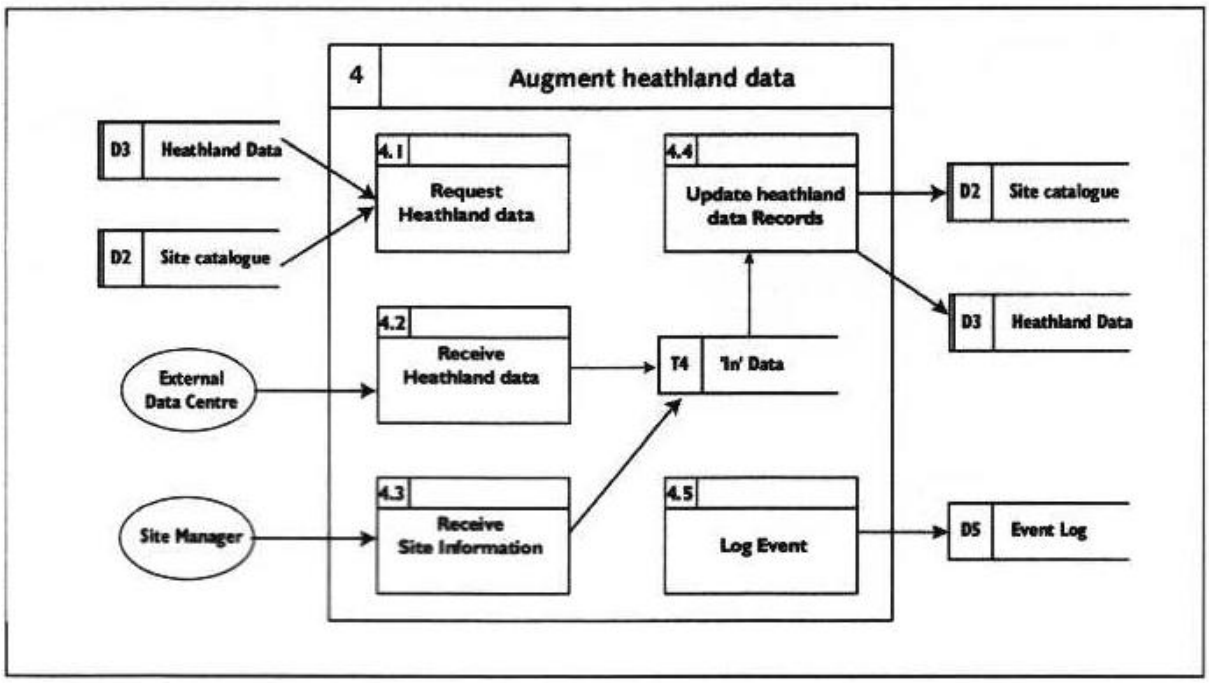
4.2 Data are received from external sources and placed in a temporary store (T4) awaiting processing.

4.3 Data routinely returned by site managers describing the site and physical and biological features.

4.4 The incoming data are 'added' to the appropriate store (D2 & D3).

4.5 The request and receipt of data are logged (D5).

Figure 7.6: Process 4 – Augment heathland data.



7.12 Other Processes

There are a number of other processes that can be identified. They have not been modelled because they are either 'one-off' processes or are outside the scope of the current model (although the model supports them and their existence is implicit in the nature of the model).

7.12.1 Process 5: Start-up process

This will obtain the start-up data for the central repository. Examples of such data are those required for the following stores:

- The Site Catalogue.
- The Contact Register.

This process will also put in place physical arrangements such as the fax template for the fire incident record.

7.12.2 Process 6: Provide access to data

This process is not modelled since it is external to the core processes of the central repository. The nature of provision of access requires agreement and suitable access protocols to be in place to ensure that access is provided in an efficient and acceptable way that does not compromise security of personal and other confidential information.

7.13 Resources required for the creation of a Central Repository

7.13.1 Staff

It is estimated on the basis of fire incidents over the past 8 years that the processes identified in the model would account for 25% of the annual workload of a full time member of staff.

This does not include the following, which require specialist staff time:

- The set up costs for designing and agreeing access protocols.
- Entering the initial data.

7.13.2 Running Costs

Running costs for the system when operational will cover consumable costs (i.e. faxing costs) and accommodation (i.e. electricity, consumables, office space, etc.).

7.13.3 Software

Office software will be required for administrative purposes (letter writing, email, etc).

GIS Software (i.e. one seat of MapInfo®) should be purchased for the management of the Site Catalogue.

Bespoke software should be developed to manage the databases required for the management and storage of the Fire Records, Contact Register, Event Manager, etc. This should be based around a relational database designed to meet NBN data model criteria. The main fire record database should be developed as an 'add-in' to Recorder 2000. This will ensure skill transfer between the two systems and avoid duplication of functionality.

7.13.4 Hardware

A single Pentium® class computer with 128MB RAM, 10Gb hard disk space and Windows 2000.

Access to a Printer, Facsimile machine, backup device and physical file storage (i.e. file cabinets) will be required. Note that costs may be lower if such facilities are provided by the hosting organisation.

Table 7.2: Estimated costs.

Initial Year

Item		Cost
75 days Staff time at SO grade		£5000
Consumables		£1000
Overheads		£1000
Hardware		£2000
Software		
(3rd party – Office/GIS)		£1700
Fire Records		
Site Catalogue		
Contact Register	Recorder2000 application	£12000
Event manager		
Heathland data		
Total		**£22,700.00**

Successive years (estimate, non index-linked)

Item	Cost
75 days Staff time at SO grade	£5000
Consumables	£1000
Overheads	£1000
Total	**£7,000.00**

These costings do not include provision for the development of the two data stores, the Site Catalogue and the Contact Register. It is very difficult to cost these from available information. The very fact that they are needed means that it is difficult to quantify the task.

The Contact Register needs to contain name, address and contact details for all 'Site managers' and their links to heathland sites or parcels. The bulk of the effort involved in creating this resource relates to finding the relevant information, entering the data is likely to require only a few days work. It is likely that information for the Contact Register would be best provided by all relevant organisations as consulted for this study and their contacts. Additionally information may be needed from the land registry. Thus work to create the Contact Register may comprise relatively little effort by a large number of people with one person acting as a co-ordinator and collator.

The Site Catalogue will be a spatial digital data set delineating all areas of heathland in Dorset and providing a controlled site name list. Additionally it will contain subdivisions for different vegetation types, management

units and tenure. In many cases these categories will overlap or be co-incident. Each of these sub-site polygons will require digitising and coding so they can be cross-referenced to the Contact Register. SSSI boundaries are already digitised, other heathland areas would require digitising along with sub-site divisions as outlined above. Because the number and complexity of sites and their sub-divisions are unknown it is not possible to cost this exercise with any accuracy.

Appendix M – Heath Warden Incident Report form, Urban Heaths Life Project, SE Dorset

HEATH WARDEN INCIDENT REPORT

To be completed within 24 hours of incident being closed by DFRS

SECTION 1 – GENERAL DETAILS

Fire Incident No:

Police Crime No. (if known):

Person Reporting / Recording:

Tel. No: **Agency:**

Date of Incident: **Start Time:** **End Time:**

Name of Heath:

OS Central Grid Ref of Incident:

Brief Description of Location:

Nature of Incident:

Fire ☐ Fly Tipping ☐ Motorcyclists ☐ Other ☐

Probable Cause of Incident (if Fire):

Controlled ☐ Malicious ☐ Accidental ☐ Other ☐

Details of Incident:

Action Taken:

Agencies Attending:

Senior Warden informed?:	**YES / NO (please circle)**
Police Heathland Officer informed?:	**YES / NO**
Site Owner / Agent informed?:	**YES / NO**
By- Law infringement?:	**YES / NO**
Site map showing area of burn attached?:	**YES / NO**
Passed to DERC:	**YES / NO**

For Use by DERC

Received:
D/b:
GIS:
Verify:

SECTION 2 – DETAILS FOR POLICE

SUSPECTS

NAME	DATE OF BIRTH / AGE	ADDRESS	DESCRIPTION

VEHICLES

INDEX NO.	MAKE	MODEL	COLOUR	DISTINGUISHING FEATURES

ANY OTHER INFORMATION (Witnesses etc)

SIGNATURE

SECTION 3 – DETAILS FOR DERC

For Use by DERC

Area of Burn: **ha / m^2 (please circle)**

Please also indicate area of burn as accurately as possible on standard site map and attach to this incident report. If known, please mark the start location of the fire on the site map with an X.

Estimate of Intensity of Burn:

Habitat(s) Present in Burn Area and Estimated Area of Each:

Dry heath	☐	area =	Scrub / Gorse	☐	area =
Humid heath	☐	area =	Grassland	☐	area =
Wet heath / Mire	☐	area =	Woodland	☐	area =
Bracken	☐	area =	Other (please specify)	☐	area =

If possible please indicate the area of each habitat on the site map.

Evidence of Casualties or Wildlife Loss:

Infrastructure Damage:

Weather conditions at time of incident:

If know, please state if a fire retardant was used (please circle): YES/NO

Dorset Environmental Records Centre (DERC), Dorset County Library Headquarters, Colliton Park, Dorchester, DTI 1XJ, 01305 225081, derc@dorset-cc.org.uk

GUIDELINES FOR COMPLETION OF HEATH WARDEN INCIDENT REPORT FORM

NB. Form must be completed within 24 hours of the incident.

SECTION 1 – GENERAL DETAILS

Fire Incident No. – this is a standard number generated by DFRS and is crucial to link fire records between DERC, DFRS and the Police. If the fire was not reported to DFRS and there is therefore no incident number, please write "Unknown to brigade" in this section.

Police Crime No. – only record this if the incident was regarded as a crime, and the crime number has already been generated by the Police.

Person Reporting / Recording – i.e. Life warden, HCT warden etc

Agency – i.e. 'Life' etc.

Date of Incident, Start Time and End Time - please use the date and start time recorded by the Fire Service.

Name of Heath – please use standard heath name provided by Andy Elliott (this is given on the standard site map).

OS Central Grid Ref of Incident – this should be the centroid grid reference for the fire. Please provide at minimum a 6-figure grid ref, and an 8-figure grid ref if available.
e.g. SZ 0281 9574

Brief Description of Location - brief description of location of fire on heath, for example "50m SW of ……".

Details of Incident - include how the incident was discovered, informant details, and a brief description of the incident e.g. "small, malicious gorse fire".

Action Taken – include which authorities were notified of the incident, and any other actions you took in relation to the incident (e.g. did you assist the fire service).

Agencies Attending – which agencies were present at the incident? i.e. DFRS, Police, Highways Agency, Southern Electricity Board, Poole Borough Council, EN, HCT etc. For each service please record if possible the number of vehicles and personnel that were present. For DFRS it would be useful if you could also record the types of vehicles present (i.e. pump apparatus, L4Ts).

Other details / descriptions of the incident can be recorded in Section 2 ("Any Other Information").

Last section on page one should be used as a checklist to ensure all relevant people have been informed and relevant actions taken.

SECTION 3

Area of Burn – please estimate the extent of the burn. For areas below 0.5 ha, please describe using metres^2. For areas above 0.5 ha, please describe using hectares to one decimal point.

Please don't forget to indicate area of burn, and if possible the start location of the fire, on standard site map (this map is originated by DERC but copies are available from the Life Streetwise office).

Intensity of Burn – please give a best endeavour estimate of the intensity of the fire. To do this, you may find it useful to consider the following questions:

1. *Has the humic soil layer been burnt or mineral soil exposed?*
2. *Has all the above ground vegetation been burnt or does some remain?*
3. ***What is the degree of charring of Calluna stems / grass tussocks?***
4. *What is the height of charring to tree stems (trunk only, to lower branches, full canopy)?*

Habitat(s) Present in Burn Area and Estimated Area of Each – please indicate which habitats were known to be present in the burn area, and if possible give estimated area of each (using metres^2 for areas below 0.5 ha, and hectares for areas above 0.5 ha). If possible, please indicate the area of each habitat on the site map.

Evidence of Casualties or Wildlife Loss – please record the number and species of any animal casualties you notice on the site. Please also record whether the fire has passed over / effected any known lizard loci, bird nesting site etc.

Infrastructure Damage – please record any obvious damage to fencing, gates, styles, telegraph poles, emergency access routes, fire breaks etc.

Weather Conditions at Time of Incident – please give estimation of temperature, rain, wind direction, estimated speed, dampness of vegetation, etc.

Fire retardant – this is a foam additive to water used by DFRS.

Appendix N - Hansard Transcription of the debate held in the House of Lords on 5 October 2000

Clause 23 [Avoidance of risk of fire or of danger to the public]
[Amendment No. 266 not moved.]

Lord Glentoran moved Amendment No. 267

Page 14, line 9, leave out ("by reason of any exceptional conditions of weather,").

The noble Lord said: Clause 23 currently provides that weather conditions alone, and exceptional weather conditions at that, which would be difficult to define, are to be used to determine whether or not land should be closed for the purposes of fire prevention. We feel that this is inadequate. The condition of the land is also a highly relevant factor when considering the need for closures to avoid risk of fire. The amendment would remove the reference to weather conditions so that closure could be considered on any grounds where fire risk had to be avoided.

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I think that I can be brief because it is fairly self-explanatory but it is clearly a very serious possibility. We would like to feel that this amendment was acceptable to the noble Baroness and the Government on the basis of the fire risk. I beg to move.

Earl Peel: I would very much like to support this amendment. I accept that at first glance it may appear somewhat pedantic. I think that my noble friend has drawn attention to a very serious matter because, as he quite rightly says, it is not the weather as such, it is the condition of the ground that should determine what decisions are made and what closure orders should be imposed if necessary. I can envisage a situation where--although I accept that, as the noble Baroness, Lady Masham, said yesterday, in North Yorkshire the weather has not been very good recently--there have been two or three weeks of intense heat and the heather is extremely dry and could be a fire risk. One may then have a week of rain and everybody thinks that the situation has redeemed itself. With one or two more days of sunshine, particularly on heathland as opposed to blanket bog, one could be very quickly back into the same situation again. It is the condition of the ground rather than the weather that counts. I need hardly remind your Lordships about the dangers of fire, both from a public sector and environmental point of view. Fires, particularly summer fires, can do immense environmental damage. I can bring a number to mind. There was a particularly bad one in 1976 on Rosedale on the North Yorkshire Moors and that ground has not recovered to this day. It has had quite a serious impact on that environment, with obvious effects on the bird species which use that part of the moor. Therefore, this is a serious amendment. I do not suggest that the other amendments are not important, but this is of particular importance. As I said, it may look unimportant and appear to be pedantic but it is not. I hope very much that the Minister will take it extremely seriously.

10 p.m.

Lord Williamson of Horton: I invite the Government to look carefully at the wording of the current Bill. The phrase "exceptional conditions of weather" is quite difficult to interpret. So, irrespective of the argument as to whether it is the condition of the land or the weather, the Bill, as drafted, seems to be capable of causing some difficulty for the authorities who would have to take these decisions. Perhaps the wording could be looked at.

The Earl of Caithness: I must confess that I had not taken on board quite the relevance of this matter until this debate. When I listened to what my noble friend Lord Peel said, my mind went back to the Wildlife and Countryside Act 1981, as a result of which closure orders could be made to prevent shooting when land is under certain conditions.

In particular, I remember there being a prevention order made--and I think it was under that legislation, although I stand to be corrected because I am speaking entirely from memory--against shooting snipe. Although the weather at the time was absolutely fine, the previous weather conditions had been such that it was deemed wrong, because there had been so many hard frosts, to continue shooting. However, by the time the order was made, the weather had changed but the relevance was in relation to the ground conditions. It is in that regard that I support my noble friend Lord Peel. That is so particularly in relation to heather and moors because any Members of the Committee who have been involved in fighting a fire on a moor will know what a horrible and dangerous experience that can be. It takes more than a week of rain to soak a moor which has dried out. Therefore, I ask the Minister to have another look at the wording of this.

Baroness Farrington of Ribbleton: At this time of night, it becomes difficult for all of us to concentrate. But my attention has been caught by various noble Lords referring to the very hot weather that occurs in Yorkshire, on the other side of the Pennines. I think I shall travel to Yorkshire more often!

Clause 23 allows the relevant authorities to make directions excluding or restricting public access in the interests of fire prevention by reason of exceptional weather conditions.

This amendment would remove the reference to exceptional weather as a precondition, so that closures could be considered on any grounds where fire risk needs to be minimised. We do not think that it is likely that conditions of high fire risk will occur independently of exceptional weather conditions. I have listened very carefully to the points made by Members of the Committee during this short debate.

We believe that the circumstances which have been outlined, where there has been a long period of dry weather followed by a short period of rain, would be covered by the Bill with the wording proposed because, even if the conditions no longer prevailed in terms of the immediate weather, the preceding weather conditions would have been exceptional. Therefore, the preceding weather conditions could be the reason for acting. The relevant authority would be able to make a direction in those circumstances.

It may be that there are other circumstances where there is a possible fire risk which has not arisen due to exceptional conditions of weather; for example, some types of vegetative cover may be flammable even in an ordinary summer. We do not believe that such circumstances are exceptional and, therefore, we do not believe that they are caused by unusual weather conditions. They are part of the fabric of the open countryside. We are not satisfied that they give sufficient reasons to restrict access to the land.

If we were to allow restrictions to be placed on public access in ordinary circumstances such as I have just described, that could mean that many parts of the countryside would be closed to the public throughout

the summer months every year--the very time when such places are most popular. However, I can assure the noble Earl, Lord Peel, and other noble Lords that, where the fire risk arises as a result of something done on the land and would constitute a danger to the public, a direction may be made under Clause 23(1)(b). It is also possible that, in some circumstances where there is a risk of fire, a direction for nature conservation reasons may be made under Clause 24 on the advice of English Nature.

I hope that the reply that I have given has been detailed enough to give the reassurance that noble Lords have sought without denying access to the open countryside in many parts of the country in a way which, were we to go too far in the other direction, would deny access almost completely in the summer

The Earl of Caithness: I am grateful to the noble Baroness for that reply. I had hoped that she would take this amendment away for consideration, but she led us on to Clause 24, and nature conservation. Such closure orders may be needed quickly. Can she reassure the Committee on the speed with which such decisions will be made? If there is a threat to nature conservation or a sudden hot spell, which Yorkshire has at regular intervals, the fire risk increases and action needs to be taken quickly.

Baroness Farrington of Ribbleton: Subject to confirmation of what I am about to say, I am certain that, within its terms of reference, English Nature would react with great speed in circumstances where there was the kind of risk to which the noble Earl has referred.

Lord Greaves: Would the Minister consider whether the word "exceptional" should be in this part of the Bill? I do not believe, for example, that the Meteorological Office would want to use a loose word like "exceptional" to describe weather. It talks about events that may occur once in five years or once in 50 years. Whether a particular weather condition is exceptional or not is a matter of opinion. What the weather is at a particular time is a matter of fact. It may help if the Government consider removing the word "exceptional", which at best is redundant and at worse inaccurate.

Lord Williamson of Horton: The noble Lord, Lord Greaves, in a sense is making the same point as I did. I am not necessarily in favour of removing a reference to the weather, as is proposed in the amendment, but the phrase "exceptional conditions of weather" will cause difficulties for the authority that has to take the decision. It is quite possible to have a continuously hot summer. So far in this debate we have talked only of Yorkshire, but there are other parts of the country where we have hot summers--they will get hotter too. There can be a hot summer, which is safe from the point of view of fire risk for a large number of months, but perhaps by September the situation may be sufficiently dangerous to make it necessary to have a

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closure. I do not like the phrase "exceptional conditions of weather". It could just be the cumulative effect of normal weather.

Baroness Farrington of Ribbleton: Come back Michael Fish! There is a difficulty in the points being raised by the noble Lords, Lord Greaves and Lord Williamson of Horton. If we were to remove the reference to "exceptional weather", the converse situation could be applied; that is, the normal pattern of weather in summer could be used as a reason for closing large areas of the countryside for long periods.

Lord Greaves: But then we come back to the point made by the noble Earl, Lord Caithness; that is, that it is a combination of the weather and its effect on the land that is important. Whatever the weather conditions, even if there had been a long hot summer, they may not have affected a specific moor very much and so the provision would not apply. It is the combination of the weather and the condition of the land that must be taken into consideration and the most important factor must be the condition of the land.

Baroness Farrington of Ribbleton: I understand the point being made by the noble Lord, Lord Greaves, but I have a concern that the solution he seeks to put forward could be used as a means of ensuring that public access is restricted in many areas for long periods of time.
I was asked by the noble Lord, Lord Williamson, whether I am prepared to reconsider the arguments put forward and see if they can be applied without denying people access to land for long periods of time in conditions that are normal for the vegetation in a specific part of the country. I do not want to mislead Members of the Committee by implying that we will come back and change the wording. However, everybody appears to seek the same objective. But there is a difference of opinion on how to achieve it without, on the one hand, reducing access too much and, on the other, still responding to exceptional circumstances.
Emergencies can be quickly dealt with under Clause 29. I promise to look carefully at all the arguments, without implying that the Government will definitely come back with an alternative.

Earl Peel: The noble Baroness implied that if the words were changed in the Bill to meet this amendment, it could result in large areas of land being closed for long periods of time, which I understand would be unacceptable. But the Government have constantly told us throughout the passage of this Bill, "Do not worry, the Countryside Agency will be reasonable and look after your interests". Now that the boot is on the other foot, does not that reasonableness apply just as well?

Baroness Farrington of Ribbleton: Of course. That is why I undertook to consider carefully the points that have been raised. Where there is a risk of fire and the

need for a direction for reasons of nature conservation, that can be made speedily under Clause 24. I feel the noble Earl, Lord Peel, suspects me of a sleight of hand in my language. But I do not wish the situation to arise where, when we come back on Report, the noble Earl accuses me of bad faith because the Government considered the points carefully but remained of the opinion that the original wording was the best to achieve the objectives that we all want.

Earl Peel: I should never dream of accusing the Minister of bad faith and certainly I was not doing so in this case. But having heard the argument used constantly, "Do not worry, the Countryside Agency will look after your interests", I thought in this case it could be turned to our advantage. However, the noble Baroness does not accept my argument on that.

10.15 p.m.
Lord Glentoran: That has been a useful and valuable debate and I thank the Minister for her encouragement. The weather is subjective but the ground--what is growing or is dead on it and the type of terrain--is more relevant. I am sure that the Minister knows, but it might be worth recording, that the Peak District National Park Authority has a sophisticated system using the Meteorological Office and computers to assess fire risk. Considering all the work that will be done, the time is coming to make our fire prevention a little more sophisticated than relying on the weather.

Baroness Farrington of Ribbleton: The noble Lord raised the issue of the Peak District National Park Authority which, I understand, considers a range of criteria in deciding whether to use its powers of closure under the National Park and Access to the Countryside Act 1949 on access agreement land. The authority's powers under the 1949 Act are based on a similar form of words to those which appear in the Bill and we are not aware of any representations that those powers have been found wanting.

Lord Glentoran: I thank the noble Baroness for that intervention. I beg leave to withdraw the amendment.

Amendment, by leave, withdrawn.