Northern Ireland
Fire & Rescue Service

Protecting Our Community

SERVICE TRAINING NOTE

OPERATIONAL 12

Wildfire Operational Safety

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Prepared by: Learning & Development Centre

VERSION CONTROL

VERSION No.	ACTION	PREPARED BY	APPROVED BY	DATE ISSUED
1.0	New Note	WC N Darley	AGC J Hamill	20.05.09
1.1	Revised Note Insert Peel & Reveal action	WC G Morrow	AGC M Smyth	24.08.11
1.2	Revised Note	WC D Shortt CC T Dunlop	SC S Hind	25 Jan 2018

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NATIONAL OCCUPATIONAL STANDARDS

FF 4

NOTES

1. AIM

To introduce students to the operational safety procedures to be applied at all wildfire incidents.

2. LEARNING OUTCOMES

By the end of the session students will be able to demonstrate an understanding of:

1. Actions on arrival
2. Extreme Fire indicators
3. Wildfire Safety L.A.C.E.S Protocol
4. Wildfire Prediction System (WPS)
5. Fire Management
6. Fuel
7. Suppression Planning
8. Effects of Weather Conditions
9. Role of Wildfire Officer (WFO)

3. INTRODUCTION

Wildfire can have a significant impact on the local economy and environment. More importantly, such events can result in either serious injury or death to members of the public or to operational personnel.

In the UK there is a lack of understanding of this type of fire and to the dangers involved in its suppression; the inadequate management systems employed by some services and agencies are in themselves a danger to personnel.

This situation is complicated by the fact that wildfire is both seasonal and sporadic, resulting in inexperience and insufficient provision within service planning. Presently UK fire services and other agencies are attempting to extinguish wildfires with no understanding of the phenomena, little or no specialist equipment and without the necessary operational expertise.

One of the fundamentals of the Incident Command System is the management of risk. This is achieved by the dynamic risk assessment process. It is difficult to understand how fire officers can be expected to manage risk without an appreciation of the dangers involved in suppressing one of the most professionally challenging incident types.

NOTES

This document gives an overview of the procedures and practises that have been adopted by Northern Ireland Fire and Rescue Service. These enable officers to manage rural fires, commonly referred to as Wildfires using safe and effective systems of work.

4. ACTIONS ON ARRIVAL

Wildfire incidents are by their very nature dangerous, it is imperative that safe systems of work are adopted from the onset. The Incident Commander must carry out a comprehensive risk assessment and brief personnel on risks and precautions to be taken. Due to the rapidly changing fire environment at such incidents the risk assessment process should be continuous.

INITIAL CONSIDERATIONS

Type of fuel(s) and characteristics

Is it uniform or mixed

Are there any ladder fuels

Is the fuel loading high/low

Quantity of fine and coarse fuels

Possible fuel change

Will fuel loading change

Does the change create an opportunity

Will the fuel change alter fire behaviour (lighter fuels may increase speed of travel and flame length)

Wind Direction

Will the wind increase or decrease during the day

Will the wind change direction

Is there likely to be any topographical influences on wind direction

What will happen if the wind suddenly changes

Potential fire spread

Where is the fire likely to spread

What will influence fire spread (wind, slope, fuel etc)

Are there any barriers that will prevent or slow fire spread

What are the geographical critical points that will help spread the fire

Where does the fire have the most potential (fuel, slope, wind aspect)

Are there any natural or man made anchor points or control lines

Fire Alignment

Note the alignment of the whole fire not just the head

If some parts are out of alignment this may be a window of opportunity

Remember parts of the fire out of alignment may move into alignment

Changes

Changes in alignment may be both positive and negative

Increase in alignment will increase fire severity and speed

Use alignment information to identify trigger points for a change of fire behaviour and know where they will occur

Identification of extreme fire behaviour

Observe current fire activity

Identify the horizontal and vertical fuel arrangement

Note likelihood of changes in fuel or arrangement

What is wind speed

Is the Relative Humidity (RH) reading low

Weather

What factors are effecting fire behaviour (wind, temp, humidity)

Obtain reliable weather forecasts at regular intervals

Take regular humidity readings (RH)

NOTES

Operational Actions

NOTES

- Make contact with land manager (where applicable)
- Request Wildfire Officer (WFO) if required
- Gather information including local fire plan
- Carry out risk assessment
- Set objectives
- Make plan
- Communicate plan and allocate tasks
- Instigate appropriate level of ICS and risk control measures
- Brief crews and operate within LACES protocol

ADDITIONAL RESOURCES

On arrival all resources whether Fire Service or rural agencies must report to Incident Command. This will ensure that the presence and location of all personnel is known and recorded. This allows all safety issues to be addressed and a full briefing to take place.

Initial briefing should include

- Situation report
- Information on suppression plan
- Individual roles
- Allocated tasks
- Identified risks
- Control measures employed
- ICS
- Team allocation

Under no circumstances should any personnel self deploy

NOTES

5. FIRE BEHAVIOUR

A good understanding of fire behaviour must be obtained so that accurate predictions on fire spread and intensity can be made. It is important that all fire fighters have a good understanding of fire characteristics so that they can maintain a safe working environment.

GENERAL

The three major factors that influence wildfire behaviour are

Fuel (Vegetation which is burning)

Weather (temperature and wind)

Topography (level or sloping ground)

These factors influence the fire and it is important that fire fighters are able to recognise and more importantly, anticipate changes in fire behaviour when fuel, weather and topography interact.

FIRE CHARACTERISTICS

Fire growth from an ignition point is usually uniform and burns using convection, drawing the flames away from the un-burnt fuel. The edges of the fire lean in towards the centre. If the fire is unaffected by wind, slope and fuel changes the fire will remain uniform and will spread out in a circular pattern. In almost all cases this pattern will eventually be affected by wind and slope which will alter fire behaviour, changing the shape of the footprint, assuming a typical fire shape of head, flank and tail. This is due to the fact that fuels adjacent to one part of the fire are heated at a greater rate and are able to support combustion more effectively, leading to a growth in fire intensity when the fire is in alignment.

PARTS OF A FIRE

Head

The head is the part of the fire being influenced by the wind and/or slope. It is the fastest part of the fire and the area of greater flame height and intensity. It is also the area where most spotting can occur, so great care should be taken if working at the head of a fire.

Flanks

NOTES

The flanks of the fire are slower moving and influence the intensity at the head. It should be noted that with a change in wind direction or slope a flank can change its behaviour and become a fast moving head fire. It is usual that at most fires the flanks are longer than the head, therefore if there is a change the new head fire will be wider and more intense. This is a serious threat to personnel working the flanks. When possible the flanks should be attacked aggressively.

Tail

The tail is the slowest part of the fire as it is usually out of alignment and is back burning. Again the tail can be influenced by changes in topography or wind direction.

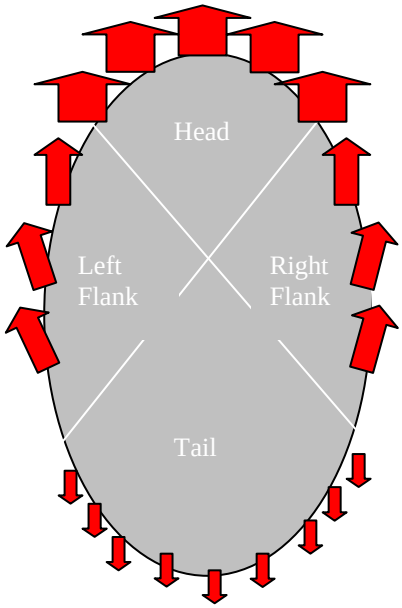


Diagram showing the parts of a wildfire

TERMINOLOGY

Flame height

The average height of the flames measured from ground level.

Flame angle

The angle between the flames and the ground, measured from the horizontal. The height and the angle of the flame will affect the amount of heat radiating on the unburnt fuel ahead of the fire.

Flame length

The length of the flames measured along the axis at the fire front. Flame length measures intensity.

Flaming zone

The part of the fire which is actively burning.

Flame depth

The depth of the continuous flaming zone behind the front edge of the fire.

Rate of spread

The rate of spread is the amount of distance a fire travels over the ground. A head fire does not achieve its maximum rate of spread until it broadens out into an advancing fire line. It should be measured in metres per hour.

Fire intensity

Fire intensity is the amount of heat energy being radiated by the fire. This is affected by variations in type and quantity of fuel and the rate of spread.

The heat yield from burning fuel is by convection (up to 85%), radiation (up to 40%) and conduction (up to 2%) This yield is transferred to the atmosphere and, more importantly, to unburnt fuel.

Fire intensity is measured in kilowatts output per metre of the fire perimeter. Operationally, the intensity of a fire can be measured using the flame height as a tool.

Flame length	*kilowatts*	*Intensity*
<1.5	<350	Low
1.5-4.4	350-1200	Moderate
4.4-6.0	1200-2000	Moderate to high
6.0-12.0	2000-5000	High
	>5000	Very high

Fire intensity will have implications on tactics, resources and safety.

NOTES

Extreme fire behaviour

NOTES

At any wildfire it is possible for the fire to adopt extreme behaviour and fire fighters should be aware that this can happen at incidents that appear to be low risk. The following will affect fire behaviour and should be considered when carrying out dynamic risk assessments.

Heavy fuel loads

Rank heather or gorse are examples of commonly found heavy fuel loading.

Weather conditions

Spate conditions or drying winds; humidity levels can be dramatically reduced by the wind or solar heating.

Air Quality	RH	Fire Behaviour
Moist Air	> 60%	Fires will spread slowly, predictable fire behaviour
Dry air	30-40%	Fires may spread rapidly or escape easily
Very dry air	<30% <25%	Spotting commences Crown fires may develop
Extremely dry air Super dry air	<20% <10%	Erratic fire behaviour

Steep slopes

Each 10 degree increase in upslope will double the speed of fire spread.

Spotting

Spotting occurs when hot sparks and burning material are carried, by convection or the wind, ahead of the main fire. This causes the ignition of secondary fires which pose a significant risk to personnel. Spotting can also spread fire over control lines; these will only be effective if the line is wider than the distance the fire is projecting spot ignitions.

Ladder fire

Growing vegetation forming a link between the ground and the upper portion of the tree.

Junction Behaviour

NOTES

Junction behaviour is caused when two separate fire fronts move together. This process will result in the vegetation between the two fires being subjected to high levels of pre heating.

Fuels ignite more readily, resulting in rapid fire spread and an increase in intensity.

Crowning

Crowning is an indicator of severe fire behaviour and occurs when the fire is able to advance in heather, shrubs and trees over the canopy of the vegetation, normally without the support of a lower ground fire.

Severe fire behaviour is indicated by

- Very dark smoke
- Surging or pulsing flames
- Crowning
- Increase in spotting

If fire behaviour is erratic or fast changing it is a sign of danger.

6. SAFE WORKING AT WILDFIRE INCIDENTS

TOPOGRAPHY

Topography refers to the features of the landscape such as hills, gullies, valleys, crags etc. These can alter fire behaviour by bringing it in and out of alignment. Fire fighters must understand this concept so that they are able to apply tactics that are appropriate to the situation. They must appreciate that wildfire behaviour will change and its intensity will fluctuate, depending on the level of alignment.

A good knowledge of how topographical features influence fire behaviour will also assist fire fighters in planning safe escape routes.

Changes in topography can often affect fire behaviour and can act as trigger points where changes to tactics should be considered

Slope

NOTES

A slope will bring the fire either in or out of alignment depending on whether the fire is going up or down. When a fire is burning up slope the flames are nearer to the fuel and therefore vegetation is subjected to a higher level of pre heating. This, coupled with actual flame contact, accelerates fire spread and increases fire intensity. The opposite happens when a fire is burning down slope as there is little pre heating and little flame contact.

It is important to remember that for every 10 degree increase in slope the fire doubles its rate of spread.

A fire ignited on flat ground with no wind and with an even fuel load; will burn in a circular pattern. If an up slope is introduced, the fire will spread up hill and develop a head.

A down slope has the opposite effect and slows fire spread and intensity as it moves out of alignment. A downward slope is generally the safer place to be.

Aspect

Aspect will also play an important part in how a fire will interact with fuel and the features of terrain. It refers to the direction a topographical feature faces and in particular whether it is in or out of sunlight. Solar pre heating can dramatically alter fire behaviour and increase spread and intensity.

Southerly facing slopes will experience higher temperatures, lower humidity and lower fuel moisture content.

Northern aspects will normally be cooler and damper with a resulting change in vegetation.

East facing slopes will be warmer in the morning and cooler in the afternoon.

West facing slopes will be cooler in the morning and warmer in the afternoon.

These changes are important as slopes and the vegetation on them will support fire to a greater or lesser degree, depending on the time of day.

Altitude

NOTES

Increases in altitude will have an effect on the type of vegetation. There will also be a drop in temperature during the night with an increase in humidity and moisture levels.

Topographical effect on wind

Wind is affected by the roughness of the earth's surface and flows in a similar way to water; the rougher the surface, the more disturbances is caused to the flow.

Hills cause disturbance to the wind's flow and, on the lee side, turbulence can cause unpredictable fire behaviour.

Winds at the top of ridges are usually stronger due to the air being compressed by the upslope of the ridge. This high pressure air flows over the ridge top and enters an area of low pressure causing an eddy. This reaction can lead to unpredictable fire behaviour as it moves over the ridge top.

Topographical features can dramatically affect the prevailing wind direction

Valley's and gullies

Valleys form an elongated depression between uplands and areas on a lower level, they normally contain a river or stream. Valleys and gullies can change the direction of the wind and increase its strength. When a fire is burning in this type of feature its intensity and spread can be increased due to the wind and slopes. Valleys and gullies act in a similar way to a chimney.

Fire fighters must take extreme care when working upslope of a fire in either of these topographical features.

Teamwork

Team work on a fire ground is an important safety factor. By working in organised groups, individuals are better protected and are able to employ safe systems of work. Teams should normally work in groups of 5-10 and should be under the supervision of a team leader, smaller groups can be deployed but no one should be allowed to work alone. The team leader is responsible for the general safety of the personnel under their control. Nevertheless, everyone must ensure that their actions do not impair the

safety of either themselves or the team as a whole; they should be alert to any danger that might affect the team.

NOTES

Team leaders should not be confused with sector commanders; these will normally supervise a number of teams.

Teams deployed operationally must:

- Obtain current information on the fire situation and get a comprehensive brief
- Understand clearly what their instructions are
- Take appropriate equipment and provisions to enable them to work safely and achieve their objectives
- Once deployed they must be in communication with each other and their supervisors and incident control
- Ensure that they understand the identified escape route and place of safety
- Appoint a lookout to observe fire behaviour, team activity and weather (this is normally the team leader)

Team Leaders

The team should come under the control of a supervisory officer or 'team leader'. This individual will supervise the activities of the team and act as a lookout and safety officer.

Fire severity will change and it is important to understand that the timing of any attack will have an effect on the outcome. For instance it would be careless to attack a fire when it is in full alignment, if that alignment is about to change. Likewise it is often better to delay offensive operations until the fuel load either drops or fuel type changes. This simple concept, if understood, can dramatically improve the success of offensive operations as well as improving the working environment of team members.

Briefing

The team leader should ensure that all members of the team are briefed and that they understand the plan of attack. All safety issues such as escape routes and places of safety should be fully explained and understood by all members of the team.

Equipment

NOTES

Wildfire equipment carried on a fire appliance is usually basic, but if used properly can be effective. Team work not only utilises the equipment more effectively it also improves individual and team safety. The standard equipment provided on appliances includes beaters and backpacks; there are other tools that may be useful such as spades and foam additive.

Fogging Units

Fogging units are particularly useful when they are deployed alongside teams. By deploying fogging units in support of operational teams more can be achieved and the H&S of personnel is dramatically improved.

LACES PROTOCOL

Everyone must be aware of the risks involved and of the measures that must be put in place to protect personnel.

LACES is a protocol that must be followed by everyone on a fire ground. If the guidelines are followed then the safety of all personnel will be greatly increased.

LACES ensures that, if a dangerous situation develops, a lookout can communicate a warning to the team. Once this warning is given, individuals will understand where they must go and what route they have to take. Everyone must be aware of the escape route and place of safety at all times.

Lookouts

To maintain an appropriate level of supervision at a wildfire, it is essential that lookouts are appointed. These officers play an essential role in the maintenance of appropriate and safe systems of work. They can be appointed at operational, tactical and strategic levels of ICS.

Lookouts must be appointed to oversee the activities of personnel deployed on the fire ground. Each team must have a lookout and where necessary tactical and strategic lookouts should be deployed in order to manage the safety of a number of teams.

NOTES

Team lookouts (Operational)

Operational tasks will be carried out by Teams and these should consist of between 5 and 10 personnel. The Team leader should also act as the lookout and as such they must constantly monitor fire behaviour. The team leader may if it is necessary delegate this task to another member of the team but this person must be a watch or crew manager. The team lookout must operate in close proximity of the team so that any warning or instruction can be heard by all members of the group. If there is more than one team committed then team lookouts should be in communication with each other.

Sector Lookouts (Tactical)

At larger or more complex incidents where more than one team is committed, consideration should be given to appointing a sector lookout.

When appropriate this role should be carried out by a member of the Specialist Wildfire Group (SWG).

The role of the sector lookout is to take an overview of fire behaviour and advise team lookouts on any safety issues. This might include changes to fire intensity, fuel loads, rate of spread, etc. They should also point out windows of opportunity to suppress the fire and areas of critical importance. Sector commanders should not normally take on the role of sector lookout.

Incident Lookout (Strategic)

This role is a specialist one and can be instigated either by the Incident Commander or by the incident safety officer. The Strategic lookout should take a general overview of the fire and its potential and identify areas of risk. This should be done by the use of appropriate mapping systems and where possible obtaining aerial reconnaissance. The incident lookout should communicate with all levels of command to ensure that information regarding any potential risk is cascaded to appropriate officers.

Awareness

NOTES

Awareness of risk includes an understanding of specific and generic hazards on the fire ground. All personnel should ensure that they understand their role in the suppression plan and that they monitor their own and crew's safety at all times.

Communications

Communication is a key factor on the fire ground. It is the responsibility of everyone on a fire ground to ensure that all safety issues are communicated to relevant personnel. Supervisors must ensure that crews are effectively briefed and that their instructions are clear and understood by everyone. It should be remembered that a wildfire is a very dynamic incident and changes may occur suddenly, changes to fire behaviour or to the operational incident plan must be cascaded to all relevant personnel.

The maintenance of effective radio communications is also important. It is imperative that contact between incident control and operational personnel is maintained. Teams operating on the fire line must update incident control of any changes to the operational situation; likewise they must be informed by incident control of any changes in fire behaviour, tactics or planning.

Radio communication should also be established with other agencies so that information can be exchanged. If aerial helicopters are in use it is important to establish radio contact so that their operations can be directed from the ground. Incident commanders must ensure that an effective communications system is used.

The timely transfer of information between operational personnel and commanders is imperative to a successful outcome. Without relevant information it is impossible for managers to organise safe and effective systems of work.

Consideration should be given to the use of mobile and satellite phones. The use of mobile phones will be utilised by Specialist Wildfire Officers as a back up the tetra radio system.

Escape Routes

Escape routes are pre-planned routes that take personnel from a place of danger to an area of safety. Due to the dynamic fire behaviour at wildfire incidents escape routes must be continually monitored and changed if necessary.

Escape routes must be established at all wildfire incidents during the risk assessment and before commencing operations. When establishing escape routes it is important to remember that wildfire firefighting by virtue of its nature will cause fatigue, and therefore steep uphill slopes should be avoided as escape routes. When mobilising at wildfire incidents crews should avoid parking appliances directly on roads or pathways which are likely to be designated as escape routes.

NOTES

Safety Zone

Safety zones are places where personnel can congregate which are deemed to be free from risk from fire. The width of the safety zone should be at least 1.5 times the height of the surrounding vegetation and large enough to accommodate everyone. Often at wildfire incidents the Black Area will be a designated safety zone, it is important in this instance that the team leader ensures that the vegetation within has been fully burnt and not surface burnt. If the area has only suffered surface burn there is a risk of re ignition following a sudden change in fire alignment.

ACTION TO BE TAKEN TO PREVENT BURN INJURIES TO FIREFIGHTERS AFTER AN EXTREME HEAT EVENT

Peel & Reveal

During the North West Technical Officers' meeting on 2 March 2011 some new information was made available on the issue of what to do in relation to first aid and preventing burn injuries to firefighters after an extreme heat event.

Upon leaving the risk area the firefighters involved should have all their **PPE removed ASAP** to prevent heat transfer through the multi-layered fire kit. Because the kit is designed to prevent heat transfer there is a lag before the firefighter involved will feel the heat, however once the heat passes through to the skin the kit's design will actually keep the heat in and exacerbate any burn injuries unless removed. Tech R&D has contacted an A&E Chief Consultant and he confirmed that from his perspective the kit should be removed immediately to assess the extent of any injuries and accelerate any treatment. The casualty should then be treated ABC etc. as normal.

7. INCIDENT COMMAND

NOTES

Incident management team

The incident management team should be set up at larger incidents and should include leading officers assigned to manage the incident. It should include both fire service and non fire service managers. This team should normally operate at the incident control or a forward control point and should operate at a strategic level.

Strategic Command Role

This level of command at a wildfire incident must take a long term view of priorities. Baring in mind that some incidents will last for some day's or even weeks careful planning will be required. Strategic planning will be based around the needs of the incident as a whole and in particular those of the tactical and operational commanders.

Where there are other agencies in attendance it may be necessary to include these within the strategic command team

Tactical Command Role

Tactical Command should be linked but not normally part of the Strategic Command Team. Their priorities differ and the roles of each team should be kept independent. Tactical commanders should concentrate on operational planning. It is important that the tactical commander has appropriate wildfire understanding, if they are not a wildfire specialist it is essential that a specialist is part of the team. The tactical command team is responsible for the formulation of a fire suppression plan, they must include a fire map which is an essential part of the planning process.

The tactical commander must identify safe systems of work and ensure that these are adequately resourced. All resource requirements should be identified to the strategic command team.

A decision on the size and composition of teams should be made as part of the suppression plan. This information should be communicated to the incident resource officer who is responsible for the formation of these teams.

It is imperative that the tactical command team is constantly updated on operational developments. This will

enable them to constantly review their plans and address any safety issues.

NOTES

Where possible the tactical command team should be in a position to view the incident. It is important that the Tactical Team has strong communication links with operational commanders.

Operational Command Role

The Operational Commander has the responsibility to implement the fire suppression plan and will control all deployed resources. The safety of all personnel deployed on the fire ground is of critical importance. The LACES protocol should be adopted and where necessary sector lookouts should be appointed. If the Operational commander is not a wildfire specialist they should be supported by a member of the SWG.

The operational commander must be physically present at or near to the scene of operations. It is essential that they are regularly updated by all operational officers.

The Command Team

A Command Team should be appointed to support the incident commander at any incident. This should include all relevant managers and where appropriate a representative of the SWG. It is therefore of the utmost importance to include representatives of external agencies within this team, their position should reflect their managerial responsibilities and competencies.

Command Support

Command Support should be introduced at all wildfire incidents. The duty of command support is to assist in the management of the incident.

The following duties may be carried out by Command Support

- Maintain radio communications between Regional Control Centre (RCC) and the Incident Commander
- First point of contact for attending appliances and personnel
- To assist in liaising with other agencies
- To direct resources to allocated areas
- Maintain appropriate records such as personnel and equipment in attendance

At larger or more complex incidents additional duties may include

The marshalling of resources

Liaising with SWG

Giving appropriate support to sectors

Liaising with other agencies

Maintaining precise records of personnel and equipment including those from supporting agencies

NOTES

Sectors

Due to the nature of this type of incident sectorisation should be considered at an early stage.

At a wildfire incident it will be usual to delegate certain responsibilities to Sector Commanders. This will ensure that the appropriate level of control is maintained.

The creation of sectors should be carried out on the instructions of the Incident Commander. Officers with appropriate skills should be appointed to command each sector and wildfire specialists should be used appropriately, consideration to the normal supervisory role of SWG officers is important. For example a Crew Commander should not be appointed to an inappropriate level of command.

Sector commanders should physically remain in the area of their command; they should provide direct and visible leadership. At a wildfire incident there is the likelihood that operational personnel are operating within an environment of constant change. The sector commander must be in a position to monitor these changes and take appropriate actions to ensure that the systems of work employed are effective and safe.

Where possible all operational commanders should place themselves in a position where they can view the teams under their control. They should maintain an effective communication link with the team and sector lookouts.

Sector commanders must have a thorough understanding of the suppression plan, they must ensure that all personnel under their control are fully briefed.

In situations where the sector commander is not a wildfire specialist they should be supported by a SWG member.

The ICS provides clear command and communication lines, operational sectors should report to either the

Incident Commander or operational commander if there is one in place. Commanders of support sectors should report to Command Support.

NOTES

SPECIALIST ROLES

Resource Officer

It is absolutely necessary that control over all resources is established from the onset. To achieve this, it may be necessary to appoint a resource officer who will establish systems to monitor all resource issues.

On arrival, all operational personnel must report to command support or to the relevant rendezvous point. Under no circumstances should any unit self deploy. All equipment and personnel must be identified and recorded by command support. These records must include information on the resources committed by supporting agencies and it is the responsibility of the lead agency officer to provide this information to the fire service.

Similar levels of control must be maintained throughout the incident. When equipment or personnel are deployed all relevant information should be recorded.

Welfare and Relief Officer

The incident commander should consider appointing a welfare and relief officer. This officer will manage issues such as feeding stations, rest areas, 1st Aid points, drinking water, relief crews etc. At larger or prolonged incidents this officer should obtain the support of an officer from Emergency Planning, consideration should also be given as to whether it is necessary to appoint an officer to coordinate these activities at RCC.

Incident Safety Officer

At large or more complex incidents an officer should be appointed to oversee safety issues at a strategic level. This officer should check the effectiveness of control measures put in place and advice the OIC on any additional measures that should be instigated.

8. SPECIALIST WILDFIRE GROUP (SWG)

NOTES

INTRODUCTION

Not everyone at a wildfire incident can be trained to a specialist level, but incident commanders must guarantee that safety issues are monitored by highly competent personnel. SWG members should be appointed to supervise risk critical areas within the ICS.

Specialist wildfire group (SWGO's) officers should be utilised as required, they are trained to carry out a number of roles on the fire ground and can be used at a strategic, tactical or operational level. The group consists of a number of officers from Watch Commander to Group Commander role. This group of officers are known as Wild Fire Officers (WFO) The activities of the group will be managed by the most senior WFO present.

The formation of the Specialist Wildfire Group (SWG) is an important development. Members of this group will provide command support to the officer in charge, will support the operational activities of teams deployed onto the fire ground at both sector and team level, and when necessary will form operational teams which will be deployed to evaluate and attack the fire using direct and indirect methods.

Wildfire specialists have a high level of understanding of fire behaviour, fire spread, fuel types, suppression techniques and operational procedures. They will use this knowledge to improve operational effectiveness and safety.

NOTES

Command support

One of the primary functions of the SWG is to provide tactical support to the incident commander. They will assist in formulating an operational plan which will be effective and safe.

Wildfire specialists will take a tactical overview of the following factors

- Expected fire spread
- Fire behaviour and severity
- Environmental and economic impact
- Fire suppression plan
- Resource requirement
- Time of day and weather
- Critical points
- Safety issues

Expected fire spread

It is important to assess the fire's potential to spread. This will be affected by local topography, weather and vegetation. To forecast the fire's likely development, wildfire specialists will use various tools, including the Wildfire Prediction System (WPS), Mapping, Air Surveillance and Local Fire Plans.

This will ensure that an accurate prediction can be made on the likely fire spread and of the fire's probable footprint.

Fire behaviour and severity

A fire's behaviour and severity is dependant on many factors but the most important are fuel and weather. These variables have a huge impact on how fire is able to proliferate. Other factors to be considered include, time of day, topography and the Wild Fire Prediction System (WPS).

Observation is also important and an understanding of smoke plume appearance will give an important indication of the severity of the fire and likely fire behaviour.

NOTES

Environmental and economic impact

Although all wildfires have a detrimental affect, which can be measured either in economic or scientific terms, it is important to understand that an ‘assessment of impact’ should be carried out. This assessment may influence the operational plan as it will identify key priorities.

Value of land can be either environmental such as ‘Sites of Special Scientific Interest’ (SSSI) or economic, where land or vegetation has a high monetary worth. It is imperative that these areas are identified so that damage can be minimised. Local fire plans and knowledge will assist in this process.

Fire suppression plan

Once wildfire specialists have identified likely fire spread, fire behaviour and severity, and carried out an impact assessment they, will be in a position to formulate an operational suppression plan.

A map of the area should be used and this should be marked with any useful information which might include the following

- Likely fire spread
- Fire alignment
- Possible fire footprint
- Areas of high value
- Areas of operational significance such as ‘Critical Points’ or ‘ Windows of Opportunity’
- Rendezvous and feeding points
- Command areas such as main and forward control points
- Allocated resources
- Anchor points
- Safe areas
- Sectors
- Holding areas
- Suitable roads and tracks
- Helicopter landing areas
- Open water locations

NOTES

Documentation

At larger incidents the plan should be written down whilst incorporating an Analytical Risk Assessment (ARA) so that it can be understood by everyone in the command team and to enable relevant information to be passed on to sectors, teams and individuals.

Resource requirements

The Fire Suppression Plan will identify the amount of resources necessary to extinguish a fire. Most of the personnel and equipment required will usually be provided by the fire service but some supplementary equipment may be provided by other agencies e.g. Forestry Commission.

Time of day and weather

At the beginning of the day the ground is relatively cool and humidity is moderate or high. As the sun warms the surface, temperatures rise and humidity falls. Later the solar heat generated by the sun reduces and temperature falls and humidity rises. The sun also changes its position and areas move in and out of aspect. These changes affect fire behaviour, severity and fire spread. The fire will either be moving into a period of development or its activity will be reduced.

Night time has historically been a period when operational activity is stopped, in the past it has been considered unsafe to allow fire fighters to continue their activities during the hours of darkness. Nevertheless this period is now recognised as a window of opportunity, as the severity of any fire is dramatically reduced during the night.

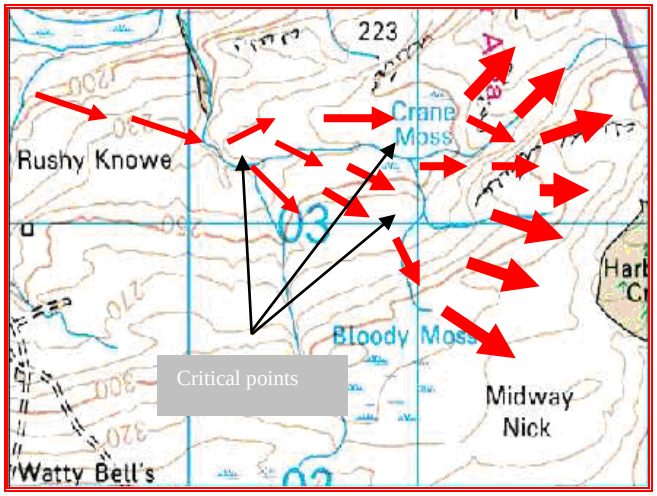
Wildfire specialist teams may be deployed during the night as a matter of course and, if it is deemed safe other teams may be instructed to continue fire fighting operations.

Critical points

Topography or the ‘lay of the land’ can influence fire spread and fire behaviour. Critical points can be described as topographical features that will significantly alter fire spread or fire behaviour. These changes can be either simple or complicated.

A simple example is where a fire is burning on a flat area of ground towards a steep upslope, the critical point can be described as the point where the fire reaches the upslope and where its behaviour can change dramatically.

A more complicated example might be when a fire spreads into an area that contains several water courses; this will encourage development in several directions and into areas where the fire would have otherwise not travelled.



NOTES

Safety

The main purpose of the SWG is to ensure that wildfires are dealt with safely. The specialist skills and knowledge of wildfire officers will increase the H&S of all personnel on the fire ground.

Operational Support Activities

Another role of the SWG is to support the activities of operational personnel on the fire ground. This is normally done by appointing wildfire officers as sector commanders. As such they will be able to monitor operational activities which will include safety issues. In certain situations they should be appointed as ‘team leaders’

This is advantageous if a team requires closer supervision and control, an example of this might be if the head of a fire is attacked or if fire fighting operations continue during the hours of darkness.

At some incidents it may be useful to appoint a wildfire officer as a ‘strategic’ look out; it may be possible for an officer to obtain a position from where an overview of the

whole incident can be obtained. This officer will then be able to give advice on fire behaviour, fire spread and safety issues.

NOTES

Where a helicopter or Sky watch is available it is beneficial for a wildfire officer to take an Arial overview of the incident, this will assist in obtaining important information that cannot be obtained from the ground. If the police helicopter is in attendance then this can be used to transmit live footage of the fire via a video link to wildfire officers at incident command.

WILDFIRE SPECIALIST TEAMS

Teams consisting of wildfire specialists will be deployed at most wildfire incidents. These will perform any number of roles at a fire which include

- Observation of fire behaviour and spread
- Reconnaissance
- Identify windows of opportunity
- Defend critical points
- Fire fighting operations including direct and indirect tactics

SWG teams will consist of between 2 - 6 members, depending on their role. Observation and reconnaissance teams will normally consist of 2 members while a fire fighting team should consist of a minimum of 4 persons.

SWG teams will be expected to operate on the fire ground for lengthy periods and will take equipment and provisions necessary for the team to carry out its function. They will normally operate in advance of the fire and take appropriate action.

These teams have specialist skills including a capability to ‘fight fire with fire’. Each of these officers will carry drip torches which will enable them to launch offensive and defensive burning operations. These tactics can be used to create back burns to limit fire spread or to defend critical points. The fire can also be suppressed by lighting secondary fires that will be drawn into the main fire; this has the affect of lowering fuel loads and intensity.

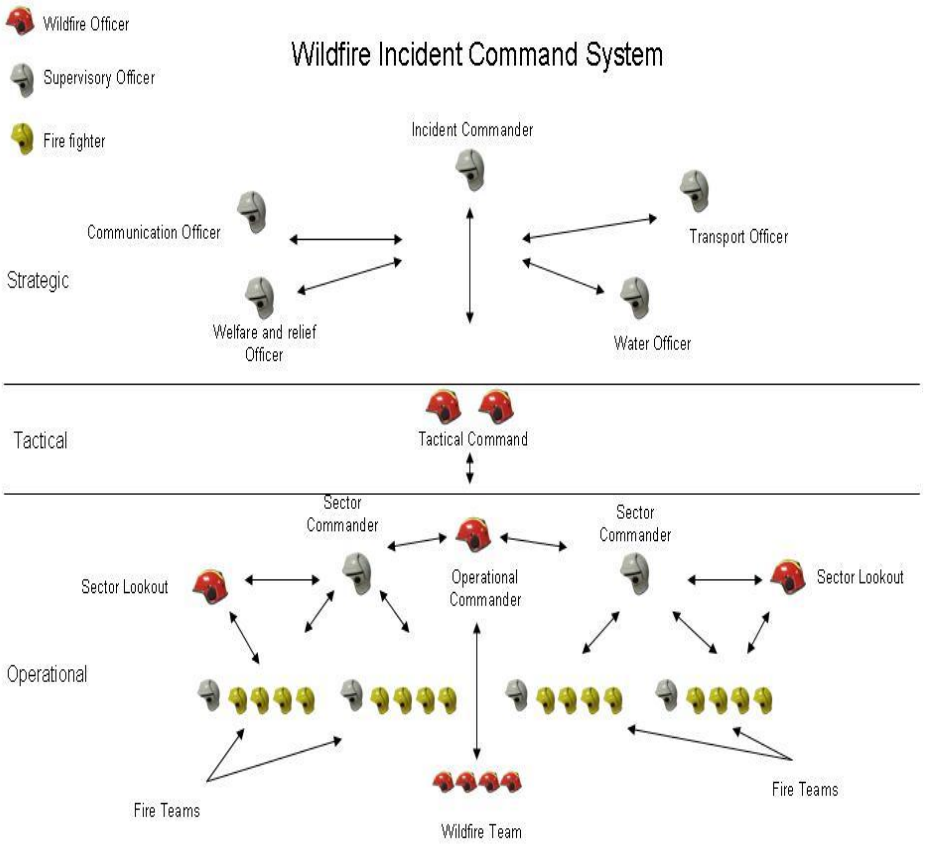
One of the most important benefits of the deployment of SWG teams is that they will give reliable and specific information regarding fire activity. They will pass information to incident command which will allow the

command team to continually evaluate the effectiveness of the fire suppression plan.

The diagram below is an ‘example’ of an Incident Command System which can be used to ensure that specialist officers are in place to manage risk at all levels of command.

The normal command team deals with strategic issues allowing wildfire officers to concentrate on the fire suppression plan. Within the tactical command team a wildfire officer will direct fire operations. This is cascaded to Sector commanders, in this example these are supported by Wildfire specialists acting as lookouts. A wildfire team is also deployed to support fire fighting operations and to undertake the more hazardous objectives outlined in the fire suppression plan. All of the risk critical roles are carried out by specialist officers maintaining a high level of control throughout the command structure.

NOTES



MOBILISATION OF WILDFIRE OFFICERS

Wildfire Officers should be mobilised to attend wildfire incidents under the following circumstances;

- If the incident is attended by 4 or more appliances
- If control room personnel deem that the attendance of a wildfire officer is necessary (This for example may be as a result of information received at the time of call)
- If the OIC of an incident that has less than 4 appliances in attendance requests the mobilisation of a wildfire officer

Where wildfire officers are mobilised to incidents that have 4 or more appliances in attendance then a minimum of two wildfire officers should be sent. Once in attendance the wildfire officer(s) must assess the fire's severity and potential and resource the incident accordingly. The number of wildfire officers that are required should also be considered and this information should be passed on to control.

Controls have a record of all contact numbers for wildfire officers and will be responsible for mobilising wildfire officers to incidents. Wildfire officers in attendance will operate on a buddy buddy system and may directly mobilise further Wildfire Officers if necessary.

NOTES

ROLE OF WILD FIRE OFFICER

The role of the SWG team members has been described but it is important to understand that the primary duty of any wildfire officer must be that of ensuring the operational safety of 'all personnel' for the duration of the incident. The officer in charge will still have the responsibility for general safety but wildfire officers must ensure that fire teams involved in fire fighting adopt safe systems of work and that their activities are properly monitored.

The operational commander will verify that the LACES protocol is followed at all times. A continual assessment of risk should be carried out and changes to the operational plan should be made accordingly.

Wildfire officers should update the officer in charge at regular intervals to ensure that they are fully aware of all operational issues.

The inclusion of relevant land representatives into the command structure must be considered and where appropriate these can be deployed to assist in the management of sectors or act as team leaders.

It is of crucial importance that an effective communication system is established. This will enable risk critical information to be cascaded to everyone on the fire ground by SWG members.

TACTICAL CONSIDERATIONS

Whenever it is safe to do so operational tactics should be aggressive. Commanders should not commit their resources until they understand what potential the fire has and how it will develop. As soon as possible a comprehensive risk assessment should be carried out; it should include the following analysis

- Information on the current fire situation including rate of spread, severity and fire behaviour
- An understanding of the fires potential future development
- Identification of critical points
- Location of windows of opportunity

Carry out an impact assessment by Identifying areas of either economic or environmental importance

Weather information

Specific risk identification

Control measures required

Resource requirement

To give an overview of risk, where ever possible a fire map should be used. This will aid planners to develop an understanding of not only the current but also the future risks involved in suppressing the fire. It can also be used to assist in formulating a plan of operations as it will identify areas of tactical importance as well as those of high risk.

The information shown on a fire map can include

Ignition point

Wind direction

SSSI's

High value locations such as grouse moors

Fire footprint

Potential fire spread

Critical Points

F1, F2, and F3 areas

Areas of extreme fire behaviour such as crowning or spotting

Windows of opportunity

Rendezvous points

Anchor Points

Hazardous areas such as bogs or cliffs

Natural control lines

Deployed resources

Safe areas

Look out points

Water sources and other useful

Information

Bogs, cliffs, open water etc.

The complexity of any fire map will depend on the size and nature of the incident, nevertheless a fire map will be useful at any fire however small.

NOTES

The fire map should be constantly updated with all relevant information.

NOTES

9. FIRE SUPPRESSION TECHNIQUES

INTRODUCTION

There are various methods which can be used to suppress a fire but all must be carried out with safety as the first priority. It is imperative that whatever tactic is used, everyone is aware of the plan and all have an identified escape route to a place of safety.

The purpose of fire suppression is to extinguish the fire and this can be best achieved by establishing a line from which fire fighting operations can be carried out. There are various methods by which suppression can be achieved including indirect and direct attack.

Types of attack include, applying water, foam and other retardants, beating out the fire, or establishing a control line by removing all vegetation available to the fire. A number of these methods may be employed at a fire depending which is most appropriate to a given situation. Tactics will depend on a number of factors including

- Fire behaviour
- Location of the incident
- Available resources
- Topography
- Water supplies

Fire fighting operations can be determined to be either offensive or defensive.

STRATEGIES

Offensive tactics are usually the most successful in suppressing fire; they reduce the impact of the wildfire by reducing the area burned and restricting the amount of damage caused by fire fighting operations.

Strategies include

- Direct attack
- Parallel attack
- Indirect attack

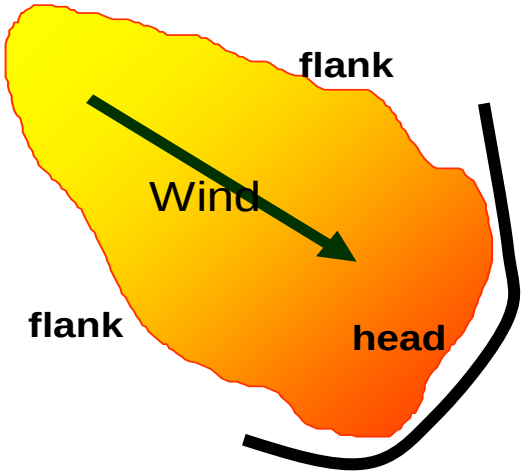
The difference between indirect and direct attack is best described as follows

NOTES

Direct Attack

Direct attack is where the fire is attacked by fire fighting at the fire perimeter by teams using water lines, beaters and hand tools. This method should only be used at fires which are of low intensity and where fire behaviour is predicted to remain so. Personnel using this method are required to work at or close to the fires edge and it is important to ensure that the safety of fire fighting team is not compromised, the LACES protocol must be followed at all times.

Direct attack should be used at fires with a flame length of up to 2 meters.



Indirect Attack

Indirect attack is when firefighting operations are carried out away from the line perimeter, it is a method used to suppress wildfire. It can be used both offensively and defensively.

Offensive burns are those which are launched directly at the fire and which are intended to move towards the approaching fire front.

Defensive burns are those which are used to create a burnt area before the arrival of a fire front and so starve the fire of available fuel.

Indirect methods are appropriate when fire intensity is high and flame length is above 3 meters. The use of fire is

necessary as it is the only tactic which can be used successfully against large fires.

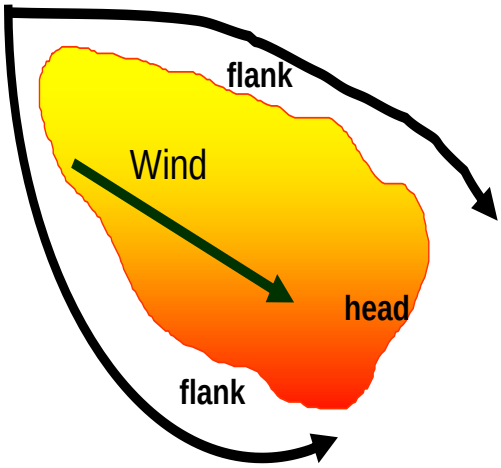
This type of operation should only be carried out by specialist officers.

NOTES

Parallel Attack

This method involves building a control line parallel to the fires edge, far enough away from the fire to allow crews to work out of the heat and smoke. A control line can be built using hand tools swipes or other machines.

This method should be used when flame length is above 2 meters.



Parallel attack should include

The construction of a control line

Burning out the vegetation between the fire and the control line. (By SWG)

Due to the intensity of the fire parallel attack operations should be monitored closely.

CONSTRUCTING A CONTROL LINE

Control lines can be constructed either by hand or by machinery such as a digger, plough or swipe. Through arrangements made by the Northumberland Fire group, machinery is available or can be leased to construct control lines, a list of available equipment and contact details are kept in control.

NOTES

Whenever possible machines should be used to construct control lines but when this is inappropriate they should be constructed by hand. This is best achieved by working in teams of 5 or 6, each team member should have an allotted task and everyone must understand the role they are to carry out.

The first team member should use appropriate equipment such as a chain saw to cut through the undergrowth or heather.

The 2nd and 3rd members of the team should cut the edges of the control line about 750mm apart.

The rest of the team should clear all remaining vegetation from between the edges. A team of six should be able to clear 50 meters of line every 15 minutes.

DEFENSIVE BURNING

NOTES

Defensive burns should be carried out against a strong anchor point such as a track or established control line.

Defensive burns should be used to reinforce control lines which can either be ones that have been constructed or that were already in existence such as a road or track. The purpose is to ensure that the approaching wildfire will not jump the control line and is achieved by burning off available fuel before the arrival of the main fire.

When constructing a defensive burn the black area should be a minimum of 2 ½ times the flame length of the approaching wildfire. Consideration should also be given to the distance of any spotting which will result in the defensive line being breached by spot fires.

Burns should be managed carefully and the ignition pattern chosen must be one that does not allow the fire to develop where it might over run the control line. Control is maintained by ensuring that the interaction between the separate fires keeps the burn at low intensity.

There are various methods which can be used including the following

- Lines of fire
- Points of fire
- Fingers of fire

Lines of fire

This is a method which should be used in areas of low fuel loading and where fire intensity is low.

Specialist officers ignite a number of lines of fire, the first one will burn up to the anchor point and the others will burn into the black area created by the previous burn. The distance between the lines can be extended as the black area is established.

This will be achieved by staggering the formation of the lines as demonstrated in the following photograph.

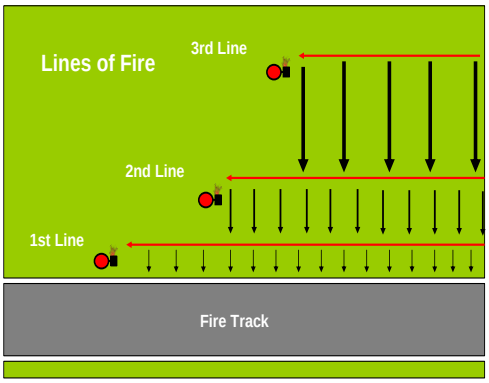
NOTES

Advantages

This is an effective and speedy method to create a black area over which fire will not burn

Disadvantages

In areas of high fuel loading lines will result in high severity fires



This illustration shows three lines of fire being burnt against a fire track. Note the difference in the space of the lines of fire.

Points of fire

Points of fire should be used in situations where fuel loads are high or where conditions dictate that the intensity of the backburn be kept low.

Specialist officers will ignite points of fire at suitable intervals so that the fires interact in such a way that each fire is unable to develop fully. This method relies on cooperation between operatives so that the pattern is established and maintained throughout the burn.

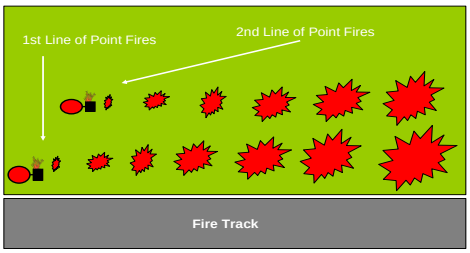
Advantages-

Low intensity is achieved

Points can be lit in areas of high fuel load.

Disadvantages-

More time is required to carry out this type of burn.



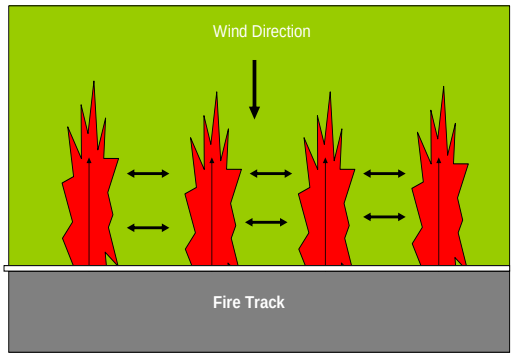
This illustration shows point fires being in two lines, the fires are lit in such a way as to prevent any of the points to develop to their full potential.

The photograph above shows a situation where ground fuel is burnt using points without the risk of igniting the canopy.

Fingers of fire

This is another method which will enable fire intensity to be kept to a minimum. Specialist officers will ignite lines of fire at right angles to a control line. By using this method the fire is unable to develop a head and the burn will only expand as a tail or flank fire.

NOTES



The illustration above shows fingers of fire which have been lit from a control line. The fires cannot develop a head so will only burn as a flank or tail fire.

NOTES

Offensive Burning

Offensive burning is an indirect method which can be used to suppress fire. This tactic involves attacking the fire with fire.

An offensive burn is normally lit some distance from the fire perimeter and burnt from a strong control line such as a track or constructed line.

Specialist officers will use appropriate tactics to ensure that operations are carried out safely. The burn should normally be lit against the wind so that its intensity is low, the resulting fire will create a burnt area that will strengthen the control line. Once the offensive burn is near to the main fire the junction effect will take place, the two fires will interact and severity will rise but should quickly fall.

Offensive burns can also be used in situations where the main fire is not in alignment. The controlled burn can then be used to overwhelm the wildfire by burning into it and starving it of fuel.

The series of photographs below show an offensive burn where the main fire is burning against the slope and wind, A fire is lit from a control line and it burns in full alignment overcoming the original fire.

This tactic is highly technical and must only be used by experienced specialist officers following an extensive risk assessment.

NOTES

SUPPRESSION STRATEGIES

Due to the nature and size of some incidents it may be necessary to employ several techniques in order to bring the fire under control. It is important to appreciate that wildfire is dynamic and its behaviour will change.

It is imperative that all personnel are aware that these changes can mean an increase in fire severity and speed of fire travel.

Understanding when and where changes occur will not only allow operational plans to be put into effect but will also improve the safety of everyone on the fire ground.

Fire Suppression strategies must be based on understanding, consideration should be given to:

- The predicted fire behaviour
- Where changes will occur
- The suppression tactics to be used
- Available resources

Having considered these factors it is necessary to identify when and where

a suppression plan will be successful (window of opportunity) Timing is crucial, as any attack must be within the capabilities of available resources.

To commit at the wrong time or with insufficient resources will lead to failure.

It is often necessary to wait for fire behaviour to change, or until more resources have become available. If this situation arises it is necessary to restrict the fire and this is usually achieved by pinching the fire.

NOTES

PINCHING

Pinching is a tactic where the flanks of a fire are attacked. The purpose is to prevent the fire front from widening and to lower the intensity of the head. Pinching is a useful strategy when planners are waiting for the severity of the head fire to lower. Direct and indirect tactics can be used to pinch the flanks. When working on the flanks it is important that team and sector lookouts are aware that a change in wind direction may result in a flank fire becoming a head fire.

FIRE SIGNATURE

By observing fire behaviour at different locations during a wildfire, officers will be able to gain useful information on rate of spread, flame length and severity. This information can be used to predict fire behaviour, for example a fire in an F1, F2 or F3 alignment can be expected to behave in the same way when in similar fuel type. This phenomena is termed to be a fire signature, this knowledge will assist in formulating a suppression plan as it will identify areas that are within our threshold of control. It will also help identify future resource requirements and appropriate suppression tactics.

10. WILDFIRE PREDICTION SYSTEM (WPS)

NOTES

This is a method that can be used to predict fire behaviour and assists operational personnel and planners alike.

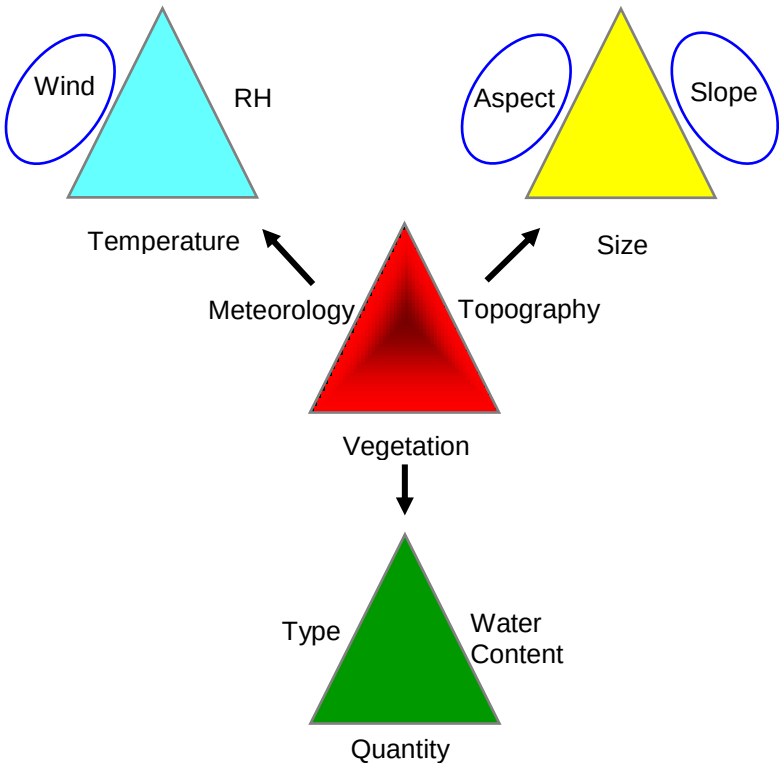
The system is based on the 'alignment of forces concept'. By recognising that wildfire is influenced by three major factors we can understand current fire behaviour and predict where the fire behaviour will be within or outside the threshold of control. This allows firefighters to proactively identify risks brought about by changes in fire behaviour. They can then switch between defensive and offensive operational modes as appropriate.

The three alignment forces are:

Wind

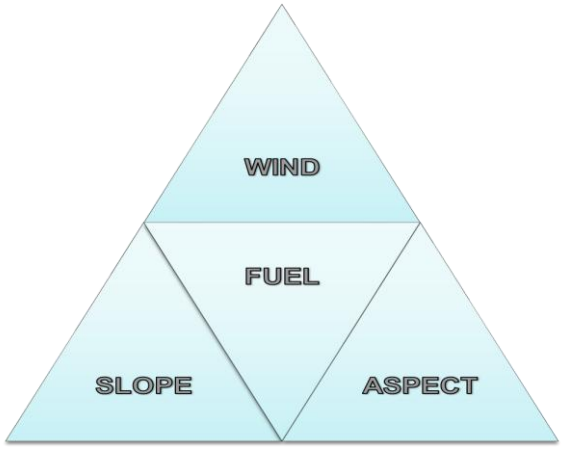
Slope

Aspect



The three forces of alignment in conjunction with the presence of fuel make up the Wildfire triangle.

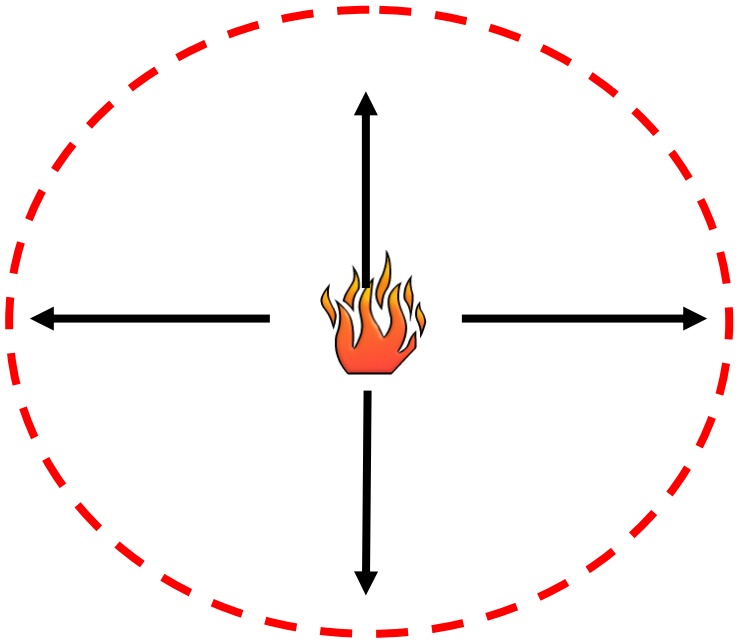
NOTES



Although fuel is not an alignment force it is a variable which supports fire development.

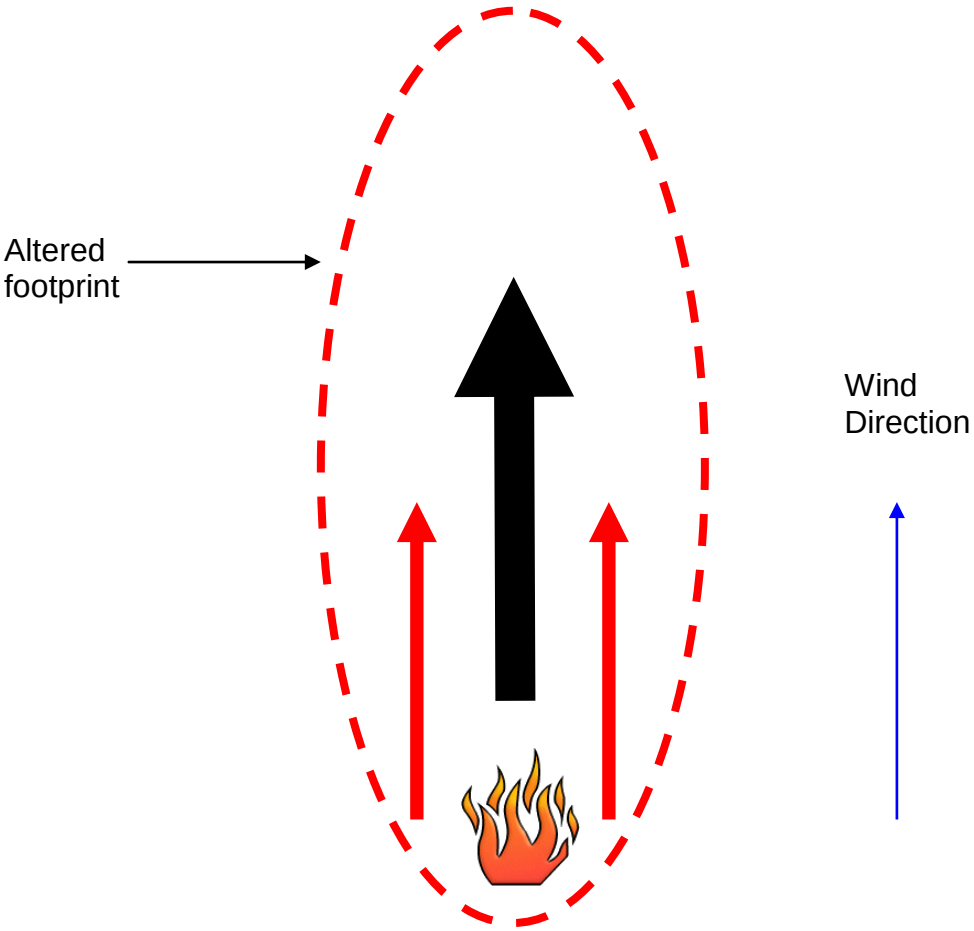
Without topographical or meteorological influences fire will burn with equal intensity in all directions.

NOTES



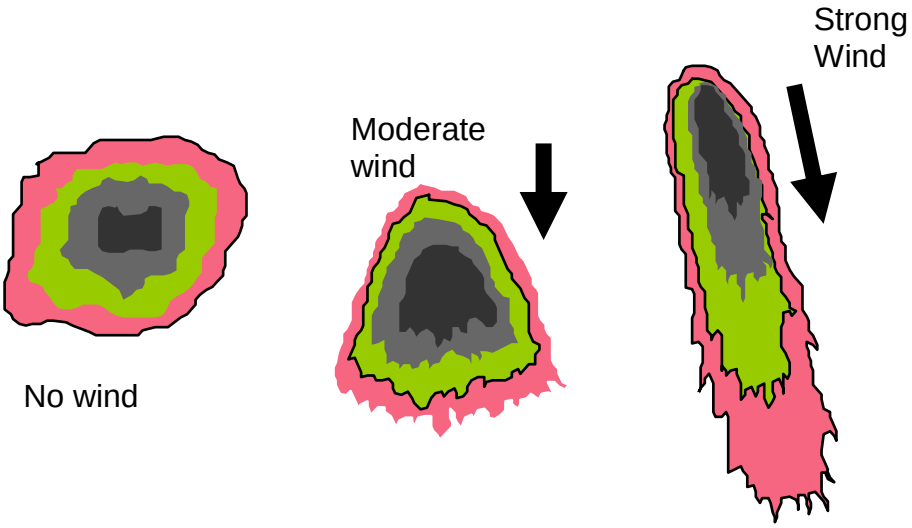
WIND

Wind will influence fire development by driving the fire and giving it direction. It will influence fire intensity by feeding the fire with added oxygen and therefore increasing the intensity.



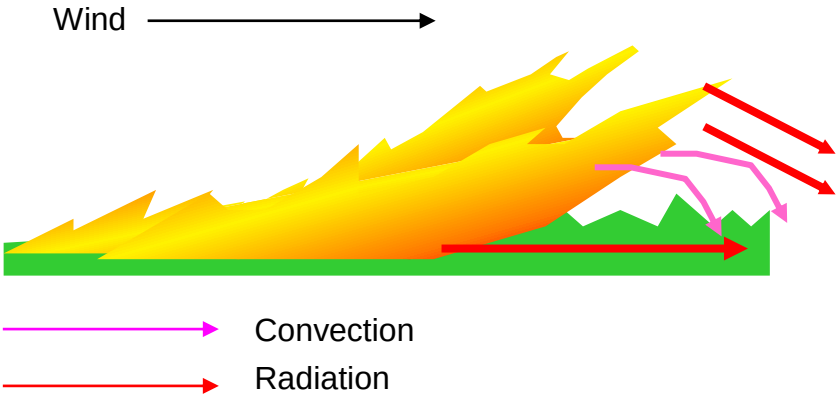
The wind strength will influence the fire foot print the stronger the wind the narrower the footprint established.

NOTES



Where a strong wind is present the head of the flame will be driven forward closer to the fuel causing pre heating of fuel as a result of convection currents and radiated heat.

Wind effect

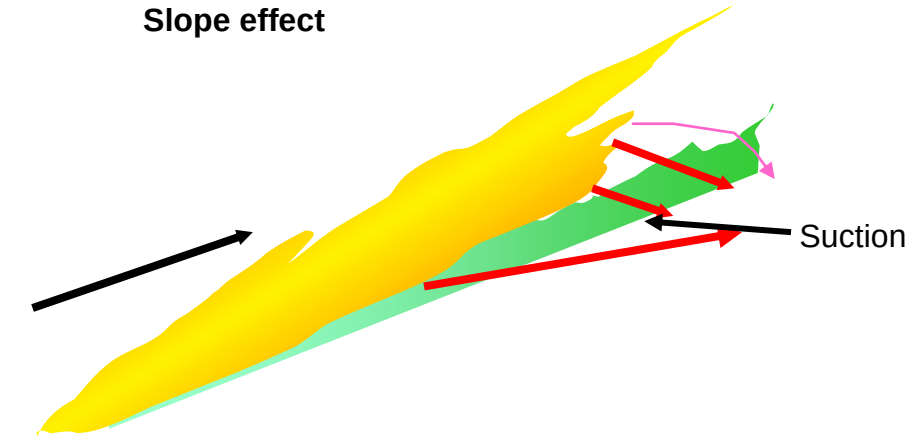


Slope

NOTES

Slope of the terrain will increase the speed of the fire, alter the direction of fire travel and increase intensity. (see section 6)

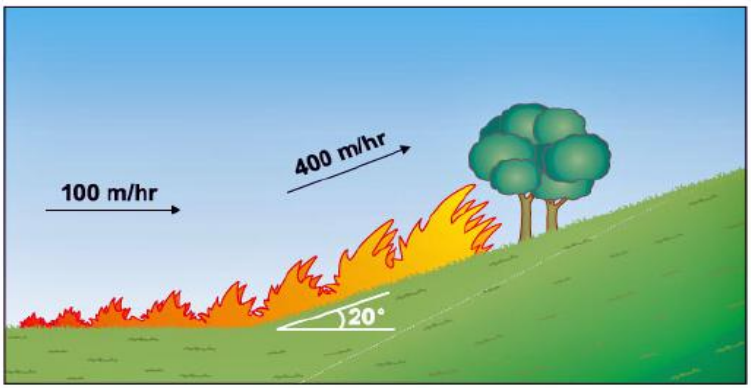
Slope effect



Convection

Radiation

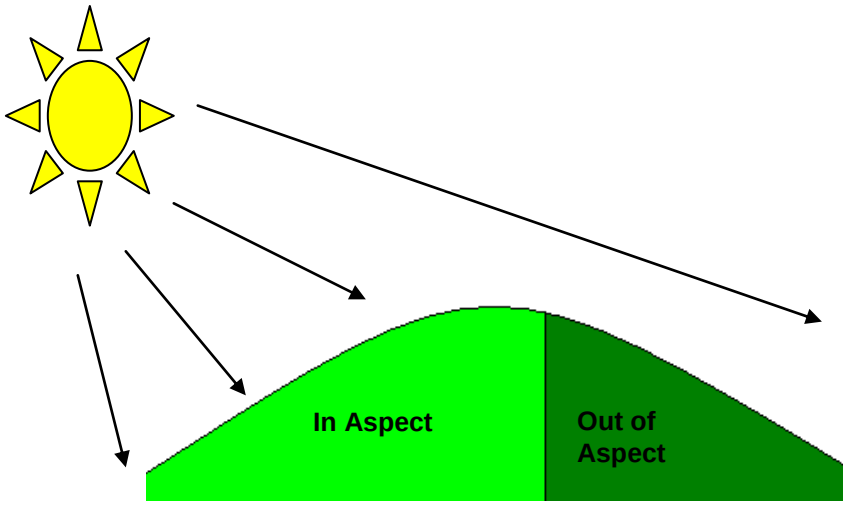
It must be remembered that with every 10 degree increase in slope the speed of fire travel will double.



Aspect

NOTES

Aspect is when the surface of the ground is subject to solar pre heating. (see section 6)



A few minutes of sunlight will significantly alter fire behaviour.

It is likely that when a fire has all three factors in its favour, fire behaviour will be maximised within the fuel type.

The Wildfire Prediction System is therefore an excellent tool and is a key element of any fire suppression plan.

FIRE BEHAVIOUR MODES

Fire can be described as being in one of three behaviour modes

No alignment (influenced by none of the forces)

Partial alignment (influenced by some of the forces)

Full alignment (influenced by all of the forces)

Each alignment force acting in the fires favour will increase the severity of the fire by a factor of one therefore the influence of Wind, Slope, Aspect will each increase the severity by a value of +1. This principal gives us an alignment value which can be termed as **The Alignment Factors**, the number of factors which are working in favour of the fire.

For reasons of simplicity the fire behaviour can therefore be described as

F0 (when it has no fire alignment)

F1 (when it has one force in its favour)

F2 (when it has two forces in its favour)

F3 (when it has all three forces in its favour)

At larger wildfire incidents the WPS can be used as a tool to manage risk and gather information on potential fire activity. Incident commanders can use it to maintain effective situational awareness and set clear, safe and effective operational activities.

Fuel

Although fuel is not a force of alignment it is still a very important factor which influences fire behaviour. Fire activity in vegetation is affected by

Type

Quantity

Arrangement

Alignment

The types of vegetation fuels can be categorised into four types

Grass/Crops

Woodland

Heath or Moorland

Scrub

Grass

Grass burns readily and because of its lighter fuel loading is strongly influenced by alignment with wind and slope, fire spread can be rapid and is a significant risk. An important consideration when fighting fires in areas of grassland is the speed at which it can carry the fire into heavier fuel loading such as gorse or heather leading to a rapid change in fire behaviour.

Due to the fact that grass fires spread rapidly they may not burn to mineral earth, leaving sufficient fuel which may support fire in the same area should there be a change in wind direction. Coastal areas of grassland are strongly influenced by sea breezes and undulation in the topography.

NOTES

Characteristics
Light to moderate fuel loading (less than 6 t/ha)
Mostly fine surface fuels
Maximum wind penetration
Low/Moderate intensities
High rates of spread
Short residual burning time
Limited short distance spotting

NOTES

Crops

Agricultural areas of grassland such as wheat or corn have a much higher fuel loading than natural grassland, this results in different fire behaviour. Crop fires are generally slower moving and burn with much more intensity. This type of fuel is strongly influenced by wind but is not normally located on steep slopes; it tends to be uniform with little change to its horizontal arrangements.

Characteristics
Moderate fuel loading (more than 6 t/ha)
Mostly fine surface fuels
Maximum wind penetration
Uniform fuel
Moderate intensities
High rates of spread
Short residual burning time
Limited short distance spotting

NOTES

Natural Woodland

Natural is a term used to describe woodland which is indigenous and is not cultivated for the production of timber. They generally contain a mixture of deciduous and coniferous tree species. Fuel types and arrangements differ significantly from those found in plantations. The main difference in fire behaviour is that aerial fires are less common and there will be less fire activity in the canopy.

Surface litter and ground vegetation play an important part in variations in fire development and rate of spread, if there are fine fuels such as grass at ground level then the fire spread will be high. If it is coarse fuel such as brash, fire spread will be slow with a corresponding change in intensity.

Characteristics
Moderate to high fuel loading
Fine and coarse surface fuels
Mixed fuel variation
Moderate wind penetration at ground level
Moderate to high fuel intensities
Variations in rate of spread
Moderate to long burning time
Limited spotting

NOTES

Conifer Forest

Plantations are common areas of woodland and usually consist of a single or limited number of species of pine. Trees are planted close together in a regimented formation, in many plantations the spacing between trees can be less than two metres. The fuel characteristics vary with the plantations age, and the systems used to manage the woodland, such as pruning and thinning. It is normal for any brash to be left where it falls thus creating substantial surface fuel.

Fire behaviour in plantations can be extreme and there is a likelihood of aerial activity, the vertical fuel arrangement and close proximity of other trees allows fire to access the canopy. Torching and crowning are more likely in younger trees. As trees get older the bottom branches do not retain their needles and a gap grows between the branches and the surface fuels, older trees get less light through the canopy and as a result there is a reduction of live vegetation with little or no shrub growth. These developments widen the ladder fuel arrangement and reduce the likelihood of aerial activity.

Characteristics
High fuel loading
Fine and coarse surface fuels
Age of vegetation dictates variation in fuel arrangement
Little wind penetration at ground level
Potential ladder fuels
Potential extreme fire behaviour such as torching/crowning
Moderate to long burning time
Likelihood of spotting

Moor and Heathland

There are a number of different classifications of heath and moor; in appearance they can be almost identical. Both can have similar vegetation and can be found in upland and lowland areas. The main difference is that heath is located on well drained soils while moor is found in wetter areas where sphagnum mosses help retain water levels.

Many different plant species are present with the most abundant being grass, bracken, gorse and small shrubs such as heather. The horizontal arrangement of the vegetation plays an important part in fire development and fire behaviour; some areas contain mixed vegetation while other areas have large areas of uniform fuel. Another consideration is peat which is commonly found on moors and is a ground fuel which can cover vast areas to a considerable depth.

NOTES

Characteristics
Moderate to high fuel loading depending on vegetation
Fine and coarse surface fuels
Mixed fuel variation
Some wind penetration at ground level
Short to moderate burning time
Likelihood of spotting

Scrubland

Scrubland is a classification of fuel type which is quite common across the UK including urban areas. It usually consists of mixed vegetation types including grass, gorse, shrubs and small trees. A generic descriptive is an area of mixed vegetation found on the fringes of other classifications of fuel types or contained in pockets within them.

Fire behaviour in scrubland is dependant on the plant species, vertical and horizontal arrangements and the changes in behaviour that these variables will induce. Such areas are of high risk as fire behaviour can be erratic with rapid changes to flame length and fire spread. In some areas of scrubland a particular plant species is dominant, for example large areas of gorse or bracken are common, within these more uniform areas of scrubland it is easier to predict fire behaviour.

Characteristics
Moderate to high fuel loading depending on vegetation
Fine and coarse surface fuels
Mixed fuel variation
Moderate wind penetration at ground level
Potential ladder fuels
Short to moderate burning time
Rapid changes to fire behaviour
Limited spotting

NOTES

Coarse and Fine Fuel

Characteristics of Fine fuel
Up to 6mm in diameter
Consists of leaves, grass and small twigs either living on plant or present in surface litter
Dries quickly
Rapid loss of moisture when pre heated
Ignited easily
Burns readily at or near fires edge
Gives momentum to rate of spread
More fine fuels will increase rate of spread
Coarse fuels rely initially on burning fine fuels for ignition
Can cause extreme fire behaviour such as torching, crowning and spotting

NOTES

Characteristics of Coarse fuel
More than 6mm in diameter
Consists of twigs, branches and logs either living or found present in the surface litter
Dries slower than fine fuel depending on diameter
Slower loss of moisture when pre heated
Depends initially on fine fuels as source of ignition
Burns more slowly sometime for a considerable length of time
Active in the fire zone within the fire perimeter
Does not have a significant effect on fire spread

FUELS AIDE MEMOIR	
FINE FUELS	**COARSE FUELS**
CHARACTERISTICS	
< 6mm diameter	> 6mm diameter
Dead leaves, twigs, bark in litter layer. Shrubs, grass	Sticks, branches, logs
Ignites more easily and ignites first	Heated by burning fine fuel until able to burn
Burns readily	Burns slowly
Provides the characteristic flame height of fire front	May burn or smoulder for considerable time behind fire front
Causes spotting as burning embers are carried through the air starting secondary fires ahead of fire front	Burning or smouldering longer may lead to extended mopping up
Drives the forward spread of fire	Consumed in the smouldering zone behind the fire front
The more fine fuels present the greater the rate of spread and intensity of fire	Will not contribute significantly to the behaviour and spread of fire

NOTES

GLOSSARY OF WILDFIRE TERMS

Anchor point	A strong point from which a control line can be constructed
Aspect	Direction a slope faces in relation to the sun
Backburn	An area of vegetation that is burned deliberately to create a black area free of fuel combustibles
Backing	This is when a fire burns against the wind or slope
Backpack	A portable sprayer with hand pump
Black area	An area that has been burnt by fire
Break out	Where a fire escapes from an area of containment
Burning out	Intentional burning of parcels of unburnt fuel inside a fire perimeter
Candling	A single tree or a small clump of trees burning from the bottom up
Control line	A natural or constructed barrier which prevents fire spread
Command	The authority to direct the actions of resources at a wildfire incident
Command Point	The point from which the incident commander operates

Command Support	Command Support is the role undertaken by one or more officers at an incident. The role includes recording, liaison, resource management and information gathering. At a larger incident these roles may be undertaken by a team of officers tasked with managing sectors.
Contained	Where the spread of fire is halted
Controlled	The point at which the fire is contained within its perimeter and no break out is expected
Critical point	An area of topography that will have a critical effect on the development of the fire
Crown	The upper area of foliage at the top of a tree
Crowning	When a fire burns freely in the upper foliage and moves from tree to tree sometimes without the support of a ground fire
Direct attack	An offensive fire suppression tactic which involves an attack being made at or near to the fires edge
Drip torch	Hand held device used to ignite fires by dripping flaming liquid on to vegetation to be burnt
Escape route	A pre-planned route for fire teams to move to a place of safety

NOTES

Extreme fire behaviour	A level of fire activity that prevents the fire from being suppressed using direct methods. Fire behaviour is difficult to predict as in this state the fire can influence its own pattern of development
Fingers of fire	Ignition system used by wildfire specialist creating low intensity offensive and defensive burns
Fire behaviour	The manner in which the fire interacts with fire variables
Fire break	A natural or constructed fire barrier
Fire perimeter	The entire outer edge of the fire
Fire suppression	The activities involved in extinguishing wildfires
Fire suppression plan	Operational plan identifying tactics and resources required to safely manage a wildfire incident
Fire suppression map	A map identifying critical locations on a fire ground which can be used at command and operational levels
Flame angle	The angle between the inclined flames and the ground in front of the fire
Flame height	The vertical distance between the ground and the tip of the flames
Flame length	The total length of the flame produced by the fire

NOTES

Flank attack	A suppression tactic which involves attacking the flanks of the fire sometimes referred to as ‘pinching’
Fogging system	Fire fighting system usually carried on an all terrain vehicle
Fogging unit	Vehicle equipped with a fogging system
Fuel	Any material, normally vegetation that once ignited sustains fire activity
Fuel moisture content	The water content of fuel expressed as a percentage measured against totally dry fuel
Fuel loading	The amount of fuel available to burn
Fire line	The burning perimeter of the fire
Head	The most intense part of a wildfire normally located at the front part of the fire
Incident command system	The system selected by the incident commander to manage organisational, command and risk issues at a wildfire
Incident commander	The officer in charge of the incident having overall responsibility for selecting appropriate management Systems
Incident management Team	The incident commander and appropriate command staff responsible for managing the incident

NOTES

Incident safety officer	Officer appointed by the incident commander to examine the effectiveness of control measures put in place by tactical and sector commanders
Indirect attack	This is a suppression tactic that does not involve attacking the fire with water and hand tools at the fire edge. It usually involves operational activities such as back burning or the construction of control lines some distance from the fire
Junction zone	This term is used to describe the fire behaviour demonstrated when separate flame fronts join This phenomena usually results in increased fire severity, flame length and fire activity
Knockdown	Stopping the spread of flame
LACES	Wildfire safety system to be used at all incidents
Lines of fire	Ignition system used by wildfire specialist creating offensive and defensive burns
Mineral earth break	A term used to describe a control line that has been constructed by removing all vegetation down to earth level
Mopping up	The final phase in the suppression of a wildfire where all hot spots and potential ignition sources are removed and the area is made safe

NOTES

Multi agency cooperation	A term used to describe the functions and activities of agencies involved in working together at a wildfire
Parallel attack	This is a suppression technique where fire fighting operations run parallel with the fire. This tactic is employed to limit the lateral spread of the fire by constructing fire lines near to the fire edge. This method can be used to pinch both flanks and encircle the fire
Patrol	This term is used to describe the use of teams to contain fire within control lines or prevent flare ups during the mop up phase
Pinching	Attacking the fire from both flanks working from the tail towards the head
Pocket fire	This is an area of fire that is burning within the fire perimeter
Points of fire	Ignition system used by wildfire specialist creating low intensity offensive and defensive burns
Prescribed burn	A land management exercise where an area of land is deliberately burned to meet identified objectives
Rate of spread	This normally refers to the speed of the fire as it burns through vegetation
Relative humidity	The amount of water vapour in a given volume of air normally given as a percentage

NOTES

Resources	All personnel and equipment available to meet incident requirements
Resource officer	Officer with the responsibility to instigate effective control over all resources in attendance at an incident
Running fire	A rapidly spreading fire with a developed head
Safe systems of work	Safe working practises that limits exposure to identified hazards to an acceptable level
Safety	A state where the exposure to risk has been controlled to an acceptable level
Safety officer	An officer who is given responsibility to manage areas of risk
Safety zone	An area clear of flammable materials used as a retreat for personnel and equipment
Sector	An area of responsibility delegated to a sector commander, sectors can be involved to be either operational or support activities
Sector commander	An officer tasked with responsibility for tactical and safety management of a clearly identified part of an incident
Specialist wildfire Group	A team of trained wildfire specialist officers WFO
Spotting	Fires started by airborne sparks and embers projected ahead of the main fire

NOTES

Strategy	Plans formulated by the incident commander that will meet the requirements of the incident
Tactics	The manner in which operational resources are deployed to meet the requirements of the strategic plan
Tail	The rear or trailing part of a wildfire which burns against the wind or slope
Test fire	A small fire lit to test fire behaviour before any defensive or offensive operations
Topography	Geographical features of terrain
Topographical wind	The direction of the wind can be changed by topographical features such as valley's, crags and gorges
Welfare and relief officer	Officer with the responsibility to instigate effective arrangements for the control of all matters relating to the welfare of personnel in attendance at an incident
Wildfire	A generic term used to describe an uncontrolled rural fire in various vegetation types
Windows of opportunity	An area which will allow suppression methods to be applied to the fire

NOTES