

Air quality guidance note

Agricultural stubble burning

1 Industry description

Stubble is the base of the plant and the straw residue remaining on the surface of the soil following the harvest of particular crops. This includes material discharged from the harvester. For a range of reasons, this material is often burned so that the land is clear for reuse.

‘Agricultural stubble burning’—or ‘crop stubble burning’—is one of several types of ‘**prescribed biomass burning**’. All involve the deliberate use of fire for management purposes.

In some countries, Malaysia for example, high purity silica is produced from **rice stubble**. The 14% silica content of rice straw and husks is also a factor to be considered in controlling emissions from any attempt to burn this high-energy fuel for heat recovery.

The type of crops subject to biomass burning, and the periods during which this occurs, include:

- **Cotton:** This is practised in the Gunnedah area in late autumn and winter between May and August. The stubble is cut green and burned in piles, creating large amounts of smoke.
- **Rice:** This is practised during the autumn. There is an annual burning of 30,000 ha in the Murrumbidgee Irrigation Area.
- **Sugarcane:** This is practised in northern NSW in winter and spring, between June and December. The industry is currently preparing a burning reduction plan.
- **Wheat:** This is practised in north-western NSW during autumn.

This guideline focuses on the regulation and preferred management of stubble burning and the roles and responsibilities of local government officers, other local authorities and the owners or managers of agricultural land.

2 Potential emissions to air

Agricultural stubble burning produces broad area emissions of **smoke, particulates, breakdown products, dioxins and associated odour**. Each of these can have adverse off-site impacts if not properly managed.

Burning may also involve the **release of pesticides and herbicides** that have been used on the crops to be burnt. Of particular concern is the large quantity of pesticides used on cotton crops.

2.1 Impacts

The impacts of the emissions, and hence the potential for health effects, are heightened if the burning is conducted during periods when the prevailing weather is conducive to very poor dispersion and poor dilution of the smoke.

In the case of broad area stubble burning, poor dispersion occurs when the smoke plume is confined close to the ground and drifts almost intact, rather than dispersing and diluting itself downwind.



Smoke

The composition and intensity of the smoke produced from the combustion of the biomass is influenced by all of the following factors:

- crop area burned
- meteorological conditions
- soil moisture content
- nature of the stubble, its density and its moisture content.

The smoke contains a range of pollutants as a result of both the complete and incomplete combustion of the biomass.

These pollutants include carbon monoxide and fine particulates of varying composition. The fine particles consist of black carbon (that is, soot) and other material formed through the incomplete combustion process of the biomass, such as dioxins and the group of chemical compounds generally referred to as polycyclic aromatic hydrocarbons (PAHs) which may also adhere to the soot particles.

Carbon monoxide

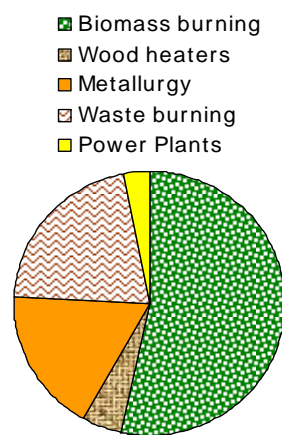
Carbon monoxide is produced from incomplete combustion of organic materials such as stubble.

Particulates

Stubble burning is a transient, high-intensity source of respirable and inhalable particulates in rural areas.

Because of their potential health impacts on sensitive people who may be confined indoors, overseas and local studies are investigating infiltration of fine particles into homes—see for example www.epa.gov/appcdwww/iemb/penetration.htm (US EPA website).

Section 3.6 in Module 1 of this Toolkit describes toxic air pollutants and how they are currently being managed in Australia.



Sources of dioxin emissions in Australia

Other potential rural sources of particles include domestic wood heating, bush fires and wind-blown dust.

Future findings in this area will have implications for understanding the impact on indoor air quality of emissions from biomass burning in general and agricultural stubble burning in particular.

Subregional impacts

The simultaneous burning of stubble on several properties can result in significant cumulative impacts at a subregional level, particularly in conditions where dispersion is low.

3 Regulation and enforcement

Section 7.5 in Module 2 of this Toolkit describes in general terms the regulation of open air burning in NSW. The publication *Regulation of Open Burning in NSW* (DEC, June 2003) gives details of specific regulations for all types of open air burning. It can be found at: www.environment.nsw.gov.au/air/roob/index.htm.



3.1 Councils in Schedule 8

A local council can ask to be listed in Schedule 8 of the Protection of the Environment Operations (Clean Air) Regulation 2002, which prohibits some types of open burning.

However, in these council areas there is a specific exception which allows the burning of vegetation, for agricultural purposes, on the premises on which it grew.

The exception is for agricultural operations that encompass:

- burning for purposes of clearing for agriculture
- burning of stubble, orchard prunings, diseased crops, weeds or pest animal habitats
- burning pasture for regenerative purposes.

3.2 Councils not in Schedule 8

In council areas which are not listed in Schedule 8 of the Clean Air Regulation there is a general requirement that burning must be done in a manner which minimises air pollution.

4 Responsibilities of owners and operators

Responsibility for the environmental management and resolution of any air pollution-based nuisance, or other off-site impacts caused by smoke emitted from properties during periodic burning, rests with the owner and the occupier of the land.

4.1 Responsibilities to control and carry costs

Landowners and operators should consider the following before burning stubble:

- The **significance of the generated smoke** can be viewed in terms of its impact on identified surrounding sensitive land uses. A person who burns anything in the open must take all practicable means to prevent or minimise air pollution.

See the POEO (Clean Air) Regulation 2002, clause 6C.

- The means of preventing or minimising air pollution may include taking reasonable measures to make sure that the **material being burnt is not wet**, and that **only material that is suitable for disposal by burning** is being burnt, having regard to possible effects on human health and the environment.
- The potential for **smoke impacting on any person** should be taken into account, due to wind direction or due to prevailing weather conditions inhibiting adequate dispersion of the generated smoke (e.g. overnight or early morning), and including the potential for **creating a traffic hazard on public roads** through a reduction in adequate visibility.
- The **start time and duration of the burn** is important, with the primary concern being whether the fire can be extinguished by nightfall.

There is no specific requirement to have fires extinguished by nightfall. However, under the *Rural Fires Act 1997*, someone must be in attendance all of the time a fire is alight. **Therefore if a landowner cannot attend the fire overnight, it must be extinguished.**

The nature of the terrain becomes a factor in the potential impacts of pollution at night-time. For example, if burning in a valley, there is potential for accumulation and channelling of smoke along the valley floor, in a manner totally different to what occurs during the daytime. In this case sensitive land uses in these areas could be at risk.

A further important consideration is whether ongoing and effective management can be maintained during the day and, if required, at night. Management may include the need to abruptly extinguish the fire. The required resources (both human and material) are a consideration for a given size of blaze.

4.2 Notification and permits

With these responsibilities in mind, the following questions should be considered by the landowner or operator in consultation with the local council and Rural Fire Service so as to minimise air pollution from stubble burning:

- Has the owner or operator of the property:
 - **identified all sensitive sites in their area** (e.g. schools, day care centres, hospitals, age care facilities etc.) and
 - **checked that wind directions** will not be prevalent in the direction of these sites for the period of the burn.

The **onus is on the owner** to not allow visible smoke to impact sensitive sites. If it is seen or reported to be seen, or justifiable complaints are being received, the operator may be required to extinguish the fire.

- **Have all of the local neighbours been notified?** Neighbours may include public land managers such as the National Parks and Wildlife Service, Forests NSW or the Sydney Catchment Authority, as well as private landowners.
- Are there any **neighbouring areas** that are also about to be burnt?
- Has the **local fire authority** been notified?
- Does the **local council require a permit**, and if so, has this been issued? e.g. if burning during a designated fire danger period, or within the jurisdiction of the NSW Fire Brigade or Rural Fire Service (RFS).
- Is there currently a **no-burn order** in place for this local district? (These are usually only applicable to districts in and around Sydney, the Illawarra, the Central Coast and the Lower Hunter.)

Section 133 of the POEO Act allows DECC to ban burning in the open, conditionally or unconditionally, on days when weather conditions mean that burning is likely to contribute to significant air pollution.

DECC initiates the **no-burn procedure** by notifying the RFS two days before the proposed ban. Following discussions between the RFS and DECC, DECC finalises the no-burn notice on the day before it comes into effect.

- Has a **total fire ban day** been declared for this region?
- The land occupier must demonstrate that all recommended steps have been taken to ensure that **the fire will not go beyond the site boundary**.
- Where a **boundary is adjacent to crown land** (e.g. a forest or national park) then extra supervisory conditions may be required, and the operator has a clear responsibility to ensure their fire does not enter crown land.

Mindful of the potential adverse cumulative impacts of a number of stubble burning operations, local councils or shires may choose, in collaboration with the local RFS, to establish a **coordination roster** to manage the number of individual burns, or the total area of a burn, for the benefit of the local community.

4.3 Good practice

Control technology and methods for managing emissions from stubble burning are not practicable:

- Effective **extinguishment of the burn** is the only way to stop or control impacts due to emissions.
- **Enhancement of combustion efficiency through the use of fuels or accelerants is NOT recommended.**
- **Limiting the area to be lit** and supervised is one way of managing or controlling the potential extent of impacts, by limiting the volumes of smoke produced and the dimensions of the ensuing smoke plume.
- **Consideration of wind direction** could allow burns to occur when the wind is blowing away from town or nearby residents.
- **Burning should not be scheduled after rain.**

Beyond these simple measures, there is little that can be done to control the smoke from stubble burning operations.

5 Alternatives to stubble burning

It was once common to see fields of crop stubble being burned after harvest. This practice is slowly changing to reflect better soil conservation methods. Now, rather than burning the stubble, farmers may work it back into the soil where it can add valuable organic matter. Exceptions to this apply in areas that have excessive weeds or disease, where burning is still perceived to be the best management alternative.

Landowners or operators should seriously consider whether stubble burning is actually necessary.

Council officers can encourage landholders to review the need for stubble burning and examine the feasibility of using alternative stubble management practices.

Some sources of research findings and information sheets for different crops are contained in the following section on educating landowners and operators.

5.1 Advantages of not burning

One advantage of not burning crop residue is the resultant potential reduction in soil and water erosion. Retained stubble can improve or maintain soil quality and moisture by protecting the soil surface from the elements.

- Stubble cover provides a cushion for the soil so that the **impact of rain decreases** and the soil is not as easily dislodged and moved.
- The stubble also provides a **wind barrier** and holds the soil in place so that less nutrient-rich topsoil is lost.
- Crop residue also **slows water run-off**, which increases infiltration of water and increases soil moisture. Ground cover also reduces evaporation, which can help in dry years.

6 Local government management

Agricultural activities in NSW are generally not scheduled under the POEO Act, and owners and managers of farms who burn crop stubble do not require a licence from DECC to undertake this activity.

However, authorised local government officers have an important role to play in managing the compliance process for these non-scheduled premises and enforcing positive environmental outcomes through the use of statutory notices, orders and directions.

6.1 Fostering coordination

Local government can foster a coordinated approach to local stubble burning and thereby achieve significant benefits for local air quality.

Working in collaboration with the Rural Fire Service, local councils can foster communication between local landowners, farmers and government agencies, including agriculture and environment agencies, with a view to:

- **establishing a timetable** for stubble burning in the local area so that air quality impacts can be minimised
- **agreeing on approval and assessment procedures and management practices** that are to be adopted locally
- **developing a communication strategy** for keeping the community informed about local initiatives in regard to agricultural stubble burning.

6.2 Educating landowners and operators

Council officers can encourage landowners to review the need for agricultural stubble burning and examine the feasibility of using alternative stubble management practices.

Research into alternatives to burning

Over the last decade CSIRO Land and Water, the Grains Research and Development Corporation and other organisations have undertaken several research projects in relation to alternatives to stubble burning.

Rice growers initiative

In the case of rice stubble management there is a joint initiative in the Riverina to provide growers with information to help them decide what to do with stubble after harvesting. Information can be obtained from Griffith City Council or Leeton Shire Council.

Cotton stubble management

The Cotton Catchment Communities Cooperative Research Centre (Cotton CRC) has published *NUTRIpak—a practical guide to cotton nutrition* which includes a chapter on cotton stubble management. This can be found at: <http://cotton.pi.csiro.au/Assets/PDFFiles/NUTRIpak/13Stubbl.pdf>

The advantages of retaining cotton stubble are listed in this illustration.

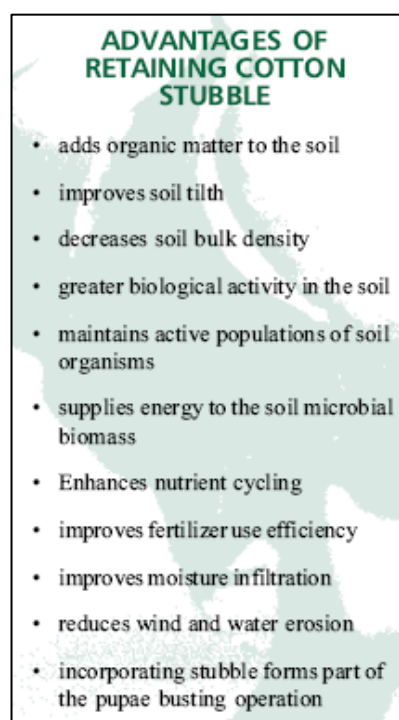
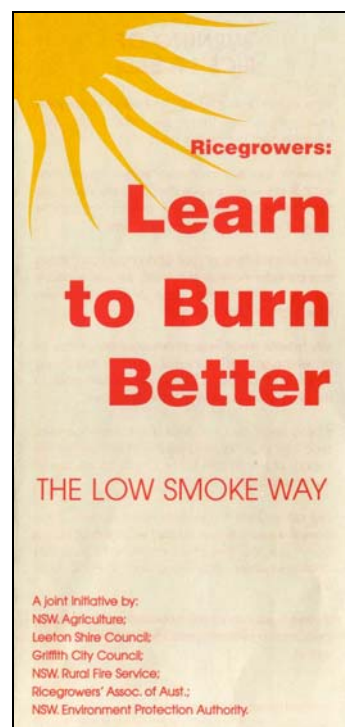
Sugar cane trash management

James Cook University in North Queensland hosted the Cooperative Research Centre for Sustainable Sugar Production (Sugar CRC). Up until the end of its operations in June 2003 the centre produced many publications including several on the management of 'sugar cane trash'. CRC research showed that retaining stubble—'trash blanketing' rather than burning—improves the soil nutrient status.

Technical papers and information sheets can be found at <http://www-sugar.jcu.edu.au/frame-publications.html>.

Wheat stubble management

The Commonwealth Grains Research and Development Corporation sponsors wide-ranging research on all matters relating to the efficient and environmentally responsible management of grain production. Information on publications relating to stubble management, including



From the Cotton CRC publication *NUTRIpak—a practical guide to cotton nutrition*

planting into stubble as an alternative to burning, can be found at <http://www.grdc.com.au/home.cfm>.

7 Considerations for conditions

The following considerations relate to conditions that could be used in notices, permits or orders. These are indicative only, and may not be applicable, depending on the circumstances. Specific conditions will need to be drafted for particular circumstances.

7.1 Conditions on permits to burn

- **If the area is within a district controlled by the NSW Fire Brigade** then a permit is always required to burn stubble. This permit must be obtained from the local Fire Brigade and the operator will be expected to comply with all documented conditions in the permit.
- **If the area is outside the NSW Fire Brigade area of control** then a permit is required if stubble burning is to be conducted within the designated bushfire danger period from 1 October to 31 March. This permit can be obtained from the local Rural Fire Service and the operator will be expected to comply with all documented conditions in the permit.
- **Permits usually are issued for a period of 21 days** and the operator will be expected to check their permit has not expired before undertaking final preparations to burn.

7.2 Designated no-burn and total fire ban periods

- Irrespective of permits, **no burning is allowed during designated no-burn periods** as advertised on the DECC website: www.environment.nsw.gov.au/airqual/aqupd.asp.

No-burn periods are also advertised in the Sydney Morning Herald, via the DECC Environment Line on 131 555, or on the local fire authority telephone advisory service. No-burn periods are usually only applicable to districts in and around Sydney, the Illawarra, the Central Coast and the Lower Hunter.

Operators must check that a no-burn period is not in force in their district before initiating a burn.

- No burning is allowed during designated **total fire ban** periods. These are advertised widely in the media and as for other no-burn periods.

Operators must check that a total fire ban is not in force in their district before initiating a burn.

7.3 Responsibilities of owners and operators

Owners or operators have clear responsibilities in relation to stubble burning on their properties. They must:

- **provide 24-hours notice to the local fire service** before starting any stubble burning, irrespective of any permits obtained
- **provide 24-hours notice of their intention to burn to any neighbouring property owners or managers**; this includes agencies responsible for neighbouring crown land or national parks or catchment areas (if any).

- **demonstrate knowledge of the location of any local sensitive sites** that have the potential to be affected by smoke from their stubble burning operation; these sensitive sites must be identified (e.g. schools, day care centres, hospitals, aged care facilities, sporting grounds, etc.) and the direction from the burn area to these sites must be established
- **not permit smoke from their stubble burning operation to be blown by the wind to an area where it can be injurious to the health of any person**, or cause, or be likely to cause, discomfort or inconvenience to any person; the operator must extinguish the fire if this occurs, or has been reported to occur; smoke from stubble burning should not be the source of a complaint to the DECC Environment Line
- **not burn crop stubble when it is damp** and therefore likely to generate excessive quantities of smoke; this would include the presence of morning dew on the crop, which should be allowed to evaporate before burning is started
- not permit smoke from their stubble burning operation to **obscure public roadways** and cause a traffic hazard
- demonstrate that all recommended steps have been taken to **ensure that the fire will not go beyond their site boundary**; this would include adequate fire breaks around trees; where boundaries are adjacent to crown land (e.g. forest, national park) then extra supervisory conditions may be required
- demonstrate that **adequate resources are available in order to extinguish the fire at any time during the proposed burn period**; in particular, be able to demonstrate that the required resources are available to **extinguish the fire before nightfall**

For locations where sensitive sites are visible from a prospective burn site, and zero impacts at these sites cannot be guaranteed, the operator should not burn crop stubble when the prevailing wind is towards the direction of the identified sensitive land use. The duration of the prevailing wind must also be checked and determined to be within the anticipated timeframe of the burn so as to avoid wind changes or shifts that could give rise to problems.

Although it is not specifically banned, night time burning should always be discouraged.

The overnight meteorological conditions generally cause very poor dispersion of the released smoke which can result in significant impacts much further away and at higher concentrations than during the daytime. These conditions can persist through the early morning, particularly in areas of undulating terrain or near significant bodies of water.

At night, tracking the smoke plume becomes more difficult and therefore the risk of causing discomfort or harm to the community could become unacceptable.

Agricultural stubble burning: air quality management checklist

This checklist has been designed for:

- assessment officers—to help identify potential air pollution issues, so appropriate conditions can be applied to any permit in order to minimise the impacts of air pollution
- owners and operators—to help identify and manage potential impacts on air quality.

Company

Address

Site location

Contact name	Permit assessment
	Complaint response
Phone	Compliance inspection
Fax	Time & date of inspection
Email	Inspector's name

A Site location and context

What are nearby sensitive land uses?

(e.g. schools, hospitals, day care centres, car detailers etc.)

	Land use	Distance	Comments
North			
South			
East			
West			

What are the characteristics of the site that will effect the dispersion of air pollution?

Topography	
Winds	
Other	

B Sketch plan of the site

Draw a sketch plan of the site showing the surrounding land uses, nearby buildings and local topography.



Note particularly:

- nearby sensitive land uses (schools, homes, other affected premises, etc.)
- locations of any complainants
- locations and heights of nearby buildings or trees
- wind directions during times of complaint (night and day)
- any other relevant features.

Comments:

C Results of smoke and odour survey

Date	Time	Location ¹	Wind speed ² (estimate)	Wind direction	Temperature ³	Weather: cloudy sunny	Odour type	Odour strength: weak medium strong	Comments

- 1 Make observations upwind and downwind of source premises.
- 2 Estimate in metres per second, or knots, or by the Beaufort scale, or, failing that, descriptively e.g. still, light breeze, moderate wind, strong wind and so on.
- 3 If the temperature is not known or cannot be measured at the time of the survey, then find and record it later.

D Managing the burn area

Question	✓	Comments
Have local fire authorities been notified? Indicate who and when.		
Have neighbours been notified, including agencies responsible for neighbouring crown land, national parks or catchment areas if any? Indicate who and when.		
Has the area of stubble to be burnt been examined recently? Indicate who and when.		
Is the stubble wet?		
Have measures been taken to stop the spread of fire beyond the property boundary? Indicate what measures.		
Are there any neighbouring areas that are also about to burn off material? Indicate who and when.		
Are there any public roads bordering the burn area that may have visibility significantly reduced? Indicate which.		
Can the fire be extinguished by nightfall? Record the planned start and finish times.		
Has provision been made to extinguish the fire immediately upon request by an authorised officer? Indicate what provisions have been made.		
Are there enough people supervising the fire for the given area? Indicate area and numbers.		

E Permit provisions

Question	✓	Comments
Is the burn period within the statutory bushfire danger period from 1 October to 31 March?		
Is this area within a district controlled by the NSW Fire Brigade? Indicate contact person.		

If yes to either of the two points above then a permit to burn is required. These can be obtained from the local fire service. Any permit will include a list of conditions that must be complied with.

Question	✓	Comments
Is the proposed burn day a declared no-burn day? *		
Is the proposed burn day a total fire ban day?		

If yes to either of the two points above then the permit to burn is suspended.

Question	✓	Comments
Has the permit to burn expired? Permits are for a period of 21 days.		

* No-burn days are usually only applicable to districts in and around Sydney, the Illawarra, the Central Coast and the Lower Hunter.

Check the Sydney Morning Herald, the DECC website: www.environment.nsw.gov.au/airqual/aqupd.asp, the DECC Environment Line on 131 555, or your local fire authority telephone advisory service.

List any attachments here:
