10 AIR

INTRODUCTION

This chapter discusses beneficial management practices for protection of air quality. It contains introductory information on the relationship between agriculture and air quality. It also contains information on concerns, legislation and beneficial management practices related to:

- air emissions
- dust and particulate
- odours
- open burning

AIR CONTAMINANTS

Common Air Contaminants

The key air contaminants that define air quality are gaseous emissions, dust and particulates. These contaminants can have an impact on human health and the environment as well as contribute to climate change.

📖 **The Health of Our Air**

The following air contaminants are listed in alphabetical order. While air quality can be influenced by agricultural production, it also may be influenced by many other human activities and natural phenomena.

Ammonia (NH_3). Ammonia easily volatilizes from urine, manure, fertilizer, compost and crop residues. Agriculture is the largest emitter of ammonia to the air both in BC and globally. Ammonia contributes to reduced visibility by reacting with other chemicals in the air to form secondary particulate matter, (i.e. ammonium sulphate and ammonium nitrate). These compounds are a major component of fine particulate matter in the air of the Fraser Valley. Elevated levels of fine particulate can reduce visibility and are a concern to human health.

Carbon Monoxide (CO). Carbon monoxide originates mainly from the combustion of fuels used to heat buildings and greenhouses, and from farm equipment (both biomass and fossil fuels). The effects of carbon monoxide tend to be localized; at high concentrations the gas can cause asphyxiation, and at lower levels it produces symptoms of impaired perception and reflexes. Carbon monoxide also contributes to smog formation, but to a much lesser degree than nitrogen oxides or volatile organic compounds.

Nitrogen Oxides (NO_x). Nitrogen oxides aid in the production of ground level ozone, a known respiratory irritant and crop growth retardant. Nitrogen oxides also contribute to acid rain production. Nitrogen oxides like carbon monoxide and sulphur oxides originate mainly from the combustion of fuels used to heat buildings and greenhouses, and from farm equipment (both biomass and fossil fuels).

Ozone (O_3). Ozone is unique among the atmospheric gases in that in the upper layers it is highly beneficial whereas near ground level it is a serious pollutant. Ground-level ozone is primarily formed by the reactions of other pollutants such as nitrogen oxides and volatile organic compounds. Both ground-level ozone and particulates contribute to smog formation which has detrimental effects on the human cardio-respiratory system and on crop productivity. Human caused emissions have tended to deplete ozone in the upper atmosphere while increasing its concentration at ground level.

Sulphur Oxides (SO_x). Sulphur oxides originate mainly from the combustion of fuels (both biomass and fossil fuels) used to heat buildings and greenhouses, and from farm equipment. Sulphur dioxide (SO_2) can damage vegetation and can have negative effects on the human cardio-respiratory system. Sulphate (SO_4^{2-}) reacts with other chemicals in the air to form, among other things, ammonium sulphate which contributes to acid rain and is also a major component in the formation of fine particles within the atmosphere.

Volatile Organic Compounds (VOC). Volatile organic compounds are released from various types of manure, petroleum products, and some types of pesticides. Many volatile organic compounds and nitrous oxides aid in the production of ground level ozone, a known respiratory irritant and crop growth retardant. Volatile organic compounds can be a source of odours and also contribute to the formation of fine particulate matter, causing health and visibility concerns.

Dust and Particulate

Particulates are very small particles in the air. Coarse particles are defined as being greater than 2.5 µm in diameter, and are created primarily from natural or mechanical processes. Fine particles are 2.5 µm or less in diameter and are typically produced in chemical reactions.

Examples of coarse particulates include dust from livestock operations, cultivation, crop operations, crop harvest, and road dust. Examples of fine particulates include ammonium nitrate and ammonium sulphate, formed in reaction with other air pollutants, typically seen as the white haze common to the Fraser Valley under specific weather conditions. Once air borne, particulates may drift for very long distances and can stay in the atmosphere for days.

Specific health problems associated with exposure to fine particulates include aggravation of respiratory and cardiovascular disease, reduced lung function, increased respiratory symptoms and premature death.

Greenhouse Gases

When the sun's rays strike the earth, light energy is converted into heat energy which in turn is radiated back into the atmosphere. Certain gases called 'Greenhouse Gases'(also known as Global Warming Gases)[absorb some of this heat energy, resulting in a warming of the earth's atmosphere. This is known as the greenhouse effect. Greenhouse gases such as carbon dioxide,

methane, nitrous oxides and other gases are discharged by many human activities, including agriculture.

Carbon Dioxide (CO_2). Carbon dioxide is a greenhouse gas produced by the combustion of fossil fuels and biomass. Carbon dioxide is a major contributor to the greenhouse effect and is therefore associated with climate change. Trees, vegetation and soil organic matter can remove carbon dioxide from the atmosphere and store as carbon.

Methane (CH_4). Methane is a greenhouse gas produced during anaerobic decomposition (decomposition in the absence of oxygen) of organic wastes such as manures. Animals, particularly ruminants, emit methane gas that contributes to the greenhouse effect.

Nitrous Oxides (N_2O). Nitrous oxide is a greenhouse gas produced in the soil from the biochemical reduction of nitrate to gaseous nitrogen compounds, a process known as denitrification.

IMPACTS ON AIR QUALITY

Heat Production and Agricultural Boilers

Heat is used in greenhouse production, animal housing and for general space heating. Traditional fuel sources for boilers include natural gas and in some cases, coal. These fuel sources are being replaced by biomass and subsequently new regulations that set standards for air quality have been implemented. Burning biomass in boilers produces particulate matter (PM), CO_2 and other air contaminants. There are several ways to reduce the impact of biomass boilers with emission control technology and beneficial management practices.

➔see Heat Production and Agricultural Boilers, page 2-39

Indoor Poultry and Livestock Housing

Indoor poultry and livestock housing can have either natural or forced ventilation systems that help circulate air within the animal housing area. Both ventilation systems contribute to PM and NH_3 emissions, as well as odour that occurs outside of the animal housing area. In animal facilities, ammonia results primarily from the breakdown of manure. Undigested feed protein and wasted feed are additional sources of ammonia in animal production systems. Strategies to reduce ammonia from animal housing focus primarily on preventing ammonia formation and volatilization, or downwind transmission of ammonia after it is volatilized.

➔see Indoor Poultry and Livestock Housing, page 3-2

Manure Handling and Storage

The main pollutants associated with the production and handling of manure are methane (CH_4), ammonia (NH_3) and nitrous oxide (N_2O). Methane is produced under anaerobic conditions during the microbial breakdown of organic compounds in manure. Manure handled as liquid or slurry will emit methane. Manures handled as a solid will have a lesser moisture content and will emit less methane if kept dry. Ammonia is produced in the decomposition of the organic nitrogen compounds in manure. Methane and ammonia are present during both storage and handling of manure. N_2O emissions occur mainly from manure application to soils. N_2O emissions will be significant if the manure is first handled dry and then handled wet. VOCs are also formed from the breakdown of manure both anaerobically and aerobically.

Noise

For the purposes of this publication, noise is considered a nuisance, not an environmental concern. Noise generated by farm activities has the greatest potential for creating nuisance in densely populated areas where farm sites are developed near property boundaries.

Nutrient and Chemical Applications

Pathogens. Many organic wastes, including manures, contain micro-organisms such as bacteria, viruses and parasites. Some of these micro-organisms may be pathogenic (disease causing) to animals of the same or of a different species. Many diseases are transmissible between animals and human beings. Most pathogens die off rapidly when dried or exposed to sunlight. However, there are some that can remain infectious in the air over extended distances and periods of time.

Pesticides. Pesticides include insecticides, herbicides, fungicides and rodenticides. The application of pesticides can result in the formation of spray droplets, mists, or dusts. These airborne particles are prone to drift and can be transported over many kilometres to contaminate other properties. In addition, these pesticide particles may be hazardous to non-target organisms. Applicators and workers may be affected if restricted entry intervals as specified on labels are disregarded.

Active ingredients within some pesticides are volatile and can evaporate from target areas and move with air currents to unwanted locations.

Odours

The handling, storing and composting of wastes; the application of manure and pesticides; and the decomposition of crop wastes can create odours that are offensive to neighbours. Odours, which are generated by farming activities in compliance with the *Code* under the *Agricultural Waste Control Regulation* and with the practices outlined in this publication, should be considered nuisances rather than health hazards.

Open Burning

Open burning produces many harmful air emissions. Smoke from the open burning of vegetation and wood introduces a range of contaminants into the air, including particulate matter, carbon dioxide, carbon monoxide, nitrogen oxides, and hydrocarbon compounds.

Ash and dust particulates are introduced into the air mainly by open burning of plant prunings and other similar materials. Fly ash, a term for the larger particulates in burning emissions, can create aesthetic concerns and nuisance complaints. Open burning of plastics and other specific wastes as defined by the *Open Burning Smoke Control Regulation* is prohibited and produces many harmful air emissions that can cause localized environmental problems and health impacts.

AIR EMISSIONS

AIR EMISSION ENVIRONMENTAL CONCERNS

Primary environmental concerns related to air emissions from agriculture are:

- pollution caused by fossil fuel combustion, wood burning, livestock emissions, waste disposal, soil emissions, and manure handling which results in the following:
  - release of ammonia (NH_3), sulphur oxides (SO_x), volatile organic compounds and nitrogen oxides (NO_x) which can chemically produce secondary particulate which poses a risk to human health and reduces visibility
  - release of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) (i.e. manure, petroleum) that create ground level ozone and lead to the formation of smog which is a concern to human and vegetative health.
  - release of greenhouse gases, mainly carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), which are linked to global climate change

This chapter addresses environmental concerns related to poor air quality, whereas Chapter 12 addresses environmental concerns related to climate change. Poor air quality and climate change are different phenomena, but the emission sources for both of these environmental issues are similar. Taking actions to reduce the pollution from agricultural sources will help improve air quality and address climate change.

For information on these concerns:

➔ see Air Quality Factors, page 10-1, and refer to Contaminants, and Greenhouse Gases

➔see Impacts of Agricultural Activities on Greenhouse Gas Emissions, page 12-6

AIR EMISSION LEGISLATION

The following is a brief outline of the main legislation that applies to air emissions.

➔ see page A-1 for a summary of these and other Acts and Regulations

Local Bylaws

Regional and municipal governments can pass bylaws to control emissions such as backyard and open burning, wood stoves and vehicle idling. These governments can also address air pollution through land-use and transportation planning, regional growth strategies and sustainability plans. Local Governments can put in place bylaws that restrict air emissions from industrial and business operations.

Environmental Management Act

This Act provides the Ministry of Environment with the authority to manage, protect and enhance the environment.

The *Code* under the *Agricultural Waste Control Regulation* has two references to air emissions:

- Section 17: states that emissions from forced air ventilation systems must not cause pollution
- Section 18: regulates type of fuel and emissions from wood fired boilers used in agricultural production
- Sections 18.1 – 18.6 set emission standards, testing and reporting requirements for boilers and heaters fuelled by biomass

Under the Environmental Management Act, local governments may be delegated authority to manage air quality within their boundaries. For example, Metro Vancouver has been delegated authority to manage air quality within its boundaries. It administers laws that regulate emissions from industrial, commercial and industrial sources, through permits, compliance promotion and enforcement.

The Act also enables the Province to regulate the emissions from industrial and business operations through the issuance and enforcement of air emission permits.

The *Open Burning Smoke Control Regulation* governs smoke from open burning of vegetative debris from the forestry industry, agriculture sector, land developers and individual property owners. It sets conditions such as setbacks, smoke release periods and venting conditions that must be met.

Motor Vehicle Act

The *Motor Vehicle Act* is administered by the Ministry of Transportation and Infrastructure and requires emission control devices on certain heavy diesel vehicles in the province.

As of October 1, 2010, in accordance with the *Motor Vehicle Act*, heavy diesel vehicle emission control devices must be installed on all BC registered commercial diesel vehicles of model years 1989-1993 with a Licensed Gross Vehicle Weight (LGVW) of more than 8,200 kg. Farm vehicles with a LGVW under 17,300 kg are exempt from these retrofit requirements.

Canadian Environmental Protection Act

The federal government's role in addressing air quality issues is defined through the *Canadian Environmental Protection Act*. Many emission sources that lie beyond provincial authority are subject to federal regulation, standards and guidelines. These include motor vehicles and fuels, marine vessels, railways and off-road engines applicable to agricultural vehicles.

The *Off-Road Compression-Ignition Engine Emission Regulation* introduces emission standards for diesel engines used in off-road applications such as those typically found in construction, mining, farming and forestry. Emissions from engines used in agriculture that are newer than 2006 are subject to the *Regulation.*

➔ see Climate Change Legislation, page 12-8
➔ see page A-1 for a summary of these and other Acts and Regulations

AIR EMISSION REDUCTION BENEFICIAL MANAGEMENT PRACTICES

Proper management of manure, crops, nutrients and machinery will greatly assist in reducing pollution causing air emissions from farm operations. Poor air quality and climate change are different phenomena, but their causes are similar. Taking actions to reduce the pollution from agricultural sources will help improve air quality and address climate change.

Comply with applicable air emission related legislation, including the above, and where appropriate, implement the following beneficial management practices to reduce air emissions from agriculture.

Table 10.1 outlines some common farm practices and the resulting air emission(s). The table will help to determine the positive impact that the following beneficial management practices will have on reducing air emissions from agriculture.

Air Emissions Reduction

Implement the following practices to reduce air emissions:

- maximize the use of renewable energy, such as electricity, wind or solar
  ➔ see Climate Change Mitigation Beneficial Management Practices, page 12-10, and refer to On-Farm Energy Production
- use energy-efficient equipment and operating practices
- use high efficiency motors and pumps
- use efficient irrigation equipment to reduce pumping energy requirements
- maintain engines in efficient running order
- use energy saving practices to reduce fuel usage by farm machinery
  - avoid unnecessary idling
  - keep tires inflated at optimum tire pressure
  - graze livestock rather than growing forages that require transport to separate feeding areas or feedlots
  - reduce tillage and therefore reduce the use of machinery and the fossil fuel used for equipment
- keep internal combustion engines well maintained and include emission control devices if necessary (such as air filters, diesel injectors or catalytic converters)

- for compliance with the *Motor Vehicle Act* diesel retrofit requirements, emission reduction devices are verified by the following agencies
  ➔ see Air Emission Legislation, page 10-6
  - US Environmental Protection Agency
    http://www.epa.gov/otaq/retrofit/verif-list.htm
  - California Air Resource Board
    http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

♦ use appropriately sized and efficiently operated heating plants for greenhouse and other production facilities
  - use energy management systems that ensure optimization of temperature and humidity
  - if used, ensure solid fuels have optimum moisture content (less than 20% moisture, suggested)
  - implement rigorous maintenance programs for all heating system components, particularly for solid fuel boilers
  - ensure that biomass fuelled boilers meet emission testing requirements
    ➔ see Climate Change Mitigation Beneficial Management Practices, page 12-10, and refer to Energy Conservation and Fuel Switching

♦ change livestock feed rations to
  - reduce nitrogen content of excretions thus reducing ammonia emissions
  - reduce methane emissions

♦ use manure handling practices that minimize emissions
  - make more frequent manure applications at lower application rates using sleighfoot or shallow injection equipment for more efficient use of nitrogen
  - use covered manure storages to reduce methane and ammonia emissions
  - use solid rather than liquid manure handling systems
    ➔ see Manure Gas Emissions Reduction, page 3-33

♦ use drainage or irrigation systems to optimize soil water content
  Drainage Management Guide
  B.C. Irrigation Management Guide

♦ apply nutrients and manure efficiently to match crop needs
  Nutrient Management Reference Guide

♦ establish and maintain adequate windbreak or shelterbelt buffers around farm buildings and livestock facilities to improve energy efficiency
  ➔ see Buffers, page 11-4

♦ increase carbon within the soil to reduce carbon entering the atmosphere
  - increase soil organic matter
  - minimize cultivation
  - grow perennial crops
  - avoid the burning of crop residue, and incorporate residues into soils

♦ follow beneficial management practices for open burning
  ➔ see Open Burning Beneficial Management Practices, page 10-19

Ozone Production Reduction

Ozone is a secondary pollutant formed mainly from VOCs reacting with other contaminants in the atmosphere. Ground level ozone can have a negative impact on crop production. To reduce ozone production, reduce VOC production.

Ammonia Emissions Reduction

Agriculture is the largest emitter of ammonia to the air both in BC and globally. Ammonia easily volatilizes from urine, manure, fertilizer, compost and crop residues. It contributes to reduced visibility and reacts with other chemicals in the air to form secondary particulate matter, (i.e. ammonium sulphate and ammonium nitrate). These compounds are a major component of fine particulate matter in the air of the Fraser Valley. Elevated levels of fine particulate can reduce visibility and are a concern to human health.

➔ see Manure, page 3-33, and refer to Manure Gas Emission Reduction
➔ see Nutrient Application, page 6-28, and refer to Field Spreading Emission Reduction

VOC Emission Reduction from Fuel Evaporation

Fuel evaporation during storage results in VOC emissions and is an environmental concern. Evaporation from aboveground tanks is due to heating of the tank by the sun which causes the fuel to volatilize and vent to the atmosphere. Underground tanks have lower evaporation losses.

➔ see Petroleum Beneficial Management Practices, page 2-22 and refer to Petroleum Storage
📖 **Farm Storage and Handling of Petroleum Products**

Table 10.1 Agricultural Air Emission Sources

Practice	Air Emission
Livestock and poultry housing (exhaust fans)	Ammonia, Dust and Particulates, GHG [CH_4], Odour
Poultry barn clean out	Dust, Particulates and Odour
Manure storage	Ammonia, Odour, GHG [CH_4],
Manure spreading	Ammonia, Dust and Particulates, Odour
Manure injection	GHG [N_2O] (in saturated conditions)
Open burning	Dust and Particulates, GHG [CO_2], Other Criteria Air Contaminants
Dry field tillage	Dust and Particulates
Diesel use	GHG [CO_2], Dust and Particulates, Other Criteria Air Contaminants
Fuel use	GHG [CO_2], NO_x, SO_x, VOCs, Particulates
Using boilers for heat production	GHG [CO_2], Dust and Particulates, Other Criteria Air Contaminants
Incinerators	GHG [CO_2], Dust and Particulates, Other Criteria Air Contaminants
Turning of compost windrows	Dust and Particulates
Grazing ruminants	GHG [CH_4]
GHG [specific gas] refers to Greenhouse Gas or Global Warming Gas	

DUST AND PARTICULATE

DUST & PARTICULATE ENVIRONMENTAL CONCERNS

Primary environmental concerns related to dust and particulate are:

- release of mineral or organic compounds that contribute to particulate or secondary particulate formation that results in:
  - health risks when inhaling the particulate
  - visual impairment such as smog from the particulate in the outdoor (ambient) air

For information on these concerns:

➔ see Air Quality Factors, page 10-1, and refer to Dust and Particulate

DUST & PARTICULATE LEGISLATION

The following is a brief outline of the main legislation that applies to dust and particulate.

➔ see page A-1 for a summary of these and other Acts and Regulations

Local Bylaws

Regional and municipal governments can pass bylaws to control emissions such as backyard and open burning, wood stoves and vehicle idling. These governments can also address air pollution through land-use and transportation planning, regional growth strategies and sustainability plans. Permits may be given by local governments that restrict emissions from industry and business operations.

Environmental Management Act

This Act has a clause in section 3(5)(j) that gives an exemption for requiring a permit to introduce dust into the environment:

- "nothing in this section or regulation prohibits emission into the air of soil particles or grit in the course of agriculture or horticulture"

The Act is unclear on whether the release of "organic dust" from livestock barns through ventilation systems or from activities associated with grain cleaning and handling requires a discharge permit. However, regardless of permit requirements, pollution must not occur from any emission into the air.

The *Code* under the *Agricultural Waste Control Regulation* has two references to air emissions:

- Section 17: states that emissions from forced air ventilation systems must not cause pollution
- Section 18: regulates emissions from biomass fired boilers including particulate limits

Farm Practices Protection (Right to Farm) Act

This Act protects farmers from liability in lawsuits alleging nuisance associated with dust resulting from the farm operation when they meet certain regulatory conditions.

DUST & PARTICULATE BENEFICIAL MANAGEMENT PRACTICES

Suppression measures to prevent the release of dust from livestock barns and fields will contribute significantly towards reducing the potential for pollution and complaints. Comply with applicable dust related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment.

Dust Suppression

Dust can result from a variety of farm practices and can be a nuisance to neighbours. Several measures can be taken to reduce the amount of dust generated from farm activities. Implement the following practices for dust suppression:

- avoid cultivation in situations where the soil will become or is excessively dry
- minimize the amount of time soil is left bare in fields
- evaluate and modify activities that may create dust such as tillage, harvesting, grain handling, livestock handling, feed processing
  - work soils when moisture conditions are least likely to generate dust
  - practice minimum tillage
  - bale straw instead of chopping
- choose manure application methods that apply manure directly to the soil rather than into the air
- choose cropping, crop residue and cover crop management practices that minimize soil loss by wind erosion
  ➔ see Soil Erosion Risk, page 8-10
- design ventilation structures to deliver emissions either to the ground or to the air in a manner that reduces dust drift
- chose spray equipment which places spray on the target rather than into the air when there is a risk of drift
  ➔ see Pesticide Use, page 5-17
  📖 **Farm Nuisance-Dust**

Particulate Suppression

Particulate matter 2.5 μm or smaller can remain suspended in the air. Implement the following practices for particulate suppression:

- avoid burning crop residue or land clearing
  ➔ see Open Burning, page 10-11
- maintain general sanitation and housekeeping in livestock housing
  ➔ see Indoor Poultry and Livestock Housing, page 3-
- reduce ammonia production that leads to secondary particulate formation
  ➔ see Manure Handling and Storage Beneficial Management Practices, page 3-35 and refer to Nutrition and Ration Management
  📖 **Management of Dust in Broiler Operations**
  📖 **Siting and Management of Poultry Operations**
  📖 **Fine Particulates – What They are and How They Affect Us**

Dust and Particulate Capture

Some sources of particulates can be controlled using emission control devices to catch dust and particulates. This can be used for ventilated animal housing, boilers and internal combustion engines.

- keep internal combustion engines well maintained and include emission control devices if necessary (e.g. air filters, diesel injectors or catalytic converters)
- install a dust-removal system on building ventilation fans including chemical or wet scrubbers or cartridge filters
- install dust suppression system, such as an electrostatic precipitators, that will reduce airborne particulates and exhausted particles
- install bio-filters on animal housing to reduce dust and odours
- install vegetative filters to provide capture of dust at exhaust fan outlets
  ➔ see Indoor Poultry and Livestock Housing, page 3-3, and refer to Protection of Air Quality
- implement emission control devices on biomass burners
- use greenhouse boilers with low particulate generation
  - ensure solid fuels have optimum moisture content (< 20% moisture content, suggested)
  - implement a rigorous maintenance program for all heating system components, particularly for solid fuel boilers
    ➔ see Heat Production and Biomass Boilers, page 2-39
- develop wind screens, breaks or strategies to reduce dust movement off the property

ODOURS

ODOUR ENVIRONMENTAL CONCERNS

Primary environmental concerns related to farm odours are:

- direct odours and particulate carrying odorous compounds that come from animal housing areas, manure handling and storage areas and land where manure is applied, resulting in:
  - high levels of odours that result in air pollution and health impacts to humans
  - the nuisance they pose to neighbours

For information on these concerns:

➔ see Air Quality Factors, page 10-13, and refer to Odours

ODOUR LEGISLATION

The following is a brief outline of the main legislation that applies to odours.

➔ see page A-1 for a summary of these and other Acts and Regulations

Farm Practices Protection (Right to Farm) Act

This Act protects farmers from liability in lawsuits alleging nuisance associated with odour resulting from the farm operation when they meet certain regulatory conditions.

Environmental Management Act

This Act has requirements under the *Code* under the *Agricultural Waste Control Regulation* regarding odour:

- Sections 3 and 30: state agricultural wastes and products must be managed in a manner that prevents pollution
- Section 19: states "nothing in this Code is intended to prohibit various odours from agricultural operations or activities on a farm, providing such operations or activities are carried out in accordance with this Code"

A 1997 Provincial Court of BC judgement determined that odours that cause or are capable of causing material physical discomfort to a person are classified as an emission that causes pollution. Odours not causing pollution by this definition may still, however, be a nuisance.

ODOUR BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable odour related legislation, including the above, and where appropriate, implement the following beneficial management practices to protect the environment and minimize nuisance to neighbours.

Odours from Livestock. Odours in livestock production typically originate from indoor livestock housing; from manure handling, storage and composting areas; and from fields during the course of manure spreading. Odours come from many sources, the most common are:

- ammonia from manure in indoor livestock housing
- odorous compounds carried on dust from indoor livestock housing, and from manure spreading
- odorous gases from manure storage, either wet or dry
- harmful odorous compounds from manure breakdown in the lack of oxygen (anaerobic conditions)

Odours associated with livestock operations are largely the result of gases produced from manure and other decomposing organic matter. Livestock housing can also produce odourous ammonia emissions from dry manure as well as dust that carries odour.

When manure decomposes in the presence of sufficient oxygen, a process known as aerobic decomposition, few malodorous gases are produced. On the other hand, the decomposition of manure in the absence of oxygen, known as anaerobic decomposition, results in the release of many odorous and often dangerous gases, including ammonia, hydrogen sulphide, methane, and other toxic organic chemical substances. Manure odours from solid manure can be minimized by keeping the manure sufficiently dry to allow air movement and aerobic conditions through the pile to occur.

➔ see Manure, page 3-33, and refer to Manure Gas Emission Reduction

Odours from Crop Residues. Decomposition of post-harvest crop residues or vegetative processing waste can result in significant odour generation if not managed properly. Specifically, residues from cole crops pose a high risk of odour generation that can be a nuisance to neighbours. In order to minimize odours from crop residues, incorporate residues into the soil immediately post-harvest. Dispose of waste from crop processing in a manner that minimizes odour generation.

➔ see On-farm Processing and Sales Beneficial Management Practices, page 2-42

Strategies to reduce odours can either be to prevent the gaseous emissions, cover gaseous emissions, or reduce particles carrying odour or prevent drift of particles carrying odour.

📖 **Farm Nuisance - Odour**

Vegetative Buffers. Through the establishment of adequate buffers, odours can usually be managed to reduce nuisance or pollution. The use of vegetative buffers surrounding exhaust fansand farm boundaries, Figure 10.1, can effectively reduce the impact of odours.

- install vegetative buffers around exhaust fans or farm borders
- seek expert guidance when attempting to construct vegetative filters for odour or dust reduction purposes

➔ see Buffers, page 11-4

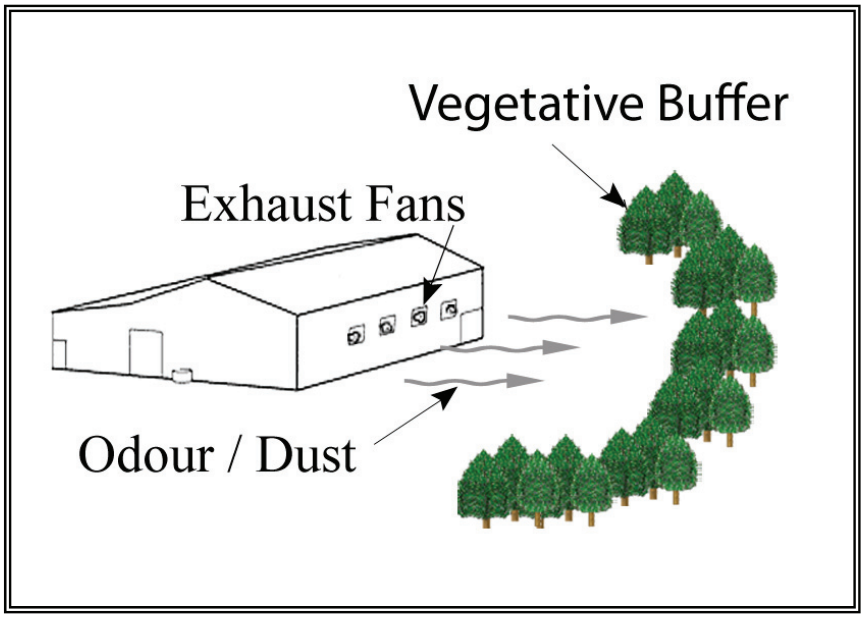

Figure 10.1 Vegetative Buffer around Ventilation Exhaust

Outdoor Livestock Odour Reduction

Implement the following practices to reduce odours from outdoor livestock areas:

- handle the manure as a solid and keep it as dry as possible
- minimize the area covered by manure in confined livestock areas
- clean pens often and move manure to storage facilities
- remove livestock mortalities promptly and dispose in an approved manner

Indoor Barn Odour Reduction

Implement the following practices to reduce odours from barns:

- handle solid manure in as dry a state as possible
- remove wet manure from buildings frequently
- remove dead animals promptly and dispose in an approved manner
- install vegetative buffers surrounding barn exhaust fans
- use mechanical filters on barn exhaust to trap odorous dust particles
  ➔ see Indoor Poultry and Livestock Housing, page 3-4, and refer to Protection of Air Quality
- use chemical or biological odour control agents when other management methods are unsuccessful
  - several such agents are available commercially, but they have been used in the past with varying degrees of success
  - evaluate odour control products on-farm before buying large quantities

Biofilters. Biofilters are used in farm operations to trap and degrade odours within the air before they leave an indoor facility. Biofilters trap particulates that can carry odorous compounds and also reduce ammonia and hydrogen sulphide emissions by providing an environment for biological degradation of the trapped compounds.

- use biofilters or filters on barn exhaust systems
  ➔ see Indoor Poultry and Livestock Housing, page 3-4, and refer to Protection of Air Quality

Manure Storage and Handling

Long-term storage of manure is a necessity on many farms. Livestock and poultry producers farming on minimal land areas require storage to facilitate the timely sale or delivery of manure to crop producers. Carefully plan and manage the handling, composting, spreading or storage of all wastes to avoid the creation of odorous conditions. Comply with all manure storage regulations and implement the following beneficial management practices to avoid generation of odours:

- minimize disturbance of stored manure when putting fresh manure into storage tanks
- use covers on manure storage areas
- minimize surface area of manure to reduce emissions

➔ see Manure, page 3-33, and refer to Manure Gas Emissions Reduction

Manure Treatment for Odours

In situations where well-managed manure storages or field spreading practices are not enough to control odours, manure treatment options can be considered. These could include aerobic treatment and carbon reduction for liquid manure systems and composting for solid manure. Where appropriate, implement the following manure treatment options:

- apply regular frequent aerobic treatments by mixing or turning manure to prevent anaerobic conditions
- apply additives to manure piles to reduce the impact of odours when land applying
- compost manure following the guidelines outlined in Chapter 2

➔ see Compost, page 2-24, and refer to Compost Beneficial Management Practices

➔ see Manure, page 3-33, and refer to Manure Gas Emissions Reduction

OPEN BURNING

The term "open burning" is defined in the *Open Burning Smoke Control Regulation* as "the combustion of material with or without control of the combustion air and without a stack or chimney to vent the emitted products of combustion to the atmosphere."

OPEN BURNING ENVIRONMENTAL CONCERNS

Primary environmental concerns related to open burning are:

- release of fine particles into the air that
  - results in a health risk from inhaling the particulate
  - results in visual impairment from the particulate
- escape of the open fire that results in a fire safety risk to the environment
- release of greenhouse gases, mainly carbon dioxide (CO_2) and release of other air contaminants that effect local air pollution
- release of other contaminants as a result of illegal burning of waste other then agricultural debris (e.g. plastics, coated woods and waste, solvents, wire, etc.)
  - results in health risks from inhaling the particulate and
  - results in health risks and environmental risks from deposition of contaminants in the localized environment

For information on these concerns:

➔ see Air Quality Factors, page 10-1

OPEN BURNING LEGISLATION

The following is a brief outline of the main legislation that applies to open burning.

➔ see page A-1 for a summary of these and other Acts and Regulations

Because burning is practiced in a wide range of farm activities, agriculture is given special consideration in legislation. Both municipal and provincial governments regulate open burning. Before carrying out any burning operation, check for:

- restrictions imposed by local government bylaws
- pollution concerns regulated by MOE under the *Environmental Management Act*
- fire safety concerns regulated by the Ministry of Forests, Mines and Lands under the *Forests and Range Practices Act*

Note: the following is only a summary of burning requirements, contact all relative agencies regarding necessary details before igniting any fire.

Local Bylaws

Local fire departments, municipalities, improvement districts or regional districts may have smoke management plans (guidelines), specific bylaws or restrictions on open burning. **Where local regulatory requirements are more stringent, they apply over provincial legislation**

Farm Practices Protection (Right to Farm) Act

This Act protects farmers from liability in lawsuits alleging nuisance associated with odour, noise, dust or other disturbance resulting from the farm operation when they meet certain regulatory conditions.

Environmental Management Act

This Act provides the Ministry of Environment with the authority to manage, protect and enhance the environment.

There are specific standards and exemptions under the *Open Burning Smoke Control Regulation* and *Code of Practice* for various materials burned on the farm. A waste discharge approval or permit for burns is **not** required under this Act for:

- agricultural burning of leaves, crops, weeds, foliage or stubble
- residential (i.e., backyard) burning of leaves, foliage, weeds, crops or stubble
- burns that satisfy all the terms and conditions set out in the *Open Burning Smoke Control Regulation* and the *Open Burning Smoke Control Code of Practice*
- burns conducted to comply with the *Weed Control Act*

All other burns (e.g. household, industrial) require a waste discharge approval or permit from MOE. **Note: Metro Vancouver is the agency that gives approvals within its boundaries.** Even though permitted, open burning must not pollute the air. Schedule A provides a list of materials that are prohibited from being open burned.

The *Open Burning Smoke Control Regulation* requires a burn operator to:

- explore all possible options to reduce, reuse or recycle as much of the material as possible
- burn only vegetative matter such as tree branches, limbs, roots, shrubs, etc.
- burn only on the same site from which the material was gathered and not include material from offsite
- do not burn prohibited materials, or substances that normally emit dense smoke or noxious odours
- burn the material more than 100 m from a neighbouring residence or business and more than 500 m from a hospital, continuing care facility, or school that is in session
- ensure that smoke from open burning does not pose a hazard at airports or highways by significantly reducing visibility
- ensure that the ventilation index is "good" on the day the burn is started and forecast to be "good" or "fair" on the following day (see the regulation for further information and requirements)

http://www.weatheroffice.gc.ca/forecast/textforecast_e.html?Bulletin=flcn39.cwvr

- ensure satisfactory control and feeding of the fire, and make sure adequate equipment and staff are available to ensure the regulatory limits are met
- follow all of the burning restrictions that are relevant to the sensitivity zone
  - these restrictions include a smoke release period of either 72 or 96 hours, and restrictions on the number and frequency of burns per year
    http://www.env.gov.bc.ca/epd/codes/open_burning/pdf/OBSCR_map.pdf

Wildfire Act This Act regulates open fires within 1 km of forest land or grass land. It is administered by the Ministry of Forests, Mines and Lands.

- Section 2: requires reporting a forest land or grass land fire
- Section 3: prohibits dropping, releasing or mishandling a burning substance, or any other thing that the person reasonably ought to know is likely to cause a fire
- Section 4: states Section 5 & 6 do not apply to the City of Vancouver or a municipality or a local government having an open fire bylaw
- Section 5 & 6: regulates non-industrial and industrial open fires

Wildfire Regulation. This Regulation applies to all open fires within 1 km of forest land or grass land.

- Sections 4 – 12: outline fire prevention requirements
- Sections 13 – 17: outline fire control requirements
- Sections 18 – 24: outline permissible open fires (category 1, 2, 3 and resource management fires) - a burn registration number is required for category 3 fires – call toll free **1-888-797-1717**
- Schedule 1: outlines three Danger Regions of BC
- Schedule 2: defines five different Fire Danger Classes using a matrix of Build-up Index and Fire Weather Index
- Schedule 3: provides restrictions on High Risk Activities as required in Section 6(3)

OPEN BURNING BENEFICIAL MANAGEMENT PRACTICES

Comply with applicable open burning related legislation, including the above, and where appropriate, consider the following beneficial management practices to protect the environment.

Open Burning

The risks associated with outdoor fires are the reason for local and provincial regulations.

- whenever possible, consider alternatives to burning such as:
  - reducing the size of the materials (such as by chipping) to allow it to be used as mulch or used as a compost material
  - recycling as much material as possible before burning
- any fire attendee should have equipment and water on hand appropriate to control for the size and type of fire. Follow the information in the *Wildfire Act* and *Regulation*
- use the flow chart in Figure 10.2 to determine if the *Open Burning Smoke Control Regulation* applies to the open burn

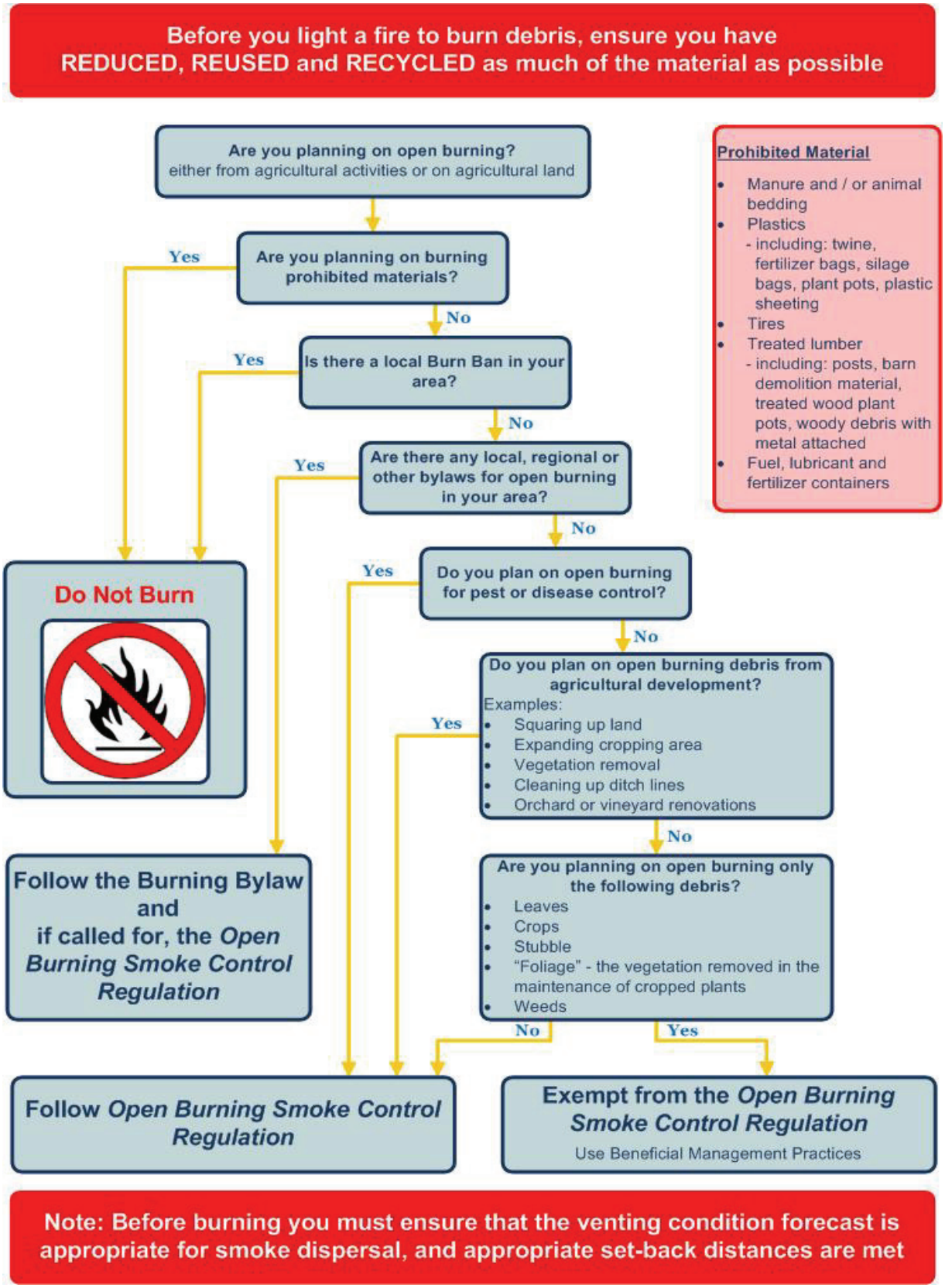

Figure 10.2 Burning Practices Flow Chart

Where agricultural burning is necessary, many smoke-related problems result from poor open burning practices. Emissions containing particulate matter from open burning can limit visibility, release harmful gases, and aggravate respiratory conditions in susceptible individuals. Particulate emissions and pollution can be reduced by implementing the following practices to reduce smoke production:

- build good piles with clean, dry debris (do not include stumps, rocks, or soil) to reduce smouldering stage
  - pile to approximate a haystack shape where the material does not splay out at the sides, and the dimensions approximate a base-to-height ratio of 1:1
  - avoid overloading of fires that may restrict combustion, and cause smouldering and increased smoke
- minimize the smouldering stage, as this stage can contribute more than half of the total particulate emitted during the burn
- control the fuel properties
  - avoid compaction of the material
  - allow fuel to dry before burning to reduce the moisture content of the pile
- use forced air technology (i.e. air curtain incinerators, or other appropriate air-assist technology) as these can reduce emissions by up to 90%
- avoid burning during periods of calm stable air or when the venting index is poor, when smoke is unlikely to disperse properly
- use woodwaste as heating fuel instead of open burning
- follow local smoke management plans guidelines on open burning within your municipality

Note: ensure that there are no contaminants in the fire, such as tires, plastic or other prohibited materials (see Table 10.2)

Table 10.2 Materials Prohibited from being burnt under the *Open Burning Smoke Control Regulation*

tires	treated lumber
plastics	railway ties
drywall	manure
demolition waste	rubber
domestic waste	asphalt
paint	asphalt products
hazardous waste	fuel and lubricant containers
tar paper	biomedical waste

Although the *Open Burning Smoke Control Regulation* does not regulate the agricultural burning of crops, weeds, foliage or stubble, voluntary adoption of the Regulation is suggested for these burns.