Assessment of the potential air quality impacts of vineyard spraying in and around Blenheim

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June 2007

Executive Summary

This report investigates potential air quality issues from viticulture spraying, including the potential accumulation of chemicals in the Blenheim area. The report stems from concerns about the adequacy of existing legislation and practices in protecting the environment given the significant increase in the amount of land being used for vineyards in the Blenheim area.

The main objective of the report was to identify the chemicals with the greatest potential for accumulation in the air over Blenheim and those that posed that greatest risk in terms of toxicity. The information could then be used to develop a monitoring strategy to determine the potential impacts of any accumulation of spray in Blenheim and potentially result in the implementation of additional measures to avoid, remedy or mitigate the effects of viticulture sprays.

Accurate quantification and assessment of potential impacts was not possible because of issues relating to data collection and collation. However, the analysis suggests that around 115 tonnes of sulphur could be released in the vineyards around Blenheim per year. A range of chemicals are released in smaller quantities that have greater toxicity. Identification of a specific chemical for monitoring was not possible because of uncertainties in the amounts of different chemicals used.

Internationally there is little information available on an effective strategy or design of a programme for monitoring air accumulation impacts associated with spray drift. The topic is currently being researched in America and it is likely that recommendations for monitoring will be available within the next few years. A monitoring strategy could be developed in the absence of the American research results. However, it may be more cost effective to wait for the latter, and for better information on the quantities of chemicals used, before progressing with an extensive programme. A preliminary investigation, however, could measure sulphur as an indicator of the potential for accumulation.

Notwithstanding the current information gaps, this study identifies a number of issues in the industry and makes recommendations including revisions to the proposed Wairau/ Awatere plan to better regulate the spray industry. Information requirements regarding these issues are outlined in the report. MDC and industry could take several steps to improve base line data. These include;

- Developing working relationships with key industry organisations including New Zealand Winegrowers.
- Reviewing agrichemical requirements in the proposed Wairau/ Awatere Plan to improve clarity and consistency for applicators, provide for collation of agrichemical use data, sensitive area identification, notification, signage etc.
- Investigate all drift complaints using a standardised format to improve monitoring and record vital information.
- Increase awareness throughout the community of complaints processes and inform complainants of any outcomes.

- Annual communication with other data collection agencies, for example the National Poisons Centre to ensure that the number of agrichemical incidences in Blenheim is being accurately represented.

- Regular monitoring of groundwater, rainwater and public water supplies for all agrichemical residues.

- Monitoring of spray drift deposition in specific sensitive areas of concern.

- Development and adoption of a quick, simple standardised spray plan and spray diary software that incorporates information from a proposed spray plan plus the actual spray programme. This would be submitted electronically and include other relevant information such as equipment used and sensitive area identification. The adoption of this approach would improve agrichemical use analysis, council knowledge and investigations.

- Collate spray diary information for at least five years to enable information to be used as part of a future observational study of the health of the Blenheim population.

- Increase agrichemical exposure knowledge of medical professionals and encourage suspected incidents to be reported.

Contents

1 Introduction

Productive vineyards in Marlborough have increased from 2,655 hectares in 1997 to 11,488 hectares in 2006. By 2009 it is predicted that this figure will increase to 13,647 hectares (New Zealand Winegrowers, 2006).

This rapid expansion has resulted in many positive impacts on the community, such as increased industry, employment and tourism opportunities. However, there is also some concern about the loss of native habitat, landscape diversity and the reliance of the region on a monoculture. The expanding scale and associated proximity of the industry to urban areas has also raised concern about noise and potential health and environmental issues relating to agrichemical use.

Figure 1.1 provides an indication of the scale and proximity relative to Blenheim.

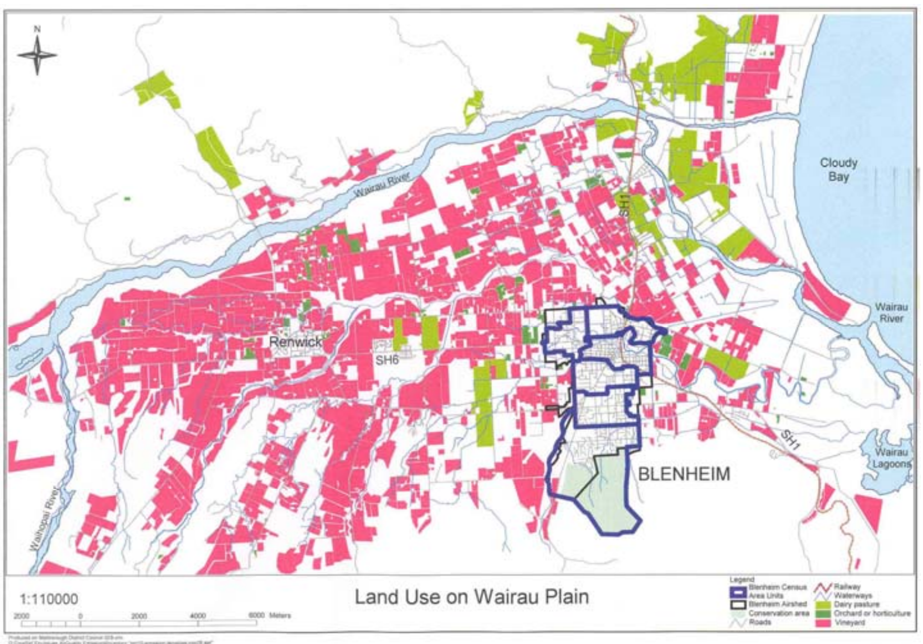

Figure 1.1: Land use on the Wairau Plain (2006) (source Carol Mills, MDC).

Public concern about agrichemical use and associated spray drift is not limited to the Marlborough district. Many other regions, particularly those with intensive horticulture operations have also highlighted spray drift as a significant air quality issue.

Agrichemical exposure through spray drift or environmental contamination can cause both acute and chronic health effects in humans. However, for a number of reasons, the impact of agrichemicals especially with regards to chronic illnesses are not well characterised. Incidents involving spray drift in New Zealand have also not been well documented and there has been very little collation of information on agrichemical use or trends. In general, the assessment of the impacts of spraying agrichemicals have tended to be reactive rather than proactive, for example the use of DDT.

The term “spray drift” is often associated with the visible drift from a sprayer, however, drift can also include agrichemicals volatilising from plant surfaces and the movement of spray contaminated particles. All forms of drift contribute to the amount of agrichemicals that can potentially be absorbed and accumulated in the atmosphere. Visible or primary drift is particularly relevant because it is possible to minimise the effects and therefore reduce the amount of agrichemical impacting on sensitive areas or evaporating before it reaches its target. In comparison, there are only limited ways of reducing volatilisation and contaminated particle movement.

There has been very little investigation into the effects of agrichemical accumulation in the atmosphere. This is a concern for an area like Blenheim which has a relatively high collective agrichemical use in a concentrated area. These unknown effects combined with the lack of historical documentation of agrichemical use and poor diagnosis and recording of health impact data highlights a need for further investigation.

The purpose of this report is to provide a scoping study which examines possible health impacts arising from vineyard agrichemical use. This includes spray drift and the potential for agrichemical accumulation in the atmosphere given the scale of industry around Blenheim. This is being evaluated to determine whether additional controls on the viticulture industry are necessary.

2 Sprays and the Atmosphere

The processes by which sprays may enter the atmosphere are shown in Figure 2.1. This report primarily deals with spray drift and volatilisation.

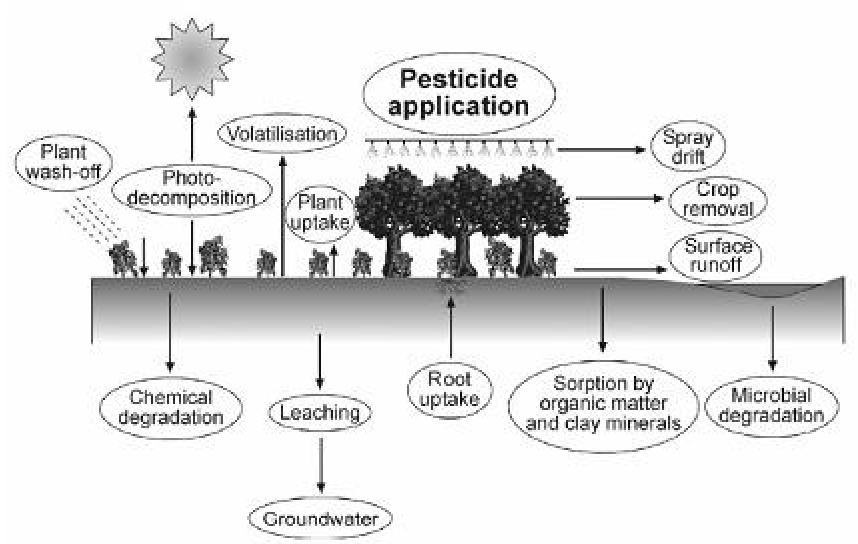

Figure 2.1: Fate of pesticides in the environment (Sarmah, et al., 2004).

Small particles of varying diameter are formed and discharged to air when an agrichemical is forced through a spray nozzle under pressure. These particles may remain suspended or fall to the ground depending on gravitational forces, air viscosity, particle radius and evaporation rate of the agrichemical solution. The longer the particle remains in the air, the higher the risk of it drifting beyond its target. All spray particles can move off target but smaller particles tend to move the most. Drifting particles may evaporate in the atmosphere or onto land which is a non target sensitive area. Residues on target and non target areas can then volatilise from plant and soil surfaces in comparatively high concentrations for several days after application (Felsot, , 2005). Agrichemical particles in the atmosphere can come back to earth in rain, snow, or dust fall. Airborne transport of agrichemicals is a major route for their widespread dispersion in the environment ((New Zealand Agrichemical Education Trust [NZAET], (Standards New Zealand [SNZ], 2004)).

2.1.1 Primary Spray Drift

Primary drift is the physical movement of agrichemical through the air at the time of application or soon thereafter to any off-target site. Primary drift increases the likelihood of evaporation before a droplet reaches its target and therefore may increase the amount accumulated in the atmosphere.

The applicator is responsible for primary drift as they;

a) Determine whether environmental conditions are suitable for spraying, this includes assessment of wind speed, direction, atmospheric stability, temperature, relative humidity and also whether the conditions are conducive to volatilisation at the time of application, and

b) Can minimise drift by making decisions relating to product selection, sprayer technology, height of spray release, droplet size and inclusion of drift reducing additives.

2.1.2 Secondary Spray Drift

There are two forms of secondary drift:

- The movement of spray contaminated dust, soil or sand particles.
- The movement of spray as a gas.

Volatility describes the ease at which an agrichemical converts to a gaseous state and is largely dependant on the vapour pressure of the agrichemical. Products which are more concentrated tend to have a higher vapour pressure which increases the risk of volatilisation and secondary drift.

Other factors that affect the rate of volatilisation of an agrichemical from a target surface include:

- Airflow (up to 10 times the rate in still air) (NZAET, SNZ, 2004).
- Temperature (0.5% per degrees Celsius) (NZAET, SNZ, 2004).
- Relative humidity.
- Rate of penetration into the target surface.
- Presence of any adjuvant and the chemical to air interfacial area.

An agrichemical that is tightly absorbed to soil particles is less likely to volatilise. Light sandy soils that are low in organic matter will increase the risk of volatilisation. Plant surfaces and soils with a high moisture content will also increase the risk of volatilisation.

The applicator has very little control over secondary drift. They can however, select less volatile formulations and avoid spraying if the temperature is predicted to increase in the days following application. The volatility of chemicals currently used in viticulture in New Zealand are considered in section 11.5.

3 Factors that Affect Drift

3.1 Environmental Factors

Wind speed and atmospheric stability are the main meteorological variables impacting on spray drift. Temperature and relative humidity also play a role but are less important.

3.1.1 Wind Speed and Wind Direction

The relationship between spray drift and wind speed is generally linear; as wind speed increases so does the spray drift. For example, an 8001 tip applying 50 L/ha will lose about three per cent drift at a 10 km/h wind speed, seven per cent at 20 km/h, and 11 per cent at 30 km/h (Saskatchewan Agriculture & Food, Saskatchewan Rural Development [SAFSRD], 1997).

Unfortunately it is not that simple, at low wind speeds, wind direction is more variable and no wind is often associated with the inversion conditions described in section 3.1.2. To account for these factors, the New Zealand Standard, NZS 8409:2004 Management of Agrichemicals otherwise known as the code of practice (COP) recommends spraying at wind speeds greater than 1 m/s and less than 6 m/s and also applying agrichemicals in a cross wind (starting at the downwind edge) in order to increase the proportion of spray reaching the target.

3.1.2 Atmospheric Stability

The typically unstable nature of the atmosphere during the daytime is conducive to dispersion of air contaminants because the turbulence promotes ready mixing (Figure 3.1).

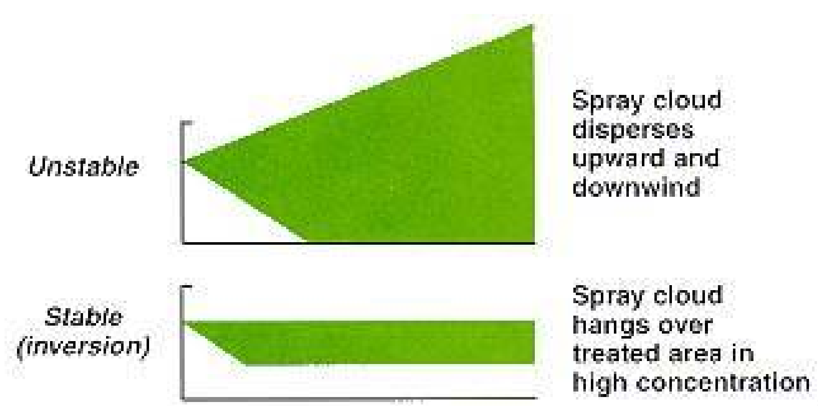

Figure 3.1: Fate of a spray cloud under unstable and stable (inversion) conditions (SAFSRD, 1997).

Under inversion conditions, however, dispersion is restricted and any drift in the air remains concentrated, and can hang over the treated area for a long time. Inversions usually occur in calm conditions which, if not recognised, can encourage some applicators to spray in these conditions. If the wind speed then increases, this concentrated spray drift cloud can move from the target area and impact on sensitive areas some distance away.

The COP suggests that spraying under inversion conditions should only be carried out if the spray droplets are non evaporative, are discharged below the inversion layer, and are greater than 250 microns in diameter.

3.1.3 Air Temperature and Relative Humidity

Temperature and relative humidity impact on the speed with which the chemicals within a spray droplet evaporate. As air temperature rises and relative humidity drops, there is an increase in the evaporation rate of droplets. For example, under warm and humid conditions (20° C and 80 per cent relative humidity), a 100um droplet evaporates completely in 57 seconds. In hotter, drier conditions (30° C and 50 per cent relative humidity), the same droplet is evaporated in 16 seconds. A 50um drop would last only four seconds under the hot and dry conditions, enough time to fall only 15 cm. (SAFSRD, 1997).

The spray drift implications occur both as a result of the agrichemicals volatilising (and the potential for secondary drift) and because of the potential impacts of changes in particles size associated with the volatilisation of chemicals. For example, a particle large enough to withstand drift may evaporate down to a size which makes them drift-prone in the time spent between the nozzle and the target plant (SAFSRD, 1997).

3.1.4 Rain

Most agrichemical applicators will not spray on days that rain is imminent, however, on some occasions this may accidentally happen. Rain can wash the agrichemical off the target on to adjacent land and into waterways. In addition, rain dilutes the spray, reducing the concentration at the target, thus reducing its effectiveness.

3.2 Physical Factors

3.2.1 Buffer Zones and Shelter Belts

A buffer zone can minimise the effect of primary spray drift by allowing an agrichemical to disperse to insignificant concentrations before reaching a sensitive area. Factors influencing the required width of a buffer zone include application technique, agrichemical used and the presence of a shelterbelt.

The characteristics of the shelterbelt are also important. The COP makes the following conclusions with regard to shelterbelts:

a) Natural (live) shelter is much more effective than artificial shelter.
b) The porosity and density of the shelter is important – a minimum thickness of 1m and a porosity or about 50% is recommended.
c) Porosity and density are a function of the thickness of the shelter.
d) For effective reductions in wind speed (and hence drift reduction) the width to height ratio of shelter is critical. A width to height ratio of about 3.5 is recommended (i.e. a shelter 1m wide (thick) should be 3.5-4m high).
e) Any spray released at or above shelter height will not be contained by the shelter.

General buffer zone widths for different application methods are described in table 3.1.

Table 3.1 outlines the buffer zones recommended by the COP.

Application Method	Distance (metres)	
	With shelter	Without shelter
Boom sprayer	2	10
Air blast sprayer	10	30
Aerial application	100	300

Note
These distances are subject to:

a) The equipment used (boom, air-blast, aircraft) being calibrated and operated correctly.
b) All other appropriate strategies being observed to reduce spray drift hazard.
c) Shelter should be complete and without gaps at the base.

3.3 Application Factors

The following application options can influence the amount of spray drift produced.

3.3.1 Application Method

The type of sprayer used will influence the amount of drift produced. For example aerial and air blast spraying are generally more conducive to drift compared with other methods. The type of sprayer used is generally dependant on what type of spray is being applied e.g. herbicide, fungicide etc.

3.3.2 Sprayer Technology

Coarse droplets are less likely to drift. There are a number of ways coarse droplets can be achieved. These include:

a) Reducing the spraying pressure.
b) Using high carrier volumes.
c) Using low drift nozzles.

Low drift nozzles are a good option as they do not affect sprayer speed or carrier volumes. In research trials, spray drift from an XR 11002 nozzle was cut in half by using a DG 11002 nozzle (Figure 3.2).

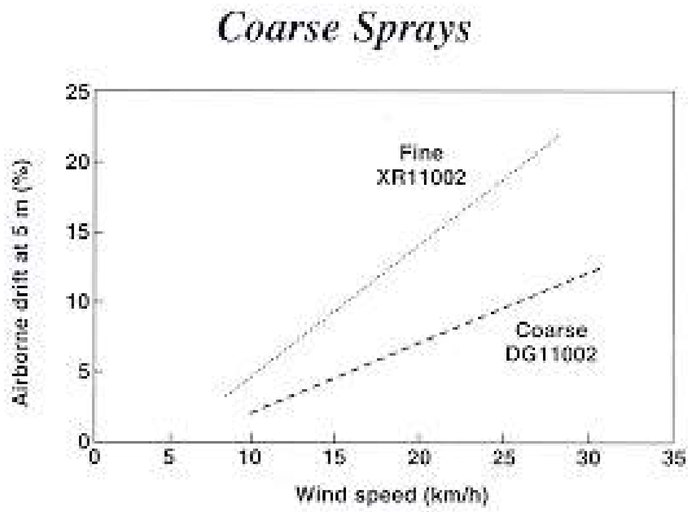

Figure 3.2. The effect of nozzle type on spray drift (SAFSRD, 1997).

It is important to consider the properties of the target plant when considering a low drift nozzle. Some difficult to eradicate wet weeds do not retain coarse droplets as well and as a result reduce the efficacy of the spray.

Nozzle and sprayer technology is continually improving and the amount of drift can be reduced considerably. For example sprayers can be programmed to emit coarser sprays near sensitive areas and can also be fitted with canopy sensors which automatically alters the spray pattern when a foliage gap is detected, thus reducing unnecessary discharge. Air assist can also help reduce drift by using an air stream to carry spray particles towards the target faster. This reduces the amount of time in the air and the amount of wind exposure. Operator expertise is important in potential air assist drift reduction as it is dependant on setting the direction and velocity of the air blast to match the atmospheric and crop canopy conditions (SAFSRD, 1997).

The use of shrouds or cones can also help reduce drift although they become less effective at higher travel speeds. Setting the booms to the minimum recommended height and angling nozzles forwards can also help in some cases.

3.3.3 Travel Speed

Spray drift has been shown to increase with travel speed. This is due to:

a) Increased stress on the spray exiting the nozzle causing a finer, more drift prone spray to be produced.
b) Additional speed causes the spray to stay aloft longer.

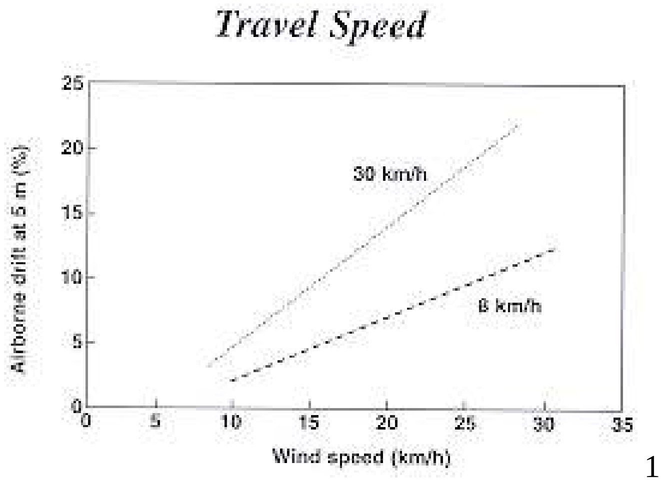

Figure 3.3. The effect of travel speed on spray drift. Note - 30 km/h travel speed conducted using XR11002 tips applying 30 L/ha. 8 km/h travel speed done using XR8001 tips applying 50 L/ha (SAFSRD, 1997).

3.3.4 Active Ingredient and Adjuvants

Applicators can select less volatile agrichemicals as a way of reducing both primary and secondary drift. Products of lower toxicity can also be selected in order to reduce the impact of any drift.

Spray additives such as adjuvants which work to increase the coarseness of the spray droplets can also help reduce drift although they have some limitations which can reduce their effectiveness or the effectiveness of the spray application.

3.3.5 Sprayer Calibration and Operator Expertise

Sprayers must be calibrated regularly to ensure that the correct amount of agrichemical is applied. Operator expertise is important in calibration, operation and general equipment maintenance in order to minimise potential malfunctions, spills or accidents.

4 Accumulation of Agrichemicals

The fact that agrichemicals can move into the atmosphere raises concern about the possible impacts on human health and aquatic and terrestrial ecosystems. Unfortunately, there has been very little research into the atmospheric and chemical processes that take place once an agrichemical has been absorbed. The United States have set up a National Air Quality Programme to address this lack of knowledge. They have identified that the following areas need development:

- The best techniques for rapid, cost-effective monitoring and analysis of pesticides, pesticides bound to dust particles, and new and emerging chemicals in soil, water and air; including knowledge of the limitations and operational requirements of measurement systems.
- Knowledge of current pesticide loading to air, water, and soil systems and persistence of pesticides in the atmosphere.
- An understanding of reactions of pesticides and synthetic organic chemicals in the atmosphere, including aspects that directly affect non-target contamination.
- The best methods to apply pesticides accurately, effectively, efficiently, and economically, including information on the performance of new pesticide formulations and delivery systems.
- Additional information on the emission rates and total loss of agricultural pesticides to the atmosphere during and after application to soil and on emissions from spray drift related to various application systems.
- A better understanding of processes and mechanisms important in wet and dry deposition and partitioning between air-water-particulates in the atmosphere.
- Research that allows information gathered at one scale (e.g., laboratory) to be accurately used at other spatial and temporal scales (e.g., watershed).
- Effects of preferential flow and macropores on pesticide volatilisation.
- Effects of new irrigation methods on pesticide transport to the atmosphere.

The goals of the programme are:

- Develop simple, accurate, inexpensive methods to measure volatile concentrations and pesticide residues bound to particulate matter in the atmosphere, and develop analytical methods for new pesticides and transformation products.
- Develop simple, accurate, inexpensive methods to estimate pesticide emissions, deposition, and off-site transport.
- Monitor air, soil, and water for the presence of pesticides and transformation products.
- Quantify factors that control movement and availability of synthetic organic chemicals relative to their transport, degradation, and persistence in air and soil-water environments.
- Understand the integrative roles of sorption, transformation, partitioning, energy, preferential flow, and the influence of microbial communities in soil and the root zone area as they affect transport of pesticides to the atmosphere.

5 Rules and Regulations

5.1 The Hazardous Substances and New Organisms Act 1996 (HSNO Act)

The Hazardous Substances and New Organisms Act 1996 (HSNO Act) was introduced to protect the environment, and the health and safety of people and communities, by preventing or managing the adverse effects of hazardous substances and new organisms.

The Environmental Risk Management Authority (ERMA) was set up by the HSNO Act to assess and impose controls on hazardous substances.

Assessment

This involves consideration of the following substance properties:

(i) Explosiveness.
(ii) Flammability.
(iii) Ability to oxidise.
(iv) Corrosiveness.
(v) Acute and chronic toxicity.
(vi) Eco-toxicity.

Agrichemicals were transferred over to the HSNO Act in July 2004. All previously registered substances and any new substances are now assessed under this system which follows the European “Globally Harmonised System” for chemical risk classification. This system is a vast improvement and provides more information in a standardised format, however, it is debatable how this information will be utilised by growers.

Controls

The key controls on hazardous substances include:

- Setting exposure limits.
- Ensuring that persons who handle agrichemicals are competent.
- Keeping written records.
- Keeping equipment used to apply agrichemicals in sound condition.

Note: Highly toxic agrichemicals are subject to tighter controls.

Exposure limits seek to define the maximum amount of a substance or component of a substance that can be present in air, water, or soil. Tolerable Exposure Limits (TELs) relate to human exposure whereas Environmental Exposure Limits (EELs) relate to the environment. These maximum allowable concentrations for non target areas allow for measurement where previously proof of damage and injury would have been required. This could be an excellent tool for drift investigation, however, there are some concerns that EELs and TELs do not address the following issues:

- Crop sensitivity.
- Organic systems.
- Sensitive populations, e.g. pregnant women.

More research is required to determine how an agrichemical user will know when limits have been reached, how users assess the impact of cumulative applications and how a group of users should behave.

ERMA are currently in the process of reassessing EELs and TELs. There are currently no EELs or TEL's set for any transferred substances, however it is likely that many will be set in due course.

It should be noted that the ERMA process is intended to determine an acceptable level of control and residual risk, not zero risk.

5.1.1 Approved Handler

HSNO legislation requires that particularly hazardous substances must be secured or under the control of an Approved Handler who has knowledge of the substance. Other employees may handle the substance provided the Approved Handler is available at the location and given the employees instruction on how to handle the substance. Many of the chemicals used in viticulture require approved handler status (see Appendix A). In order to obtain these chemicals, the purchaser needs to provide proof of approved handler certification.

5.1.2 Tracking

Very hazardous substances require tracking and are tightly controlled under HSNO. They require records to be kept from the point of import or manufacture in New Zealand, through distribution, use and disposal. Tracking records must be readily available and understandable. A tracked substance cannot be transferred to another person unless there is an Approved Handler who will take responsibility for the substance.

5.2 Marlborough District Plan

Resource management plans can help mitigate agrichemical spray drift through land use and discharge controls.

Land use controls can help reduce the issue of conflicting land uses such as activities requiring the use of agrichemicals and residential dwellings. This can be achieved by the application of minimum subdivision areas to maintain low-density housing in rural areas or by prohibition of intensive agriculture in rural-residential areas and zones. Another approach is to separate uses by specifying setbacks or buffer zones. However, none of these methods solve the problem of agrichemical spray drift where the land use patterns are similar or where the patterns are already established (i.e. existing use rights apply and there is no mechanism to impose rules retrospectively in the context of district plans) (Ministry for the Environment [MfE], 2002a).

Regional plans can be used to control discharges of contaminants into or onto land, air or water. Rules in regional plans relating to spray use may include applicator education requirements, restrictions on the types of chemical used and controls to prevent off- target agrichemical drift. They can also include application controls such as notification, signage, record keeping, spray plan including sensitive area identification, incident reporting, waterway protection, adherence to manufacturers instructions, using best practicable options and complying with the COP.

As a unitary authority, Marlborough District Council (MDC) has the advantage of being able to integrate both land use and discharge controls in one plan.

MDC recognizes and addresses the issue of spray drift in its current plan (1998). This is by way of land use policies such as limiting the scale of subdivisions and dwellings for rural purposes in a manner which minimizes potential conflicts between residential and rural activities and through specific agrichemical discharge rules (outlined in Appendix B). MDC also promotes environmentally sustainable practices and education through its rural awards programme. However, with agrichemicals now transferred to the HSNO Act 1996, parts of the plan need to be reviewed in order to incorporate HSNO legislation and amendments to the Resource Management Act (RMA). This review may also be an appropriate time to consider any improvements to the current requirements and also increase consistency and clarity within the plan.

This process may involve analysis of other district, regional and unitary authority plans. There are now a number of plans which contain good examples of both direct and indirect management strategies and more specific rules regarding spray drift. Recent plans, such as the Environment Canterbury Natural Resources Management Plan outline more specific and detailed requirements in the plan rather than relying on information to be retrieved from the COP. There are also recommendations from the Agrichemical Trespass Ministerial Advisory Committee ([ATMAC] (MfE, 2002a)), which could be utilised, for example, it was suggested that notice to affected persons and providing signs in public places was a key to enable people to reduce the adverse affects themselves.

The MDC Plan has no current provision for notification and signage with the exception of

- Aerial applications involving deadly poisons (rural zones 2 & 3).
- Hand and aerial applications involving deadly poisons (conservation zone).
- Application of agrichemicals in the district recreation zone.

The ATMAC recommended that regional councils develop a consistent approach to notification that is suitable for regional needs and recognizes both a user's right to use agrichemicals and the public's right to know what is being used.

A revision of the Plan may also be an opportunity to make provisions for ease of future risk analysis and at the same time increase council knowledge of industry practice which may in turn help investigation of complaints. Unitary authorities can also use HSNO controls in plans as minimum performance standards and apply more stringent measures in dealing with more sensitive areas.

5.2.1 Growsafe

An applicator is required under the Plan to have a GROWSAFE introductory certificate. The certificate is designed to ensure that the applicator has met the assessment requirements of the NZ Agrichemical Education Trust (NZAET) for the application of agrichemicals safely and accurately, in accordance with the COP. The GROWSAFE Introductory Certificate is endorsed by ERMA as delivering the theoretical knowledge requirements for the Approved Handler test certificate. Courses have been upgraded to include a HSNO component and now have a common set of resources to ensure consistency across New Zealand.

5.2.2 NZS 8409:2004 Management of Agrichemicals

The MDC Plan requires specific agrichemical activities to be carried out in accordance with the COP (NZS 8409:2004 Management of Agrichemicals), which is the main guide for the application of agrichemicals in New Zealand. The code is designed to ensure that the practices associated with agrichemicals are safe, responsible, and effective, with minimal adverse impact on human, environmental and animal health. The code is approved by ERMA and is designed to inform growers on how to meet the requirements of HSNO regulations and controls. It includes information on drift minimization and includes the following guidance chart for applicators.

Table 5.1: Drift hazard guidance chart

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Potential drift hazard scale			
Factor	**High hazard**	**Low hazard**	**Comment**
Wind speed	Zero/very low (less than 1 m/s) or greater than 6 m/s	Steady (1 – 3 m/s)	Measure or estimate using smoke
Wind direction	Unpredictable	Predictable, and away from sensitive areas	Use smoke to indicate
Humidity	Low (delta T > 8 °C)	High (delta < 4 °C)	Measure, using whirling psychrometer
Atmospheric stability	Inversion layer present	No inversion layer	Use cold smoke to indicate
Maximum height of release of agrichemical	> 1.5 m above the target	< 0.5 m above the target	Application technique See 5.3.4.2
Particle (droplet) size	< 50 microns diameter	> 250 microns diameter	See Q1
Volatility of agrichemical	High (vapour pressure > 10 mPa)	Low (vapour pressure < 0.1 mPa)	Check product label, SDS, or PSC
Sensitive area	Close (< 100 m) away	None, or more than 1 km distant	Identify on property protocol (see M4)
Buffer zone	None	Yes (> 100 m)	Guideline only
Shelter belts	No shelter	Live shelter, > 3 m high and 1 m thick	Not for herbicides
Toxicity	Class 6.1A, B, C, D	Class 6.1E	Check label

NOTE –

(1) The potential drift hazard scale is given as high or low, and intermediate situations should be rated accordingly. For example, a droplet size of 150 microns diameter would represent a moderate drift hazard.

(2) Some factors can be changed to reduce the hazard rating, e.g. use lower volatility chemical, larger droplet size.

(3) All of the weather related factors are to be assessed at the application site.

(4) Toxicity of the agrichemical has been included on the chart, but use of a schedule heading is only one indicator of toxicity and is not always sufficient. In all cases, users should select the least toxic agrichemical that is suitable for the specific application. Check the label and product information.

(5) 1 m/sec = 3.6 km/h; 6 m/sec = 20 km/h (approx.).

6 Complaints

MDC has recorded at least 16 spray drift complaints implicating vineyard agrichemical applications since September 2005. Most complaints involved operators spraying in very windy conditions. Complaints ranged from concern over visible drift on neighbouring properties to an implication that drift had caused one death and sickness in other dogs. Complaints involved both tractor mounted sprayers as well as aerial (helicopter) applications.

These complaints indicate that primary spray-drift is occurring in Marlborough and the exact extent and impact of both this primary drift and the less publicised, secondary drift should be investigated. It is clear that some applicators are not committed to minimising drift. It needs to be determined whether this is an industry wide occurrence due to operational issues and pest and disease reduction pressures or whether it is the result of a small number of operators not undertaking best practice.

It is important to note that prior studies have identified that spray drift incidences are generally under-reported so it is difficult to determine whether this is a true indication of incidences. Historically, there has also been an issue with the data quality of the incidences that have been reported. This has meant that the extent of the problems and exact nature of the issues and agrichemicals involved have been difficult to determine.

In September 1998, the public health service set up a software package called “driftnet” which aided the systematic collection of information and conduction of investigations relating to agrichemical spray-drift incidents. Unfortunately, it was discovered that this system was not capturing known incidence data and by 2003, the number of reported incidences were so low that maintenance of driftnet ceased. The reason it was not capturing known data was because agencies such as Ministry of Health, Regional Councils, Vegetable and Potato Growers Federation (VegFed), National Poisons Centre, BIO-GROW®, Occupational Safety and Health, Department of Labour, District Council, Accident Compensation Corporation (ACC) and insurance companies have had their own data collection system and none of these systems are interrelated.

7 Impacts

This section identifies what is known about the impacts of agrichemical drift and identifies areas which make the impacts difficult to assess.

7.1 Health Impacts

There are a number of ways that agrichemicals can enter the body. Historically dermal contact and ingestion have been considered the most significant exposure mechanisms, particularly in the context of primary spray drift. In comparison, field measurements indicate that inhalation of aerosol or vapour spray drift is a minor route of human exposure (Ministry of Health, 1998). However, there are uncertainties associated with these conclusions which suggest that more comprehensive studies are needed. In particular, there is little information available on combined agrichemical use in a region and the potential for chronic effects associated with long term repeated exposures.

Exposure can have a range of effects and symptoms can vary according to the agrichemical involved and the way it has entered the body. This can make it difficult for medical professionals to diagnose agrichemical poisoning especially when dealing with effects such as multiple chemical sensitivity syndrome and chronic illnesses. Observational studies are also difficult to implement because of a dearth of data tracking agrichemical use.

7.1.1 Acute Health Effects

The fact that New Zealanders are experiencing acute health effects from agrichemical exposure was acknowledged by the Agrichemical Trespass Ministerial Advisory Committee [ATMAC] (MfE, 2002a). This committee also accepted that in many cases occurrences are not being reported to appropriate authorities such as Medical Officers of Health or Occupational Safety and Health.

Sensitivity
The ATMAC report (MfE, 2002a), indicates that about one in 8–10 people experience some form of allergic sensitivity to one or more environmental agents. Sensitivity and allergies are generally caused by a large exposure to a substance and then triggered by subsequent smaller exposures. The issue of agrichemical sensitivity is not well supported by research or New Zealand data.

7.1.2 Chronic Effects

Long term effects of agrichemical poisoning can arise from a single exposure or from repeated small exposures. Chronic effects associated with exposure can be difficult to establish. Toxicological data can provide an indication of potential impacts. However, observational studies (e.g., epidemiology) are often necessary to demonstrate an activity is having a health impact. Drawing conclusions from observational studies can be difficult because of uncertainties in the causality of the relationships.

7.2 Environment Impacts

Contaminated water is a key environmental impact of spray drift which can present risks to health, water supplies, aquatic environments and irrigated crops. The main ways that agrichemicals enter waterways include:

- Flow or spillage from storage or mixing areas.
- Flow of soil with adsorbed chemicals.
- Wash off from target areas after rainfall.
- Spray drift.

Groundwater contamination is very serious as it is difficult to reverse. In a 2001 survey, 100 wells were sampled throughout New Zealand. Pesticides were detected in 30 percent of wells; of those, 66 percent of the pesticides detected were triazines. A total of 20 different pesticides were detected, however, only one sample exceeded the drinking water standard (MfE, 2002a). Triazines are found in herbicides containing simazine, atrazine, and terbuthylazine (see Appendix A).

It is interesting to note that in 1993, Denmark imposed restrictions on the widely used product, Round Up (glyphosate) because of concern that it may be contaminating groundwater.

7.3 Property Impacts

Spray drift can result in loss of crops or income. Drift can also impact on properties with registered organic status. Damage is not always evident immediately after the situation has occurred. This can make it difficult to identify the source and enable prosecution. The difficulties in providing evidence and costs of mitigation result in very few drift cases being contested.

8 Sensitive Areas

The risk associated with drift can be simply defined as;

RISK = EXPOSURE (the chance of human contact) X HAZARD (how poisonous the substance is).

Exposure is usually dependant on the proximity of sensitive areas. The COP identifies the following areas as sensitive:

a) Residential buildings.
b) School buildings.
c) Public places and amenity areas where people congregate.
d) Public water supply catchments and intakes.
e) Water bodies and associated riparian vegetation.
f) Sensitive crops or farming systems (e.g. organic farms, greenhouses).
g) Wetlands, indigenous vegetation habitat areas and reserves.
h) Public roads.

In applying chemicals, users complying with the COP are expected to identify by way of a map, sketch, field notes or other documentation any sensitive areas located near the target area.

The issue of sensitive areas is likely to be important in Blenheim as many vineyards are currently planted very close to public roads and would not comply with the recommended buffer zones as described in section 3.2. In addition, the proximity of residential dwellings to vineyards may be an issue.

It is also important to note that while it is possible for an applicator to assess the effect of environmental conditions in relation to sensitive areas at the time of application, there is also the risk of secondary drift in the days following application which needs to be assessed. This may be an issue given the amount of agrichemical applied to the region and potentially absorbed into the atmosphere especially given the scale and proximity of the industry relative to Blenheim.

9 Trends in Agrichemical Use

There have been significant changes in agrichemical use patterns in New Zealand over the last decade. The main change is a shift to less persistent and more selective agrichemicals (Manktelow, et al, 2005). Motivations for change include; international agrichemical withdrawals, pest resistance problems, increased interest in sustainability, product residue issues and market restrictions.

Grower organisations are instrumental in the promotion and education associated with these changes. The key industry organisation in New Zealand is the New Zealand Winegrowers (NZW). NZW was established in 2002 and aims to represent, promote and research the national and international interests of the New Zealand wine industry. Winemakers and grape growers are members of New Zealand Winegrowers as a result of their membership of either the Grape Growers Council or the Wine Institute.

NZW produce an export spray schedule which gives growers detailed information including guidelines on resistance strategies, Maximum Residue Levels (MRL) and Pre-Harvest Intervals (PHI) associated with particular agrichemicals and their application timing. It is expected that most vineyards will base vineyard agrichemical management on these guidelines in an effort to comply with export regulations and therefore maximise their marketing options.

The NZW Board are also committed to promoting sustainable systems and are proposing to have all industry members participating in an independently audited system by 2012 (Gregan, P, 2007). This may be through schemes such as Sustainable Winegrowing New Zealand (SWNZ), ISO 14000, Organics, Biodynamics etc.

Forty seven percent of the vineyard area in Marlborough are currently managed under SWNZ (pers. comm. S. Van der Zijpp, 25 May, 2007). SWNZ was established by volunteer grape growers in August 1995 as an industry initiative directed through New Zealand Winegrowers. SWNZ was commercially introduced in 1997 and has been adopted by growers from all the grape growing regions. The SWNZ programme is based around vineyard self-audit scorecards and the collection and analysis of production input and outcome data. This system gives growers information and score card point incentives regarding the sustainability of certain practices. This includes agrichemical related issues such as the number of applications and the types of agrichemicals used.

SWNZ data collection and analysis is an important development as there has never been regular statistical collection of any agrichemical use data in New Zealand. Poor data quality and lack of collection has meant that potential risk reduction associated with changes in agrichemical use have not really been investigated.

10 Collation of Agrichemical Use Data

Numerous chemicals are available to target the same pest, disease or weed problems. An effective evaluation of the potential health impacts of spray drift requires details on the agrichemicals being applied and the frequency of application. Without accurate records and collation of this exact data, it is difficult to determine the amount of each active ingredient entering the atmosphere and therefore, the potential health risks associated with these chemical amounts. All growers are currently required to keep spray diary records. Collation of this data would give an indication of the types of chemicals selected for use and when they are used.

Manktelow, et al (2005) identified a number of issues associated with using the information contained in the diaries to determine how much of the chemical is being applied:

1) They require over-simplification of real world practices, especially where blocks are treated over several days or where only parts of blocks are treated, for example when alternate row spraying, or when only targeting the fruiting part of the canopy. In many cases this leads to over-reporting of agrichemical use, as partial applications usually get recorded as full block applications.

2) They usually require the user to record agrichemical application rates in just one format or set of units (e.g. as an applied rate per 100 litres of dilute spay mix OR as an applied rate per hectare) and as such often lead to incorrect recording of actual application rates.

3) They are usually not set up to accurately record chemical use rates when two distinct application systems are recorded on the same spray diary. The authors found this to be a problem mainly when herbicide applications to under tree strips are recorded along with canopy applications.

4) Grower descriptions of the products actually applied are frequently generic (e.g. copper or sulphur) and as such make it impossible to always be certain exactly which product has been used and hence the actual quantity of active ingredient being applied.

5) The authors also found that most calibration information was expressed in terms of a full canopy application volume to a mature block of trees or vines (i.e. the largest spray volume and application rates likely to be used on a property) and most growers record applications as having been made to those specifications. While it has been impossible to quantify, it appears that many spray applications are made using lower spray volumes and chemical rates as growers speed up and turn off spray nozzles to reflect the requirements of smaller or partly foliated canopies.

MDC currently has access to spray diary records by request. Analysis of all diaries from Marlborough district would involve considerable resources and have limited effectiveness given current data quality.

The Sustainable Winegrowing New Zealand (SWNZ) report on 2003-04 Scorecard and Spray Diary Data can be used to give some indication of industry practise, however, the limitations with the SWNZ data are:

- Information is only collected from SWNZ members - membership demonstrates commitment to sustainable practises and non member activity is likely to be more relevant to public health.
- SWNZ only releases certain information and access to all the information required and more recent data is restricted
- Scorecard changes prior to 2002/2003 year have limited annual comparisons. Annual comparisons are important as weather conditions and associated pest and diseases vary between seasons.
- Scorecards and spray diary information does not always correlate.
- Not all members submit spray diaries or submit in a usable format.

There is a need for industry to adopt a standardised spray diary which addresses issues mentioned in this section and enables simple data analysis. Ideally this would be in an electronic format but transferred to growers that still use paper based systems. The lack of collection and knowledge of agrichemical use needs to be addressed in order to provide for future health impact analysis.

11 Vineyard Spraying

This section collates factors that influence the impacts of vineyard spray drift or accumulated concentrations of agrichemicals in the air over Blenheim.

Key factors include the quantities and types of agrichemicals used and meteorological conditions. As indicated in previous sections, the properties of different agrichemicals that impact on their effects include their relative toxicity, volatility and application method.

11.1 Spraying Regimes

The majority of agrichemical applications occur during the growing season, mainly between October and March. Timing of applications during this period can be critical to good pest and disease control. Applying agrichemicals at the correct time may also reduce the need for further applications and the use of more hazardous chemicals, however, it may also involve decisions to spray in marginal conditions. Either decision can impact on the amount and type of potential agrichemical accumulation.

The suggested export wine grape spray schedule (Appendix C) gives an indication of what agrichemicals can be applied at different vine growth stages. This schedule is a guideline by which growers will adapt their own programme depending on regional and seasonal variations in environmental conditions and associated pest and disease problems. The economics of applying chemical and concern for the environment have seen a trend away from calendar spraying and there is now more emphasis on applying agrichemicals once monitoring thresholds have been triggered.

11.2 Quantities Used and Frequency of Spraying

In the absence of being able to obtain reliable information from spray dairies, it is not possible to accurately ascertain the amount of active ingredients being used in the Blenheim area. However, given that approximately half of the Marlborough area is managed under SWNZ principles, it is possible to get an indication of some industry practises and key agrichemicals of concern. This is achieved through identification of scorecard incentives and data from the 2003/2004 report on scorecards and spray diaries. It is important to note that SWNZ members have already demonstrated a commitment to sustainable practices and the practises of growers who have not embraced SWNZ or organic principles are more likely to be of concern. The limitations of using SWNZ data to indicate industry practise are discussed in section 10.

This section evaluates what is known about the types and amounts of agrichemicals likely to be applied in the Blenheim area. To simplify the assessment, the agrichemicals used on vineyards have been categorised as follows:

- Fungicides.
- Insecticides and Miticides.
- Herbicides.

The relative toxicities of the relevant agrichemicals mentioned in this section are discussed in section 11.6.

11.2.1 Fungicides

Grapevines diseases are a major threat to grape growers as they can have a catastrophic effect on production. Management techniques and fungicide applications are usually relatively intense in order to prevent wine quality issues and economic losses. However, certain weather conditions can result in epidemics that even the most rigorous management will not prevent. Disease monitoring programmes and adoption of all appropriate cultural techniques can help minimise fungicide input.

There are a large number of diseases that can occur but botrytis, powdery mildew, downy mildew and black spot are likely to be of most significance to this report due to occurrence and associated fungicide input. Fungicide input usually involves regular agrichemical applications and is mainly concentrated in a six month period during the growing season. This may have relevance when considering potential atmospheric concentrations.

A summary of SWNZ recommendations for disease follows:

- Ideally use risk based disease management.
- Minimise resistance to botrytis by reducing the number of fungicide applications and ensuring application timing is ideal.
- More than 21kg/ha of elemental sulphur is not recommended and applications after veraison are considered unsustainable.
- No more than 2 applications of demethylation inhibitors (DMI) fungicides (Bayleton, Rubigan, Topas, Systhane, Alto, Mitek) is recommended and more than 4 is considered unsustainable.
- No more than 7 applications of Mancozeb.
- No more 3 applications of Delan (Dithianon) and application after fruit set is not considered sustainable.
- Wood diseases should be controlled by vine management.
- Copper use is not ideal and if used, there should be no more than 3 applications. More than 4 is considered unsustainable.
- No more than 3 applications of Euparen sulphamides.
- No more than 1 application of Shirlan (pyridinamine) is recommended and more than 2 is unsustainable.
- There should only be 1 or 2 applications of Switch, Scala or Pyrus (anilopyrimidines) depending on total number of botrytis sprays applied;
- No more than 2 applications of Captan, Bravo and Thiram.
- No more than 1 application of dicarboximides (Sumisclex, Rovral, Ronalin, Defence, Ippon, Fortify) is recommended and more than 2, or if used at bloom or bunch closure is considered unsustainable.
- No more than one application of Teldor is recommended and greater than 2 is considered unsustainable.
- Applications of biological sprays (Botry-zen, Serenade max, Sentinel) are recommended to control botrytis.
- No more than a total of 3 botrytis sprays, more than 6 is considered unsustainable;
- Canopy management is encouraged to help maximize control and minimise disease.

A summary of SWNZ data 2003/2004 (national figures are used unless Marlborough is specifically mentioned) shows that:

- Most vineyards monitored and predicted disease and infection periods.
- Approx 80% of vineyards in Marlborough used less than 18kg elemental Sulphur for the season.
- There were some Sulphur applications after veraison.
- Mancozeb use varied.
- Very little Delan was used.
- The average number of Sulphur applications in Marlborough was 4.5 in the 2002/2003 year and 4.9 in the 2003/2004 year.
- The average number of DMI used in Marlborough was 1.5 (2002/2003) and 1.4 (2004/2004).
- 91% of Marlborough blocks recorded botryticide use.
- Average number of botryticide applications was 4.4.
- A small number (3 max) of Marlborough vineyards used more than 6 applications (considered unsustainable).
- No more than 2 applications of Euparen Multi were made.
- There was little use of Shirlan.
- 21% of growers in Marlborough used more than 2 applications of Captan.
- Most regions used very little Bravo (chlorothalonil).
- Thiram use was minimal.
- Dicarboximide use was variable.
- Only 18% of botryticides were applied within 2 days of a severe infection period in Marlborough, however, there may have been legitimate reasons for this.

11.2.2 Insecticides and Miticides

Relative to disease, insect problems in grapevines are usually relatively minor and easy to control. Most vineyards now monitor pest populations and do not apply insecticides until monitoring thresholds have been exceeded. The most commonly controlled pests are usually mealy bug, leaf roller, erineum mite and grass grub. Phylloxera can be major issue, however, it usually resolved with vine replacement. Lemon tree borer and various other pests may need to be addressed occasionally. Insecticide applications can start late in vine dormancy and then applied as necessary through the growing season.

A summary of SWNZ recommendations for insect pests follows:

- Regular insect monitoring and controls should only be used when monitoring indicates it necessary.
- The best form of leafroller control is Proclaim, Success/Entrust or Bacillus Thuringiensis, followed by Mimic, Prodigy or Avaunt.
- Organophosphates are generally discouraged, are not appropriate for some insect pests and more than 1 application in a season is considered unsustainable.
- Mealy bug is best controlled by insect growth regulators (IGR's) eg Applaud as they are specific to the pest. Tokuthion is not recommended and Lorsban is considered unsustainable. Grass grub is best controlled by "trap" trees to divert adults. Spot spraying is acceptable but multiple spot sprays are not recommended and calendar spraying is considered unsustainable.
- Sulphur should be used to control blister mite and ideally, predators should be introduced to control other mites. If a miticide is required, predator safe options should be used.

A summary of SWNZ data 2003/2004 (national figures are used unless Marlborough is specifically mentioned) shows that:

- Nearly all vineyards monitored for insects.
- Leafroller management has improved and control was not always necessary.
- Insect growth regulators (IGR's) are now the main form of control of leafroller.
- Application number and organophosphate use is continuing to decrease.
- Grass grub was controlled by spot spraying.
- No miticides were used for blister mite.
- Mimic was the most common (32% of total insecticide use), Applaud (15%) then Karate Zeon (8%).
- There were no insecticides used to control mealy bug in Marlborough in the 2003/04 season.
- The national average number of organophosphate applications has dropped below 0.5 and the average number of IGR applications is less than 1.

11.2.3 Herbicides

Herbicides are used in vineyards to control weeds beneath the vines. Most vineyards only spray a strip down either side of the vines and then mow the remaining area. A few vineyards may negate herbicide application on their older vines by use of mechanical under-vine weeding and mowing. On the other hand, some vineyards may completely spray out the inter-row space for the entire season. This practise is not very common and the trend is more towards inter-row crops that have practical purposes such as increasing beneficial insects. These inter-row crops may be sprayed out or cultivated once in spring in frost prone areas.

SWNZ encourage the use of herbicides which are less persistent in the soil and less toxic to operators. Residual herbicides and those containing simazine or paraquat and diquat are discouraged with SWNZ preferring vineyards to opt for Buster or translocated herbicides such as Round-up and Fusilade. It is also preferable that difficult weeds are targeted with spot spraying rather than broadcast spraying application.

Herbicide application timing is not as critical as it is for fungicides and insecticides. As a result there should be less pressure to apply them in marginal conditions. The application method should also be less conducive to drift.

- A summary of SWNZ data 2003/2004 (national figures are used unless Marlborough is specifically mentioned) shows that;93% of the blocks recorded in Marlborough used herbicides.
- The national average application number was 3.2 (where blocks recorded using herbicides).
- The majority (91%) reported spraying a strip less than 1 metre.
- 87% spot sprayed compared with 9% that sprayed the whole herbicide strip.
- One property (nationally) sprayed the whole vineyard area for the entire season.
- Glyphosate (eg Round up) was the main translocated herbicide used (85%) with Terbuthylazine products (eg Folar, Terb 500) making up the remainder 15%.
- Use of glufosinate ammonium (Buster) was also common but could not be quantified due to discrepancies in data between scorecards and spray diaries.
- Residual herbicide use ranged from 9-16% as a result of these discrepancies.

11.2.4 Summary

The number of applications of each type of agrichemical and the application timing was not included in the SWNZ report. This makes it difficult to ascertain how much of each active ingredient is likely to be used in Blenheim and whether the concentration of applications could be a significant factor in agrichemical accumulation. SWNZ highlighted that there were also some data discrepancies between scorecards and spray diaries especially in relation to herbicide use that would question the potential accuracy of any calculations. Growers may select agrichemicals based on resistance strategies, supplier, grower, SWNZ recommendation, personal preference, perceived efficiency and cost. SWNZ data is useful but does not provide all of the required information and a complete analysis of all Marlborough growers would be needed to assess potential health effects of current industry agrichemical use.

11.3 Application Methods

Application equipment and its calibration can influence drift and accumulation potential of agrichemicals. Prior studies have shown that particular equipment types can present more risk, however, they have also identified that calibration and applicator expertise can be of greater significance. Applicators are required to hold GROWSAFE Introductory certification which includes general equipment calibration techniques. It may need to be determined whether growers utilise this information or whether there is a need for more practical education requirements such as GROWSAFE Applied. There are no current regulations relating to equipment specifications aside from some label recommendations. Collation and trend analysis of equipment details associated with spray drift complaints may help determine whether this is a relevant issue.

11.4 Meteorological Conditions

Meteorological conditions that may be suitable for spraying[1] include wind speeds greater than 1 ms^{-1} and less than 6 ms^{-1}. Table 11.1 shows the number of hours between 6am and 8pm per month when conditions are not suitable for spraying. This shows that from October to March, when spraying is most frequent, there are between 11 and 14 hours per day, on average, when conditions may be suitable for spraying. Note that meteorological conditions will vary across the plains and that some microclimates may experience different wind effects.

This indicates that the meteorological conditions in Blenheim are likely to be suitable for spraying. The extent to which spraying on non-suitable days is required will, however, depend on the number of operators available to spray, their workload and their resources.

[1] Temperature is also a factor for some agrichemicals.

Table 11.1: Summary of meteorological conditions for 2006 (NIWA climate station)

	Unsuitable conditions (hr/month)	Suitable spray conditions (hr/month)	% of hours available	Average hours per day
January	83	382	82%	12
February	35	385	92%	14
March	56	409	88%	13
April	53	397	88%	13
May	68	397	85%	13
June	46	404	90%	13
July	30	435	94%	14
August	40	425	91%	14
September	94	356	79%	12
October	106	359	77%	12
November	118	332	74%	11
December	66	399	86%	13

11.5 Volatility of Agrichemicals Used

Ideally an assessment of the potential for heath impacts associated with different agrichemicals would include an assessment of the volatility of the different agrichemicals being used. Volatility is important as it describes how easily a substance will turn into a gas or vapour.

The COP identifies high volatility and drift hazard when an agrichemicals vapour pressure exceeds 10 mPa. Agrichemicals with vapour pressures less than 0.1 mPa are considered to be a low drift hazard. Vapour pressure and agrichemical concentration are important factors in determining whether a product will volatilise into the atmosphere after application.

Vapour pressure is not a mandatory requirement of product labels or safety data sheet (SDS). Analysis of vineyard agrichemicals listed in Appendix A show that approximately 75% of SDS obtainable did not have vapour pressures included or they stated that the vapour pressure was “not available”, “not determined”, “not applicable” or only available for part of the substance. SDS accessibility was another major issue encountered. Lack of volatility data makes it difficult to assess the comparative risks of agrichemical accumulation in the atmosphere and also reduces its effectiveness as a growers tool to minimise spray drift.

11.6 Toxicity and Health Risks of Agrichemicals Used

With limited comparative volatility data, it is difficult to ascertain the agrichemicals which are more likely to be retained in the ambient air. There are also difficulties in obtaining quality data which would enable accurate assessment of the amounts of each agrichemical being used in Marlborough. However, it is possible to consider the hazardous nature of agrichemicals that can be selected for use in vineyards and the indications of use obtained from SWNZ data in section 11.2.

The more hazardous agrichemicals are often substances that have one or more hazard classification listed in Schedule 1 of the Hazardous Substances (Tracking) Regulations. These include:

- Flammable liquids (Classes 3.1A and 3.2A).
- Flammable solids (Classes 4.1.2A, 4.1.2B, 4.1.3A, 4.2A and 4.3A).
- Oxidisers (Classes 5.1.1A, 5.2A and 5.2B).
- Toxic substances (Classes 6.1A, 6.1B and 6.1C).
- Ecotoxic substances (Classes 9.1A, 9.2A, 9.3A and 9.4A).
- Explosive substances (note: there are some exceptions to this).

Growers can opt for a range of different chemicals to control pest and diseases. It is expected that in order to meet export regulations, most growers will select agrichemicals from Appendix A.

A number of these substances are likely to be re-evaluated or have the risks and benefits examined in more detail by ERMA. Re-evaluation can result in a change in approval conditions or in extreme cases, withdrawal of approval. Grounds for reassessment of following active ingredients will be developed over the next five years.

Table 11.2: Active ingredients which will be reconsidered by ERMA in the next five years.

ACTIVE INGREDIENT	TRADE NAME OF AGRICHEMICALS WHICH CAN BE USED IN VINEYARDS
Chlorothalonil	BALEAR 500SC, BARRACHLOR 720, BARRIER, BLIZZARD, BRAVO, BRAVO 720SC, CHLOROTEK and ELECT 750SC
Paraquat	GRAMOXONE AND PREEGLONE
Carbaryl	CARBARYL 50F and SEVIN FLO
Chlorpyrifos	CHLORPYRIFOS 48EC, LORSBAN 50EC, LORSBAN 750WG, PYCLOREX 48EC and TOPELL
Diazinon	DEW 500, DIAZINON 50W, DIAZINON 800EC, DIAZONYL 60EC and DIGRUB

The summary from ERMA evaluation sheets on each of these active ingredients follows:

Chlorothalonil

Chlorothalonil is used as a fungicide for a variety of fruit, vegetables and ornamentals in New Zealand. It is also used in antifouling paints and antisapstains. There are 25 products containing chlorothalonil that are currently registered for agricultural use in New Zealand. Chlorothalonil has the potential to cause adverse effects to the kidneys and is suspected of being carcinogenic. It is also a skin sensitiser and corrosive to the eyes, of which several incidents have occurred involving workers re-entering treated fields. Chlorothalonil is very ecotoxic to the aquatic environment. It degrades to a persistent and eco-toxic degradation product. Hexachlorobenzene (HCB), an impurity in chlorothalonil, is listed as a Persistent Organic Pollutant (POP) under the Stockholm Convention (to which New Zealand is a signatory) and its levels as an impurity in chlorothalonil have been limited to 40 ppm by the United States Environmental Protection Agency (US EPA) and Food and Agriculture Organisation of the United Nations (FAO), and to 100 ppm by the Australian Pesticides and Veterinary Medicines Authority (APVMA).

Paraquat

Paraquat is a non-selective contact herbicide used to control weeds and grasses both in agricultural and non-agricultural areas. There are seven products containing paraquat that are currently registered for agricultural use in New Zealand. Ingestion of paraquat is usually fatal and it may cause serious lung and kidney damage. Accidental, deliberate and occupational poisonings have been reported in many countries. Countries overseas (e.g. EU member states) have requirements that paraquat formulations should contain an effective emetic, blue/green colourants and stenching agents to avoid poisoning from occurring. Emetic and stenching agents are added to registered products in New Zealand, which is a HSNO requirement. Paraquat is also very ecotoxic to aquatic environment. Many overseas regulatory jurisdictions have recently reviewed paraquat and have imposed measures to mitigate occupational, public health and ecological risks.

Carbaryl

Carbaryl is a broad-spectrum carbamate insecticide which is used on fruit trees, vegetables, ornamentals, lawns and the control of wasp nests. It is also used as a veterinary medicine on pets. There are currently seven products containing carbaryl that are registered for agricultural and veterinary medicine use in New Zealand. Carbaryl has the potential to cause adverse effects to the nervous system in humans at low concentrations. It is also suspected of being carcinogenic. It is also very ecotoxic to fish and honeybees. Many overseas regulators have reviewed, or are in the process of reviewing, carbaryl. The US, UK and Australia have imposed new and more stringent measures to mitigate the risks associated with products containing carbaryl in their respective countries. New measures have been proposed in Canada.

Chlorpyrifos

Chlorpyrifos is used in a variety of formulations on a variety of crops and also as an ectoparasiticide. There are currently 15 products that contain chlorpyrifos available for agricultural use in New Zealand. Chlorpyrifos has the potential to cause adverse effects to the nervous system in humans at low concentrations. Chlorpyrifos is also very ecotoxic to the aquatic organisms, birds and honey-bees. Chlorpyrifos is also bioaccumulative. A large number of human health and aquatic incidents involving chlorpyrifos have been reported overseas. The US, Canada and Australia recently imposed new and more stringent measures to mitigate the residential, occupational, dietary and ecological risks of chlorpyrifos. It is noted that the risks of the substance being use as an ectoparasiticide in food production are not assessed in the US EPA or APVMA review of chlorpyrifos.

Diazinon

Diazinon is an organophosphate pesticide used both as an insecticide for control of a range of insects on a variety of crops and in veterinary medicines for control of fleas and ticks. There are currently 32 products containing diazinon that are registered for agricultural and veterinary medicine use in New Zealand, including 14 insecticides and 18 veterinary medicines. Diazinon has the potential to cause adverse effects to the nervous system in humans at low concentrations. Diazinon is also very ecotoxic to aquatic organisms, birds and honey-bees. A large number of human health and environmental incidents involving diazinon have been reported overseas. The US recently imposed new and more stringent measures to mitigate the occupational, ecological and dietary risks of diazinon. The APVMA have also proposed similar measures. Canada and the European Union are currently in the process of reviewing diazinon.

Concerns about the following active ingredients were also highlighted in 2006 and 2007 re-assessment submissions and may be considered after the initial priority list has been completed.

Table 11.3: Active ingredients that may also be considered for re-evaluation by ERMA

ACTIVE INGREDIENT	TRADE NAME OF AGRICHEMICALS WHICH CAN BE USED IN VINEYARDS
Dicofol	KELTHANE 35
Mancozeb	DITHANE RAINSHIELD (NEO TEC), MANCOZEB 80W, MANEX II, MANZATE 200DF, PENNCOZEB DF, MANKOCIDE DF, RIDOMIL GOLD MZ WG
Iprodione	DEFENCE, FORTIFY, IPPON 500SC,ROVRAL FLO, ROVRAL GOLD, ROVRAL WP
Procymidone	SUMISCLEX
Simazine	GESATOP 500FW, GESATOP 900WG, SIMAGRANZ 900WG, SIMANEX 500SC, SIMAZINE 900DF
Diuron	AGPRO DIURON 800, KARMEX 80DF
Linuron	LINURON 50 DF, AFALON FL
Permethrin	ATTACK
Cypermethrin	RIPCORD
All Organophosphate insecticides	TOKUTHION 500EC, ATTACK, DIGRUB, DIAZONYL 60EC, DIAZINON 800EC, DIAZINON 50W, DEW 500, TOPELL, PYCHLOREX 48EC, LORSBAN 750WG, LORSBAN 50EC, CHLORPYRIFOS 48EC

The fact that these active ingredients have been identified indicates that there may be potential issues with spray drift and large volumes accumulating in the atmosphere. However, many of these agrichemicals are just options growers may select to control a particular weed, pest or disease. Indications from section 11.2 are that SWNZ members generally limit or avoid many of these agrichemicals. However, this only accounts for approximately half the vineyard area in Blenheim and amounts of each agrichemical used by SWNZ were not always specified. In absence of actual data to determine the amounts of specific agrichemicals being used and in what sort of quantities, it is difficult to establish inherent risks associated with these practises and whether monitoring for these specific active ingredients is worthwhile.

Given the scale of industry around Blenheim and the fact that there is little information relating to atmospheric agrichemical accumulation and its effects, it is also important to consider the collective use of a fungicide like sulphur. Products containing sulphur are not comparatively hazardous (usually classed 6.4 and 9.1D). However, they are used frequently (SWNZ Marlborough data showed 4.9 applications in 2003/2004) and within a relatively short time period (generally every 10-14 days from bud burst until veraison). 80% of Marlborough SWNZ growers used less than 18kg/ha elemental sulphur in 2003/2004. If for example the Marlborough average (including non SWNZ members) worked out at 10kg/ha, the amount applied to the region would be 115 tonnes per year.

The lack of knowledge surrounding the processes that take place when different agrichemicals are released make it difficult to determine the impacts of sulphur or any other agrichemical. The development of environmental exposure limits (EEL's) and tolerable exposure limits (TEL's) to account for current limitations and setting limits for each agrichemical may enable analysis of whether the concentrations around Blenhiem are of legitimate concern. There is not currently enough information to limit monitoring to specific agrichemicals. However, future data collation and collaboration with industry organisations such as SWNZ may help resolve this issue.

It is important to note that some of the agrichemicals identified in this section do not currently require tracking. This may indicate that the knowledge and controls related to these substances may be inadequate. This situation may be resolved as part of re-evaluation by ERMA. However, it highlights the fact that knowledge about agrichemicals and impacts of their use is continually evolving and that there may be unidentified risks associated with any number of them.

12 Summary

The purpose of this report was to determine if spray drift and agrichemical accumulation in the atmosphere is a community health concern given the intensive vineyard operations surrounding Blenheim. The result of this investigation would then determine whether additional controls are needed on the industry in order to minimize these impacts.

The assessment of the impacts of agrichemical use involved consideration of; the factors that influence of primary and secondary drift, current knowledge of agrichemical accumulation, rules and regulations, complaints, impacts of agrichemical exposure, sensitive areas, agrichemical use trends and current agrichemical use in vineyards.

Analysis of these areas resulted in identification of a number of current limitations which inhibit accurate assessment. These include a lack of standardized systems to capture and collate agrichemical use data for all industry members in Marlborough, as well as a lack of knowledge relating to the processes surrounding agrichemicals and their persistence and accumulation in the atmosphere. There are also indications that historically in New Zealand, the true incidence of spray drift has not been represented and that the quality of reporting and subsequent investigation has not been sufficient. The wide range of symptoms associated with agrichemical exposure has also made it difficult to diagnose and known incidences have also not been reported to appropriate authorities. Agrichemicals were only transferred to the HSNO Act in July 2004 and knowledge of agrichemicals and development of suitable controls is still evolving. Measurable environmental standards such as environmental exposure limits (EEL's) and tolerable exposure limits (TEL's) need development and limits set for agrichemicals of concern as well as agrichemicals with a high usage.

A number of recommendations were suggested to address these issues and ensure accurate assessment and future analysis is possible. Some of these suggestions require MDC to develop relationships with a number of organizations in order to ensure that the required data is captured and that the impacts are represented accurately. These include key industry organizations such as NZW and SWNZ, as well as, ERMA, Ministry of Health, United States Agricultural Research Service as well as agencies involved in collection of impact data e.g. National Poisons Centre.

The Plan needs to be updated to include HSNO legislation and improve clarity and agrichemical management requirements. There also needs to be provision for accurate standardised data collection and analysis of factors relating to agrichemical use. These records should be maintained for a period of at least 10 years for use in future health studies of the Blenheim population. MDC also need to develop a standardized approach to drift complaints and investigations in order to capture all necessary data and allow for future comparisons.

13 Recommendations

This section identifies how MDC can resolve current limitations associated with determining and managing potential impacts of spray drift and atmospheric agrichemical accumulation around Blenheim.

The report has also highlighted a number of areas which could be improved within the industry. These recommendations are listed in Appendix D.

Action 1: **Develop working relationship with key industry organisations such as NZ Winegrowers, and Sustainable Winegrowing New Zealand (SWNZ).**
Reason: All parties have something to offer and are working towards the same goal.

Action 2: **Update Plans to incorporate HSNO legislation.**
Reason: Toxic Substances Regulations (1983) is no longer relevant.

Action 3: **Review agrichemical requirements in the proposed Wairau/ Awatere and operative Marlborough Sounds Resource Management Plan.**
Reason: Improve clarity and consistency for applicators, provide for collation of agrichemical use data, sensitive area identification, notification, signage etc.
Suggestions: Analyse other plans and recommendations from significant sources. Include specific information rather than referencing the COP.

Action 4: **Review other plan management strategies e.g. setbacks, buffer zones/shelterbelt requirements.**
Reason: Minimise potential land conflicts and cross boundary effects.

Action 5: **Promote GROWSAFE Applied certification for applicators.**
Reason: GROWSAFE Introductory encompasses a wide subject area and is usually delivered in one day. GROWSAFE Applied is more practical.

Action 6: **Investigate all drift complaints using a standardised format.**
Reason: Many spray drift complaints have not been investigated and lack vital information.
Suggestions: Examples are given in Appendix E.

Action 7: **Increase awareness in community of complaints process and inform complainants of any outcomes.**
Reason: Encourage reporting, increase community confidence and identify where industry needs to improve.
Suggestions: Provide grower requirements and spray drift information on MDC website and have online complaints submission which includes all required information.

Action 8: **Annual communication with other data collection agencies e.g. National Poisons Centre**
Reason: Ensure that the number of agrichemical incidences in Blenheim is being accurately represented.

Action 9: **Ensure enforcement orders, prosecution, abatement notices or infringement notices are issued where appropriate.**
Reason: There must be some repercussions and incentives for repeat offenders. It only takes a few poor operators to give an industry a bad reputation.

Action 10: **Regular monitoring of groundwater, rainwater and public water supplies for all agrichemical residues and ensure public has access to this information.**
Reason: Ensure public safety.

Action 11: **Monitoring of spray drift deposition in specific sensitive areas of concern.**
Reason: Ensure public safety from primary and secondary drift.

Action 12: **Development and adoption of a quick, simple standardised spray plan and spray diary software that incorporates information from a proposed spray plan plus the actual spray programme. This would be submitted electronically and include other relevant information such as equipment used and sensitive area identification.**
Reason: Improve agrichemical use analysis, council knowledge and investigations.
Suggestions: Work with SWNZ and NZ Winegrowers to develop existing software e.g SprayLog.

Action 13: **Spray diary information is collated for a period of at least five years.**
Reason: Enable information to be used as part of a future observational study of the health of the Blenheim population.

Action 14: **Review MDC responsibilities under the HSNO Act.**

Action 15: **Monitor how effective controls under HSNO Act are in strengthening agrichemical use.**
Reason: The control of agrichemicals under the Act is relatively recent and there may be areas for improvement.
Suggestions: Note areas of concern and work with ERMA to address the issues or address them in additional Plan requirements.

Action 16: **Remain updated with ERMA EEL and TEL developments and how these can be applied.**

Action 17: **Keep updated with United States Department of Agriculture, Agricultural Research Service and, National Air Quality Programme in relation to the knowledge gaps associated with agrichemical accumulation.**

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