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Orchards near sensitive water resources

Purpose

Orchards are a long-standing and valued contributor to the well being of the community and State economy. Like other Western Australian industries, they need to operate in harmony with the environment to ensure their sustainability and community support. Orchards conducted intensively without barriers to prevent chemical leaching into the environment can pose a threat to the quality of this State's water resources. Threats may arise from chemical leaching driven by over-watering, excessive or poorly timed use of fertilisers or pesticides, soil erosion, inappropriate storage of chemicals and disposal of wastes that can leach contaminants. Pollutants can move into surface water catchments as suspended solids, bound to other sediments, or into groundwater by dissolving in water. This note offers guidance on establishing and operating orchards within the vicinity of sensitive water resources and aims to minimise any risk of water contamination.

The Department of Water is responsible for managing and protecting the State's water resources. It is also a lead agency for water conservation and reuse. This note offers:

- the Department's current views on the establishment and operation of orchards;
- guidance on acceptable practices used to protect the quality of Western Australian water resources; and
- a basis for the development of a multi-agency code or guideline designed to balance the views of industry, government and the community, while sustaining a healthy environment.

This note provides a general guide on issues of environmental concern, and offers potential solutions based on professional judgement and precedent. The recommendations made do not override any statutory obligation or Government policy statement. Alternative practical environmental solutions to suit local conditions may be considered. Regulatory agencies should not use this note's recommendations without a site-specific assessment of any project's environmental risks. Any conditions set should consider the values of the surrounding environment, the safeguards in place, and take a precautionary approach. The note shall not be used as this Department's policy position on a specific matter, unless confirmed in writing.

Scope

An orchard is defined as *a garden consisting of a small cultivated wood without undergrowth* and typically incorporates fruit or nut trees. This note covers commercial orchard varieties grown in Western Australia. These are diverse and include cool climate varieties such as apples, stone fruit, mulberries, peaches and cherries and Mediterranean climate species such as almonds, avocados, olives, dates, citrus and figs.

Tropical species such as bananas, mangoes, papaws and various nut trees are also included. Each species requires different conditions, inputs and management techniques to optimise crop yield while avoiding nuisance to neighbours or harm to the environment.

This note is not intended to cover vine crops such as grapes, passion fruit and berries, or orchard species grown in home gardens for on-site consumption, however it may offer useful advice to home gardeners.

Commercial orchards in most areas of Western Australia require a reliable year-round low salinity water source. This limits their distribution to areas such as around the Ord River, the Gascoyne River, the Swan Coastal Plain, Perth Hills and within the south-west corner of the State.

This note applies to both new and established orchard operations growing plants alongside or upstream of sensitive water resources (as detailed in Appendix C).

Recommendations

Starting an orchard

1. A whole farm plan should be prepared covering establishment and management of the orchard as an essential tool to ensure the optimum use of natural resources. The plan should include a map of the farm, neighbouring areas, the location of any nearby surface or ground water resources and a strategic plan for the farming enterprise including establishment, operation, best practice management, markets, finance, water and environmental management, ongoing risks and opportunities.

2. When seeking approval for a new orchard or expansion of an existing orchard, farmers should obtain a Horticultural Development Application (HDA) kit from the Department of Water or the Department of Agriculture and Food. The HDA kit contains an application for the clearing of native vegetation, a licence application for extracting ground and/or surface water and outlines the requirements of the various other government agencies. The first point of contact for land use planning related queries should be the local government authority (LGA).

3. Growers seeking to commence drawing water from any well, wetland or waterway should contact their local Department of Water office to find out the statutory obligations and whether sufficient water is available for allocation in declared management areas. With the exceptions of domestic and stock use and fire fighting, a licence is needed to draw water from the environment under the *Rights in Water and Irrigation Act 1914,* in proclaimed areas.

4. Clearing of native vegetation in particular parts of the State is restricted through amendments to the *Environmental Protection Act 1986* proclaimed in 2004. Under the new laws many instances of clearing native vegetation require a permit. Exemptions from a permit for low impact day to day clearing activities may apply. Land owners are required to submit an application to clear if an exemption does not apply, which are subject to a detailed assessment process. Clearing applications will be assessed for the impact on biodiversity, water and soil resources, salinity and other environmental issues. Alternatively, if there are significant environmental impacts on non-land degradation matters, such as biodiversity, the proposal may be referred for assessment to the Environmental Protection Authority under Part IV of the *Environmental Protection Act 1986*.

Site selection

Within Public Drinking Water Source Areas

Public Drinking Water Source Areas (PDWSA) include Underground Water Pollution Control Areas, Water Reserves and Catchment Areas declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947*. They provide for public (scheme) water supplies within defined catchments.

The By-laws under these Acts provide the Department of Water with regulatory powers to protect water resources used for public drinking water supplies.

Policy used to protect PDWSA defines three priority classifications of land areas based on land tenure and intensity of use. Management strategies differ for each priority classification. For detailed information, refer to this Department's Water Quality Protection Note *Land Use Compatibility in Public Drinking Water Source Areas*.

5. In Priority 1 (P1) PDWSA, orchards are an incompatible land use. Incompatible means the activity is likely to conflict with this Department's strategy to protect drinking water quality. In P1 areas the objectives are no degradation of water quality and risk avoidance. This Department will oppose all proposals for new or expanded orchards in P1 areas.

6. In Priority 2 (P2) PDWSA, orchards operated intensively (ie involving irrigation and/ or regular additional inputs of chemicals to soils, including fertiliser) are a conditional land use. P2 areas are managed based on the principle of risk minimisation. The management objective is to ensure that there is minimal risk of contamination of the water source beyond its present ambient (seasonal) quality. Orchards are generally accepted in P2 areas with conditions eg protective buffers to water resources and constraints on chemical application.

7. In Priority 3 (P3) PDWSA, orchards are a compatible land use. However, management practices should demonstrate that the activity can be conducted using best environmental practice without a significant risk of increasing contamination to local water resources above the guideline values defined in the current *National Water Quality Management Guidelines*. P3 areas are designed to manage the risk of contamination to water sources.

Near natural waterways, within defined Waterways Management Areas or in the Swan River Trust Management Area

8. Newly developed orchards should not be situated within any waterway riparian zone.

9. Adequate separation buffers should be maintained between orchards and waterways to minimise the risk of degradation of water resource quality. These separation buffers are determined on the basis of waterway values, vulnerability and biophysical criteria (detailed in the Department of Environment and Conservation's Water Note 23, see Appendix A, Reference 2e). The buffers should be covered with natural vegetation, sustained with minimal intervention and protected from impact caused by adjoining land use activities. For further information refer to the Department of Water's Water Quality Protection Note *Vegetated buffers to sensitive water resources*.

10. If a development is located within a Waterways Management Area, approval must be sought under the *Waterways Conservation Act 1976* from the Department of Water's regional office.

11. If an orchard development is located within a Swan River Trust Area approval must be sought from the Trust in accordance with the *Swan River Trust Act 1988*. For information on the locations of these areas, contact the Swan River Trust.

Near Conservation valued wetlands

12. On the Swan Coastal Plain, a proposed orchard development within 200 metres of any Ramsar listed, Conservation or Resource Enhancement category wetland and those identified under an Environmental Protection Policy should be referred to your local Department of Environment and Conservation office for assessment. Wetland types include lakes, damplands, sumplands and palusplains. Supporting information should demonstrate that the management practices to be employed will protect the wetland from deleterious impacts associated with the orchard operations. For more information see the Department of Environment's *Position Statement: Wetlands 2001*. For advice on wetland buffers contact your local Department of Environment and Conservation office.

13. Outside the Swan Coastal Plain, proposed orchard developments within 200 metres of any wetland should be referred to your local Department of Environment and Conservation office for assessment. Supporting information must demonstrate that the management practices employed will protect the wetland from deleterious impacts associated with the orchard operations. For advice on wetland buffers contact your local Department of Environment and Conservation office.

Other siting constraints

14. A minimum vertical separation distance of two metres to the maximum (wet season) groundwater table is recommended for free draining soils. This is to avoid waterlogging and allow for soil contaminant filtration and aerobic microbial action.

15. The size of the property should be evaluated to match with the requirements for orchard area, buffer distances, stormwater management and expected future expansion plans. An orchard should not be established close to an existing or proposed urban or rural residential zone. The Environmental Protection Authority Guidance Statement No. 3 provides information on determining appropriate separation distances.

16. Special issues that should be considered in relation to orchard siting include lot sizes, memorials to titles, effects of increased public access and traffic, urban pressures and increased tourist activity.

17. The layout of a property and its general topography should be considered carefully in the establishment of an orchard. Slopes should be taken into consideration for their effect on water movement through the orchard and across the whole property. For instance, it may be possible to gravity feed water rather than use pumped irrigation systems.

18. Orchards should not be established on steep ground, as the greater the slope, the greater the risk that soil erosion may occur. Slopes exceeding one in ten have increased erosion potential. Erosion risk also increases with slope length.

19. Trees infested with pests eg insects, scale or fungi are a menace to adjacent farms. When evaluating sites for replanting or suitability for commercial production, the current efforts made by neighbours, municipalities and regional districts to fight pest infestations should be considered.

Orchard management

20. Orchards should be laid out such that the row direction, planting width, training system and canopy management optimise air movement and sunlight exposure to facilitate disease control and improve fruit quality. Well planned and properly maintained trellising for tree sculpting together with effective canopy management and training can reduce the frequency of spraying and the amount of chemicals required.

21. Domestic grazing animals and vermin should be excluded from the orchard prior to and during harvest. This is designed to minimise the potential for contact of disease causing microbes with fruit and water. Ideally animal manures used to fertilise orchards should be properly composted or sterilised before application. Composting of animal manures involves storing in heaps for at least three months, with monthly turning to aerate the pile.

22. Areas of native vegetation should be protected or restored wherever practicable. Native vegetation serves a range of beneficial purposes such as harbouring natural pest predators, filtering water run-off, acting as a wind-break and binding soil reducing the potential for erosion. Local native vegetation should be maintained or reintroduced to slopes, along stream banks, in wetland buffers, along the perimeter of the farm and on degraded or unproductive land.

23. The best quality planting material available should be used when establishing an orchard. Cultivars vary in their growth habit, growth cycle, disease susceptibility and need for chemical application, all of which may impact on product yield and quality.

24. The mixing of early and late-season fruit varieties in the same row should be avoided, as this may result in inefficient labour and machinery operations. Different varieties also have different tolerances to pests and diseases and may need different control programs.

25. Mechanical servicing of tractors, cultivators and other orchard machinery should be managed in accordance with the Department of Water's Water Quality Protection Note *Mechanical Servicing and Workshop Facilities*.

26. Packaging, washed chemical drums, bags and inert waste materials should be recycled where possible or disposed of at a local government approved facility remote from sensitive water resources. Green wastes, such as aged trees, are best mulched and recycled on the property.

27. Fruit storage (eg in cool rooms) and preservation should be conducted under safe and sanitary conditions. Chemical preservation and fumigation of fruit should be carried out to supplier's and health (food safety) specifications.

28. Waste liquids or wash-down should be captured in an adequately designed process waste management system, or disposed of off-site in a local government approved facility. Waste containers should always be available and waste materials disposed of regularly.

Soil management

29. A Soil Management Plan, prepared in consultation with a soil professional, should be used to define the most appropriate management practices for orchards. Good soil management promotes healthy plant growth, productivity and overall fruit quality, while preserving soil structure. Investing time and energy in maintaining soils will keep them more resilient and create a buffer under tough climatic conditions, as well as reducing the requirements for water, fertiliser and pesticide use.

30. The application of soil amendments in established orchards should be carefully considered as poor timing and nutrient imbalances can be detrimental to productivity and the health of the fruit trees, and may result in leaching of contaminants into water resources. Compost, manure and mulch are recommended as they are organic and allow beneficial soil fauna and microbes to flourish, provide nutrients in a stable form over an extended period of time, add organic matter to the soil, improve the physical condition and mineral balance of the soil, reduce the erosion potential and keep the soil cool. If organic matter is used, it is best incorporated into the topsoil bed to achieve an even spread of nutrients with the least amount of waste.

31. The following factors should be considered in preparing a soil management plan:

    a. Fine-textured soils and clays have lower water infiltration rates and bind chemicals more easily, thus preventing them from rapidly moving downward. They are also more erosive and susceptible to surface sealing. This is particularly true when irrigation is applied frequently and the surface is not allowed to dry between irrigation events.

    b. Sandy soils and gravel generally have a lower water-holding capacity and higher infiltration rates. This is an advantage in terms of getting water into the soil without the routine runoff, but it can lead to over-irrigation resulting in wastage and the potential for leaching of nutrients into the groundwater. Sandy soils can be amended with clay, loam or organic matter to increase moisture retention and minimise leaching of nutrients.

32. Soil structure and fertility can be damaged by over-cultivation, soil ripping or tillage, removal of ground cover, excessive nutrient leaching from over irrigation, drought or storm events. In windy regions, growers should consider planting or building permanent windbreaks on their property and mulching between planting rows. Susceptibility to wind erosion is greatest when plants are young and/or the ground is unprotected from the elements.

33. Establishing perennial grasses or annual cover crops between planted rows, or during periods of rest between the removal of old plant stock and the establishment of new plants provides protection for soil from the detrimental effects of wind and water. This can reduce dust problems and soil compaction, improve soil structure and increase the uptake of excess nutrients. Planting nitrogen-fixing groundcovers such as legumes can also be beneficial in replacing nitrogen in the soil.

34. Compaction reduces soil pore size and lowers a soil's ability to hold both air and water. Severe compaction may lead to premature fruit tree aging, damage to tree roots, poor drainage, excessive run-off and less effective uptake of nutrients. Under suitable conditions, it may be possible to break up existing layers of shallow surface compaction in the soil by tillage.

35. Intensive production makes it necessary to enter farms with machinery when ground moisture conditions may lead to compaction. Compaction can be reduced by cutting back on the frequency of equipment use, limiting the area affected by equipment and using equipment with axle weights and tyre dimensions which decrease the load transferred to the soil.

Water management

36. Growers should implement water use efficiency procedures in all aspects of their business. For further information, see the Water Corporation's web page at www.watercorporation.com.au/W/waterwise_index.cfm.

37. Producers should ensure that the quality of surface water leaving or passing by the farm is not degraded by farm operations. Any contaminated stormwater should discharge into a well-designed process waste management system. Periodic testing of drainage run-off helps in assessing if a potential water contamination problem exists. Orchardists should contact a water testing laboratory (see *Analysts* in the Yellow Pages) for advice on collecting and consigning representative samples.

38. Reducing or capturing unnecessary water flows off the orchard is effective in preventing contaminated run-off problems. Where it is impracticable to prevent run-off, waterways should be protected with culverts or earth berms and wetlands protected by maintaining or rehabilitating buffers with local native species.

39. Where dams are planned, the location should be carefully considered to minimise breaks in waterway vegetation continuity. Where practicable, gullies and waterways should be fenced off to reduce access and disturbance to the waterway or its riparian vegetation.

40. Waterways and wetlands should not be altered from their natural state. Growers should avoid converting waterways and wetlands into drains and restore them to their natural condition wherever practical. Straightened waterways can be difficult to maintain as the waterway re-asserts its natural form, meandering across the landscape. Meanders (natural bends in the waterways), riffles (areas of shallow, fast flowing and broken water over rocks or logs), woody debris and pools within a waterway are just as important as vegetation. They provide different areas of habitat for stream flora and fauna and contribute to the overall health of the system. A healthy waterway or wetland is an asset. The *Rights in Water and Irrigation Act 1914* and associated regulations constrain interference with watercourses for proclaimed surface waters.

41. In some instances, diverting degraded waterways around properties or piping drainage water through a property can assist in reducing contamination. However, this should only be attempted after all other steps have been taken to reduce the pollutant inputs. Topographic data will be required to design stream diversions. The waterway should be designed so that the longitudinal slope and banks are not too steep. The banks should be designed with a maximum slope of one to four.

The maximum bed slope needed to prevent erosion will depend on the bed paving materials, channel depth and shape, channel vegetation, and hydrological conditions. Typical sandy bedded watercourses on the Swan Coastal Plain have a slope of about one to a thousand. Steeper slopes can be acceptable where effective channel stabilisation techniques have been employed, such as installation of bed control structures, log or rock riffles.

42. In designing diversion channels, a stable natural channel form should be replicated as far as practical, including the shape, cross-sectional area, slope, meander pattern and vegetation composition of a healthy waterway. Further guidelines on stabilising and designing waterways are provided in the Department of Environment and Conservation's *River Restoration Manual*.

43. Where freshwater supplies are limited, stormwater and wastewater may be stored in dams and used on the property. Dam water should be carefully managed to maintain its quality. Recycling the water through the property can help in the removal of further nutrients and other potential pollutants. The water should be routinely tested to ensure contaminants (eg salt accumulation) do not threaten the crop.

44. Dams used to recycle treated wastewater for irrigation or evaporation should be designed to waste stabilisation pond criteria, with capacity for effective water containment during the statistical wettest year in ten. Waste stabilisation ponds are most easily installed where the land slope is less than one in 10, the watertable is below one metre from the pond base and the soils are deep and sufficiently impermeable (less than 10 millimetres per day permeability) to retain the wastewater. Low permeability clay and/ or synthetic pond liners should be used in porous soils. See the Department of Water's Water Quality Protection Note *Ponds for Stabilising Organic Waste* for more information.

45. Most fruit trees require a watertable depth of more than half a metre below the surface for an optimum root depth. The maximum watertable depths of a site should be considered early in the selection process. Good drainage is also important as it reduces surface run-off, which in turn reduces the transport of contaminants. Any drainage channels should be properly located and designed to reduce the risk of erosion and minimise nutrient transport. Vegetated or grassed swales should be used to convey drainage waters, rather than trapezoidal ditches. Densely vegetated swales have gently sloping banks and the native vegetation assists filtering and trapping of sediments and pollutants. Benefits of improved drainage include an improved soil structure, increased fertiliser uptake, greater flexibility for cropping, longer growing season and greater erosion control.

46. A large proportion of stored contaminants are released in the first runoff flush after rain. Retention basins, swales and similar water treatment processes can be integrated into a farm layout to capture this water and minimise the release of potential contaminants from surface water run-off. Ditches or intercept drains, contour banks or vegetated filter strips should be constructed across the slope on the contour to control overland flow. Ditches can be backfilled with gravel to increase the infiltration and interception of surface water. Revegetating stream beds and basins with native rushes and sedges can also help to reduce the speed of water flow and filter out excess nutrients. See the Department of Water 's *Stormwater Management Manual for Western Australia 2004* for more information.

Irrigation

47. To ensure that an irrigation system is designed correctly, the grower should consult an irrigation specialist. The specialist should provide an irrigation plan complete with design parameters and operating characteristics.

48. Controlled water application on plants (via trickle irrigation, drip line or low level micro sprinklers) is preferred to broad scale watering (via knocker sprinklers or water cannons) as it provides precise and even wetting. Where sprays are necessary to limit frost damage or leaf burn, part circle sprinklers or shrouds should be used or sprinkler heads realigned to direct spray only on the trees where practicable.

49. Soil moisture should be monitored using tools such as tensiometers or neutron probes. These tools monitor water penetration of the soil and may be used as a tool to plan appropriate water application rates or initiate irrigation cycles. Electronic timing devices can be used to vary the amount and frequency of water application in orchards to match the seasonal conditions.

50. Poor irrigation practices can cause environmental problems including waterlogging, salt build-up and excessive loss of nutrients. This wastes resources and may affect crop performance. Irrigation water should be tested regularly for salt and pH levels and seasonal limits set for acceptable usage.

51. Irrigation systems should be inspected frequently and faulty nozzles cleaned, repaired or replaced promptly. Common faults include blocked filters, lime or iron encrustation, leaking gaskets, defective sprinkler bearings (resulting in leaks and uneven rotation), shrouding by posts and uneven pressures due to incorrect pipe sizes or differences in field elevation. Vegetation that impedes the spray should be cleared from around sprinkler heads or the sprinkler height adjusted.

52. An irrigation schedule should be based on soil and environmental conditions rather than the calendar, to ensure that plant requirements are met without water being wasted. Irrigation should be turned off after moderate to heavy rainfall has replenished moisture in the root zone. It is best to irrigate during the late evening or early morning hours when evaporation and wind losses will generally be the lowest.

53. Irrigation should be designed to suit the stage or age of trees (eg if you put young plants in amongst older ones and on the same irrigation line, put in a smaller sprinkler head for the trees with less root development). It is preferable to have different age trees on different irrigation lines. Sufficient water should be applied to wet the top-soil profile, however drainage below the plant's root zone should be minimised.

Pollutants

54. All potential sources of pollution on your property such as process area wash-down, stormwater run-off, leaking fuels, pesticide and fertiliser leaching, disinfectants, fumigation, fruit processing solution wastes, septic tanks and rotting fruits should be considered, and all necessary practical steps taken to minimise the potential for environmental contamination.

Fertiliser management

55. Fertiliser application should be targeted to the area encompassing the root zone of the plants. Typically nutrients are applied through top dressing, however, fertigation (the controlled application of soluble fertiliser in irrigation water) is increasingly being used as an efficient way of applying the required nutrients.

56. Regular soil and leaf analysis is recommended to assist in establishing the nutrient status of an orchard. The application of nutrients to the soil must be linked to an understanding of the background fertility of the soil in the root zone, the chemistry of the irrigation water (including the pH and soluble salts), specific tree requirements and the timing of the plant growth cycle.

57. Accurate monitoring records of cropping history, fertiliser application and fruit yield and quality should be maintained. These provide the basis for decision-making in future applications.

58. Excessive application of nutrients should be avoided, as high nutrient levels can be detrimental to tree health and reduce fruit yields. For example, heavy nitrogen application during summer can promote excess leaf growth which competes with the developing fruit for carbohydrate reserves.

59. Fertilisers should be selected preferentially for low solubility or slow release to achieve extended nutrient supply. For example, nutrients in composted organic matter are less susceptible to leaching and are released more slowly into the soil than soluble inorganic chemical fertilisers. Using small quantities of fertiliser frequently when needed or applying the fertiliser during periods of low rainfall will assist in optimal plant growth and hence minimise contaminant leaching.

60. Stockpiling fertilisers and animal manures in areas where the run-off can flow into waterways and wetlands should be avoided. Composts should be prepared in accordance with the *Agricultural Composting Handbook* available from the Department of Agriculture and Food. Manure should be fully stabilised before use and nutrients in the manure should be at appropriate levels for healthy plant growth.

61. Fertiliser storage areas and transfer stations need to be managed carefully. They should be located away from areas where excess nutrients can potentially run-off into waterways, wetlands, ditches and bores. Fertilisers should be stored in a dry, weather-proof area with concrete floors featuring bunds around the perimeter and/or recovery sumps to provide containment and aid in the clean-up of spills. They should also be stored out of direct sunlight in a well-ventilated, cool, dry area in order to maximise their shelf life.

62. A 30 centimetre air gap between the water supply outlet and any liquid fertiliser mix container or an approved back flow prevention device is recommended to avoid contamination of the water source. Liquid fertiliser tanks should not be left unattended during the filling procedure to avoid overflows.

Pesticide and herbicide management

63. If an orchard is located within a Public Drinking Water Source Area (PDWSA) orchardists should follow the advice given in the Department of Water's *State-wide Policy No.2 - Pesticide use in PDWSA*.

64. Where herbicides are used in the management of orchards, spraying should be conducted in accordance with the Department of Health's *PSC 88 Use of Herbicides in Water Catchment Areas,* and follow the Department of Environment and Conservation's *Water Note 22 Herbicide Use in Wetlands*.

65. Where possible, the use of pesticides and herbicides that remain mobile and toxic in the environment over an extended period of time should be avoided. Alternately pesticides and herbicides with a low water solubility and persistence can be used to avoid water resource contamination.

66. Other factors to consider in the selection process are the adsorption level (how strongly it clings to soil), volatility (how easily it vaporises into the atmosphere), specificity (how target-specific it is to the pest) and toxicity (the degree to which it is harmful or poisonous). Note that pesticides and herbicides generally require air and sunlight to break down.

67. An integrated pest management (IPM) approach for controlling pests is recommended. IPM is a site-specific, systematic approach to controlling pests which seeks to minimise the damage caused by pests, the potential environmental impacts of pesticides and the development of pest-resistance to pesticides. IPM is achieved by encouraging ecological processes and pest predators in order to ensure that pest levels are maintained at manageable levels. It should also be noted that vigorous, healthy plants are less prone to pest attack and require less pesticide inputs.

68. A monitoring program of pest and weed populations, associated cycles and their preferred environmental conditions is recommended. By identifying the presence of pests and weeds and the stage of their life cycle prior to spraying, the pesticides or herbicides used can be target-specific. Monitoring allows pesticides and herbicides to be applied at the most critical times, resulting in more effective control. It can also allow treatment to be limited to an affected part of an orchard. Records of pesticide and herbicide usage and the impacts over time allows for evaluation of the effectiveness of the control methods used. This ensures that pesticides and herbicides are having the desired effect, and allows determination of whether there are more efficient and environmentally friendly ways of controlling the pests and weeds.

69. All pest control options should be considered, including selecting more resistant crop strains, crop rotation, encouraging pest predators, netting, applying pest deterrents, hand picking pest organisms off plants and new technologies such as covered spray systems that recycle the excess spray. Use of pesticides and herbicides should be minimised wherever practical. Where only a few pests or weeds are found, hand pick or spot spray them before they take hold. It is far easier to remove a few pests or weeds when they are first seen on the property than to wait until a full-scale control effort is necessary.

70. When pesticides and herbicides are called for, those that are least toxic to the environment and least damaging to non-targeted organisms should be used. Pesticide application during times of low activity should protect beneficial insects and pest predators.

71. To help control weeds on the property consider mowing or slashing the weeds prior to or during flowering and leave the mulch to protect the soil surface.

72. Consider climatic conditions (eg temperature, wind and rainfall) when using pesticides and herbicides as this can impact on the effectiveness and quantities required. Pesticides and herbicides should not be applied prior to rainfall events and high volume mist sprayers should not be used in wind velocities likely to cause spray drift. To reduce spray drift impact establish barriers, such as windbreaks, between the application site and areas that may be harmed.

73. Pesticides and herbicides in different chemical groups should be rotated to reduce the potential for pests to develop resistance to specific active ingredients.

74. All spray equipment should be properly set up and calibrated before the chemicals are applied This should occur at least three times every season if equipment is used regularly. Trial runs using water are recommended to ensure the rate of application is even. Regular calibration helps reduce the amount of over spray of trees that can lead to off-site contamination. All of the following are important when calibrating spray equipment; tractor speed, pressure gauge settings, air volume, chemical rates, nozzle selection and target pests, weeds or diseases. To limit wind drift, select the spray pressure, nozzle type and nozzle dimensions to avoid the generation of fine spray droplets.

75. It is good practice not to purchase more pesticide or herbicide than you will be able to use in one growing season. All chemicals in the spray tank should be used up or recycled and the spray tanks washed out after each application. Concentrated residues and unwanted pesticides and herbicides should not be allowed to run to waste on the ground or into water systems. Equipment wash water may be used to dilute the following spray batch.

76. Only pesticides and herbicides that are registered for the particular pest and crop of interest should be used. The label will provide all directions for correct use including the safety precautions. Suppliers of chemicals provide a Material Safety Data Sheets for each chemical they sell. The brochure *Preparing Farm Chemical Containers for Safe Disposal* produced by AVCARE (National Association for Crop Protection and Animal Health), should be followed.

77. Growers should check with their suppliers to see what types of packaging can be recycled. Non-recyclable packaging material should be taken to an approved local government landfill site. For information on disposal of empty pesticide containers, contact your local Agriculture Protection Board or the Department of Agriculture and Food. Growers should contact their local council for details of the *DrumMuster* program. *DrumMuster* is the collection scheme for non-returnable rigid metal and plastic containers used for packaging of crop production and animal health products.

78. Pesticide and herbicide storage areas and filling stations should be located away from areas where they can potentially run-off into waterways, wetlands, ditches or bores and be managed carefully.

These products should be stored in a dry area with concrete floors featuring perimeter bunds and/or recovery sumps to provide containment and aid in the clean-up of spills. They should be kept out of direct sunlight in a well-ventilated, cool, dry area in order to maximise their shelf life.

79. Products that deteriorate or become chemically altered should be appropriately disposed of to avoid creating an environmental hazard. The pesticides and herbicides should be in a locked storage area with warning signs on entrances and only be accessible to authorised people.

80. Only a licensed applicator should apply any necessary highly toxic chemicals. Only registered pesticides or crop regulators should be used and the action of the chemical should be well understood before application. All chemicals must be used in the manner and for the purpose prescribed on the label and in accordance with the *Health (Pesticide) Regulations 1956*. To do otherwise is an offence and may harm operators, neighbours and the environment.

81. All pesticides must be stored, applied, transported and disposed of in accordance with the *Health (Pesticides) Regulations 1956*. Only undamaged, labelled, and securely closed pesticide and herbicide containers should be transported. They where practical should be securely held in a secondary spill container and spill clean-up equipment carried in the vehicle.

82. Anyone handling pesticides or herbicides should be familiar with spill response procedures. Any person responsible for the storage or use of pesticides or herbicides must have container labels, off-label permits and material safety data sheets.

Emergency response

83. A contingency plan for the orchard should be developed, outlining management responses to various abnormal operating situations that could impact on water resources, see the Department of Water's Water Quality Protection Note *Chemical Spills – Emergency Response* for more information. Scenarios include the disruption to power supplies, fire, floods, accidental spillage of chemicals, vandalism and variable loading of the wastewater treatment and disposal system. The contingency plan should be followed when an incident occurs. Key employees should be trained and assigned roles in emergency management procedures and techniques.

84. The Department of Environment and Conservation's regional office should be notified, as soon as possible, of any significant chemical spill or leakage into the environment where there is the potential to contaminate surface or ground waters. If the chemical spill occurs in a public place (eg on a road or in a town), or is likely to endanger public health and safety, then advise the local government authority so that they can manage the clean up. If residues in agricultural produce are a possible outcome, then the Department of Agriculture and Food should be alerted. If a licensed Pest Control Operator caused the spill, then under the terms of their licence, they must notify the Department of Health's Pesticide Safety Branch.

85. Items such as a list of emergency telephone numbers, a fire extinguisher, a broom, shovels, absorbent materials (eg clay, kitty litter or sawdust), emergency protective gear, containers to hold contaminated waste and materials to decontaminate spill areas (eg bleach, detergent or hydrated lime as appropriate) should be available to workers at all times.

86. If a spill occurs, the affected area should be isolated and contained as quickly as possible. Soak up the liquid with absorbent material and then remove the residue in a disposal container. Repeat this procedure several times to ensure the area has been decontaminated. The area should not be hosed down with water. Advice should be sought from a local environmental health officer on how to dispose of the contaminated material.

More Information

We welcome your views on this note. Feedback provided on this topic is held on file No. **16143**. This note will be updated periodically as new information is received or industry/activity standards change. Updates are placed on the Department's internet site www.water.wa.gov.au select *Drinking water> Publications> Water Quality Protection Notes.*

To comment on this note or for more information, please contact the Water Source Protection Branch at our Atrium offices in Perth, phone (08) 6364 7600 (business hours), fax 6364 6525 or use *Contact us* at the Department's internet site, citing the note topic and version.

Where a conflict arises between the Department of Water's recommendations and any proposed activity that may affect a sensitive water resource, this note may be used to assist negotiations with stakeholders. The negotiated outcome should not result in a greater risk to water quality than if the Department's recommended protection measures were used.

In October 2005, the State Government announced the formation of the Department of Water. From January 2006, the Department of Water has assumed primary responsibility for managing the State's water resources. Once the Department of Water is legally established, it will replace many of the present functions of the Water and Rivers Commission and operate in parallel (with separate powers) to the Department of Environment and Conservation. The recommendations made in this note will then change to match the assigned responsibilities of the two Departments.

Department of **Water** Department of **Environment and Conservation**		SWAN RIVER TRUST
www.water.wa.gov.au Telephone: (08) 6364 7600 Facsimile: (08) 6364 7601 Level 4, The Atrium 168 St Georges Terrace Perth Western Australia 6000	www.dec.wa.gov.au Telephone: (08) 6364 6500 Facsimile: (08) 6364 6520 Level 4, The Atrium 168 St Georges Terrace Perth Western Australia 6000	www.swanrivertrust.wa.gov.au Telephone: (08) 9278 0900 Facsimile: (08) 9325 7149 Level 1, Hyatt Business Centre 20 Terrace Rd East Perth Western Australia 6004

Appendices

Appendix A - References and further reading

1. Australian Government - National Water Quality Management Strategy -
   a. *Australian and New Zealand guidelines for fresh and marine water quality* 2000
      see web page www.deh.gov.au/water/quality/nwqms/index.html
   b. *Australian drinking water guidelines* 2004
      see web page www.health.gov.au/nhmrc/publications/synopses/eh19syn.htm
   c. *Rural land uses and water quality - a community resource document* 2000
      see www.awa.asn.au, email bookshop@awa.asn.au, or request from a library service.

2. Environmental Protection Authority (WA)
   a. Position statement No. 4 *Environmental Protection of Wetlands 2004*
   b. Draft guidance statement No 33 *Environmental guidance for Planning and Development 2005*
   c. Guidance statement No 3 *Separation distances between industrial and sensitive land uses*;

   see internet site www.epa.wa.gov.au.

3. Department of Environment and Conservation (WA)
   a. *River restoration manual – A guide to the nature, protection, rehabilitation and long-term management of waterways in Western Australia*
   b. *Position statement – Wetlands 2001*
   c. *Position statement – Urban stormwater management in WA 2003*
   d. *Foreshore Policy 1. Identifying the Foreshore Area*
   e. Water Notes:
      - *WN8 Habitat of rivers and creeks;*
      - *WN10 Protecting riparian vegetation;*
      - *WN11 Identifying the riparian zone;*
      - *WN20 Rushes and sedges;*
      - *WN23 Determining foreshore reserves;*

   see internet site www.dec.wa.gov.au; select *Department of Environment* > *Water* > either *Wetlands* or *Waterways,* then *Publications*.

4. Department of Water (WA)
   a. *State-wide Policy 2. Pesticide Use in Public Drinking Water Source Areas 2000.*
   b. Water Quality Protection Notes:
      - *Industrial sites near sensitive environments*;
      - *Irrigation of vegetated land with nutrient-rich wastewater;*
      - *Land use compatibility in Public Drinking Water Source Areas;*
      - *Mechanical servicing and workshop facilities;*
      - *Nutrient and irrigation management plans;*
      - *Toxic and hazardous substances - storage and use;*
      - *Chemical spills – emergency response;*
      - *Vegetation buffers to sensitive water resources;*
      - *Ponds for stabilising organic waste.*
   c. *Stormwater management manual for WA* 2004

      see web page www.water.wa.gov.au, select *Drinking water* > *Policy* or *Water Quality Protection Notes* or *Stormwater.*

5. Department of Health (WA)

   PSC 88 Department of Health WA – Use of herbicides in water catchment areas;
   see web page http://www.population.health.wa.gov.au/Environmental/index.cfm.

6. Department of Agriculture and Food (WA)
   a. *Agricultural composting handbook*
   b. *Preparing farm chemicals*

   see internet site www.agric.wa.gov.au.

Appendix B - Statutory requirements and approvals

Approval Required	Comments	Relevant Acts and Policy	Regulatory Agency
New orchard development	Must be consistent with Town Planning Scheme and local by-laws.	*Planning and Development Act 2005* *Swan Valley Planning Act 1995*	Local Government Authority WA Planning Commission
Significant impact on the values and ecology of land and natural waters	An Environmental Impact Assessment under the *Environmental Protection Act 1986* Part IV Environmental Impact Assessment Part III Environmental Protection Policies.	*Environmental Protection Act 1986* *Environmental Protection Policy (Swan Coastal Plain Lakes) 1992*	Minister for the Environment – advised by the EPA
Development near prescribed water resources such as Public Drinking Water Source Areas	Orchards are incompatible with Priority 1 source protection areas, wellhead protection zones, reservoir protection zones and within buffers to designated waterways and wetlands. Departmental advice should be sought for developments in Priority 2 or 3 PDWSA.	*Metropolitan Water Supply, Sewerage and Drainage Act 1909* *Country Areas Water Supply Act 1947*	Department of Water - regional office
Licence to draw water from surface or groundwater sources	Water draw from proclaimed Groundwater Areas or from any confined aquifer.	*Rights in Water and Irrigation Act 1914*	
	Water draw from proclaimed Surface Water Catchments.		
	Disturbance of bed or banks of proclaimed waterways		
Development in a Waterways Management Area	Development approval required from Department of Environment and Conservation.	*Waterways Conservation Act 1976*	
Development in a Swan River Trust Management Area	Development approval required from Swan River Trust.	*Swan River Trust Act 1988*	Swan River Trust
Land clearing (for clearing > one hectare of land)	Formerly the Commissioner of Soil and Land Conservation had authority to issue approvals to clear land.	*Environmental Protection (Clearing of Native Vegetation) Regulations 2004*	Department of Environment and Conservation
Aboriginal heritage (especially in areas such as native bush or near watercourses)	Significant Aboriginal sites must be protected.	*Aboriginal Heritage Act 1972*	Department of Indigenous Affairs

Appendix C - Sensitive water resources

Clean water resources used for drinking, sustaining aquatic and terrestrial ecology, industry and aesthetic values, along with breathable air, rank as the most fundamental and important needs for viable communities. These water resources should remain within specific quality limits, and therefore require stringent and conservative protection measures. Guidance on water quality parameters necessary to maintain water values are published in the Australian Government's *National Water Quality Management Strategy Guidelines* (see web page www.deh.gov.au/water/quality/nwqms/index.html).

The Department of Water strives to improve community awareness of catchment protection measures for both surface water and groundwater aquifers as part of a multi-barrier protection approach to maintain the quality of water resources and their values.

To be considered sensitive, water resources must support one or more of the environmental values described below. Human activity or land use poses a risk to water quality if contaminants could be washed or leached into sensitive water resources in discernible quantities. These water resources include shallow groundwater accessed by water supply wells, waterways, wetlands or estuaries. Community support for these values, setting of practical management objectives and implementation of a sustainable protection strategy are seen as key elements in protecting and restoring the values of these water resources.

Sensitive water resource values include:

a. Public Drinking Water Source Areas (ie Water Reserves, Catchment Areas or Underground Water Pollution Control Areas) proclaimed or assigned under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, the *Country Areas Water Supply Act 1947* or the *Health Act 1911.*

b. Private drinking water supply sources, including the following uses:
   - human or stock consumption;
   - commercial or industrial water supplies (with specific qualities that support the activities eg aquaculture, food processing or crop irrigation); and
   - garden or municipal water supplies (which can affect people's health or well-being).

c. Groundwater aquifers that sustain important ecological functions eg cave ecology.

d. Waterways (excluding engineered drains or constructed features) with ecological and / or social values such as swimming, fishing, boating and aesthetic appeal, including:
   - waterways managed under the *Waterways Conservation Act 1976*, ie the Avon, Peel-Harvey, Leschenault, Wilson Inlet and Albany Waterways Management Areas; and
   - the Swan-Canning Estuary and lands managed under the *Swan River Trust Act 1988*.

e. Wetlands possessing conservation values (except those highly disturbed, unless subject to active management to restore specified environmental values) and including:
   - RAMSAR wetlands (see internet site www.ramsar.org);
   - Policy areas covering water resources defined via Part III of the *Environmental Protection Act 1986* eg *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992;*

- Wetlands described by Department of the Environment and Heritage (Australia) in A *Directory of important wetlands in Australia,* (see web page www.deh.gov.au/water/wetlands/databases.html, or the Department of Environment and Conservation web page www.naturebase.net/national_parks/wetlands/wa_wetlands.html);
- Conservation and Resource Enhancement category wetlands identified in the *Geomorphic Wetlands of the Swan Coastal Plain* dataset, all wetlands identified in the *South Coast Significant Wetlands* dataset and high value wetlands identified in the *Geomorphic Wetlands Augusta to Walpole* dataset. **Note:** the Augusta to Walpole wetland dataset to date has not been subject to a detailed evaluation process.

  The Department of Conservation and Environment is the custodian of these datasets and is responsible for maintaining and updating the information within them. The datasets ban be viewed or downloaded from the internet site www.dec.wa.gov.au, select *Environment* > *Tools, systems and data* > *Geographic Data Atlas* > *Inland waters* > *Wetlands.* Guidance on viewing the wetlands is provided on the same website at *Water* > *Wetlands* > *Data* > *Wetland mapping* > *How to view wetland mapping* or by phoning 6364 6500.

Appendix D - Recommended buffers for new or expanding orchards

Water resource	Comments	Minimum Separation
Private drinking water supplies	Buffer to bores, wells, soaks, waterways and dams used as sources of human or stock water supplies	100 metres
Public drinking water supplies	Buffer to bores, wells or surface waters used as sources of public drinking water supplies under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or *Country Areas Water Supply Act 1947* by-laws, for Wellhead Protection Zones and Reservoir Protection Zones	500 metres for P1 areas 300 metres for P2 & P3 areas 200 metres for reservoirs and feeder streams
Wetlands	Swan Coastal Plain: Conservation category, Resource Enhancement, Environmental Protection Policy wetlands	200 metres
	Outside the Swan Coastal Plain: all wetlands	Consult with the Department of Environment and Conservation for specific site conditions
Banks of streams, rivers and estuaries with permanent water	Recommended separation distance to reduce nutrient inputs and control turbidity from potential sources. Determined using biophysical criteria	
Banks of waterways that flow intermittently	Recommended separation distance to reduce nutrient inputs from potential sources. Determined using biophysical criteria	
Groundwater table	This separation distance measured from the historical maximum level watertable to ground surface has been recommended to reduce nutrient inputs from potential sources.	Two metres