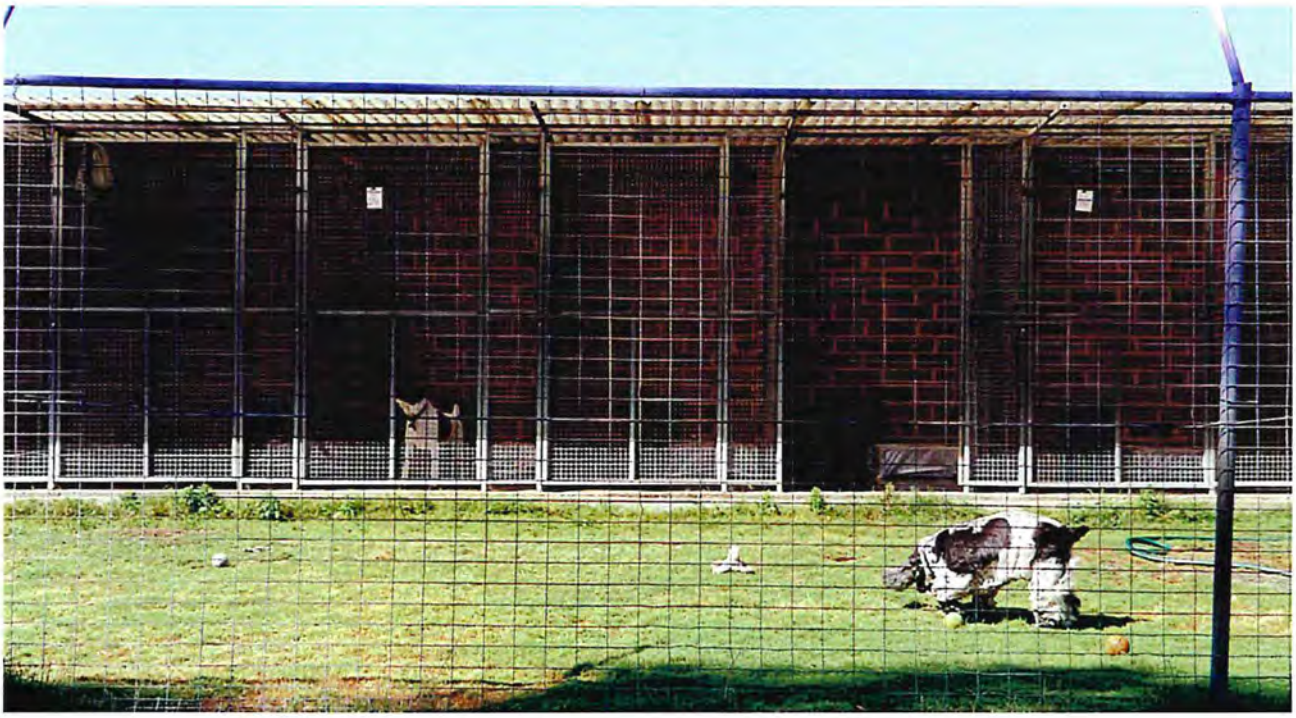
GOVERNMENT OF WESTERN AUSTRALIA

TECHNICAL REPORT ON KENNEL WASTE DISPOSAL AND MANAGEMENT FOR PUBLIC DRINKING WATER SOURCE AREAS

Jandakot Groundwater Protection Policy Area



WATER RESOURCE PROTECTION SERIES

WATER AND RIVERS COMMISSION REPORT WRP 29

1998

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TECHNICAL REPORT ON KENNEL WASTE DISPOSAL AND MANAGEMENT FOR PUBLIC DRINKING WATER SOURCE AREAS

Jandakot Groundwater Protection Policy Area

prepared by
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Water and Rivers Commission
Policy and Planning

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Foreword

Areas where groundwater is drawn for public water supply are declared as Underground Water Pollution Control Areas (UWPCAs). The Water and Rivers Commission is responsible for the protection of groundwater quality in these areas.

The Jandakot UWPCA was proclaimed in September 1975 for the protection of the groundwater source known as the Jandakot Mound. This water source provides a substantial contribution to the Perth metropolitan water supply system and it is therefore essential that the source is protected from contamination.

The Canning Vale and Banjup kennel zones are located in Priority 2 (P2) source protection areas of the Jandakot UWPCA. Priority 2 source protection areas are defined to ensure that there is no increased risk of pollution to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. The provision of public water supply is a high priority in these areas. Some development is allowed under specific guidelines.

Kennels are a restricted land use activity in P2 source protection areas. This means that kennel operations may be compatible with the management objectives of the P2 classification if appropriate site management practices and lot densities are adhered to.

The lot sizes at Canning Vale and Banjup are smaller than would normally be acceptable for kennel zones in Priority 2 areas. However, the zones have been established for a number of years. In recognition of this, the Water and Rivers Commission has worked with the kennel owners of Canning Vale and Banjup and the local government authorities to develop waste disposal and management guidelines for the areas.

The Draft Statement of Planning No. 6 - Jandakot Groundwater Protection Policy and the associated Metropolitan Region Scheme Amendment, have recognised the Priority 2 classification in the area. A Rural - Water Protection zone is proposed for the Canning Vale and Banjup areas. Under the Draft Policy, Water Quality Protection Guidelines No. 25: Waste management of kennel operations within the Jandakot UWPCA, would be used in establishing, approving and managing kennel operations.

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There is limited knowledge of the impact of kennel operations on groundwater sources. In order to determine the impact of the kennel operations in Canning Vale and Banjup on the Jandakot groundwater source and develop possible waste management guidelines, initial groundwater quality investigations were undertaken by consultants on behalf of the Water and Rivers Commission in March 1996 (Golder Associates, 1996). These investigations involved the installation of monitoring bores and the sampling of private bores.

The Canning Vale and Banjup kennel zones are located in Priority 2 (P2) source protection areas of the Jandakot UWPCA. Priority 2 source protection areas are defined to ensure that there is no increased risk of pollution to the water source. The provision of public water supply is a high priority in these areas. Some development is allowed under specific guidelines.

The Water and Rivers Commission is committed to developing waste management guidelines for kennel operations in the Canning Vale and Banjup areas in close consultation with land owners. The objective of the guidelines is to minimise the risk of groundwater contamination from activities on the land.

The Draft Statement of Planning Policy No. 6 - Jandakot Groundwater Protection Policy and the associated Metropolitan Region Scheme Amendment, have recognised the Priority 2 classification in the area. A Rural - Water Protection zone is proposed for the Canning Vale and Banjup areas. Under the Draft Policy these guidelines would be used in establishing and managing kennel operations. The development of the guidelines has involved:

1. liaison with kennel owners through public meetings and the formation of a committee with kennel owner representatives;
2. a literature research into domestic waste, septic tanks, nitrogen loads and alternative waste management techniques;
3. further groundwater quality investigations in the Canning Vale and Banjup areas; and
4. nitrogen load modelling.

Liaison with kennel owners

Throughout the investigation, Water and Rivers Commission representatives have liaised closely with the kennel owners and the local government authorities. The formation of a kennel advisory committee provided an avenue for the kennel owners to be involved with the development of the guidelines and provide advice to the Water and Rivers Commission about kennel operations and practices.

An information sheet was sent to all kennel owners in the Canning Vale and Banjup zones which detailed the investigations that had taken place and the status of the guidelines.

Literature review

The literature research indicated that there were a number of waste disposal techniques available for potential use in the kennel operations. Through the course of the investigation a majority of these were discounted for a variety of reasons. These reasons included the techniques not being:

- economical;
- effective in the removal of waste from the property;
- proven to be effective for kennel operations;
- specifically designed for nutrient removal; or
- appropriate for animal faeces.

Groundwater quality investigations

The water quality investigations completed by Golder Associates in 1996 and the Water and Rivers Commission in 1997, indicated the presence of elevated nitrate concentrations in groundwater at the water table in both the Canning Vale and Banjup kennel zones. At some locations the nitrate levels were above NH&MRC/ARMCANZ drinking water guidelines. The water quality investigations also established that the elevated nitrate levels found within the Canning Vale kennel zone were not the result of neighbouring land uses.

The contamination recorded was largely confined to the upper portion of the aquifer near the water table. The Water and Rivers Commission considers that the potential contamination threat to the drinking water supply from kennel operations can be minimised with the establishment of appropriate management.

Monitoring of the groundwater quality in the kennel zones will be continued by the Water and Rivers Commission.

Nitrogen load modelling

Nitrogen load modelling indicated that the Canning Vale and Banjup kennel zones have the potential to contaminate the shallow groundwater source if appropriate waste management practices are not established.

Calculation of the estimated nitrogen load generated from a typical lot indicated a potential nitrate concentration in the recharge water of approximately 5 mg/L in Banjup and 12 mg/L in Canning Vale. These results are consistent with Water and Rivers Commission policy of opposing subdivision to less than 2 ha in P2 areas as the recharge water quality is outside the criteria for drinking water protection.

Estimates of the current and potential future total nitrogen loads from the kennel zones indicate there is potential for a 3 kg/ha/yr and 1 kg/ha/yr increase in total loads in Canning Vale and Banjup respectively, within the next ten years. The implementation of waste disposal guidelines could potentially decrease current loads by approximately 2 kg/ha/yr in both Canning Vale and Banjup.

Waste disposal and management guidelines

The proposed guidelines provide a framework for the establishment of kennel operations that will ensure risks to water quality are minimised whilst also recognising land owners' aspirations to develop viable kennel operations on their properties.

The emphasis of the proposed guidelines has been on prescribing appropriate waste management practices rather than limiting dog numbers. The guidelines recognise the need to allow flexibility as all kennel operations are not the same and as the size of operations increases the stringency of guidelines increases.

The Water and Rivers Commission's modelling of nutrient inputs to groundwater indicate that with implementation of the guidelines a significant decrease in the loads to groundwater can be achieved whilst still accommodating the expansion of kennel operations.

An important issue in the development of the guidelines was to ensure they could be practically implemented and minimise impacts on the kennel owners. To achieve this, a coordinated approach between kennel owners, local government authorities and the Water and Rivers Commission is recommended.

Implementation

The waste management guidelines will be implemented through the local government authorities' planning approval processes. Compliance with the guidelines will only be enforced at kennel operations where an application is made to Council for planning approval for the development of a new kennel establishment or for the extension of an existing kennel operation. However, the Water and Rivers Commission considers it necessary to place some controls on the existing larger operations (ie 50 dogs in Canning Vale and 100 dogs in Banjup) in order to minimise the contamination risk to the groundwater. This will involve the Water and Rivers Commission providing permit approval to the larger operations under the condition that all solid waste is removed off-site. In addition, compliance with the guidelines will be encouraged at all operations, where practical.

Where application is made for the development of a new kennel operation or for the extension of an existing kennel operation which will result in more than 50 dogs on the property in Canning Vale and more than 100 dogs on the property in Banjup, the operation will require Water and Rivers Commission approval in addition to local government authority approvals. The proposal will be referred to the Water and Rivers Commission by the relevant local government authority.

1. Introduction

1.1 Background

The Canning Vale and Banjup kennel zones are located within the Jandakot Underground Water Pollution Control Area (UWPCA). Both zones are currently classified for Priority 2 source protection (refer to **Figure 1**). Priority 2 source protection areas are defined to ensure that there is no increased risk of pollution to the water source. The provision of public water supply is a high priority in these areas. Some development is allowed under specific guidelines (refer to **Appendix A** for priority classification objectives and land use compatibility).

The Draft Statement of Planning Policy No. 6 - Jandakot Groundwater Protection Policy and the associated proposed Metropolitan Region Scheme Amendment, have recognised the Priority 2 classification in the area. A Rural - Water Protection zone is proposed for the Canning Vale and Banjup areas. Under the Draft Policy these guidelines will be used in establishing and managing kennel operations.

The Water and Rivers Commission is committed to developing waste management guidelines for kennel operations in the Canning Vale and Banjup areas in close consultation with land owners. The objective of the guidelines is to minimise the risk of groundwater contamination from activities on the land.

Development of the guidelines has involved:

- liaison with kennel owners;
- literature research into domestic waste, septic tanks, nitrogen loads and alternative waste management techniques;
- further groundwater quality investigations in the Canning Vale and Banjup areas; and
- nitrogen load modelling.

In addition, several kennel operations were inspected to observe current waste management techniques. A questionnaire was distributed to all properties to gain an appreciation of kennel layouts and management practices.

This report discusses the investigation, consultation and research that has been undertaken to develop the waste disposal and management guidelines.

1.2 Kennel advisory committee

An advisory committee was formed to assist the Commission in the development of waste management guidelines for kennel operators in the Canning Vale and Banjup kennel zones. The members include kennel owners from both zones (5), representatives from the relevant local government authorities (City of Cockburn (1) and City of Canning (1)), representatives from the Water Corporation (2) and representatives from the Water and Rivers Commission (3) (refer to **Appendix B** for committee member details).

The objectives of the project were developed during the committee's first meeting, as well as an outline of its role in the process.

1.3 Site visit

The members of the advisory committee inspected a number of kennel operations in the Canning Vale and Banjup areas. This provided the Water and Rivers Commission with a knowledge of existing operations and their current waste management techniques.

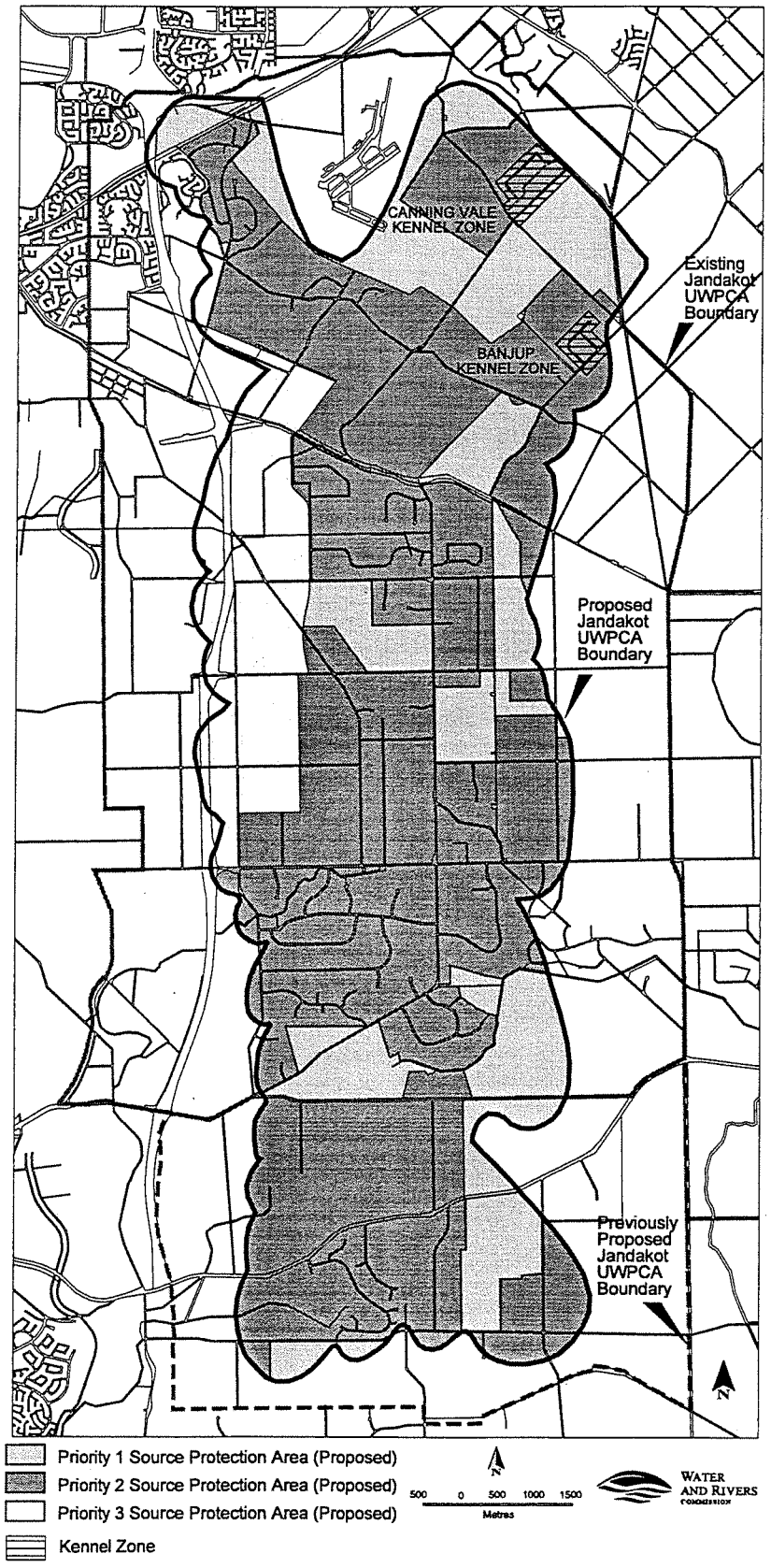

Figure 1. Locality Map of the Canning Vale and Banjup Kennel Zones

2. Investigations

2.1 Literature research

An initial phase of the project involved the research and collation of information on current waste management practices, possible waste management options, estimated nitrogen loads and proposed strategies for implementation of the guidelines. Information was gathered from past publications, personal communications with academics, commercial manufacturers and representatives from other government agencies. A questionnaire was also delivered to all land owners in the Canning Vale and Banjup zones. The questionnaire responses are summarised in **Section 3**.

The output from this research has been a completed site survey for both the Canning Vale and Banjup areas, an estimate of total nitrogen loads from kennel properties, a summary of potential waste management techniques (costs and benefits), an estimate of nitrogen loads under a number of scenarios based on various waste management techniques, waste disposal and management guidelines and an implementation strategy.

2.2 Groundwater quality investigation

The Water and Rivers Commission engaged consultants in April 1996 to investigate the impacts of the Canning Vale and Banjup kennel zones on groundwater quality.

A census of available private bores was undertaken within a 1 km radius of the kennel zones. The census targeted shallow screened private bores as close as possible to the potential contamination sources, taking into account both the regional groundwater flow and the production bore capture zone information. Thirty bores were sampled. The locations of the private bores sampled are shown on **Figure 2**.

The investigation concluded there was some evidence of elevated nitrates and ammonia in groundwater, near the water table, in both the Canning Vale and Banjup areas. Several bores also contained bacteria in excess of NH&MRC/ARMCANZ drinking water guidelines (refer to **Appendix C** for further details).

Recommendations included further investigation into the impact of the soil blending activities, to examine the impact on groundwater quality of on-site disposal of kennel waste at a small scale and re-sample private bores with bacterial contamination.

2.3 Further groundwater quality investigations

Further to the recommendations made by Golder Associates in 1996, the Water and Rivers Commission undertook shallow groundwater quality investigations in the Canning Vale and Banjup kennel zones in February 1997. The aim of this investigation was to delineate the impact of the neighbouring soil blending facilities from the impact of the kennel zones and to further define the groundwater quality within the zones.

Four bores were drilled along Acourt Road in order to differentiate between the potential contamination from the soil blending facilities and the kennel operations in Canning Vale. Six bores were drilled within the Canning Vale kennel zone and five bores were drilled within the Banjup kennel zone (refer to **Figure 2**). Where field tests showed high levels of nitrate or ammonia, a second sample was taken from that bore at a greater depth. Primary groundwater samples were taken at depths between 2.5-7.5 m below ground level. Secondary. samples were taken at depths between 5.5-11.5 m below ground level.

The water quality results indicated the presence of elevated levels of nitrates within the Canning Vale kennel zone and some samples exceeded NH&MRC/ARMCANZ guidelines. However, the nitrates were largely confined to the upper portion of the aquifer near the water table as previously indicated by Golder Associates.

Some samples taken from the Banjup kennel zone indicated the presence of high levels of phosphorus, correlating to high turbidity and low pH (refer to **Appendix C** for further details). Although the presence of phosphorus is not a major concern to drinking water supplies, the cause of these high values will be further investigated by the Water and Rivers Commission as high levels of phosphorus can be a significant environmental concern for wetlands.

The groundwater samples taken along Acourt Road contained no elevated levels of nitrates or ammonia. This suggests that the elevated levels of nitrate found within the Canning Vale kennel zone were not a result of the operations of the neighbouring soil blending facilities. Samples taken within the compound of the Water Corporation production bore J140 (down-gradient of both the soil blending facilities and the Canning Vale kennel zone) indicated moderate levels of nitrate as well as the presence of bacteria. The source of this contamination will be further investigated by the Water and Rivers Commission.

The Water and Rivers Commission consider the groundwater investigations show that contamination is occurring from the Canning Vale and Banjup kennel zones. However, it is considered that this can be managed.

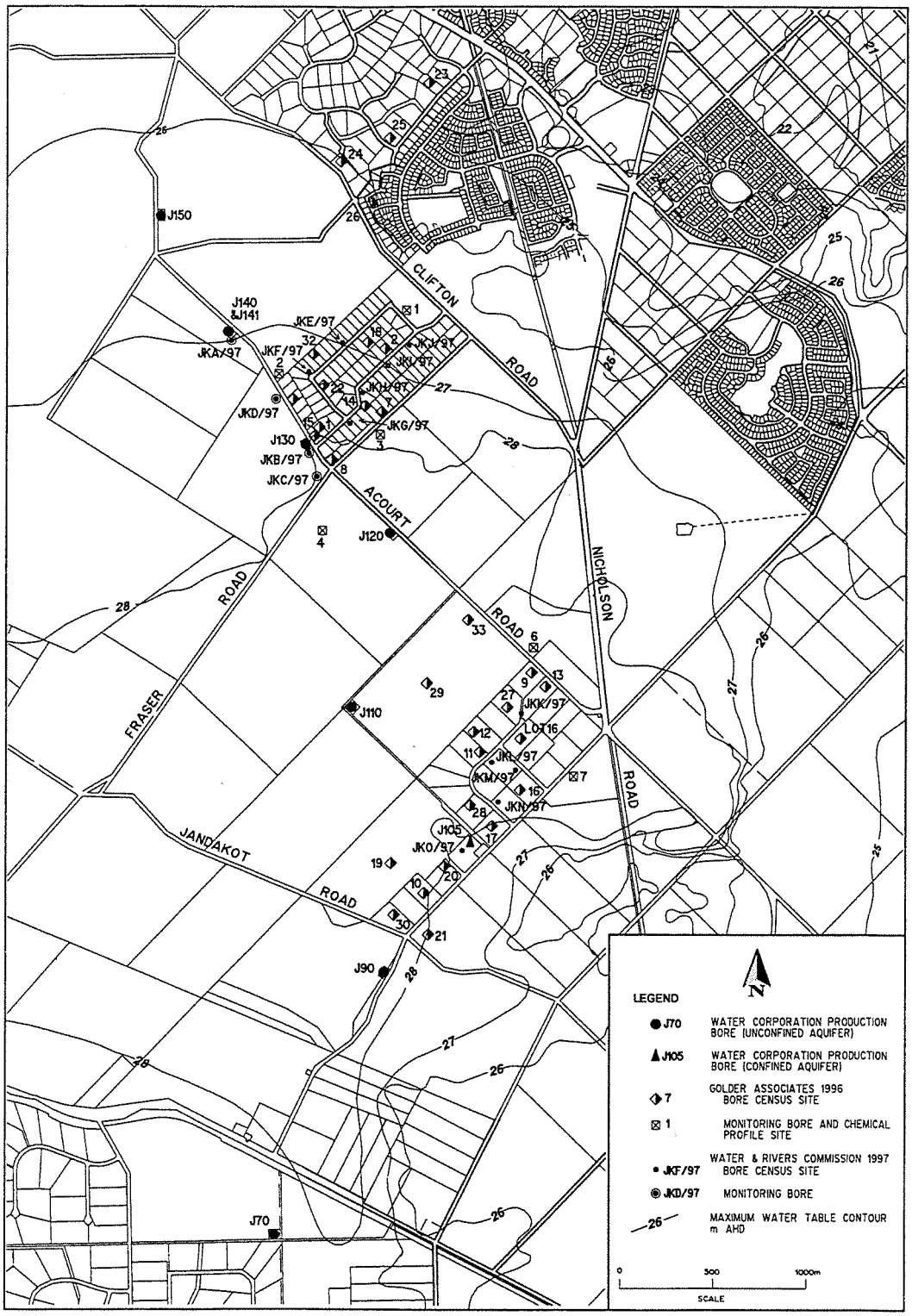

Figure 2. Groundwater Quality Investigations - Sample Locations

3. Surveys

Surveys were distributed to all land owners within the Canning Vale and Banjup kennel zones (refer to **Appendix D**). Below is a summary of the responses.

3.1 Canning Vale

3.1.1 Zone characteristics

Approximately 50% of the survey responses were returned. The premises are mainly used for the breeding, boarding and grooming of dogs and cats. The dogs are usually of various sizes and the number of dogs per property can range from 2 - 100. The average number of dogs per property ranges from 10 - 30.

Out of the 44 responses, 14 kennel owners indicated that their properties are fully developed. Another 22 of these indicated they had future development plans, ranging from current plans to developments in approximately 10 years.

3.1.2 Current waste management

The respondents dispose of the dog faeces off-site (61%). Some dispose of all kennel waste via the septic system (25%) and one kennel owner disposes of dog faeces via an on-site compost.

All responses indicated that kennel owners currently dispose of dog urine from the kennel compartments via the septic systems.

Table 1 indicates the different types of cleaning and pet care products and the range in volumes which are used for the wash down of the dogs and kennels.

Table 1. Type and amount of cleaning and pet care products - Canning Vale

Product	Annual amount used / property (L)
chlorine	40 - 100
bleach	10 - 1000
detergent	60 - 200
disinfectant	20 - 1000
shampoo	12 - 300
flea rinse	2 - 20
vinegar	200

The surveys indicated that all the cleaning and pet care products are disposed to septic systems.

Most of the residents in the Canning Vale kennel zone do not use their bore water for drinking purposes. This is because the area is connected to scheme water supply. No problems in water quality from the private bores were indicated by the survey responses.

The general comments of kennel owners from the Canning Vale kennel zone regarding the development of the waste management guidelines were:

- connection to sewerage would solve the problem;
- off-site disposal of faeces should be enforced;
- guidelines should be easily understood and applicable to all;
- interested in worm farm/ dung beetle trials;
- chlorine use for cleaning purposes is important;
- survey to be issued to all land owners, not just kennel owners;
- bi-annual checking and monitoring of properties to take place;
- annual inspections and inspections when properties change hands to occur; and
- incentives to use premium foods and accreditation through guidelines.

3.2 Banjup

3.2.1 Zone characteristics

Approximately 20% of the surveys were returned with responses. The premises are mainly used for the breeding and boarding of dogs and cats. The dogs are of various sizes and the number of dogs per property can range from 10 - 100.

Most respondents planned further development of their properties.

3.2.2 Current waste management

The responses showed that most of the kennel owners dispose of the dog faeces off-site. Some dispose of all kennel waste via the septic system or bury faeces on-site.

All responses indicated that kennel owners currently dispose of dog urine deposited in the kennels via septic systems.

Table 2 indicates the different types of cleaning and pet care products and the range in volumes which are used for the wash down of the dogs and kennels.

Table 2. Type and amount of cleaning and pet care products - Banjup

Product	Annual amount used / property (L)
chlorine	60 - 200
bleach	50
detergent	60 - 1000
disinfectant	50
shampoo	2 - 44

The surveys indicated that all the cleaning and pet care products are disposed to septic systems.

Most residents in the Banjup kennel zone use their bore water for drinking purposes since this area is not connected to the scheme supply. No problems in water quality from the private bores were indicated by the survey responses.

The general comments by kennel owners from Banjup kennel zone regarding the development of the waste management guidelines were:

- encourage off-site disposal of faeces;
- guidelines need to be flexible;
- interested in worm farm/ dung beetle trials;
- do not want to change current cleaning practices; and
- reservations about off-site disposal; flies around bin, cost and only moves the problem.

4. Waste management options

A number of waste management options were identified by the surveys and the kennel advisory committee. These included current methods and possible future methods of waste disposal. The following provides an outline of the issues and discusses advantages and disadvantages related to each of these waste management options.

4.1 Deep sewerage

The connection of Canning Vale to deep sewerage would be costly. The cost per lot would be approximately $40 000 plus rates (Water Corporation). The cost would have to be covered by the residents as it is not covered in the sewerage infill program, and therefore, not funded by the Government. An even greater cost would be incurred by residents for connection to occur in Banjup.

Sewerage in these areas is not planned by the Water Corporation unless water quality problems become evident in their public water supply bores.

4.2 Septics for urine and faeces

An average dog produces approximately 2 g N/day from faeces and 2.5 g N/day from urine (Dr Nick Costa, pers comm, 1997). If both faeces and urine were disposed of through the septic system, there is the potential for approximately 4.5 g N/day to leach to groundwater from each dog.

Septic tanks do not remove nitrogen from the wastewater and therefore leaching can still occur.

4.3 Faeces disposed of off-site

An average dog produces 2 g N/day and 2.5 g N/day from faeces and urine, respectively. Approximately half of the nitrogen content of the dog waste can potentially be removed from the property by the off-site disposal of faeces. This technique should be encouraged as a simple means of reducing nutrient load.

Community concerns about this technique related to the issues of:

- odour;
- cost;
- flies; and
- off-site disposal only moving the problem.

The Water and Rivers Commission recognises the community concern that off-site disposal of faeces only moves the problem. However, it is considered that if faeces are disposed of in a designated landfill, it is of overall benefit to water quality protection in the Jandakot area. The water quality protection constraints at the landfill site will be less stringent than those in a drinking water supply area.

4.4 Burying faeces

The burial of faeces is not a common practice and is not encouraged by the Water and Rivers Commission. The burial of faeces results in nitrogen "hotspots" which are more prone to leaching and may result in a health issue.

4.5 Dung beetle activity

Dung beetles reduce the amount of visible animal waste by burying it. However, nutrients can still leach to the groundwater.

Dung beetles are most effective in rural areas and would be difficult to retain in an urban environment. The beetles cannot be contained and will leave if they are not supplied with adequate faeces. It is estimated that residents would be required to replace about 1000 - 2000 beetles approximately every 2 - 3 months. In addition, the concrete floors of the kennel operations would restrict the beetles' ability to bury the faeces.

Overall this is not a viable waste management technique for the kennel operations in Canning Vale and Banjup since it wouldn't reduce the water quality impacts.

4.6 Composting

Composting is the natural decay of organic material. This waste disposal technique is unsuitable for the breakdown of animal faeces. In addition it does not remove nutrients.

4.7 Earthworms

A compost bin can be constructed on-site to contain worms that move through the soil and digest organic material. The enzymes from the worms' intestines mix with the soil and organic matter to produce worm castings. These can then be applied as a replacement fertiliser.

This technique reduces pathogens but does not reduce the nutrient load. It is not favoured as the nitrogen is not removed off-site if used as a substitute for fertiliser. It is possible that the "manure" created could be sold by residents, however this has not been investigated by the Commission.

Dr Harry Hofstede from Murdoch University has shown interest in designing an appropriate system for the kennel operations. It is estimated that this will cost approximately $10 000 per system.

There is a possibility that if kennel dogs are wormed, that traces of the medication in the faeces will kill the earthworms thus reducing the effectiveness of this as a viable waste management technique for use in kennel operations.

4.8 Irrigation with effluent

Because it is fairly new in many areas, there are few studies that assess the long term impact of wastewater irrigation on groundwater and soils.

There are a number of limitations to this technique being applied to the kennel operations. These include odour, aesthetics, site and soil suitability, transportation and the acreage of land required.

This is not a viable technique since health issues make the area unsuitable for on-site distribution.

4.9 Alternative on-site wastewater systems

These types of systems have advantages over conventional septic systems in areas of high groundwater levels.

4.9.1 Phosphate retention by amended soils

This technique is based on the conventional septic system plus the use of amended soils to limit the leaching of nutrients. The amended soils must be replaced from time to time.

This system is approved by the Health Department of Western Australia as a phosphate removal on-site wastewater system which can be installed in areas of high groundwater levels. The approval does not extend to nitrate removal and that parameter has not been assessed by the Health Department of Western Australia.

The cost of these systems is higher than conventional septics at approximately $7000 - $10 000.

4.9.2 ATUs

Aerobic Treatment Units (ATUs) are based on the aerobic digestion of waste with the effluent available for garden reticulation. There are currently three brands of ATUs approved by the Health Department of Western Australia.

These systems rely on a constant power supply and regular maintenance is required. The cost is also greater than a conventional septic system.

4.10 Enzymic additives in septics

Enzymic additives refer to the products of bacteria that can be added to septic systems to increase the efficiency of solid breakdown. This is destroyed by the use of household cleaning products that enter the septic system.

This technique is used to enhance the breakdown of solids and is unlikely to reduce the nutrient load. The large amount of cleaning and pet care products used in

the kennels could potentially reduce the effectiveness of the enzymic additives and thus reduce the viability of this technique for waste disposal on kennel operations.

4.11 Zabel Filter in septics

The Zabel Filter is a small device that is fitted to the outlet of the septic tank to reduce the amount of solids passing through to the drainage receptacle. The Zabel Filter retains the solids in the septic tank and lowers the BOD which improves the quality of effluent.

The filter has been tested in kennel operations and is effective for the collection of hair and solids that enter the septics. However, no figures are available on the efficiency of the device to retain nitrogen in the septic system. The Filter also requires regular cleaning.

4.12 Cleaning techniques and products

There are a range of products used in daily kennel operations. The following may have a detrimental impact on the effective operation of the septic system or groundwater quality:

- flea rinses (can contain pesticides);
- detergents (normally contain nutrients); and
- disinfectants (can reduce the effectiveness of the septics).

There are no Council by-laws regarding kennel sanitation or acceptable products. Further investigation is required into cleaning and pet care products that are septic and groundwater "friendly", as well as the potential impacts of "unfriendly" products. These investigations will be initiated by the Water and Rivers Commission and information will be provided to the kennel owners.

5. Nitrogen load modelling

5.1 Introduction

In order to estimate the typical nitrogen loads from kennel operations in Canning Vale and Banjup, nitrogen load modelling was performed on the basis of two waste management technique scenarios. The assumptions made in these scenarios are outlined in **Table 3**.

Nitrogen loads per property were estimated from the survey responses. An estimate of the nitrogen load from a typical lot (without kennel operations) in both Canning Vale and Banjup was calculated to compare with the relative loads from lots with kennel operations. Total current and potential future annual nitrogen loads were also estimated for the Canning Vale area and Banjup area.

5.5.1 Factoring peak/non peak periods

Kennels operate at different capacities throughout the year. To simulate this, it was assumed that for two-thirds of the year kennels work at half capacity and for one-third of the year work at full capacity. Peak periods were assumed to sum to approximately one-third of the year which took account of school and public holidays.

The surveys indicated that the average number of dogs per property was usually half of the maximum number of dogs.

5.1.2 Nitrogen output from dogs

Estimates of the amount of nitrogen a small, medium or large dog excretes were provided by Dr Nick Costa of Murdoch University (refer to **Appendix E**). The values for small and large dogs represented the range in nitrogen loads. The value for a medium dog represented the load from an average sized dog (20-25 kg).

Nitrogen loads from the faeces of an average sized dog were estimated to be approximately 2 gN/day. Nitrogen loads from the urine of an average sized dog were estimated to be approximately 2.5 gN/day. The estimates are based on the nitrogen content of typical dog foods and the digestibility of nitrogen in a dog's system.

Nitrogen is also lost through the shedding of skin and hair and this could be as high as 1 gN/day. Hair takes a considerable time to break down so it was suggested that the removal of hair before entering the septic system be included in the guidelines.

5.1.3 Household septics

Two scenarios for household septics were tested. An average nitrogen load from a household septic is estimated at 18 kgN/household/yr (Whelan & Parker, 1987). This figure is based on a household supporting four people. As indicated by the site visit, a more realistic figure for the Canning Vale and Banjup kennel zones is 8 kgN/household/yr (Porter, 1980). This is based on a household supporting two people.

5.1.4 Fertiliser use

A fertiliser producer advised the average nitrogen content in typical household fertilisers is approximately 12%. However, some more powerful fertilisers contain nitrogen contents of up to 40%. A nitrogen content of 12% is assumed for the model.

The estimated number of bags of fertiliser applied was based on past surveys and studies on the use of fertilisers on different sized properties in the Perth region (Kinhill Engineers, 1995).

5.1.4.1 Canning Vale

Two scenarios for properties in the Canning Vale zone were modelled: 1) approximately two average sized bags of fertiliser (approximately 5 kgN/yr) applied annually and 2) no fertiliser (0 kgN/yr) applied.

5.1.4.2 Banjup

Three scenarios for properties in the Banjup zone were modelled: 1) approximately six average sized bags of fertiliser (approximately 15 kgN/yr) applied annually, 2) approximately two average sized bags of fertiliser (approximately 5 kgN/yr) applied annually and 3) no fertiliser (0 kgN/yr) applied.

5.1.5 Recharge estimates

The volume of recharge to groundwater per property was estimated using the average rainfall measured at Jandakot Aerodrome for the period 1973-1990. It was assumed that 22% of the rainfall contributed to groundwater recharge. This assumption was based on a previous study by Davidson (1995).

The volume of recharge to groundwater is dependent on the area of the property. The lots in the Canning Vale kennel zone are 0.4 ha, while the lots in the Banjup kennel zone are 2 ha. This means there will be more recharge to the larger sized lots (Banjup). However, Canning Vale is also connected to scheme water which has been included in the recharge equation. The annual recharge for a typical lot at Canning Vale and Banjup was calculated as 787 120 L/yr and 3 806 000 L/yr, respectively. The calculations are detailed in **Appendix F**.

5.1.6 Leaching factors

A nitrogen leaching factor represents the estimated percentage of nitrogen in wastewater that is able to percolate down to the water table. Leaching factors have been estimated for a variety of land uses conducted on the Swan Coastal Plain based on three scenarios: a best management practice, a most likely and a worst case scenario for Bassendean Sands and Spearwood Sands (Kinhill Engineers, 1995).

The most likely estimates for Bassendean Sands were used for nitrogen load modelling (Kinhill Engineers, 1995). These included an estimated 30% leaching factor for the nitrogen loads from the household and kennel septics and an estimated 50% leaching factor for the nitrogen load from fertilisers.

5.1.7 Denitrification rate

Denitrification is the reduction of nitrate to nitrite and ultimately of nitrite to nitrogen gas (N_2), nitrous oxide (N_2O) or nitric oxide (NO).

It has been recognised that denitrification may be occurring in the soils of the kennel zones. A conservative denitrification rate of 10% was estimated by Claus Otto of CSIRO (pers comm, 1997). This rate was used in the modelling.

5.1.8 NH&MRC/ARMCANZ drinking water guidelines

NH&MRC/ARMCANZ drinking water guidelines state that the concentration of nitrogen as nitrate in drinking water should not exceed 11.3 mg/L. The water quality criteria in the Draft Jandakot Groundwater Protection Policy SPP No. 6 suggest that in P2 areas, the concentration of nitrogen as nitrate in recharge water should not exceed 25% of the NH&MRC/ARMCANZ guideline (ie 2.8 mg/L) above background levels.

The Draft Jandakot Groundwater Protection Policy SPP No. 6 recognises the rights of kennels to establish and expand within the designated kennel zones. Kennel operations in Canning Vale and Banjup will be managed on the basis of this.

Maximum nitrate concentrations in recharge water of 10 mg/L and 5 mg/L per property were used in the modelling as a guide to the number of dogs per property that could be supported by a particular waste disposal technique.

5.2 Modelling scenarios

Two scenarios were chosen to represent waste management options for the Canning Vale and Banjup kennel areas. **Table 3** below, outlines the assumptions made in these scenarios.

A comparison of the scenario results is outlined below in **Table 4** and **Table 5**. These results indicate the number of dogs at maximum allowable nitrate concentrations in the recharge water of 5 mg/L and 10 mg/L (refer to **Appendix G** for further detail).

Table 3. Modelling scenario options

Modelled scenario options	Canning Vale		Banjup	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
All waste to septics	Y		Y	
Faeces taken off-site		Y		Y
Urine to septics	Y	Y	Y	Y
Phosphate retention by amended soils				
Fertiliser (5 kgN/yr)	Y	Y		
Fertiliser (15 kgN/yr)			Y	Y
No fertiliser				
Septics (8 kgN/yr)	Y	Y	Y	Y
Septics (18 kgN/yr)				
Leaching factors	Y	Y	Y	Y
Denitrification	Y	Y	Y	Y

Table 4. Modelling results - Canning Vale

Scenario	No. of average sized dogs (5 mg/L)	No. of average sized dogs (10 mg/L)
1	0	15
2	0	26

Table 5. Modelling results - Banjup

Scenario	No. of average sized dogs (5 mg/L)	No. of average sized dogs (10 mg/L)
1	28	76
2	73	197

In comparison with the actual numbers of dogs indicated on the questionnaires, the figures in **Table 4** are typical of small sized operations in the Canning Vale and Banjup kennel areas. The figures in **Table 5** are typical of medium - large scale operations in the Canning Vale and Banjup kennel areas.

5.2.1 Modelling vs field results

A comparison of the nitrate concentrations in the bores drilled in the Canning Vale and Banjup kennel zones and the modelling, indicates that predicted nitrate concentrations exceed measured nitrate concentrations. This may be because nitrogen is being fixed in the soil for some time before being leached to the water table. In the longer term, field results may approach modelled results.

Little study has been completed on the long term impact of nitrogen loading on the rate of denitrification. For this reason a conservative rate of denitrification was chosen in the modelling.

It should also be noted that the modelling represents nitrate concentrations of recharge water, whereas the field water samples were taken from the water table aquifer. Nitrate concentrations in the recharge water will naturally be diluted when it combines with groundwater in the aquifer. However, in the longer term, groundwater quality will approach recharge water quality.

5.3 Predicted nitrate concentration from a typical lot

The nitrate concentration generated from a typical lot (without kennel operations) was calculated to compare with the typical nitrate concentrations from the Canning Vale and Banjup kennel zones.

5.3.1 Canning Vale

The following assumptions were made for each lot:

1. the lot is 0.4 ha in size;
2. the property has a household with four people and two medium sized dogs;
3. household is connected to septics;
4. recharge is 787 120 L/yr (includes 25 920 L/yr from scheme water);
5. an average of 8 kg/yr of nitrogen applied to lawns from fertiliser;
6. 30% of nitrogen from the septic tank wastewater was leached to the water table;
7. 50% of nitrogen from the applied fertiliser was leached to the water table; and
8. 10% denitrification occurred.

The estimated nitrate concentration in recharge water from a typical lot was approximately 12 mg/L. This supports Water and Rivers Commission policy of opposing subdivision to less than 2 ha in P2 areas as the recharge water quality fails the criteria for drinking water protection.

5.3.2 Banjup

The following assumptions were made for each lot:

1. the lot is 2 ha in size;
2. the property has a household with four people and two medium sized dogs;
3. household is connected to septics;
4. recharge is 3 806 000 L/yr;
5. an average of 30 kg/yr of nitrogen applied to lawns from fertiliser;
6. 30% of nitrogen from the septic tank wastewater is leached to the water table;
7. 50% of nitrogen from the applied fertiliser is leached to the water table; and
8. 10% denitrification occurred.

The estimated nitrogen loading from a typical lot was approximately 25 kgN/ha/yr. This represents an estimated nitrate concentration in recharge water of approximately 5 mg/L.

The Draft Jandakot Groundwater Protection Policy SPP No. 6 for Priority 2 areas indicates that a maximum loading of 25 kgN/ha/yr or 25% of the

NH&MRC/ARMCANZ limit is accepted. Where a proposal will result in a loading greater than 25 kgN/ha/yr, the proponent must demonstrate the nitrate concentration in groundwater recharge over the lot will not exceed 25% of the NH&MRC/ARMCANZ limit.

5.4 Estimated total nitrogen loads

Current nitrogen loadings and likely loadings if guidelines were established and adhered to, have been calculated. These are summarised in **Table 6**. For further detail refer to **Appendix G**.

Table 6 shows that if waste management guidelines are not established, the total nitrogen load may increase by approximately 3 kg/ha/yr in the Canning Vale zone and approximately 1 kg/ha/yr in the Banjup zone.

If the proposed guidelines were established and adhered to, the current total nitrogen load could decrease by approximately 2 kg/ha/yr in both zones. This represents a significant reduction in the potential for nitrate contamination of the groundwater.

Table 6. Estimated total nitrogen loads

Kennel Zone	Current total load/area (kg/ha/yr)	Potential future total load/area (kg/ha/yr)	Potential future total load/area with guidelines (kg/ha/yr)
Canning Vale	32.0	35.2	30.2
Banjup	9.6	10.3	8.3

6. Outcomes

6.1 Maximum dog numbers for waste disposal techniques

With the modelling as a guide to the potential for nitrate contamination of groundwater, the maximum number of dogs for various waste disposal techniques was estimated. This forms the basis of the waste disposal and management guidelines (refer to **Figure 3** and **Figure 4**).

6.1.1 Waste disposal techniques in Canning Vale

In Canning Vale the following waste disposal techniques are recommended:

1. Solid waste shall be removed off-site and liquid waste from kennel compartments shall be disposed of through the septic system at operations with 6-50 dogs on the property at any time.

2. An alternative waste disposal technique, approved by the City of Canning and the Water and Rivers Commission, shall be developed for operations with more than 50 dogs on the property at any time.

6.1.2 Waste disposal techniques in Banjup

In Banjup the following waste disposal techniques are recommended:

1. Solid waste shall be removed off-site and liquid waste from the kennel compartments shall be disposed of through the septic system at operations with 3-100 dogs on the property at any time.

2. An alternative waste disposal technique, approved by the City of Cockburn and the Water and Rivers Commission, shall be developed for operations with more than 100 dogs on the property at any time.

6.2 Water quality monitoring

Following the endorsement of the guidelines, the Water and Rivers Commission will establish an annual monitoring program for water quality in the Canning Vale and Banjup areas. The parameters that will be monitored will include nitrates, phosphates and bacteria. The recommended program is detailed below.

6.2.1 Bores to be tested

1. JK1 - JK7 and JKB/97 - JKD/97 annually for nutrients (ammonia, nitrate, nitrite, total nitrogen, total phosphorus), pH, conductivity and turbidity.
2. JKA/97 annually for nutrients (ammonia, nitrate, nitrite, total nitrogen, total phosphorus), pH, conductivity, turbidity and bacteria.

6.2.2 Timing

To enable the comparison of results with previous sampling, monitoring should occur in the period February - April beginning in 1998.

6.3 Investigation of cleaning and pet care products

Following the endorsement of the guidelines, the Water and Rivers Commission will initiate an investigation into the impact on water quality of cleaning and pet care products. This will involve the research of the constituents of the main products used in the kennel operations for their compatibility with drinking water quality. It is envisaged that this will result in the production of a public information pamphlet that will recommend product constituents that are drinking water and septic tank "friendly".

6.4 Best management practices in off-site waste disposal

The majority of kennel operations will fall within the first size category (ie 6-50 dogs in Canning Vale and 3-100 dogs in Banjup) and will be required or encouraged to dispose all solid waste off-site. The Water and Rivers Commission will liaise with the local government authorities to produce a public information pamphlet outlining best management practices in off-site waste disposal.

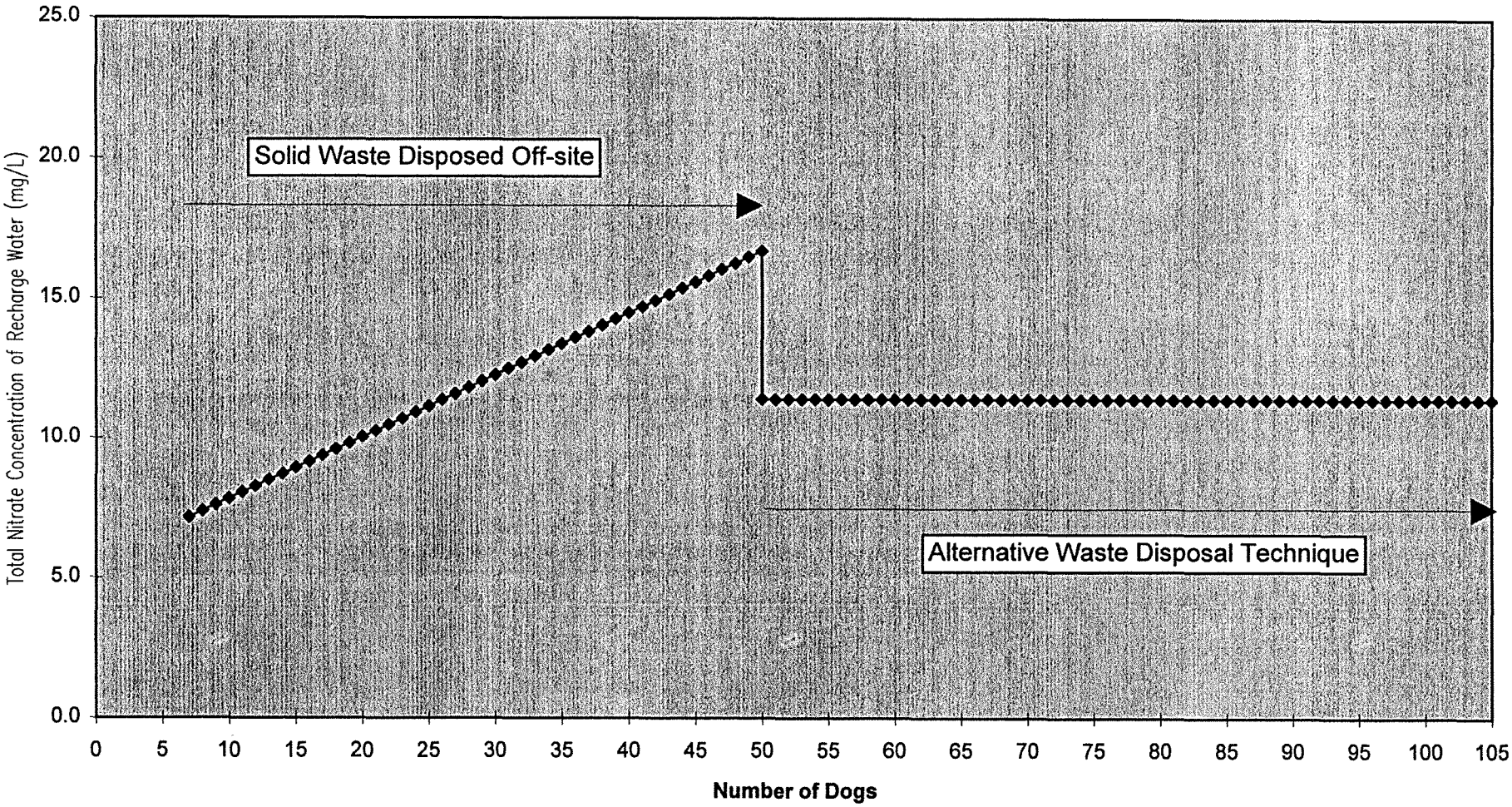

Figure 3. Waste management guidelines - Canning Vale

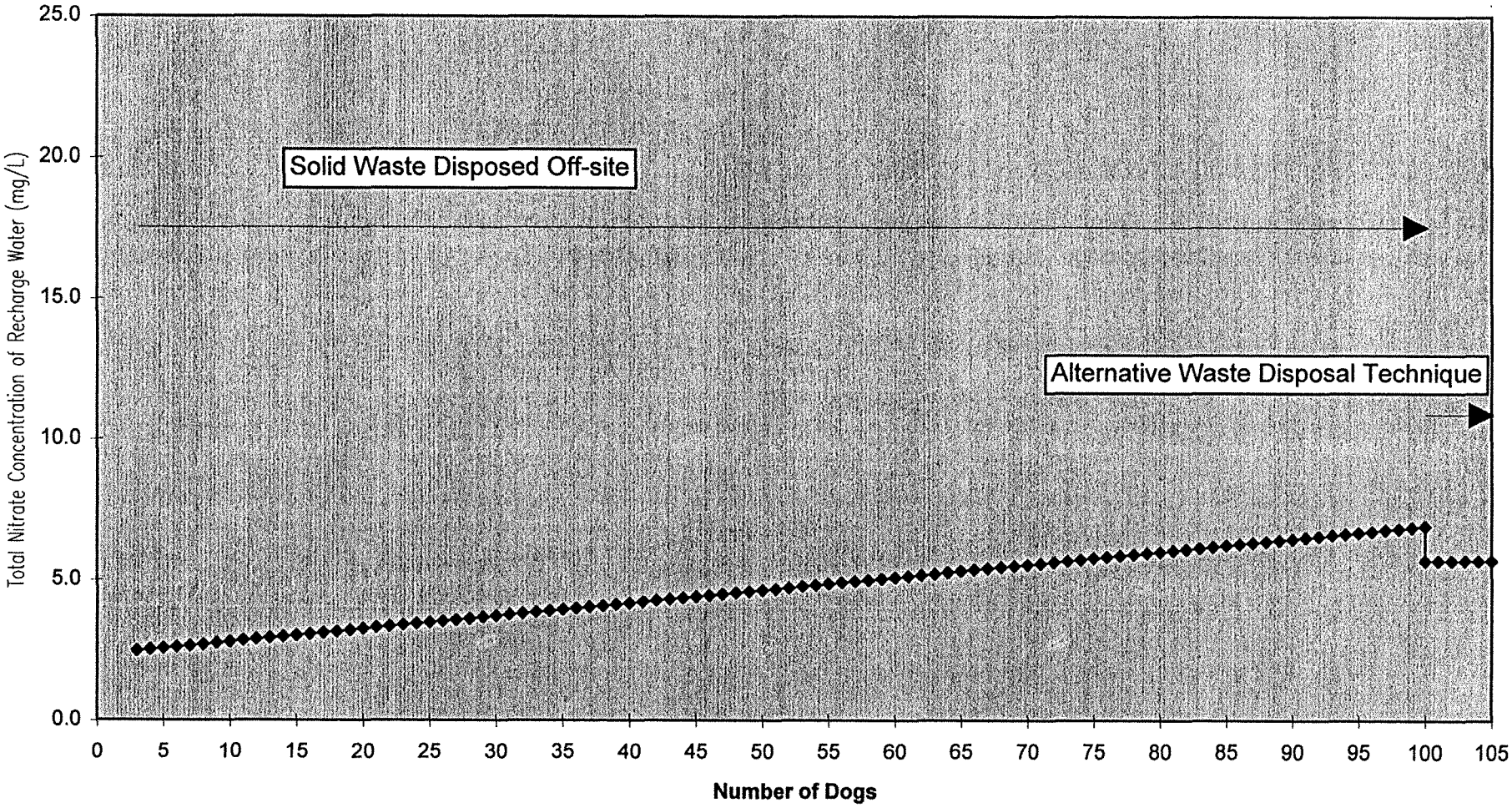

Figure 4. Waste management guidelines - Banjup

7. Guideline implementation

7.1 Implementation options

7.1.1 Option 1 : Water and Rivers Commission permit process

Option 1 is to implement the guidelines through the Water and Rivers Commission permit process. This option would require the owner/operator to provide the same information to both the Council and the Water and Rivers Commission, as the Council licence would still be required. The Water and Rivers Commission permit would not cover health and building aspects. The permit would cover waste disposal conditions related to dog numbers.

7.1.2 Option 2 : Council approval and licence process

Option 2 is to implement the guidelines through the existing Council licence process under the current by-laws. This option would require only one application for small operations and the Water and Rivers Commission would advise on conditions for the larger operations. This would be more convenient for the land owner. However, this may involve amendments to the local government authority town planning schemes or by-laws to allow enforcement. Implementation of the guidelines through the Council permit process would be appropriate.

7.2 Recommended implementation strategy

It is recommended that the guidelines should be implemented using a combination of both options described above.

The guidelines will be enforced by Council when application for planning approval is made for a new operation or extension of an existing operation that will result in the establishment or continuation of a small operation (6 - 50 dogs in Canning Vale and 3 - 100 dogs in Banjup).

Proposals for the establishment of a new operation or the extension of an existing operation that will result in the establishment of a large operation (more than 50 dogs in Canning Vale and more than 100 dogs in Banjup) will require both planning approval from the relevant local government authority and permit approval from the Water and Rivers Commission. The local government authority shall refer these applications to the Water and Rivers Commission. As a condition of the permit approval, an acceptable waste management plan will be required.

Compliance with the guidelines for established small operations will not be enforced. However, all kennel operators are encouraged to comply with the guidelines.

Established large operations shall require permit approval from the Water and Rivers Commission. As a condition of the permit approval, all solid waste generated on-site will be required to be removed off-site.

It is recommended that the City of Canning and City of Cockburn Councils approve amendment to the standard conditions of planning approval to incorporate kennel operation compliance with the guidelines as a condition of planning approval.

7.3 Inspection

It is recommended that annual inspections of all kennel operations in the Canning Vale and Banjup kennel zones are performed by the appropriate local government authorities.

Inspections should include properties that have been approved under the guidelines as well as existing properties where compliance with the guidelines is encouraged.

In addition, large kennel operations will be inspected annually by a Water and Rivers Commission representative. These inspections will ensure compliance with permit conditions.

8. Recommendations

1. The Water and Rivers Commission should undertake formal consultation regarding the proposed guidelines with the City of Canning, City of Cockburn and the Health Department of Western Australia.

2. City of Canning and City of Cockburn Councils should approve amendment to the standard conditions of planning approval to incorporate kennel operation compliance with the guidelines as a condition of planning approval.

3. The waste management guidelines should be implemented principally through the local government authority's planning approval process and managed by the relevant local government authority representatives in conjunction with the Water and Rivers Commission when assessing the larger operations.

4. Annual inspections of all kennel operations in the Canning Vale and Banjup kennel zones should be performed by the appropriate local government authorities.

5. The Water and Rivers Commission should establish an annual monitoring program for water quality in the Canning Vale and Banjup areas including nitrates, phosphates and bacteria.

6. The Water and Rivers Commission should initiate an investigation into the impact on water quality of cleaning and pet care products and direct the production of an information pamphlet for kennel owners/operators.

7. The Water and Rivers Commission should liaise with the City of Canning and City of Cockburn regarding the production of an information pamphlet on best management practices in off-site waste disposal.

8. The guidelines should be reviewed regularly (approximately every 2 years).

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Glossary

Large Operation	Means a property in Canning Vale with greater than 50 dogs or a property in Banjup with greater than 100 dogs.
Liquid Waste	Means liquid waste deposited by the dogs within sealed kennel enclosures.
NH&MRC/ ARMCANZ Drinking Water Guidelines	National Health and Medical Research Council/ Agricultural and Resource Management Council of Australia and New Zealand drinking water guidelines (1996).
Priority 2 Water Source Protection Area	(P2) source protection areas are defined to ensure that there is no increased risk of pollution to the water source.
Recharge	The downwards movement of water that is added to the groundwater system.
Rural - Water Protection Zone	The objective of the Rural - Water Protection Zone is to ensure there is no increased risk of contamination of the water source.
Small Operation	Means a property in Canning Vale with between 6 and 50 dogs or a property in Banjup with between 3 and 100 dogs.
Solid Waste	Means all solid waste generated at the kennel property
Underground Water Pollution Control Area (UWPCA)	UWPCAs are Public Drinking Water Source Areas proclaimed over groundwater areas designated for current and future drinking water supplies in the Metropolitan Area.

Appendix A

Priority classification objectives and land use compatibility

ACCEPTABILITY OF LAND USES WITHIN PUBLIC DRINKING WATER SOURCE AREAS

OVERVIEW OF PROTECTION FRAMEWORK

The Water and Rivers Commission is responsible for managing and protecting Western Australia's water resources. The Commission has developed policies for the protection of public drinking water source areas which are based on three levels of priority classification.

Priority 1 (P1) source protection areas are defined to ensure that there is no degradation of the water source. P1 areas are declared over land where the provision of the highest quality public drinking water is the prime beneficial land use. P1 areas would typically include land under Crown ownership. P1 areas are managed in accordance with the principle of risk avoidance and so development is generally not permitted.

Priority 2 (P2) source protection areas are defined to ensure that there is no increased risk of pollution to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Provision of public water supply is a high priority in these areas. P2 areas are managed in accordance with the principle of risk minimisation and so some development is allowed under specific guidelines.

Priority 3 (P3) source protection areas are defined to minimise the risk of pollution to the water source. P3 areas are declared over land where water supply needs co-exist with other land uses such as residential, commercial and light industrial developments. Protection of P3 areas is achieved through management guidelines rather than restrictions on land use. If the water source does become contaminated, then water may need to be treated or an alternative water source be found.

In addition to priority classification, **wellhead protection zones** and **reservoir protection zones** are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Wellhead protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. Reservoir protection zones usually consist of a 2 kilometre area around the top water level of a reservoir and include the reservoir itself. These zones do not extend outside water reserves. Additional restrictions apply within these zones.

LAND USE COMPATIBILITY TABLE

This table is to be used as a guideline only. Further information relating to land use and developments within Public Drinking Water Source Areas including those not listed in the table can be obtained from the Commission.

This table does not replace the need for assessment by the Commission. Please consult the Commission regarding any land use proposals in Public Drinking Water Source Areas which may impact on water resources.

DEFINITIONS USED IN THE TABLE

Compatible	The development/land use is compatible with the management objectives of the priority classification.
Incompatible	The development/land use is incompatible with the management objectives of the priority classification.
Restricted	The development/land use may be compatible with the management objectives of the priority classification with appropriate site management practices. Restricted activities should be referred to the Commission for assessment on a case specific basis.
Extensive	Where limited additional inputs are required to the land to support the desired land use, eg supplementary feed in drought etc.
Intensive	Where regular additional inputs are required to support the desired land use, eg irrigation, additional feed, fertilisers.

AGRICULTURE - ANIMALS

Development	Priority 1	Priority 2	Priority 3
Apiary	Restricted	Restricted	Restricted
Aquaculture eg. marron farm, trout farm etc	Incompatible	Restricted	Restricted
Dairy farming	Incompatible	Restricted	Restricted
Feedlots	Incompatible	Incompatible	Restricted
Livestock grazing (extensive)	Restricted	Compatible	Compatible
Livestock grazing (intensive)	Incompatible	Incompatible	Restricted[11]
Piggery	Incompatible	Incompatible	Incompatible
Poultry farming (housed)	Incompatible	Restricted	Restricted
Stables	Incompatible	Restricted	Compatible
Stockholding and saleyards	Incompatible	Incompatible[7]	Restricted[7]

AGRICULTURE - PLANTS

Development	Priority 1	Priority 2	Priority 3
Broad acre cropping i.e. non-irrigated	Incompatible	Restricted[1]	Compatible
Floriculture (extensive)	Incompatible	Restricted	Compatible
Floriculture (intensive)	Incompatible	Incompatible	Restricted
Horticulture	Incompatible	Incompatible	Restricted
Hydroponic horticulture	Incompatible	Restricted	Restricted
Orcharding	Incompatible	Restricted	Compatible
Potted nurseries	Incompatible	Restricted	Compatible
Silviculture	Restricted	Restricted	Compatible
Turf farms	Incompatible	Incompatible	Restricted
Viticulture	Incompatible	Restricted	Compatible

DEVELOPMENT - COMMERCIAL

Development	Priority 1	Priority 2	Priority 3
Aircraft servicing	Incompatible	Incompatible	Restricted[6]
Amusement centre	Incompatible	Incompatible	Compatible[6]
Automotive business	Incompatible	Incompatible	Restricted[6]
Boat servicing	Incompatible	Incompatible	Restricted[6]
Caravan and trailer hire	Incompatible	Incompatible	Restricted[6]
Carpark	Incompatible	Incompatible	Compatible
Consulting rooms	Incompatible	Incompatible[7]	Compatible[6]
Cottage industries	Restricted	Restricted	Compatible
Drive in take-away food shop	Incompatible	Incompatible	Compatible[6]
Drive in theatre	Incompatible	Incompatible	Compatible[6]
Dry cleaning premises	Incompatible	Incompatible	Restricted[6]
Farm supply centre	Incompatible	Incompatible[7]	Restricted
Fuel depot	Incompatible	Incompatible	Restricted
Garden centre	Incompatible	Incompatible	Compatible
Local shop	Incompatible	Incompatible[7]	Compatible
Market	Incompatible	Incompatible	Compatible[6]
Milk depot	Incompatible	Incompatible	Restricted
Restaurant	Incompatible	Incompatible	Compatible
Service station	Incompatible	Incompatible	Restricted
Transport depot	Incompatible	Incompatible	Restricted
Veterinary clinic/hospital	Incompatible	Incompatible[7]	Restricted
Wrecking vehicles and machinery	Incompatible	Incompatible	Restricted

DEVELOPMENT - INDUSTRIAL

Development	Priority 1	Priority 2	Priority 3
General industry	Incompatible	Incompatible	Restricted[6]
Heavy industry	Incompatible	Incompatible	Incompatible
Light industry	Incompatible	Incompatible	Restricted[6]
Power stations	Incompatible	Incompatible	Incompatible

DEVELOPMENT - URBAN

Development	Priority 1	Priority 2	Priority 3
Aged and dependent persons accommodation	Incompatible	Incompatible	Compatible[6]
Amenity building	Incompatible	Restricted	Compatible
Airports or landing grounds	Incompatible	Incompatible	Restricted[6]
Cemetery	Incompatible	Incompatible	Restricted
Civic building	Incompatible	Restricted	Compatible[6]
Club	Restricted	Restricted	Compatible[6]
Community hall	Restricted	Restricted	Compatible
Family day care centre	Incompatible	Restricted	Compatible[6]
Funeral parlour	Incompatible	Incompatible	Compatible[6]
Health centre	Incompatible	Incompatible	Compatible[6]
Hospital	Incompatible	Incompatible	Restricted[6]
Medical centre	Incompatible	Incompatible	Compatible[6]

EDUCATION/RESEARCH

Development	Priority 1	Priority 2	Priority 3
Education centres	Restricted	Restricted	Compatible[6]
Primary/secondary schools	Incompatible	Incompatible	Compatible[6]
Scientific research	Restricted	Restricted	Compatible
Universities	Incompatible	Incompatible	Restricted[6]

MINING AND MINERAL PROCESSING

Development	Priority 1	Priority 2	Priority 3
Extractive industries	Restricted[2]	Restricted[2]	Restricted[2]
Mining/mineral exploration	Restricted[4]	Restricted[4]	Restricted[4]
Tailings dams	Incompatible	Incompatible	Restricted

PROCESSING OF ANIMALS/ANIMAL PRODUCTS

Development	Priority 1	Priority 2	Priority 3
Abattoirs	Incompatible	Incompatible	Incompatible
Cheese/butter factory	Incompatible	Incompatible	Restricted[6]
Fish processing	Incompatible	Incompatible	Restricted[6]
Tannery	Incompatible	Incompatible	Incompatible
Woolscourer	Incompatible	Incompatible	Incompatible

PROCESSING OF PLANTS/PLANT PRODUCTS

Development	Priority 1	Priority 2	Priority 3
Breweries	Incompatible	Incompatible	Restricted[6]
Composting/soil blending (commercial)	Incompatible	Incompatible	Restricted
Vegetable/food processing	Incompatible	Incompatible	Restricted[6]
Wineries	Incompatible	Incompatible	Restricted

SUBDIVISION

Subdivision of land to lots of any size is incompatible within Priority 1 areas.

Development	Priority 1	Priority 2	Priority 3
Kennel subdivisions	Incompatible	Restricted	Restricted
Rural with a minimum lot size of 4 ha (unsewered)	Incompatible	Compatible	Compatible
Rural with a minimum lot size of 1 ha (unsewered)	Incompatible	Incompatible	Compatible
Special rural with a minimum lot size of 2 ha (unsewered)[5]	Incompatible	Restricted[8]	Restricted[8]
Special rural with a minimum lot size of 1 ha (unsewered)[5]	Incompatible	Incompatible	Restricted[8]
Urban residential	Incompatible	Incompatible	Compatible[6]

SPORT AND RECREATION

Development	Priority 1	Priority 2	Priority 3
Equestrian centre	Incompatible	Incompatible	Compatible
Golf courses	Incompatible	Incompatible	Restricted
Irrigated recreational parks	Incompatible	Restricted	Restricted
Motor sports i.e permanent racing facilities	Incompatible	Incompatible	Restricted
Public swimming pools	Incompatible	Restricted	Restricted
Rifle ranges	Restricted	Restricted	Compatible
Temporary recreational activities (active) eg four wheel driving, rallies	Incompatible	Restricted[3]	Restricted[3]
Temporary recreational activities (passive) eg. horse riding, bush walking	Restricted	Restricted	Restricted

STORAGE OF DESIGNATED SUBSTANCES

Development	Priority 1	Priority 2	Priority 3
Above ground storage of designated substances	Restricted[7]	Restricted[7]	Restricted[7]
Bulk chemical storage facility	Incompatible	Incompatible	Restricted[12]
Underground storage tanks	Incompatible	Incompatible	Restricted

TOURISM ACCOMMODATION

Development	Priority 1	Priority 2	Priority 3
Bed and breakfast	Incompatible	Restricted	Compatible
Caravan parks	Incompatible	Incompatible	Restricted[6]
Holiday accommodation eg farm chalets	Incompatible	Restricted[9]	Compatible[6]
Motel, lodging house, hostels	Incompatible	Incompatible	Compatible[6]

WASTE TREATMENT AND MANAGEMENT

Development	Priority 1	Priority 2	Priority 3
Deep well injection of effluent	Incompatible	Incompatible	Incompatible
Municipal landfills	Incompatible	Incompatible	Restricted
Recycling depot	Incompatible	Incompatible	Restricted
Refuse transfer stations	Incompatible	Incompatible	Restricted
Sewer (gravity)	Incompatible	Incompatible	Compatible
Sewer (pressure mains)	Incompatible	Restricted	Compatible
Used tyre storage facility (wholesale)	Incompatible	Incompatible	Incompatible
Wastewater treatment plants	Incompatible	Incompatible	Restricted
Water treatment plants	Restricted	Restricted	Restricted

OTHER DEVELOPMENTS

Development	Priority 1	Priority 2	Priority 3
Caretakers house	Restricted	Restricted	Compatible
Construction projects	Restricted	Restricted	Restricted
Forestry	Restricted[1]	Compatible	Compatible
National parks	Compatible	Compatible	Compatible
Nature reserves	Compatible	Compatible	Compatible
Radio and TV installation	Restricted	Restricted	Restricted
Major transport routes	Incompatible	Restricted[10]	Compatible

1. Restrictions apply to fertiliser application rates with strict controls on the application of pesticides and field operations.
2. Restrictions apply to the storage of fuels and chemicals with strict guidelines for rehabilitation.
3. Restrictions on the use of fuel and chemicals apply.
4. Subject to conditions placed on lease.
5. Special rural development requires appropriate planning justification including provisions in the town planning scheme text.
6. Must be connected to deep sewerage, where practical, or otherwise to an approved waste disposal system that meets water quality protection objectives.
7. May be permitted if this use is incidental to the overall land use in the area and is consistent with planning strategies.
8. Restrictions apply to siting effluent disposal systems in areas with poor land capability and a shallow depth to groundwater.
9. Restrictions apply on density of accommodation.
10. Restrictions apply on road design and construction and the types of goods that may be carried.
11. Restrictions apply to stocking levels.
12. May be permitted if the type, volume and storage mechanisms for chemicals are compatible with water quality protection objectives.

October, 1997
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Appendix B
Kennel advisory committee

COMMITTEE CONTACT DETAILS

Ron Bennetts (Water Corporation)	9420 3135
Shirley Briggs (kennel owner - Canning Vale)	9455 2786
Jade Coleman (Water and Rivers Commission)	9278 0436
Bill Currey (kennel owner - Banjup)	9397 0418
Brendan Filbey (kennel owner - Canning Vale)	9455 3957
John Hardy (City of Cockburn)	9411 3443
Jess Jackson (kennel owner - Canning Vale)	9455 1363
Sandra Keenan (City of Canning)	9231 0663
Ross Sheridan (Water and Rivers Commission)	9278 0454
Ian Thornton (Water Corporation)	9420 3019
Adrian Tomlinson (Water and Rivers Commission)	9278 0435
Linda Wines (kennel owner - Banjup)	9397 0553

Appendix C
Results of groundwater quality sampling

Water quality results of Golder Associates groundwater investigation 1996

Table C.1. Bore JK1

Depth (mbns)	pH	EC Field (mS/m)	EC Lab (mS/m)	DO Field (mg/L)	NH4-N Field (mg/L)	NH3-N Lab (mg/L)	NO3-N Field (mg/L)	NO3-N Lab (mg/L)	NO2-N Lab (mg/L)	TN (mg/L)	TP (mg/L)	FC (cfu/100 mL)
6.5	6.05	30	22.9	4.41	0.2	0.05	0.6	1.4	<0.02	2	0.02	
7.5	6	29	22.9	4.32	10	0.06	0.7	0.15	0.02	0.33	<0.01	
9	5.48	24.4	20.5	1.4	2		0.1					
10.5	5.42	18	14.1	1.15	4		0.1					
12	5.58	17.5	17.2	1.76	8	0.1	0.1	0.04	<0.02	0.42	0.01	
13.5	5.68	27.5	23.6	1.7	0.2		0.1					
15		25.5	21.6		0.2	0.1	0.1	0.02	<0.02	0.28	<0.01	
16.5	5.5	27.5	23.6	2.1	3.5		0					
18	5.65	29	25.1	1.7	2		0					
19.5	5.6	25	27	1.8	7	0.23	0	0.03	<0.02	0.5	<0.01	
21	5.7	33.6	29.7	1.6	1		0					
22.5	5.8	38	34.1	1.2	0.6		0					
24	5.75	39	36.9	1.1	0.3	0.42	0	0.03	0.02	1.1	0.02	
Monitoring Bore												
9.0-12.0	5.42	24.6	21.2	1.38	1	0.04	0	<0.02	<0.02	0.26	0.01	

Table C.2. Bore JK2

Depth (mbns)	pH	EC Field (mS/m)	EC Lab (mS/m)	DO Field (mg/L)	NH4-N Field (mg/L)	NH3-N Lab (mg/L)	NO3-N Field (mg/L)	NO3-N Lab (mg/L)	NO2-N Lab (mg/L)	TN (mg/L)	TP (mg/L)	FC (cfu/100 mL)
6		15	18.7		2	0.05	0.5	2.8	0.02	3.5	<0.01	
7.5		17	12.6		0.3		0.5					
9		19	15.2		8	0.11	0.1	0.12	<0.02	0.68	0.01	
10.5		18	13.6		2		0					
12		19	14.7		4	0.12	0	0.04	<0.02	0.56	<0.01	
13.5		18	13.6		0.4		0					
15		78	68.4		8	0.07	0	0.03	<0.02	0.38	<0.01	
16.5		118.7	114.3		0.3		0					
18		125	125		0.2	0.07	0	0.06	<0.02	0.39	<0.01	
19.5		162	157.6		0.2		0					
21		158	130		0.2	0.29	0	0.07	<0.02	0.56	<0.01	
Monitoring Bore												
9.0-12.0	5.43	24.2	15.2	1.3	0.1	0.09	0	0.02	0.02	0.52	<0.01	<10

Table C.3. Bore JK3

Depth (mbns)	pH	EC Field (mS/m)	EC Lab (mS/m)	DO Field (mg/L)	NH4-N Field (mg/L)	NH3-N Lab (mg/L)	NO3-N Field (mg/L)	NO3-N Lab (mg/L)	NO2-N Lab (mg/L)	TN (mg/L)	TP (mg/L)	FC (cfu/100 mL)
7	4.5	38	27.1		0.1	0.1	0.1					
7.5	4.9	39	31		7	0.8	0.1	0.05	<0.02	1.2	0.06	
9	4.8	46	38.2		1		0.1	0.06	0.05	2.7	0.04	
10.5		47	36.1		0.5	0.39	0					
12		47	36.4		0.6		0	0.1	0.1	5.2	0.03	
13.5		52	41.1		0.8	0.59	0					
15		88	69.9		0.4		0	0.08	0.07	2.9	0.01	
16.5		98	87.1		0.5	0.57	0					
18		96	86.1		0.5		0	0.08	0.06	2.8	0.01	
19.5		106	95.1		0.6		0					
21		109	98.1		0.4	0.48	0					
22.5		110.9	100		0.4		0	0.04	<0.02	1.2	<0.01	
Monitoring Bore												
7.0-10.0	5.9	33	29.6		0.6	0.42	0	<0.02	<0.02	1.5	0.17	

Table C.4. Bore JK4

Depth (mbns)	pH	EC Field (mS/m)	EC Lab (mS/m)	DO Field (mg/L)	NH4-N Field (mg/L)	NH3-N Lab (mg/L)	NO3-N Field (mg/L)	NO3-N Lab (mg/L)	NO2-N Lab (mg/L)	TN (mg/L)	TP (mg/L)	FC (cfu/100 mL)
3	4.47	38.4	33	1.64	0.5		0					
4.5	5.7	43.5	40.3	0.75	3	0.53	0	0.05	0.03	2	0.01	
6	6	96	90.6	0.11	2		0					
7.5	5.97	61	54.1	0.55	0	0.45	0	0.05	0.05	2.6	0.01	
9	5.6	58.1	52.7	1.17	5		0					
10.5	5.43	40.3	37.8	1.5	10	0.63	0	0.03	<0.02	1	<0.01	
12	5.39	39.2	33.8	1.45	8		0					
13.5	5.27	36.9	34.4	1.62	2	0.47	0	0.04	0.04	0.95	<0.01	
15	5.35	40.8	35.4	1.78	4		0					
16.5	5.29	39	24.6	1.72	7	0.35	0	0.03	0.02	0.65	<0.01	
18	5.34	32.2	26.8	1.46	5		0					
19.5	5.34	37.9	35.1	1.53	0.6	0.43	0	0.02	<0.02	0.72	<0.01	
Monitoring Bore												
9-11.9	5.22	44	40.7		0.6	0.61	0	0.05	<0.02	1.6	0.01	

Table C.5. Bore JK5												
Depth (mbns)	pH	EC Field (mS/m)	EC Lab (mS/m)	DO Field (mg/L)	NH4-N Field (mg/L)	NH3-N Lab (mg/L)	NO3-N Field (mg/L)	NO3-N Lab (mg/L)	NO2-N Lab (mg/L)	TN (mg/L)	TP (mg/L)	FC (cfu/100 mL)
4	3	45	37.4		0.2	0.02		9.7	<0.02	10	0.01	
4.5	4	35	27.2		0							
6	4	38	28.9		0.1	0.13		0.23	<0.02	0.6	<0.01	
7.5	4	39	31.2		0.1							
9	4.1	38	28.5	3.8	0.1	0.09		0.09	<0.02	0.36	<0.01	
10.5	4.4	35	27.2	0.77	0.2							
12	4.5	42	34.1	0.69	0.3	0.32		0.03	<0.02	0.58	<0.01	
13.5	5.1	22	14.2	0.92	0.2							
15	5	25	20.1	0.27	0.3	0.32		0.02	<0.02	0.68	<0.01	
16.5	5.2	20	12.2	0.17	0.3							
18	5	25	17.2	0.3								
19.5	5.1	21	19.8	0.3		0.27		0.05	0.05	1.3	0.1	
Monitoring Bore												
2.4-5.4	5.23	26.5	24.3		0.1	0.02	0.6-0.7	5.8	0.26	6.6	0.01	40

Table C.6. Bore JK6												
Depth (mbns)	pH	EC Field (mS/m)	EC Lab (mS/m)	DO Field (mg/L)	NH4-N Field (mg/L)	NH3-N Lab (mg/L)	NO3-N Field (mg/L)	NO3-N Lab (mg/L)	NO2-N Lab (mg/L)	TN (mg/L)	TP (mg/L)	FC (cfu/100 mL)
3.5	4.5	17	12.8	0.79	0.4	0.22		0.03	<0.02	0.78	0.02	
4.5	4.2	19	11.5	0.86	4	0.57		0.02	<0.02	1.5	0.92	
6	4.7	22	16.3	0.22	0.3							
7.5	4.7	22	28.7	0.27	0.4	0.48		0.03	<0.02	0.89	0.02	
9	5.1	31	25.3	0.56	0.5							
10.5	5	35	30.2	0.41	0.5	0.44		0.02	<0.02	1	0.01	
12	5.1	35	29.3	0.57	0.4							
13.5	5.1	35	29.3	0.3	0.6							
15	5.2	29	24.6		0.3	0.34		0.02	<0.02	1.1	<0.01	
16.5	5.2	30	24.3	0.31	0.3							
18	5.4	28	22.3	0.59	0.2							
19.5	5.3	29	22.3	0.22	0.2							
21	5.2	36	28.2	0.4	0.2	0.26		0.02	<0.02	0.82	<0.01	
Monitoring Bore												
4.0-7.0	4.9	14.7	13	0.7	0.4	0.45	0	<0.02	<0.02	1.2	0.02	

Table C.7. Bore JK7												
Depth (mbns)	pH	EC Field (mS/m)	EC Lab (mS/m)	DO Field (mg/L)	NH4-N Field (mg/L)	NH3-N Lab (mg/L)	NO3-N Field (mg/L)	NO3-N Lab (mg/L)	NO2-N Lab (mg/L)	TN (mg/L)	TP (mg/L)	FC (cfu/100 mL)
3	6.8	34	26.2	2.64	0.1	0.04		2.4	0.38	3.3	0.01	
4.5	4.6	23	16.6	0.91	0.2							
6	4.9	30	23.3	1.43	0.5	0.93		0.09	0.06	2.8	0.01	
7.5	5.1	33	26.6	1.27	0							
9	5.1	38	32.6	0.99	0.3	0.41		0.03	0.02	1.4	0.01	
10.5	5.1	41	34.6	0.76	0.2							
12	5	43	35.6	0.65	0.3	0.43		0.04	0.04	1.4	0.02	
13.5												
16.5												
19.5	5.1	49	44.5	0.63	0.3	0.34		0.03	0.03	1	0.02	
Monitoring Bore												
5.0-8.0	4.98	27.1	24.4	1.3	-	0.68	-	0.05	0.05	2.8	0.03	

Table C.8. Water quality results of Water and Rivers Commission groundwater investigation 1997

Bore	Depth (m)	TP	NH3-N (mg/L)	NO3-N	NO2-N	TN	EC 25C (mS/m)	pH	Turbidity (NTU)	Total Cols.	Thermo-tolerant Cols. (cfu/100 mL)	E-coli	Faecal Strepts
JKA	5.6	0.43	0.027	4	<0.010	6.9	18	6.3	960	50	20	20	<10
JKA	8.6	0.22	0.026	3.6	<0.010	4.3	62	4.9	460	<10	<10		<10
JKB	5	0.35	0.62	0.078	<0.010	1.9	20	5.2	510				
JKC	5.8	0.48	0.38	<0.010	<0.010	2.9	25	5.6	1200				
JKD	<6	0.25	0.026	3.2	<0.010	3.9	16	6.2	400	<10	<10		<10
JKE	7.4	0.69	0.027	10	<0.010	15	72	6.4	920	100	<10		<10
JKE	10.4	0.33	0.1	0.25	<0.010	1.6	20	5.2	1000	<10	<10		<10
JKF	3.5	0.17	0.06	0.71	0.01	2.6	55	5.2	480				
JKG	5.4	0.31	0.039	4.1	<0.010	5.9	57	5.8	670				
JKH	6.9	0.33	0.062	17	0.011	22	43	4.3	850	<10	<10		20
JKH	11.4	0.2	0.71	0.68	<0.010	4.4	39	4.7	1300	<10	<10		<10
JKI	6.5	0.21	0.03	4.7	<0.010	5.9	41	5.9	350				
JKJ	5.5	0.21	0.038	3.8	<0.010	4.7	30	6	330				
JKK	2.5	4.3	0.41	<0.010	0.038	40	16	4.8	13400				
JKK	5.5	0.17	2.5	<0.010	0.018	3.4	24	3.9	460				
JKL	3.5	5.7	0.5	<0.010	<0.010	52	11	4.2	12000				
JKM	3.6	0.78	0.31	0.24	0.013	2.9	13	4.2	680				
JKN	4.6	0.18	0.025	0.79	<0.010	1.3	13	5.4	170				
JKO	8.4	0.11	0.25	<0.010	<0.010	1.4	89	4.9	340				

Appendix D

Questionnaire for property owners in the Canning Vale and Banjup kennel zones

Questions for Property Owners in the Banjup and Canning Vale, Kennel and Cattery Areas

Owner / Operator/Lessee Details

Name:.....

Property Street Address:.....

Postal Address.....

Telephone Contact.....

What type of business or activity is undertaken on the site? (eg boarding kennel/ cattery, breeding, animal grooming service ,residence only, other)

.....

.....

.....

Site Details for Kennel/Cattery Operations

What are the approved number of animals that can be kept on the site?

.....

.....

.....

How many animals and of what type would you normally have on site. If there are seasonal variations in the numbers please provide some indication of the variation.

Animal type (eg cat, dog)	Breed or general size	Number and seasonal variation

Is the site fully developed to the approved level? If no, to what level is the site developed and what is the approximate timetable for development ?

.....

.....

.....

.....

If the site is not fully developed what are your long term plans for expansion, if any?

.....

.....

.....

.....

Waste Disposal - Kennel/Cattery

How are your kennel / cattery wastes disposed of?

Faeces.....
.....
.....
.....

Urine.....
.....
.....
.....

Food.....
.....
.....
.....

What types and quantities of products / chemicals do you use for wash down / disinfection and animal grooming?

Chemical / Product	Quantity per year	How is waste disposed of

If your waste disposal practices have changed significantly over time could you please supply details of the changes? .
.....
.....
.....
.....

Site Details for Other Land Use Activities

If there any other animals kept on the site? If yes please indicate the animal type and number.

.....
.....

Do you know of any current or past uses of your land, or nearby land that may cause contamination of groundwater?.....

Site Plan

Please draw a plan of your block showing the approximate locations of the septic systems, buildings, and bore/s.

Bore Details

If you have a bore could you please provide the following details, if they are known.

Full Depth.....

Depth of screen/slots.....

Is the bore used for drinking supply?.....

Have you had any water quality problems with your bore water? If yes could you please give any details

.....

.....

.....

.....

General Comments

If you would like to provide any other details you may think are relevant to the development of waste management guidelines for kennels and catteries please provide them. (eg innovative waste disposal ideas)

Appendix E

Estimated nitrogen output from dogs (Dr Nick Costa, Murdoch University)

Average dog = 20 kg

Consumes approximately	= 240 g dry food/day
	= 60 g protein/day (25%)
	= 9.6 g N/day (16%)
80% of total is digestible	= 7.68 g N/day
faeces	= **1.92 g N/day** (20%)
urine approximately	2 g urea / 100 mL
	= 300 mL/day
	= 6 g urea/day
	= **2.67 g N/day** (44.5%)

Small dog = 4 kg

faeces	= **0.52 g N/day**
urine	= **0.71 g N/day**

Large dog = 60 kg

faeces	= **4.30 g N/day**
urine	= **6.04 g N/day**
N loss through skin and hair	can be up to **1 g N/day**

Appendix F
Recharge estimates

Average rainfall = 865 mm (measured at Jandakot Aerodrome, average for period 1973-1990).

Assumption: 22 % of rainfall contributes to groundwater recharge (Davidson, 1995).

Assumptions (Canning Vale):

1. All properties have a private bore.
2. All garden reticulation is sourced from the bore.
3. 14.4 m^3/month of scheme water enters the septic tank per average household (Perth Urban Water Balance Study).
4. Average household = 4 people.
5. 86400 L (2 people per household) of scheme water enters the septic tank.
6. Approximately 30 % of this water is leached to the groundwater (Perth Urban Water Balance Study) =25 920 L/yr.

Lot size: Canning Vale = 0.4 ha = 4000 m^2
Banjup = 2 ha = 20 000 m^2

VOLUME OF RECHARGE PER PROPERTY (Canning Vale) = (0.22)x(0.865)x(4000) + 25 920
= 761.2 m^3/yr + 25 920 L/yr
= **787 120 L/yr**

VOLUME OF RECHARGE PER PROPERTY (Banjup) = (0.22)x(0.865)x(20 000)
= 3806 m^3/yr
= **3806 000 L/yr**

Appendix G

Estimated total current and future nitrogen loads

ASSUMPTIONS:

For both the Canning Vale and Banjup zones total nitrogen loads were predicted. A number of assumptions had to be made to achieve this and these are outlined as follows:

1. dog numbers used were taken from survey responses;
2. where survey responses indicated they catered for various sizes of dogs, these were assumed to be medium size;
3. predicted future dog numbers were taken from survey responses;
4. nitrogen loads were calculated using leaching factors and denitrification;
5. properties that indicated no future development plans were assumed to support the same number of dogs as at present; and
6. for the 56 and 23 surveys that were not returned from Canning Vale and Banjup respectively, scenarios were based on the responses of the returned surveys. These were:

    - an average number of medium sized dogs was chosen;
    - half of the properties were assumed to implement off-site solid waste disposal and the other half of the properties were assumed to use the septic system for all waste material; and
    - half of the properties were assumed to have an additional 10 dogs in the future and the other half of the properties were assumed to support the same number of dogs as at present.

Table G.1. Estimated total current nitrogen loads - Canning Vale

	Waste Disposal Technique	No of Dogs			Current		
		Small	Medium	Large	Total N (kg/yr)	Area (ha)	Total N/Area (kg/ha/yr)
Survey Responses	disposed off-site	0	102	0	25.5	0.4	63.8
	septics	33	0	0	8.7	0.4	21.8
	disposal off-site	0	80	0	21.3	0.4	53.1
	disposal off-site	30	0	0	7.3	0.4	18.2
	septics	2	0	0	5.9	0.4	14.8
	disposal off-site	30	0	0	7.3	0.4	18.2
	disposal off-site	0	25	0	10.6	0.4	26.5
	septics	0	50	0	22.4	0.4	56.1
	compost	0	16	0	11.1	0.4	27.7
	disposal off-site	0	17	0	9.0	0.4	22.6
	disposal off-site	0	40	0	13.5	0.4	33.7
	disposal off-site	0	70	0	19.3	0.4	48.3
	septics	0	9	0	8.7	0.4	21.8
	septics	0	12	0	9.7	0.4	24.4
	septics	0	16	0	11.1	0.4	27.7
	disposal off-site	0	40	0	13.5	0.4	33.7
	disposal off-site	0	0	9	9.7	0.4	24.2
	septics	0	0	18	19.3	0.4	48.3
	disposal off-site	0	20	0	9.6	0.4	24.0
	septics	2	0	0	5.9	0.4	14.8
	septics	36	0	0	9.0	0.4	22.4
	disposal off-site	0	0	9	9.7	0.4	24.2
	disposal off-site	40	0	0	7.8	0.4	19.5
	disposal off-site	0	42	0	13.9	0.4	34.7
	disposal off-site	30	0	0	7.3	0.4	18.2
	disposal off-site	0	30	0	11.6	0.4	28.9
	septics	0	10	0	9.1	0.4	22.7
	septics	0	20	0	12.4	0.4	31.0
	disposal off-site	35	0	0	7.6	0.4	18.9
	disposal off-site	0	20	0	9.6	0.4	24.0
	disposal off-site	0	28	0	11.2	0.4	27.9
	septics	42	0	0	9.5	0.4	23.8
	septics	25	0	0	8.0	0.4	20.0
	septics	0	19	0	12.1	0.4	30.2
	disposal off-site	20	0	0	6.8	0.4	16.9
	disposal off-site	0	24	0	10.4	0.4	26.0
	septics	0	9	0	8.7	0.4	21.8
	septics	0	25	0	14.1	0.4	35.2
Surveyed Total		325	724	36	428.1	15.2	28.2

Table G.1 continued

Inferred Responses	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	disposal off-site	0	30	0	11.6	0.4	28.9
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4

Table G.1 continued

	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
	septics	0	30	0	15.8	0.4	39.4
Inferred Total			1860		850.7	24.8	34.3
TOTAL		325	2584	36	1278.8	40.0	32.0

Table G.2. Estimated total future nitrogen loads - Canning Vale

	Development	Waste Disposal Technique	No of Dogs			Future		
			Small	Medium	Large	Total N (kg/yr)	Area (ha)	Total N/Area (kg/ha/yr)
Survey Responses	no development	disposed off-site	0	102	0	25.5	0.4	63.8
	no development	septics	33	0	0	8.7	0.4	21.8
	additional 14 dogs	disposal off-site	0	0	94	77	0.4	191.5
	no development	disposal off-site	30	0	0	7.3	0.4	18.2
	no development	septics	2	0	0	5.9	0.4	14.8
	no development	disposal off-site	30	0	0	7.3	0.4	18.2
	no development	disposal off-site	0	25	0	10.6	0.4	26.5
	additional 10 kennels	septics	0	60	0	25.8	0.4	64.4
	additional 12 kennels	compost	0	28	0	15.1	0.4	37.7
	additional kennels	disposal off-site	0	17	0	9.0	0.4	22.6
	double size of kennels	disposal off-site	0	80	0	21.3	0.4	53.1
	additional 8-10 kennels	disposal off-site	0	80	0	21.3	0.4	53.1
	no development	septics	0	9	0	8.7	0.4	21.8
	additional 10-20 kennels	septics	0	32	0	16.4	0.4	41.1
	no development	septics	0	16	0	11.1	0.4	27.7
	no development	disposal off-site	0	40	0	13.5	0.4	33.7
	no development	disposal off-site	0	0	9	9.7	0.4	24.2
	no development	septics	0	0	18	19.3	0.4	48.3
	additional 9 kennels	disposal off-site	0	29	0	11.4	0.4	28.4
	no development	septics	2	0	0	5.9	0.4	14.8
	possible kennel extension	septics	36	0	0	9.0	0.4	22.4
	possible kennel extension	disposal off-site	0	0	9	9.7	0.4	24.2
	no development	disposal off-site	40	0	0	7.8	0.4	19.5
	additional 4 kennels	disposal off-site	0	46	0	14.7	0.4	36.6
	no development	disposal off-site	30	0	0	7.3	0.4	18.2
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	septics	0	10	0	9.1	0.4	22.7
	no development	septics	0	20	0	12.4	0.4	31.0
	no development	disposal off-site	35	0	0	7.6	0.4	18.9
	additional 20 kennels	disposal off-site	0	40	0	13.5	0.4	33.7

Table G.2 continued

	additional 50 kennels	disposal off-site	0	77	0	20.7	0.4	51.7
	additional 5-10 kennels	septics	42	0	0	9.5	0.4	23.8
	no development	septics	25	0	0	8.0	0.4	20.0
	no development	septics	0	19	0	12.1	0.4	30.2
	no development	disposal off-site	20	0	0	6.8	0.4	16.9
	additional 3 kennels	disposal off-site	0	27	0	11.0	0.4	27.4
	additional 8 kennels	septics	0	17	0	11.4	0.4	28.5
	no development	septics	0	25	0	14.1	0.4	35.2
Surveyed Total			325	829	130	526.3	15.2	34.6
Inferred Responses	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9

Table G.2 continued

	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	no development	septics	0	30	0	15.8	0.4	39.4
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7

Table G.2 continued

	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
	additional 10 kennels	septics	0	40	0	19.1	0.4	47.7
Inferred Total				2170		934.6	24.8	37.7
TOTAL			325	2999	130	1461.0	40.0	36.5

Table G.3. Estimated total future nitrogen loads (with guidelines) - Canning Vale

	Development	Waste Disposal Technique	No of Dogs			Future (within guidelines)		
			Small	Medium	Large	Total N (kg/yr)	Area (ha)	Total N/Area (kg/ha/yr)
Survey Responses	no development	disposed off-site	0	102	0	25.5	0.4	63.8
	no development	septics	33	0	0	7.4	0.4	18.6
	additional 14 dogs	disposal off-site	0	0	94	47.1	0.4	117.7
	no development	disposal off-site	30	0	0	7.3	0.4	18.2
	no development	septics	2	0	0	5.8	0.4	14.6
	no development	disposal off-site	30	0	0	7.3	0.4	18.2
	no development	disposal off-site	0	25	0	10.6	0.4	26.5
	additional 10 kennels	septics	0	60	0	17.4	0.4	43.4
	additional 12 kennels	compost	0	28	0	11.2	0.4	27.9
	additional kennels	disposal off-site	0	17	0	9.0	0.4	22.6
	double size of kennels	disposal off-site	0	80	0	21.3	0.4	53.1
	additional 8-10 kennels	disposal off-site	0	80	0	21.3	0.4	53.1
	no development	septics	0	9	0	7.5	0.4	18.7
	additional 10-20 kennels	septics	0	32	0	11.9	0.4	29.9
	no development	septics	0	16	0	8.8	0.4	22.1
	no development	disposal off-site	0	40	0	13.5	0.4	33.7
	no development	disposal off-site	0	0	9	9.7	0.4	24.2
	no development	septics	0	0	18	13.7	0.4	34.1
	additional 9 kennels	disposal off-site	0	29	0	11.4	0.4	28.4
	no development	septics	2	0	0	5.8	0.4	14.6
	possible kennel extension	septics	36	0	0	7.6	0.4	19.0
	possible kennel extension	disposal off-site	0	0	9	9.7	0.4	24.2
	no development	disposal off-site	40	0	0	7.8	0.4	19.5
	additional 4 kennels	disposal off-site	0	46	0	14.7	0.4	36.6
	no development	disposal off-site	30	0	0	7.3	0.4	18.2
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	septics	0	10	0	7.7	0.4	19.2
	no development	septics	0	20	0	9.6	0.4	24.0
	no development	disposal off-site	35	0	0	7.6	0.4	18.9
	additional 20 kennels	disposal off-site	0	40	0	13.5	0.4	33.7

Table G.3 continued

	additional 50 kennels	disposal off-site	0	77	0	20.7	0.4	51.7
	additional 5-10 kennels	septics	42	0	0	7.9	0.4	19.8
	no development	septics	25	0	0	7.0	0.4	17.6
	no development	septics	0	19	0	9.4	0.4	23.5
	no development	disposal off-site	20	0	0	6.8	0.4	16.9
	additional 3 kennels	disposal off-site	0	27	0	11.0	0.4	27.4
	additional 8 kennels	septics	0	17	0	9.0	0.4	22.6
	no development	septics	0	25	0	10.6	0.4	26.5
Surveyed Total			325	829	130	452.8	15.2	29.8
Inferred Responses	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	additional 10 kennels	disposal off-site	0	40	0	13.5	0.4	33.7
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9
	no development	disposal off-site	0	30	0	11.6	0.4	28.9

Table G.3 continued

	no development	disposal off-site	0	30	0	11.6	0.4	28.9	
	no development	disposal off-site	0	30	0	11.6	0.4	28.9	
	no development	disposal off-site	0	30	0	11.6	0.4	28.9	
	no development	disposal off-site	0	30	0	11.6	0.4	28.9	
	no development	disposal off-site	0	30	0	11.6	0.4	28.9	
	no development	disposal off-site	0	30	0	11.6	0.4	28.9	
	no development	disposal off-site	0	30	0	11.6	0.4	28.9	
	no development	disposal off-site	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	no development	septics	0	30	0	11.6	0.4	28.9	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7	

Table G.3 continued

	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7
	additional 10 kennels	septics	0	40	0	13.5	0.4	33.7
Inferred Total				2170		776.4	24.8	31.3
TOTAL			325	2999	130	1229.2	40.0	30.7

Table G.4. Estimated total current nitrogen loads - Banjup

	Waste Disposal Technique	No of Dogs			Current		
		Small	Medium	Large	Total N (kg/yr)	Area (ha)	Total N/Area (kg/ha/yr)
Surveyed Responses	buried on-site	0	0	50	43.4	2.0	21.7
	septics	0	110	0	42.5	2.0	21.2
	off-site disposal	0	0	22	15.4	2.0	7.7
	disposal off-site	0	0	0	5.7	2.0	2.9
	buried/septics	0	20	0	12.4	2.0	6.2
	disposal off-site	30	0	0	7.3	2.0	3.6
Surveyed Total		30	130	72	126.8	12.0	10.6
Inferred Responses	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	septics	0	50	0	22.4	2.0	11.2
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
	disposal off-site	0	50	0	15.4	2.0	7.7
Inferred Total		0	1150	0	432.0	46.0	9.4
TOTAL		30	1280	72	558.7	58.0	9.6

Table G.5. Estimated total future nitrogen loads - Banjup

	Development	Waste Disposal Technique	No of Dogs			Future		
			Small	Medium	Large	Total N (kg/yr)	Area (ha)	Total N/Area (kg/ha/yr)
Surveyed Responses	no development	buried on-site	0	0	50	43.4	2.0	21.7
	expand kennels	septics	0	110	0	42.5	2.0	21.2
	another kennel block 15 - 20 race dogs	off-site disposal	0	0	42	37.4	2.0	18.7
	cats to 60 max	disposal off-site	0	0	0	5.7	2.0	2.9
	expand number of runs	buried/septics	0	20	0	12.4	2.0	6.2
	no development	disposal off-site	30	0	0	8.4	2.0	4.2
Surveyed Total			30	130	92	149.9	12.0	12.5
Inferred Responses	no development	septics	0	60	0	25.8	2.0	12.9
	no development	septics	0	60	0	25.8	2.0	12.9
	no development	septics	0	60	0	25.8	2.0	12.9
	no development	septics	0	60	0	25.8	2.0	12.9
	no development	septics	0	60	0	25.8	2.0	12.9
	no development	septics	0	50	0	22.4	2.0	11.2
	no development	septics	0	50	0	22.4	2.0	11.2
	no development	septics	0	50	0	22.4	2.0	11.2
	no development	septics	0	50	0	22.4	2.0	11.2
	no development	septics	0	50	0	22.4	2.0	11.2
	no development	septics	0	60	0	25.8	2.0	12.9
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
Inferred Total			0	1270	0	463.6	46.0	10.1
TOTAL			30	1400	92	613.5	58.0	10.6

Table G.6. Estimated total future nitrogen loads (with guidelines) - Banjup

	Development	Waste Disposal Technique	No of Dogs			Future (with guidelines)		
			Small	Medium	Large	Total N (kg/yr)	Area (ha)	Total N/Area (kg/ha/yr)
Surveyed Responses	no development	buried on-site	0	0	50	27.7	2.0	13.9
	expand kennels	septics	0	110	0	27.1	2.0	13.5
	another kennel block 15 - 20 race dogs	off-site disposal	0	0	42	24.2	2.0	12.1
	cats to 60 max	disposal off-site	0	0	0	5.7	2.0	2.9
	expand number of runs	buried/septics	0	20	0	9.6	2.0	4.8
	no development	disposal off-site	30	0	0	7.3	2.0	3.6
Surveyed Total			30	130	92	101.7	12.0	8.5
Inferred Responses	no development	septics	0	60	0	17.4	2.0	8.7
	no development	septics	0	60	0	17.4	2.0	8.7
	no development	septics	0	60	0	17.4	2.0	8.7
	no development	septics	0	60	0	17.4	2.0	8.7
	no development	septics	0	60	0	17.4	2.0	8.7
	no development	septics	0	50	0	15.4	2.0	7.7
	no development	septics	0	50	0	15.4	2.0	7.7
	no development	septics	0	50	0	15.4	2.0	7.7
	no development	septics	0	50	0	15.4	2.0	7.7
	no development	septics	0	50	0	15.4	2.0	7.7
	no development	septics	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
	no development	disposal off-site	0	50	0	15.4	2.0	7.7
	no development	disposal off-site	0	60	0	17.4	2.0	8.7
Inferred Total			0	1270	0	378.2	46.0	8.2
TOTAL			30	1400	92	479.9	58.0	8.3