

ENVIRONMENTAL PROTECTION AUTHORITY  
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## Jandakot groundwater scheme Stage 2

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Water Authority of Western Australia

Report and recommendations  
of the Environmental Protection Authority

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## Summary and recommendations

The Water Authority of Western Australia has proposed to develop the western portion of the Jandakot Mound for both private and public water supply purposes. This proposal constitutes Stage 2 of the Jandakot Public Water Supply Scheme. Stage 1 is located on the eastern flank of the mound and has been operating since 1979.

The Environmental Protection Authority (EPA) has insisted on a Public Environmental Review for the project because it has the potential to have widespread important environmental impacts.

The Water Authority's plan to manage the environmental impacts of the project was released for public comment for 8 weeks on the 28 February 1991.

The EPA believes the development's major environmental issues - the loss of wetland habitat, and the impact on vegetation and waterbirds - are manageable provided the Water Authority of Western Australia agrees to the Environmental Protection Authority's recommendations contained in this report.

### Key issues

Several major issues were raised by the public and the EPA in response to this plan and these have been addressed either by the proponent or the EPA as follows:

*"Will the development result in a sustainable groundwater resource?"*

- The EPA is satisfied that the quantity of water to be drawn from the groundwater resource is sustainable in the long-term.
- The Water Authority has used knowledge gained from the development of the Gngangara Mound and Jandakot Stage 1 groundwater schemes in the design of this plan.

*"Is the proposal ecologically sustainable?"*

- A state-of-the-art computer model has been developed by the Water Authority based on Gngangara Mound and Jandakot Stage 1 observations. This has been used to predict and reduce the likely environment impacts due to the project.
- An Environmental Management Program will be required. This will ensure that annual monitoring and reporting of environmental impacts is conducted. Revision and refinement of the computer model and pumping strategy will be conducted in the light of future environmental monitoring.
- The EPA believes that the proposal contains sufficient flexibility to manage any adverse but unexpected environmental impacts that may arise by varying the rate, time or quantity of water abstracted at individual wells within the wellfield.
- Initial water abstraction quantities will be small but will gradually increase up to a ceiling of 24 million cubic metres per annum. The rate of increase will be largely determined by demand for private wells. This gradual increase in the quantity of water that is to be abstracted, as well as environmental monitoring requirements, will permit the local animals and plants to adapt to any drier conditions that may eventuate. This gradual increase in abstraction will also allow ongoing calibration and refinement of the computer model thereby permitting adverse environmental impacts to be avoided before they arise.

*"Private abstraction accounts for two-thirds of the water to be drawn from the resource. How can this abstraction be regulated?"*

- The Water Authority will continue to issue private well licences in the Jandakot Water Supply Area up to a ceiling of 16 million cubic metres per annum. The remaining 8 million cubic metres is reserved for public water supply purposes.
- The volume of water that may be abstracted by each user is determined by the nature and area of the intended land use.

- The environmental impacts of private abstraction will be managed by dividing the 16 million cubic metre allocation into 11 sub-areas, each allocation being determined by the size, hydrology, sustainability of yield and ecology of the individual sub-areas. Revisions of sub-area water allocations will be conducted in the light of monitoring results and refinement of computer model predictions.

*"Important waterbird breeding and feeding habitats will be lost"*.

- The EPA considers wetlands to be "windows on the watertable" and that the environmental affects of groundwater pumping will be most noticeable within the wetlands of the area. For this reason the EPA places importance on maintaining the existing roles of the wetlands in the area.
- The water abstraction plan has been designed to protect the most biologically important wetlands. In some instances this will involve topping up wetland water levels with groundwater over summer.
- The abstraction plan will benefit some important wetlands by lowering artificially high water levels - a result of urbanization and vegetation clearing.
- Most waterbird breeding occurs in the period from June to December each year. The EPA has recommended that wetlands that normally contain water during this period should continue to do so.
- By ensuring that the biologically important wetlands are protected and that the waterbird breeding roles of other wetlands are maintained the overall ecological impact of the proposal should be minimal.
- The EPA acknowledges that some loss of wetland area or function is unavoidable if a water supply is to be developed in the area. Accordingly, the EPA has recommended that unavoidable losses of wetland areas or functions that may occur should be offset by wetland relocation, creation, rehabilitation or other management strategies intended to compensate for these losses. The details of this mitigation strategy will be included in an Environmental Management Program to be submitted to the EPA prior to the commencement of the project.

#### Recommendation 1

The Environmental Protection Authority concludes that the proposal to develop the Jandakot Groundwater Scheme Stage 2, as described in the PER and subsequently modified in the proponent's response to submissions, is environmentally acceptable.

In reaching this conclusion, the Authority identified the main environmental factors requiring detailed consideration as:

- wetland protection;
- remnant vegetation protection;
- habitat protection; and
- ecosystem protection.

The Environmental Protection Authority considers that these environmental factors have been addressed adequately by the environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations given in this report.

The Environmental Protection Authority therefore recommends the proposal may proceed subject to the undertakings and commitments provided by the proponent (Appendix 1) and subject to the recommendations of this report.

#### Recommendation 2

The Environmental Protection Authority recommends that the Water Authority of Western Australia modify its groundwater abstraction strategy so that the wetlands that normally contain water on the 1st of December continue to do so, thereby ensuring adequate wetland water levels during the waterbird breeding season. Details of this strategy should be included as part of an Environmental Management Program.

#### Recommendation 3

The Environmental Protection Authority recommends that the proponent submit annual and more detailed triannual reports to the Environmental Protection Authority addressing compliance with the environmental criteria and environmental objectives. The reports should include an evaluation of the effectiveness of the criteria in meeting the environmental objectives and any proposed changes to management, monitoring or mitigation of wetland impacts.

The ongoing monitoring and reporting requirements will be reviewed by the Environmental Protection Authority after 9 years.

Any breach or anticipated breach of the environmental criteria or environmental objectives should be reported to the Environmental Protection Authority immediately.

#### Recommendation 4

The Environmental Protection Authority recommends that, prior to construction of the wellfield, the proponent prepare and submit an Environmental Management Program which includes a wetland loss mitigation strategy and reflects the anticipated future land use/abstraction scenario for the area, to the satisfaction of the Environmental Protection Authority.

# 1. Introduction

In October 1988 the Water Authority of Western Australia referred to the Environmental Protection Authority a proposal to implement Stage 2 of the Jandakot Groundwater Scheme.

The Authority determined that the proposal be formally assessed under Part IV of the Environmental Protection Act (1986) and that a Public Environmental Review be prepared.

The Public Environmental Review document was released for public review and comment for a period of 8 weeks commencing on 28 February, 1991 and closing on 25 April, 1991.

Public submissions were analysed and a summary of issues was forwarded to the Water Authority of Western Australia (Appendix 3). A formal response to the questions raised in the summary of submissions was received on 11 July 1991 (Appendix 4).

## 2. The proposal

### 2.1 Context

The Jandakot Public Water Supply Area and Jandakot Underground Water Pollution Control areas were proclaimed by the Water Authority in 1975. The groundwater resource has been specifically managed for quality and quantity since this time.

Approval to develop both Stages 1 and 2 of the Jandakot Groundwater Scheme was given by the Environmental Protection Authority in 1976. Because of the time that has elapsed since this approval the Water Authority has decided to re-submit the proposal to the Authority for re-assessment.

Stage 1 of the Jandakot Groundwater Scheme has been operating since 1979. Under Stage 2 it is proposed to increase the water abstraction from the shallow unconfined aquifer from 4 to 8 million cubic metres per year by constructing a new line of wells to the west of the existing wellfield (Figure 1). Private abstraction will be set at a ceiling of 16 million cubic metres per year and allocated by issuing well licences for specific abstraction volumes based on land use.

Commissioning of Jandakot Stage 2 will most likely be required by October 1993, but may be required as early as October 1992 depending on demand.

### 2.2 Wellfield location

The Stage 2 wellfield consists of up to 13 wells located approximately 800m apart. It is proposed to align the Stage 2 wellfield parallel to and about 4km west of the Stage 1 wellfield.

The wellfield is located entirely within the Jandakot Public Water Supply Area and is located 'upstream' of Kwinana Freeway extensions and areas of intensive horticulture. The siting of the individual wells was based on:

- achieving overall environmental objectives and criteria, which had been set following extensive discussions with relevant government and non-government consultants;
- achieving wetland water level ranges that closely mimic the natural water level fluctuations observed within the larger wetlands of the area;
- prescribed setbacks from System 6 areas and natural non-degraded seasonally inundated wetlands (nominally 500m);
- optimizing the distance between wells in order to abstract the maximum quantity of groundwater that could be produced on a sustainable basis while minimizing water table drawdown (based on computer modelling);
- economic considerations (eg minimizing the length of the collector main required); and
- availability of vehicular access.

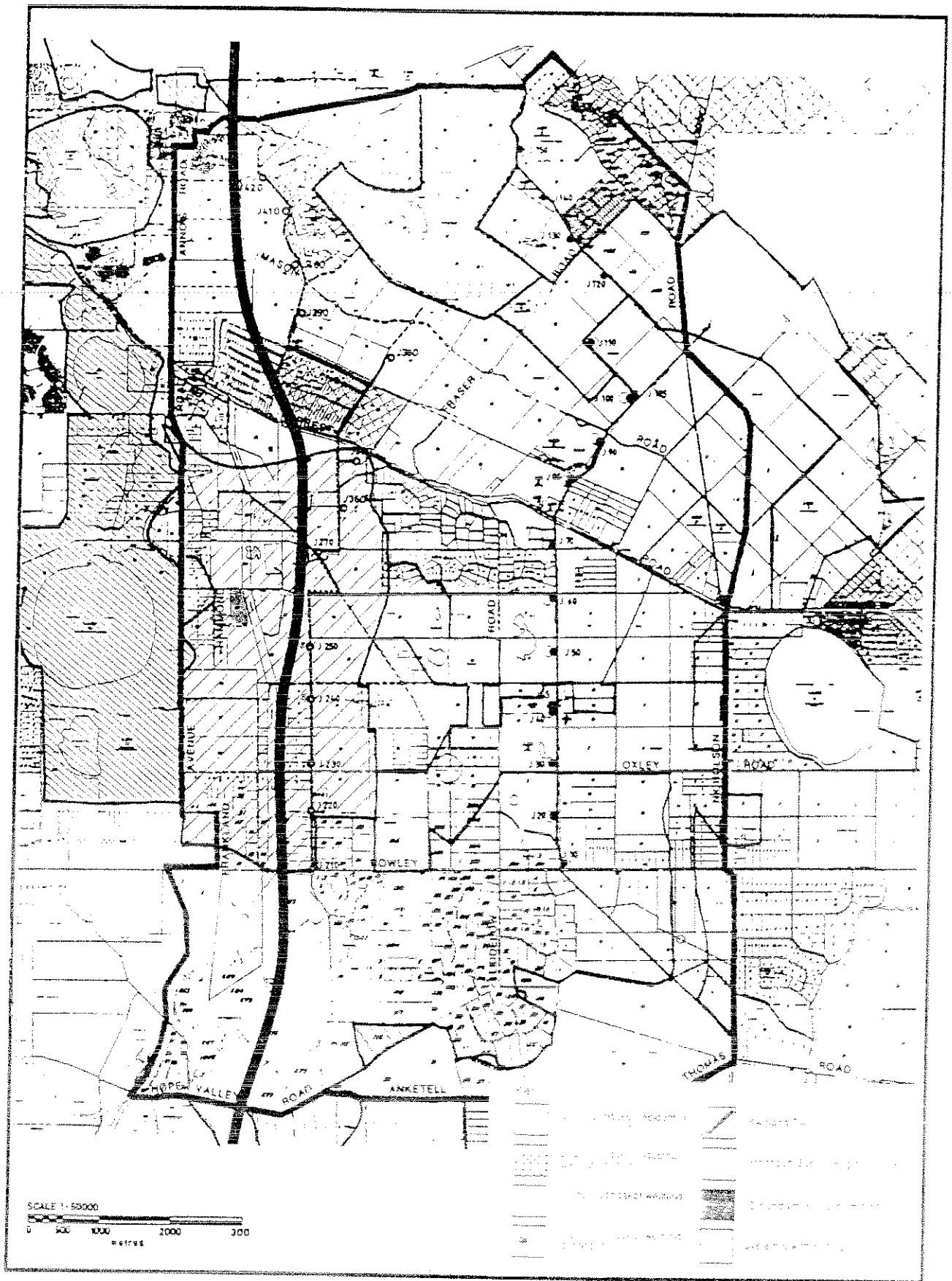


Figure 1. Location of the Jandakot groundwater scheme Stages 1 & 2.

### 2.3 Pumping strategy

It is intended that the Stage 2 wellfield would be operated for periods of between 6 and 10 months in any year. This will largely be determined by local demand. The Stage 1 wellfield is currently operated from early October to early May each year.

To date the availability of water from the Darling Range dams and a decrease in demand for water during winter have meant that it has not been necessary to operate the Stage 1 wells during winter.

### 2.4 Private wells

Existing private groundwater use from the Jandakot Public Water Supply Area has been managed under the provisions of the Metropolitan Water supply and Drainage Act (1909) since 1975. This Act requires all private wells in the area to be licensed.

The Water Authority have proposed that the groundwater allocation for private users be increased from 9 to 16 million cubic metres a year over time. This increase is expected to be sufficient to meet the demands of future private groundwater users in the area and has been incorporated into computer simulations and sustainable water yield calculations for the resource.

This report considers the environmental implications of the entire project - both public and private water abstraction proposals.

### 2.5 Existing environment

The Jandakot area is characterized by a series of ancient dunes and swales. These ancient sands are extremely porous and may store up to 389 litres of water per cubic metre of soil. The high permeability of these soils also facilitates the lateral and vertical movement of water.

Groundwater in the Jandakot area largely originates from rainfall which drains through the permeable sands to the water table. This shallow groundwater forms a regional mound or elevation in the watertable.

In areas where the watertable approaches the ground surface wetlands may occur. These wetlands are considered to be 'windows on the water table' or surface expressions of the water table and as such the water levels within these wetlands are a reflection of the water table level in the area. These wetlands may be permanent (eg Eastern Beelihar Wetland Chain) or seasonal wetlands, termed sunplands and damplands (eg Hird Road Swamp and Twin Barram Swamp, respectively), depending on the magnitude of seasonal water table fluctuations.

Wetlands may also occur where there is an impervious layer located near the ground surface. This impervious layer often takes the form of clay or 'coffee rock' (sand cemented with iron and aluminium oxides) and prevents the downward movement of rainfall through the soil resulting in an accumulation of water in the porous soil immediately above the impervious layer. This water is commonly referred to as a perched water table because it occurs above the regional water table. Perched water table wetlands generally dry out during middle to late summer due to the high evaporative losses at this time of the year hence they are generally seasonal wetlands.

### 2.6 Environmental objectives and environmental criteria

The general environmental objectives used by the proponent are:

- the maintenance of essential ecological processes;
- the preservation of genetic diversity or species diversity as reflected by habitat diversity;
- the maintenance of species abundance;



- the optimization of the quality of life for Western Australians; and
- sustainability of land use.

These objectives are based on the aims of the State Conservation Strategy (DCE, 1987), the National Conservation Strategy (Department of Home Affairs and Environment, 1984), and the World Conservation Strategy (International Union of Conservation of Nature and Natural Resources, 1980).

The proponent has elected to use environmental criteria to ensure that these environmental objectives are met. These criteria were derived following extensive discussions between government and non-government experts and encompass the essential components of the environment. These criteria have been designed to meet the environmental objectives listed above and are intended to protect the following critical elements of the Jandakot environment:

- Non-degraded seasonally inundated wetlands.
- Potentially significant wetlands between Thomsons Lake and Forrestdale Lake located within the South Jandakot Urban Development area (ie. Hird Road Wetland, Twin Bartram (east), Twin Bartram (west), Branch Street Wetland, Solomon Road Wetland, Russell Road Wetland, Bartram Road Wetland Complex, Beenyup Road Wetland and the Gaebler Road Wetland).
- 'A' Class reserves (Thomsons and Forrestdale Lakes).
- System 6 areas.
- Remnant vegetation.
- Major wetlands.
- Air quality.

It is intended that the environmental criteria would protect the wetland ecosystem as a whole.

### 3. Public review

During the public review of the PER a total of 27 submissions were received from members of the public, community groups, local government and government agencies. A detailed summary of these submissions is presented in Appendix 3. The Water Authority's response to the issues and comments raised in the summary of submissions is included in Appendix 4.

### 4. Existing and pending Government policies

A number of existing, proposed and pending Government policies encroach upon the Jandakot Public Water Supply Area. It is important that the proposed groundwater development is integrated with the policies that apply to the area both now and in the foreseeable future.

Many of these Government policies cover areas of conservation value. These areas have been identified in the Environmental Protection Authority's Conservation Reserves for Western Australia - System 6 (EPA, Report 13). The recommendations made in that report have subsequently been endorsed by Government and as a result should be afforded a high degree of environmental protection.

#### 4.1 Proposed Beelihar Regional Park

In 1986 the Wetlands Conservation Society proposed to Government that a number of wetlands in the City of Cockburn and Town of Kwinana should be managed collectively as a regional park.

The Government adopted this suggestion and announced its intention to establish the Beelihar Regional Park. The current boundaries for the proposed Regional Park are tentative, however significant changes to the general location of the park are unlikely.

It is proposed that the Beeliar Regional Park be managed jointly by the Department of Conservation and Land Management, the City of Cockburn and the Town of Kwinana. The Department of Conservation and Land Management would co-ordinate management and establish a community consultative mechanism to aid management. The Water Authority would provide expertise to aid survival of the wetlands and development of management criteria for the wetlands.

The proposed boundaries of the Beeliar Regional Park do not overlap with the boundaries of the Public Water Supply Area, except in one isolated instance (Figure 1). However, the Water Authority has recognized the impact that abstraction within the Public Water Supply Area could have on 'downstream' environments (eg Beeliar Regional Park) and has addressed these impacts during both community consultation and the design phase of the proposal.

The Environmental Protection Authority continues to strongly support the concept and implementation of the Beeliar Regional Park.

## 4.2 Proposed Jandakot Botanical Park

The Department of Planning and Urban Development is currently considering reserving or otherwise protecting land for a Jandakot Botanical Park. The Park would be for the protection of banksia ecosystems and the provision of recreational amenity. Planning for the park is not yet finalized but it is anticipated that decisions will be made in the near future.

The Jandakot Botanical Park boundaries, as currently proposed, would mean that the Stage 2 wellfield would not be located within 200m of the park. This separation should ensure that the environmental criteria pertaining to the conservation of the banksia woodland (environmental objective) would be met.

The Park would also enhance the prospects of maintaining the water quality of the resource in the long-term by limiting the occurrence of agricultural and urban sources of pollutants within the Public Water Supply Area.

## 4.3 Lakes Environmental Protection Policy

In March 1991, the Environmental Protection Authority published the Draft Environmental Protection (Swan Coastal Plain Wetlands) Policy 1991 for public comment. Regulations were published at the same time to ensure the wetlands in the Policy area were protected during the submission period. As a generality, any wetland or sumpland (semi-permanent wetland) which holds water at the beginning of summer (December 1st) must not be filled, drained or polluted.

It is important to note that development around designated wetlands is not restricted provided the requirements of the Policy are accommodated.

Water abstraction is not covered by the definition of 'draining' in either the draft Policy or the regulations. The Stage 2 proposal does not involve either wetland 'draining' or wetland 'polluting' activities, and as such is unaffected by the draft Policy and the associated regulations. The Water Authority of Western Australia's proposal has displayed a commendable degree of responsibility for the continued function of the wetlands both inside and outside the Public Water Supply Area, thereby abiding by the intent of the Draft Wetlands Policy.

Although the further loss and degradation of wetlands on the Swan Coastal Plain is undesirable it is inevitable that some further unavoidable loss will occur. Wetland degradation is predicted with the extension of the Kwinana Freeway south of Perth and the expansion of urban development into the Jandakot area. Wetland losses and degradation may be offset to some degree by a requirement for wetland restoration or construction, either on-site or off-site or of similar function or alternative function to the wetland being lost. This will ensure that there is no net loss of wetland function in the long-term.

#### **4.4 Jandakot Mound Environmental Protection Policy**

An Environmental Protection Policy for the Jandakot Mound is currently in the early stages of preparation and parallels current work by the Environmental Protection Authority to prepare an Environmental Protection Policy for the Gnangara Mound.

The purpose of a proposed policy for the Jandakot Mound would be to ensure protection of the groundwater, wetlands, (and associated ecosystems) within the Policy Area from adverse effects, including pollution, and for specified beneficial uses.

The Policy would apply to groundwater, the land above the groundwater, and wetland and groundwater dependent vegetation. It would also pertain to all land and land use activities undertaken by private individuals, corporations, government departments, government agencies and responsible authorities, within the area defined by the policy.

The principles that would underlie the Jandakot Groundwater Policy would be derived from the draft Swan Coastal Plain Environmental Protection Policy and are as follows:

- maintenance of essential ecological processes and life support systems;
- preservation of genetic diversity;
- ensuring the sustainable use of natural resources and ecosystems;
- maintenance and enhancement of environmental qualities;
- management of wetlands, groundwater, lakes, rivers and estuaries to ensure a clean and healthy condition;
- the user should be responsible for the restoration and ongoing management of environmental harm; and
- development should not exceed the environments capacity to assimilate related adverse impacts.

(These principles have also been used in the preparation of this report).

A number of beneficial uses would be covered by provisions in the policy. These would include protection and maintenance of the quality and quantity of the groundwater resources and wetlands and ecosystems dependent on the groundwater or wetlands in the Jandakot Policy Area.

Without limiting the provisions of the Environmental Protection Policy, any portion of the Jandakot Policy Area may be defined as a groundwater, wetland or ecosystem protection area, within which certain defined land use activities are incompatible and therefore not environmentally acceptable.

#### **4.5 South Jandakot urban area**

In October 1986 the State Planning Committee (now Department of Planning and Urban Development) published a planning study for the South Jandakot area. This study recommended that 1300 hectares of land be rezoned for residential purposes.

The Environmental Protection Authority assessed the proposal as environmentally acceptable in 1987, subject to a number of recommendations including the establishment of a satisfactory drainage management plan.

In 1989 the Environmental Protection Authority reported that the proponent had failed to formulate an environmentally acceptable drainage management plan. A revised drainage management plan was re-submitted to the Authority in 1990. This plan was deemed to be environmentally acceptable by the Environmental Protection Authority. Consequently, the Metropolitan Regional Scheme has been amended to rezone the land for residential purposes.

## 5. Environmental impacts and management

The Environmental Protection Authority assessed and provided advice on Stages 1 and 2 of the Jandakot Groundwater Scheme in 1976. This assessment relates to the design and environmental management of the Stage 2 scheme.

The main environmental issues considered by the Environmental Protection Authority are:

- wetland protection;
- remnant vegetation protection;
- habitat protection; and
- ecosystem protection

Based on the Environmental Protection Authority's assessment of the proposal, additional information provided in the public submissions, the Water Authority of Western Australia's response to the public submissions and further clarification of issues by the proponent and government agencies, the Authority recommends as follows:

### Recommendation 1

The Environmental Protection Authority concludes that the proposal to develop the Jandakot Groundwater Scheme Stage 2, as described in the PER and subsequently modified in the proponent's response to submissions, is environmentally acceptable.

In reaching this conclusion, the Authority identified the main environmental factors requiring detailed consideration as:

- wetland protection;
- remnant vegetation protection;
- habitat protection; and
- ecosystem protection

The Environmental Protection Authority considers that these environmental factors have been addressed adequately by the environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations given in this report.

The Environmental Protection Authority therefore recommends the proposal may proceed subject to the undertakings and commitments provided by the proponent (Appendix I) and subject to the recommendations of this report.

The Authority's experience is that it is common for details of a proposal to alter through the detailed design and construction phase. In many cases alterations are not environmentally significant or have positive effects on the environmental performance of the project. The Authority considers that such insubstantial changes should be provided for within the assessment process.

The Authority also considers that any approval for the proposal based on this assessment should be limited to five years. Therefore, if the proposal has not substantially commenced within five years of the date of this report, then such approval shall lapse. After this time, further consideration of the proposal should occur only following a new referral to the Authority.

## 5.1 Environmental criteria

Actual target values ascribed to a particular environmental criterion are essentially 'best estimates' based on humankind's somewhat limited knowledge of complex natural systems and their responses to change. As a consequence the values that are assigned to a particular criterion can never be treated as definitive but rather a guide to be refined as the inter-relationships between human activities and the environment become more fully understood. In this respect any inherent flexibility within a development proposal will always increase the likelihood of achieving the desired environmental objectives. The Water Authority of Western Australia's proposal contains considerable flexibility because of the opportunity to adjust the period of pumping, volume of water abstracted or rate of water abstracted at any one well or over the collective wellfield.

## 5.2 Setting environmental criteria

The Water Authority has elected to express the environmental objectives as a series of environmental criteria. The intent is that if these criteria are achieved then the environmental objectives will be met. It is therefore essential that the major aspects of the individual habitats present and the ecosystem as a whole are properly represented by the environmental criteria. The extensive public and government consultation that has been undertaken and the large amount of monitoring and investigative studies that have been conducted or sponsored by the proponent has ensured that the environmental criteria that are being considered are as accurate and comprehensive as currently practical.

The Environmental Protection Authority is satisfied that the environmental protection criteria that have been suggested are, under the current state of knowledge, the best criteria available. It is recognized that future monitoring will result in some further refinement of the criteria while ensuring that the environmental objectives are being achieved.

While the environmental criteria will always represent an estimation of these parameters, irrespective of the amount of scientific investigation that is conducted, some basic understanding of ecological system is required in their formulation. The wide consultation that the proponent has undertaken and inherent flexibility of the project reduces the likelihood of incurring unexpected adverse environmental impacts.

### 5.2.1 Wetland criteria

#### Lakes

Some of the environmental criteria that are proposed, particularly for the major wetlands, are based on the results of extended baseline monitoring. In the case of Bibra Lake there is a 30 year record of water level.

The extended duration of records enables an assessment to be made of the natural long term variation of some of the components of the Jandakot ecosystem. In the case of wetland water levels these ranges are simply expressed as a minimum, maximum and optimum water levels. The objective is then to ensure that the proposal does not result in these minimum and maximum values being exceeded and in fact the optimum value is mimicked as closely as possible, thereby reducing the likelihood of adverse environmental or social impacts resulting from unaccustomed water level fluctuations (ie excessive drawdown or flooding). The implicit assumption is that any water level fluctuations that fall between these minimum and maximum ranges can be accommodated by the wetland and its ecosystem based on the wetlands proven capacity to withstand wet years and dry years.

The optimum water level is not necessarily the average observed water level for a wetland. The optimum water level reflects the management objectives (EPA, Bulletin 374). For example, many of the Beeliiar Wetlands now exhibit elevated water levels because of extensive clearing (ie urbanization) in the catchment. This clearing has resulted in an increase in the quantity of groundwater which is feeding into the wetlands, causing wetland water levels to rise. The

optimum water level in this case would be lower than the recent average water level (eg Thomsons Lake). Other management objectives which may cause water level regimes to differ from the observed levels include:

- maintenance of aesthetic appeal (eg prevent flooding of recreational areas and paths),
- limitation of *Typha* spread,
- maintenance as a summer refuge for waterbirds, and
- periodic inundation of fringing vegetation.

In those instances where wetlands normally dry out completely minimum water level criteria are not applicable. Instead criteria stipulate the tolerable frequency of wetland drying based on the historical frequency of drying and the capacity of the flora and fauna to survive these dry spells. The duration and time of year of these dry spells are also specified in the criteria and reflect the natural occurrence of these episodes in dry, average and wet rainfall years.

#### Seasonal wetlands

Monitoring information covering the seasonally inundated wetlands higher on the mound is sparse. Most long-term monitoring has been concentrated on the lakes in the area.

The environmental criteria that have been proposed are designed to:

- maintain the waterbird breeding roles of the Bartram Road Wetland Complex and Twin Bartram Swamp by retaining water until the end of January, and
- maintain non-aquatic vertebrate habitat in the Beenyp Road Wetland and Solomon Road Wetland by limiting the watertable drawdown to less than 0.3 metres.

Other seasonally inundated wetlands are covered by the environmental criteria in less specific terms. The proposed approach is to locate wells no closer than 300 metres and preferably not closer than 500 metres to natural non-degraded seasonally inundated wetlands. In addition, a maximum drawdown of 1.5 metres in areas of phreatophytic vegetation (ie vegetation that relies on the water table) has also been proposed.

#### The wetlands as a system

The wetlands in the Jandakot area provide a diverse array of habitats. This diversity of habitats makes the Jandakot area a significant conservation zone.

The Water Authority has proposed that the wetlands should be protected as a group by specifying maximum acceptable habitat shifts. The permissible shifts are expressed as percentages of the original habitat areas and stipulate both loss and gain of habitats for dry, wet and average rainfall years.

Habitats have been classified on their importance to waterbirds, since waterbirds are considered suitable indicators of habitat value (PER, p 47). This approach has taken into account the importance of habitat for waterbird breeding, feeding and loafing. Rankings were then performed - Class I indicating a habitat that species of waterbirds would be most sensitive to change in while Class IV represents habitats that species of waterbirds would be least sensitive to change in. Following consultation with CALM acceptable habitat changes were then proposed (Appendix 2).

The Environmental Protection Authority believes that the seasonal wetlands in the Jandakot area (and the Swan Coastal Plain) are important in providing a diverse range of habitats. These wetlands, particularly the less disturbed wetlands near the top of the mound, provide essential spring breeding and feeding grounds for waterbirds. Loss of these habitats would place added pressure on the remaining wetlands and may interfere with waterbird reproduction. This in turn could result in a long-term reduction in species abundance and diversity. The Authority considers that the proposal to draw groundwater during late spring has the potential to affect the essential ecological functions of the seasonal wetlands in the Jandakot area. By adjusting the period of pumping, volume of water drawn or rate of water drawn from individual wells during late spring each year the seasonal wetlands may dry out earlier and be drier for longer periods, however the essential functions of these wetlands will be retained during the critical spring period.

## Recommendation 2

The Environmental Protection Authority recommends that the Water Authority of Western Australia modify its groundwater abstraction strategy so that the wetlands that normally contain water on the 1st of December continue to do so, thereby ensuring adequate wetland water levels during the waterbird breeding season. Details of this strategy should be included as part of an Environmental Management Program.

### 5.2.2 Terrestrial criteria

Terrestrial criteria have been largely based on the Water Authority's monitoring of groundwater abstraction and biological system responses obtained from the Gngangara Mound and Jandakot Stage 1 groundwater schemes. These water schemes have been operating for 11 years and 12 years respectively and are both situated in similar physiological and hydrological terrains to the proposed wellfield. Monitoring has shown that watertable drawdowns of about 2 metres has resulted in the deaths of phreatophytic (vegetation dependent on groundwater) trees on the Gngangara Mound. The Department of Conservation and Land Management (CALM) has recommended that watertable drawdowns should not exceed 1 metre in areas of phreatophytic vegetation. The criterion adopted by the proponent states that drawdowns should be less than 1 metre in areas of phreatophytic vegetation and in no case shall exceed 1.5 metres.

In sensitive areas (including System 6 areas) and where the drawdown cone immediately around a well exceeds 1.5 metres the draw would be phased in evenly over a 3 year period.

In areas where rare or endangered flora (eg orchids) are known to occur the drawdown should be less than 0.5 metre and must be less than 1 metre.

The Authority believes these criteria are adequately conservative but may be subject to future revision in the light of environmental monitoring results.

It is anticipated by the Water Authority that a lowering of the watertable will reduce the moisture content of the soil above the watertable. In areas of greatest drawdown there could be expected to be a gradual shift in the vegetation towards species which are more tolerant of these drier soil conditions (xerophytic vegetation). This is unlikely to affect the deep-rooted plants, based on the criteria limiting the lowering of the watertable under phreatophytic vegetation and the incremental nature of the reductions, but may lead to a shift towards understorey vegetation that is more tolerant of dryer conditions in the long-term.

The combination of environmental monitoring and protection criteria governing rare and endangered flora would ensure that drawdown in the area is not responsible for a further decline in the abundance of these plants.

### 5.2.3 Air quality

#### Chlorine

The Water Authority proposes to upgrade the existing water treatment plant prior to commissioning Stage 2 (Figure 1). This will involve converting the present gas chlorination system to a liquid chlorination system, obviating the need for multiple gas cylinders to be operating at once (Appendix 1). This substantially reduces the quantity of chlorine gas that might escape in the event of a major leak.

The chlorination building is also designed to contain any chlorine gas leak. Chlorine gas detectors are located in this building.

The Water Authority has proposed that a non-residential buffer zone of 400m be maintained around the plant (Appendix 1).

The design of the installation, maintenance of a buffer zone and handling procedures that have been proposed would result in an acceptable level of personal risk of fatality (less than 1 in 1 000 000 in any year at the boundary of the buffer zone).

## Hydrogen Sulphide

Hydrogen Sulphide ('rotten egg' gas) is a by-product of the water treatment process. Detailed computer modelling and previous experiences with this gas at the Mirrabooka treatment plant indicate that a 400m buffer zone should be sufficient to reduce atmospheric concentrations of hydrogen sulphide to less than 5 parts per billion. At these concentrations hydrogen sulphide would not be noticeable outside the buffer zone (Appendix 1).

### **5.3 Monitoring environmental impacts**

Due to variations in aquifer thickness, soil permeability and evapotranspiration some localized deviations from the expected watertable drawdowns could be expected. It has been proposed by the Water Authority that, although these variations are generally addressed by the computer model, a departure of up to 5% from the predicted watertable levels would still satisfy the overall environmental objectives of the proposal.

The proponent has suggested that:

- the predicted minimum wetland water levels will comply with the minimum wetland water level criteria (PER, Table 8.3) for at least 95% of the time, except for Thomson's Lake and Lake Forrestdale which naturally dry out. Compliance rates for maximum wetland water levels have not been stipulated because the abstraction scheme would help reduce the pre-existing condition of high wetland water levels, attributed to urbanization and land clearing in the area;
- the predicted watertable drawdown over large areas must comply with the maximum permissible drawdown criteria for at least 95% of the time, excluding drawdown cones.

The Environmental Protection Authority believes that the computer simulation of expected water levels changes in the area is conservative and provides the best available means of predicting these changes.

The proponent has given a commitment to undertake monitoring (Appendix 1) in order to:

- check compliance with the environmental objectives,
- review the nature and magnitude of the environmental impacts, and
- review and refine the computer model in order to optimize groundwater abstraction while ensuring environmental protection.

### **5.4 Reporting**

Reporting to the Environmental Protection Authority of monitoring results will follow the procedure established for the Gngalara Mound and Jandakot Stage 1 Schemes. This will require:

- annual reports addressing compliance with the specific environmental criteria, and
- triennial reports including an additional assessment of the effectiveness of the criteria in meeting the environmental objectives.

The Water Authority would also be required to advise the Environmental Protection Authority of any anticipated breach and report immediately to the Environmental Protection Authority any breach of the environmental criteria that may occur. This report should also outline a proposed action plan to address the non-compliance with the criteria/environmental objectives.



### Recommendation 3

The Environmental Protection Authority recommends that the proponent submit annual and more detailed triannual reports to the Environmental Protection Authority addressing compliance with the environmental criteria and environmental objectives. The reports should include an evaluation of the effectiveness of the criteria in meeting the environmental objectives and any proposed changes to management, monitoring or mitigation of wetland impacts.

**The ongoing monitoring and reporting requirements will be reviewed by the Environmental Protection Authority after 9 years.**

**Any breach or anticipated breach of the environmental criteria or environmental objectives should be reported to the Environmental Protection Authority immediately.**

The proponent has formulated contingency plans to address breaches of environmental criteria - whether these breaches cause adverse environmental impacts or not (Appendix 1). These plans are also designed to ameliorate adverse environmental impacts should they occur prior to the exceedence of environmental criterion.

The Environmental Protection Authority considers the contingency plans offer a high degree of environmental protection because the triggering mechanisms for implementation of these plans are ultimately linked to the health of the environment. That is, the environmental criteria are subservient to the well-being of individual elements of the Jandakot environment.

## 5.5 Modelling future changes in land use

The Water Authority has developed considerable expertise in predicting watertable responses to abstraction and changes in land use. This expertise was acquired during the establishment of the Gngara Mound and Jandakot Stage 1 Water Supplies and during the Perth Urban Water Balance Study (WAWA, 1987) and has culminated in the evolution of a sophisticated computer model capable of reliably predicting aquifer and wetland responses to abstraction and changes in land use. It is this model which provides the basis for predicting watertable drawdowns and likely adverse environmental impacts associated with various land use scenarios.

Three land use scenarios have been used to determine the likely future effects of the proposed wellfield. These scenarios are based on the existing land use regime; the immediate future but excluding proposed urban development and; the long-term future based on projected land use including urbanization. The model was used to optimize abstraction and adherence to the environmental objectives under various configurations of the Stage 2 wellfield. Consideration was also given to existing private water users and ensuring that the computer model was conservative in its predictions of change.

The computer model should continue to be refined and updated to take account of monitoring, validation and predictive performance and changes in land use.

## 5.6 Private wells

Administration and allocation of private well licences up to a quota of 16 million cubic metres a year will be conducted by the Water Authority of Western Australia (Appendix 1, commitments 15 - 18).

The environmental impacts of this abstraction would be managed by dividing the 16 million cubic metre quota into 11 sub-areas, each allocation being determined by the size, hydrology, sustainability of yield and ecology of the individual sub-areas.

These sub-area allocations have been incorporated into computer model predictions of the likely environmental impacts associated with the development of the groundwater resource.

## 5.7 Mitigating unavoidable wetland loss

The Environmental Protection Authority is satisfied that the proposal minimizes the impacts on the wetlands in the area, subject to the recommendations and proponent commitments contained in this report, and that some loss of wetland habitat or function is considered unavoidable if a water supply is to be developed in the area. Any loss of wetland habitat or function likely to be incurred due to the implementation of the proposal should be mitigated by the proponent. Wetland habitat and function should be determined by following the procedures described in 'A Guide to Wetland Management in Perth' (EPA, 1990).

Wetland loss mitigation is the replacement of the functions and values of wetlands that are lost by development by the creation of new wetlands or enhancement/rehabilitation of existing wetlands. If this is impractical then consideration should be given to procuring land to ensure that the remaining wetlands are protected and managed in the long-term. Priority should be given to areas that will not be included in the proposed Beeliar and Jandakot Regional Parks but which will be subject to protection and appropriate management in the long-term.

Wetland loss mitigation should only be considered when there is no feasible alternative and all appropriate and practical means of avoiding wetland loss have been addressed.

The Water Authority has suggested that the following wetland habitats would be affected to varying degrees by the proposed development (as described under scenario 3) and the mitigation strategies outlined in the PER are:

- Up to 6 important damplands would be significantly degraded. These wetlands have a total area of about 20 ha.

proposed mitigation: nil.

- 2 important sumplands would be degraded.

proposed mitigation: Solomon Rd Wetland - nil (addition of water is not feasible).

- Twin Bartram Swamp - may require addition of scheme water.

- Up to 6 important lakes may require water levels to be maintained by artificial means.

proposed mitigation: Banganup Lake - may be possible to add scheme water.

- Bibra Lake - addition of scheme water over summer.
- Lake Kogolup - addition of scheme water over summer.
- Thomsons Lake - addition of scheme water over summer.
- Lake Yangebup - addition of scheme water over summer.
- The Spectacles - manipulation of Peel Drain flows.

Numerous minor wetlands (sumplands and damplands) higher on the Jandakot Mound would also suffer reduced water levels and longer periods of drying. This would affect the use of these seasonal wetlands for waterbird feeding and breeding. The number and diversity of wetlands in the area would most likely provide sufficient alternative sites to counter this impact (the habitat loss criteria/sensitivity analysis indicates this is the case), however future development pressures will be placed on the remaining wetlands and this needs to be considered. A continued erosion of the wetland resources in the area will ultimately result in an exceedence of the capacity of the region to accommodate change leading to substantial reductions in species diversity and abundance.

Accordingly, the Environmental Protection Authority believes that the loss of wetland function and habitat that could be expected due to the proposal should be mitigated by the proponent by the creation or rehabilitation of wetlands of a similar function and area. Allowances for the anticipated success rates and interim loss of wetland function due to creation or rehabilitation should be made. Where this is impractical consideration should be given to acquiring land to ensure the long-term protection of the remaining wetlands in the area.

Details of this strategy should be encompassed in an Environmental Management Program and address wetland loss mitigation for all wetlands that are likely to be adversely affected by this proposal, including any anticipated impacts on the seasonal wetlands higher on the Jandakot Mound. Some subtle impacts may not be immediately apparent and beyond the scope of the computer model hence the Environmental Management Program should also include commitments based on future monitoring of wetland impacts.

#### Recommendation 4

**The Environmental Protection Authority recommends that, prior to construction of the wellfield, the proponent prepare and submit an Environmental Management Program which includes a wetland loss mitigation strategy and reflects the anticipated future land use/abstraction scenario for the area, to the satisfaction of the Environmental Protection Authority.**

## 6. References

- Department of Conservation and Environment (1983), Conservation Reserves for Western Australia - The Darling System - System 6. Report 13.
- Department of Planning and Urban Development (1990), Beeliar Regional Park - Proposals for Establishment, Administration and Use.
- Environmental Protection Authority (1990), A Guide to Wetland Management in Perth. Bulletin 374.
- Water Authority of Western Australia (1991), Environmental Management of Groundwater Abstraction on the Gnangara Mound - Annual Report to the Environmental Protection Authority (October 1989 to September 1990).
- Water Authority of Western Australia (1987), Perth Urban Water Balance Study, Volume 1 - Findings.
- Water Authority of Western Australia (1991), Jandakot Groundwater Scheme Stage 2 - Public Environmental Review.

## Appendix 1

Proponent's commitments on the proposal

## Summary of Environmental Management Commitments

The environmental management commitments in this PER are summarised in Table A12.1. The criteria developed in Chapter 7 are summarised in Table A12.2.

**Table A12.1** Environmental Management Commitments

No.	SECTION	COMMITMENT
1	10.1	To prepare a Management and Monitoring Programme, satisfactory to the EPA, prior to commissioning of the Stage 2 Scheme.
2	10.2	To ensure that groundwater abstraction satisfies the environmental criteria presented in this PER.
3	10.5.1	To mitigate impacts associated with construction of the Stage 2 Scheme the Water Authority will ensure:
4		• clearing of vegetation at well sites will be restricted to the area of the enclosure (approximately 25 metres square) in non-urban areas, and the immediate area of the well head in the case of wells located in public open space in urban areas,
5		• where practical the collector main will be located within existing road reserves
6		• on Crown Land, top-soil from the collector main trench will be separately stripped, stock-piled and re-spread on completion of pipe laying,
7		• on private land, the collector main route will be left in a state agreed to by the land owner/occupier,
8		• where feasible, well site compounds will be used for the storage of materials and for contractors' facilities, in preference to the establishment of separate short-term sites,
9		• where temporary construction sites are established, the area will be returned either to its original state, in the case of Crown Land, or to a state agreed to by the land owner/occupier,
10		• all work on extensions to and modifications of the Jandakot Treatment Plant will be undertaken on existing cleared areas within the boundary of the Plant site, and
11	10.5.1	• all workers involved in project construction in natural areas will be instructed on environmental protection procedures before work proceeds
11	10.5.1	In the event that monitoring indicates that there will be significant impacts of a nature not predicted in this evaluation or a breach of the specified criteria, then as discussed in sections 6.9 and 7 the Water Authority must undertake one or more of the following:
		• demonstrate to the satisfaction of the EPA that the breach in criterion is not a result of groundwater abstraction, or
		• satisfy the EPA that the breach of criterion is transient and not of permanent significance, or
		• take the relevant action as specified in section 7:
		— modify pumping from any well where such changes can have a measurable effect (say raise water levels 1 centimetre or more), except in extenuating circumstances such as where significant economic hardship would occur, or CALM declare that the low water levels would be beneficial,
		— in the case of a wetland, artificially maintain the 'action minima' water level (see Table 7.5), and
		— implement a short-term detailed monitoring programme to establish the condition of agreed species in the affected area.
12	10.5.1	To modify the chlorine withdrawal system to a liquid process prior to commissioning of the Stage 2 line of wells.
	10.5.1	To operate the treatment plant with established buffer zones so that:
13		• the personal risk hazard of fatality associated with chlorine release is less than one in a million in any year, and
14		• hydrogen sulphide levels attributable to plant operation will be below noticeable levels of 5 parts per billion.
	10.5.2	To continue to manage private water abstraction by:
15		• regularly reviewing the bulk allocations for private abstraction, as part of the total water abstraction allocation for the Jandakot PWSA, with regard to the sustainable yield of the superficial aquifer, including consideration of the environmental impacts of that abstraction,
16		• restricting the issuing of licences for private water abstraction to the limits set by the bulk allocations, for both the Jandakot PWSA in its entirety and the licensing sub-areas, and
17		• investigating and implementing efficient mechanisms for groundwater allocation,
18		• Conduct pump tests on Stage 2 wells and raise will nearby private users of groundwater prior to commissioning to assess the impact of Stage 2 wells on private wells.
	10.5.3	To protect the groundwater resource by active participation in:

- 19 • the development of Environmental Protection Policies to protect groundwater.
- 20 • the review of Regional Plans proposed by the Department of Planning and Urban Development, Local Government Town Planning Schemes, and rezoning and development applications, and
- 21 • review of development submissions to EPA.
- 22 10.5.3 To work with the Department of Planning and Urban Development to prepare an integrated Land Use and Water Management Strategy for the Jandakot Mound.
- 23 10.5.4 To actively pursue programmes in both supply and demand management. This includes ongoing public information programmes and, where appropriate, regulation for design changes and regular reviews of pricing to conserve water. Improvements in the Authority's supply system will also be pursued.
- 24 10.5.5 To actively participate in integrated management of the Jandakot catchment.
- 25 10.5.5 To review the management criteria and strategies, with the agreement of the EPA, as knowledge of the Jandakot environment and its interaction with groundwater improves.
- 26 10.5.5 To review opportunities for reducing the radius of the buffer zone required around the treatment plant to achieve acceptable personal risk and hydrogen sulphide levels.
- 27 10.6.1 To monitor water levels in groundwater monitoring wells and North, Bibra, Yangebup, Kogolup, Thomsons, Forrestdale Lakes, The Spectacles and Twin Bartram Swamp, as well as some other small wetlands.
- 28 10.6.2 To monitor vegetation transects on a triennial basis to establish significant changes in the condition, floristics or structure of vegetation communities.
- 29 10.6.2 To continue to fund the research projects 10.6.3 listed in Appendix 2 for the duration of the studies.
- 30 10.6.2 To use aerial photographs on a triennial basis to detect habitat shifts in North, Bibra, Yangebup, Kogolup, Thomsons and Forrestdale Lakes.
- 31 10.6.3 To develop a fauna monitoring programme, prior to the commissioning of the Stage 2 Scheme, which will focus on:
- waterbird species diversity and breeding success, and
  - number of families of aquatic invertebrate and at infrequent intervals, species richness.
- 32 10.6.4 To hold meetings at least annually with a Jandakot Consultative Committee which will be established in consultation with the EPA. This Committee will be informed on the scheme's operation and will provide feed-back to the Water Authority.
- 33 10.6.4 To continue to monitor community response as reported by the media and maintain the current practice of public accessibility of Water Authority officers. Upon request and adequate notice, officers will address community groups on issues associated with groundwater management.
- 34 10.7 After the commissioning of the Stage 2 Scheme, written reports to the EPA will consist of:
- annual reports addressing compliance with the environmental protection criteria, and
  - triennial reports including, in addition to a review of compliance with the criteria, an evaluation of the effectiveness of the criteria in meeting the environmental protection objectives.
- 35 10.7 To advise the EPA immediately upon becoming aware that specific environmental protection criteria might be breached. Details of the actions taken to avoid such a breach of criteria, or in the event of a breach occurring, its consequences, will be reported to the EPA at the earliest feasible date.
- 36 9.5.1 Undertake a study of Banganup Lake, in conjunction with CALM and the University of WA, to establish management criteria and consider the effectiveness of artificial maintenance of water levels.
- 37 9.5.2 Undertake a study of Twin Bartram Swamp to consider the feasibility and effectiveness of artificial maintenance of water levels.
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## Appendix 2

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### Summary of environmental criteria

Table A12.2 Summary of the terrestrial, wetland and air criteria.

**TERRESTRIAL**

**Design criteria**

- 1 Wells should not be placed closer than 300 metres to natural non-degraded sumplands (seasonally inundated wetlands) and preferably not closer than 500 metres.
- 2 Drawdowns must not exceed 1 metre in areas of phreatophytic native vegetation.
- 3 Wells shall not be placed closer than 200 metres to System Six area (M94) and preferably not closer than 400 metres as a design criterion.

**Action and Operational criteria**

- 4 Any well whose drawdown cone is estimated to be greater than 1.5 metres deep in environmentally sensitive areas will have its draw phased in evenly over a three year period.
- 5 Actual drawdowns should be less than 1 metre in areas of phreatophytic native vegetation and in no case shall exceed 1.5 metres.
- 6 In areas where rare species of orchids are known to occur, drawdowns should be less than 0.5 metres and must be less than 1.0 metres.
- 7 The Bartram Road Wetland Complex and Twin Bartram Swamp should preferably contain water until the end of January.
- 8 Water table drawdown in Beenyp Road Wetland and Solomon Road Wetland should preferably be less than 0.3 metres.

**THOMSONS AND FORRESTDAL LAKES**

*Thomsons Lake*

**Design criteria**

- 9 water levels in Thomsons Lake must satisfy those given in Table 7.2 for at least 30% of years (i.e. be an improvement on the present situation).

**Operational and Action criteria**

- 10 The average annual deviation over a four year period from the predicted water levels in Thomsons Lake must not be greater than 0.1 metres.
- 11 Should the deviation between the actual and predicted minimum water level in Thomsons Lake exceed 0.25 metres in any one year, this must be reported to the EPA as soon as possible, and
- 12 The minimum water level at Thomsons Lake must never go below 10.8 metres AHD.

*Forrestdale Lake*

- 13 At least 0.9 metre of water in the lake when water levels are at their annual maximum (the deepest point is at 21.6 metres AHD), and
- 14 A natural cycle of filling and drying should be allowed to continue.
- 15 Minimum water levels should be in the range 21.2 - 21.6 metres AHD.
- 16 Minimum water levels shall be greater than 21.1 metres AHD.
- 17 The preferred times of (earliest) drying are:  
 WET YEARS        dry by April  
 MEDIUM YEARS    dry by February-March  
 DRY YEARS        dry by January.

**MAJOR WETLANDS**

- 18 The recommended water level maxima, operational minima and action minima for the major wetlands are:

	RECOMMENDED MAXIMA	OPERATIONAL MINIMA	ACTION MINIMA
North	< 14.9	13.0-13.5	12.7
Bibra	< 15.0	13.6-14.2	13.6
Yangebup	< 16.5	13.9-15.5	13.8
Kogolup	< 14.3	13.1-14.0	13.1
Banganup		11.5	



## THE WETLAND SYSTEM

19 The maximum allowable habitat reductions (as percentages in area) for the Jandakot Area (Thomsons Lake excluded) are:

HABITAT TYPE	WET YEAR	MEDIUM YEAR	DRY YEAR
I	5	10	5
II	8	13	8
III	12	17	12
IV	15	20	15

20 Increases of habitat shall be no more than 50% greater than the values given in the above table.

21 Bibra Lake must not dry out for more than 2 years in any 3 year period, and preferably not more than 1 in 3.

22 Either Bibra Lake or Yangebup Lake must contain 0.7 metre of water and preferably 0.5 metre.

## AIR QUALITY

### *Chlorine*

23 A buffer zone be maintained around the chlorine storage area of the treatment plant, and

24 The treatment plant and chlorine handling be operated in the manner described in section 4, resulting in a level of personal risk of fatality of no greater than one in a million in any year at the buffer zone boundary.

### *Hydrogen sulphide*

25 A buffer zone be established with the distance defined by an anticipated hydrogen sulphide concentration of 5 parts per billion averaged over 30 minutes, as calculated for atmospheric conditions of Parquille class F and 2 metre per second wind velocity.

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## Appendix 3

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Issues raised during the public review period



**PROPONENT:** Water Authority of Western Australia  
**PROPOSAL:** Jandakot Stage 2 Groundwater Scheme  
**CLOSING DATE:** 25 April 1991  
**NO OF SUBMISSIONS:** 27

The following comments, issues and questions have been raised with the Environmental Protection Authority during the public review period.

### 1. General comments

- 1.1 Water Authority have approached the issue in a sound and thorough manner, however they have failed because they have misunderstood the environmental significance and management requirements of the Jandakot area (ie the environmental criteria used in Table A12.2 is incorrect).
- 1.2 The proposal should be rejected because its overall environmental impact is unacceptable. Groundwater extraction from the Jandakot Mound is not opposed provided it is carried out in an environmentally responsible manner.
- 1.3 The water contained within the Jandakot groundwater mound is already of a level well above an acceptable potable water quality.
- 1.4 This proposal is not ecologically sustainable in the long term. Other technologies need to be assessed.
- 1.5 The allocated domestic demands may not include proposed urban developments or future urban developments (deferred).
- 1.6 The City of Cockburn does not support urban development above the Jandakot Mound between the two lines of public water supply bores, nor does it support Thomsons Lake (south of Yangebup Rd) urbanisation (Section 5, pg 30).
- 1.7 Compensation should be provided to existing land owners who bought land on the mound with the intention of expanding their existing landuse (eg horticulturalists).

### 2. Alternative proposals

- 2.1 Potential realignment of the bores further to the east in order to reduce their impact on the larger and less disturbed wetlands has not been adequately covered. Several other recommendations made by consultants have also been ignored by the Water Authority (pages 24 and 25 Volume 2, Part A). These recommendations are supported by the Conservation Council of Western Australia.
- 2.2 Desalination should be considered as an alternative source of potable water.

### 3. Consultation

- 3.1 A more natural (passive) means of controlling wetland levels may be more appropriate than the highly interventionist and expensive proposal currently being forwarded by CALM.
- 3.2 Criteria 9-18 (Table A12.2) are rejected by the Conservation Council of Western Australia because these values have not been determined via the development of a management plan for the Beeliiar Regional Park (based on full public consultation).
- 3.3 There has been a lack of public consultation while determining the environmental management criteria for the Beeliiar Lakes. The criteria are based largely on the waterbird values of Thomsons Lake.

### 4. Environmental impacts

- 4.1 Benchmark botanical surveys should be conducted in several finely balanced wetlands prior to any groundwater extraction.

- 4.2 There is insufficient knowledge about the interaction between groundwater/wetlands and habitat. It is therefore essential that no action is taken without being fully aware of the long-term implications for the natural environment.
- 4.3 Wetland destruction should not be condoned. Even "degraded" wetlands provide valuable sources of food and water for wildlife. Wetland rehabilitation is also possible.
- 4.4 There will be an unacceptable impact on the Solomon Rd dampland, Beenyup Rd swamp, Lake Balmanup, Banganup Lake, Russell Rd swamp, Twin Bartram Swamps and Gibbs Rd swamp. These wetlands are important for the conservation of rare types of habitat (Semeniuk, Gold Estates Report, 1987) and flora and fauna.
- 4.5. The Jandakot area is an integrated habitat and requires protection of all components, not just a few outstanding features. The Jandakot area is already host to a number of rare and endangered flora and fauna which is placed under threat by this proposal. A complete flora and fauna survey of this area is required prior to any development.
- 4.6 The criteria that 'wells should not be placed closer than 300 metres to natural non-degraded sumplands (seasonally inundated wetlands) and preferably not closer than 500 metres' is set but not met. Figure 8.2 contradicts this.
- 4.7 Significant areas of southern banksia woodland will be degraded because of the borefield. In particular the banksia woodland near the intersection of Lyon Rd/Gaebler Rd. These areas are under-represented in secure reserves.
- 4.8 Minor and ephemeral wetlands are equally as important as major wetlands and need to be conserved in order to maintain biological diversity in the region.
- 4.9 Artificial maintenance of wetland water levels will result in changes in wetland water temperature, nutrient levels, water pH and salt concentrations. The impacts of these changes are unknown and require further investigations.
- 4.10 Groundwater schemes for areas with significant wetland and woodland areas should have a maximum drawdown of not more than 50 centimetres. Pumping rates should be adjusted accordingly.
- 4.11 Consideration has not been given to any long-term climatic changes (eg 'Greenhouse') when assessing the likely environmental impacts of this proposal.
- 4.12 It is pleasing to see that on commissioning the Stage 2 bore field nearby private groundwater users will be consulted to assess any adverse effects.
- 4.13 Areas situated over 500 metres from existing Stage 1 bores are currently exhibiting drawdowns in excess of 5 metres. Associated tree deaths may be due to drawdown effects or dieback disease.
- 4.14 Monitoring of the system should be conducted by an agency other than the WAWA.
- 4.15 Surveys should be conducted to locate areas of rare and restricted flora and fauna populations, significant vegetation complexes and monitoring sites representative of the various associations. CALM would like to provide input to these processes.
- 4.16 Contingency plans should be formulated, in consultation with CALM, to alleviate any adverse environmental impacts generated by the development.
- 4.17 CALM consider the criteria used for wetland protection to be adequate. These criteria may require further refinement in the future. CALM would like to be consulted in such a review.
- 4.18 CALM would like to provide further comment on the proposals to manage groundwater levels in the Twin Bartram Swamps, and undertake monitoring.

## 5. Technical issues

- 5.1 It is stated that 20% of rainfall serves as aquifer recharge (pg 18 Volume 1). This figure contradicts earlier tests made by the CSIRO (Groundwater Resources of the Swan Coastal Plain, 1981), which determined recharge rate at between 11.5% and 12.3% of incident rainfall. These tests were based on chloride balance studies and verified using flow net analysis. Correct determination of aquifer recharge is essential if the WAWA predictive model is to produce realistic results.
- 5.2 CALM's management criteria for the Beelihar Wetlands are crude and lack a sound scientific basis.
- 5.3 What are the adverse environmental impacts that have arisen out of the Stage 1 development of the Jandakot Mound? What drawdowns were encountered? Have the experiences gained in this phase been used to calibrate the predictive model for Stage 2?
- 5.4 CALM would like consultation with WAWA during their preparation of the Management and Monitoring Program and seeks access to their monitoring and compliance reports.

## 6. Other policies

- 6.1 The environmental criteria set by the Water Authority are inadequate and inconsistent with EPA Bulletin 374, the State Conservation Strategy and the draft EPP on Wetlands of the Swan Coastal Plain.
- 6.2 Department of Planning and Urban Development is planning to create a Jandakot Botanical Park. The Minister for Environment declared his support for this on 8 April 1990. If the proposed borefield proceeds this may pre-empt this important conservation initiative.
- 6.3 It is acknowledged that Perth's water supply needs to be increased to cater for Perth's future population increase. Government must develop strategies to decrease the growth of Perth in preference to increasing the growth of townships/cities in areas with suitable resources (including water). Concept of sustainable urban development.
- 6.4 The Jandakot area does not have a competent land use plan. It is currently the subject of a promised land use strategy, an environmental protection policy, the Beelihar Regional Park and the Jandakot Botanical Park. These concepts should have been finalized before the EPA allowed the PER to proceed.
- 6.5 The proposal should be rejected and the EPA recommend to the Minister that assessment of the environmental impact of this proposal cannot be properly undertaken until the following Government policy commitments have been completed:
  - a) the Jandakot land use and water resources strategy
  - b) the Jandakot Mound Environmental Protection Policy
  - c) the Jandakot Botanical Park planning study
  - d) the Beelihar Regional planning study
  - e) the Beelihar Regional Park management planThese reports will enable the correct environmental criteria to be set (Table A12.2).
- 6.6 The proposal is inconsistent with the EPA Environmental Protection Policy for the Swan Coastal Plain Wetlands and the EPA Bulletin 374. Some 30 wetlands will be destroyed and another 30 will be seriously degraded by the effects of groundwater drawdown.

6.7 WAWA has stated that "deep sewer residential development pose less of a threat to groundwater resources than existing landuses over the Jandakot Mound". Why is residential development of this land being dismissed by the EPA/Water Authority?

## 7. Suggestions

- 7.1 The Water Authority bores should be located on cleared land and not adjacent to wetlands or woodlands. Proposed bores near Twin Bartram Swamps and Solomon Rd swamp should be omitted.
- 7.2 No drawdown should exceed 50 centimetres. Bore extraction rates to be modified accordingly.
- 7.3 EPA should monitor closely the effects of drawdown on the natural environment (particularly wetlands and woodlands) and make these results publicly available. If detrimental environmental effects are detected the Water Authority should be directed to close down bores, reduce pumping, top up wetlands or take whatever action is necessary to alleviate these effects.
- 7.4 Section 3.3 and 3.4 neglects other effective measures that can be used to reduce water demands and conserve water resources:
  - a) Half flush toilets.
  - b) Waterless composting toilets (as used in parts of Sweden).
  - c) Continued education on water sensitive urban design, including native garden design.
  - d) Water should be treated as a scarce resource and limitations on its use should be considered- not only in drought years but when daily use exceeds a pre-determined amount.
  - e) All private bores should be licensed and metered and charges made for excess water use.
  - f) Householders should be encouraged to own rainwater tanks.
  - g) Financial incentives should be initiated to promote the planting of native gardens.
- 7.5 If water demand control measures and appropriate urban development control strategies are implemented the absolute need for this proposal is questionable.
- 7.6 Assessment of this PER must include an analysis of the records from the Stage 1 Jandakot Wellfield and the likely impact of the intended South Jandakot Borefield as well as any proposed urban development in the area.
- 7.7 Where drawdown is excessive the WAWA should be required to deepen or create new wetlands to compensate for the loss/change in habitat.

## Appendix 4

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Proponents response to the issues raised during  
the public review period



## RESPONSE TO PUBLIC SUBMISSIONS ON THE JANDAKOT GROUNDWATER SCHEME-STAGE 2 PUBLIC ENVIRONMENTAL REVIEW (PER) DOCUMENT

The following are the Water Authority's responses to the public submissions received by the EPA during the review period for the Jandakot Groundwater Scheme-Stage 2 PER. The responses have been numbered to correspond with the numbering of the submissions in the Summary of Public Submissions.

### 1. GENERAL COMMENTS

#### Submissions 1.1 and 1.2

Both comments 1.1 and 1.2 indicate that the abstraction of groundwater 'per se' is not unacceptable, but that this proposal has not succeeded in developing appropriate strategies to safeguard the environment and is therefore unacceptable. The Water Authority responds similarly to both comments.

The approach taken in developing this proposal was to examine the environmental constraints, establish appropriate criteria to protect sensitive areas of the environment and then formulate an abstraction strategy that did not breach the criteria.

The Water Authority believes the criteria presented in the proposal are satisfactory. They represent the considered opinion of not only the Water Authority, but also other agencies and information provided by expert scientists. However, future research, management programmes or monitoring results may indicate deficiencies that would necessitate changes to the criteria. For this reason, the Water Authority has clearly intended, and repeatedly indicated throughout the PER, that the criteria are interim, and do not represent intractable management strategies.

The Water Authority is confident that the approach used is appropriate for this proposal for two reasons. Firstly, the impacts of the proposal are largely related to changes in the groundwater level and are both manageable and reversible. In the worst-case scenario, monitoring may reveal that the criteria are inappropriate and that the abstraction of groundwater in the area is environmentally unacceptable. The PER clearly indicates that in that case modifications will be made to the abstraction strategy to the point that abstraction could be halted.

Secondly, the overall impacts of the scheme predicted in the PER will not occur for 10-15 years following commissioning of the Scheme, when urbanisation and the Jandakot South Groundwater Scheme are fully developed. This provides time to carefully monitor the effects of increasing abstraction and adjust the criteria. Without this time the reliance on interim criteria would not be justified. The proposed reporting and review mechanisms will ensure that the EPA and the public are aware of the progressive development and impacts of the scheme.

Given the above, the Water Authority is confident that the proposal is environmentally sound. Inadequacies in the proposal may become apparent in the future and the Water Authority appreciates constructive criticisms of the PER which could modify the proposal in a beneficial way. However, comments 1.1 and 1.2, provided by the public, do not identify specific problems or offer alternatives to the proposed criteria. In the absence of specific criticisms or suggestions, the Water Authority will rely on the process of formal assessment under the Environmental Protection Act to decide whether the proposal is acceptable.

#### Submission 1.3

Below is a table showing the concentration in Jandakot groundwater of the various water quality parameters for which the NH&MRC provide guidelines. The range of the concentrations measured at 23 sites in the vicinity of the Stage 2 wells is shown. These data were collected on 3/5/89 and were the basis for water quality assessment of Stage 2.

Several parameters are above the NH&MRC recommended guidelines for drinking water. These are marked with an asterix. None of these parameters are directly health related and standard WAWA treatment methods will reduce the values of those components to NH&MRC recommendations. Based on these and other samples, the Water Authority is convinced that the quality of groundwater in the Jandakot Mound is sufficiently high for Public Water Supply.

#### Submission 1.4

As pointed on page 7 of the PER, the Authority abstracts groundwater in accordance with a policy of sustainable yield. That means that water is not withdrawn at rates beyond the tri-annual replenishment rate and so is available in perpetuity. This means that the water will be available in the long-term with respect to aquifer considerations. However, it does not mean that it is ecologically sustainable. The criteria are set to ensure this. The Water Authority believes therefore that this proposal is ecologically sustainable in the long-term.

The management proposed for this scheme is designed to be flexible and adaptive and should monitoring reveal that the management strategy is not sustainable, then the Scheme will be adjusted as considered appropriate by WAWA, the EPA and other appropriate agencies. Again, in the absence of constructive suggestions, the Authority requires the judgement of the public, through the EPA to determine whether the proposal is acceptable and is willing to act on advice that will improve the proposal.

	Jandakot	NH&MRC		Jandakot	NH&MRC
<b>Health Related</b>					
Aldrin	<0.002	1	Arsenic	.0005-.0011	0.05
Chlordane	<0.002	6	Nitrate-N	.008 - .0	10
Chlorpyrifos	<0.050	2	Nitrite-N	.006-.027	1.00
Dieldrin	<0.004	1	Cadmium	.0001-.0013	0.005
DDT	<0.003	3	Chromium	.0006-.0270	0.05
Heptachlor	<0.002	3	Lead	.0005-.0160	0.05
Lindane	<0.002	100	Mercury	<.0002	0.001
Selenium	<.0030	0.01			

#### None Health Related

Chlorine	19-140	400	Colour	14-580	15*
Iron	0.09-0.50	0.3*	pH	4.4-7.1	6.5-8.5*
Manganese	0.001-.0.20	0.1	Turbidity	0.3 -130	5*
Sodium	22-160	300			
TDS	100-890	1000			
Sulphate	10-2 25	400			
Hardness	18-200	500			

all as milligrams per litre except pesticides (micrograms per litre), colour and turbidity (total colour units) and pH.)

This submission queried the assessment of alternative technologies for the supply of water. This point is dealt with in the response to Submission 2.2.

#### Submission 1.5

The PER takes into account future urban growth in estimating future water demand through two different mechanisms. Firstly, the effects of urbanisation in the Jandakot area have been specifically identified in terms of future groundwater demand in the Jandakot Public Water Supply Area (Figure 3.2). The same urbanisation scenario has been used in modelling the effects of groundwater abstraction in the area. Secondly, the potential domestic water demands for the Metropolitan area indicated in the report represent an estimate based on the most-likely rate of population growth and water demand. As such it implicitly takes into account future urban developments since increased population growth is synonymous with increased urbanisation.

#### Submission 1.6

The Water Authority acknowledges the City of Cockburn's objection to urban development on the Jandakot Mound between the two lines of wells and South of Yangebup Rd (Thomsons Lake). The City was represented on the Jandakot Groundwater Discussion Group and clearly stated its views in that forum.

The issue of urban development in the Jandakot area is primarily one of concern to the Minister for Planning, DPUD and the Cockburn City Council. CALM, the EPA, WAWA and other agencies have provided advice on relevant aspects. The Water Authority has advised all three parties of its policy and management priorities in the area. The Authority is not necessarily opposed to urban development on the Mound. The proposed urban development can be compatible with protection of the water resource if it is developed in accordance with the requirements specified for Priority 2 and 3 Source protection areas. This policy is explained more fully in the response to Submission 6.7.

Further resolution of this issue is in the hands of the Minister for Planning, DPUD and the City of Cockburn.

#### Submission 1.7

This submission appears to propose that compensation should be available for loss of horticultural development expectation. How this relates to the Stage 2 proposals is unclear. However, the Water Authority's management strategy for private water abstraction is clearly stated; a large increase will be made in the amount of water available for private

abstraction.

Western Australian water law does not provide for compensation to an individual for:

- restrictions placed on his use of groundwater as provided for under water management legislation; or
- interference with his ability to pump water caused by his neighbor or another party's abstraction (including the Water Authority).

The basis of water management is the vesting in the Crown of the rights to flow, control and use of underground water. It would be entirely inconsistent with this to provide compensation to an individual for loss of a 'right' to which he had no legal claim.

There is no basis in law for compensation for the loss of expectation as in the case of landowners with a grievance over an inability to increase land-use practices due to water allocations.

The Water Authority may place restrictions on the use of groundwater by landowners or occupiers through licences in proclaimed areas. There is no provision for compensation for any such restriction. Again, this is consistent with the vesting of water rights in the Crown and not the landowner.

Having said this, the Water Authority has never reduced an allocation to a landowner with an established use at the time of proclamation, or from a licensed user using their allocation in accordance with licence conditions. In the future, however, it is possible that some applications for increased abstraction will not be approved. This will be particularly so for land-uses with the potential to pollute groundwater or at such time that private abstraction reaches a level determined by the Water Authority as being inconsistent with sustainable use of the resource. Generally speaking, however, constraints placed on land use to avoid problems associated with nutrient enrichment of wetlands and estuaries are likely to be far more severe than those required to protect groundwater.

In all cases of grievance, the Water Authority has examined each case on its own merit and shall continue to do so. Should a landowner have a legitimate complaint and be dissatisfied with the view of the Authority, there is a right of appeal to the Minister for Water Resources.

## 2 ALTERNATIVE PROPOSALS

### Submission 2.1

Since Stage 2 was first proposed, the alignment of the wells has undergone a number of changes. The wells north of Bartram Rd have been realigned further east than originally intended in response to the alignment of the Kwinana Freeway and the industrial area in Jandakot. This places the wells on the eastern edge of the proposed residential area where land use is predominantly public open space and schools and therefore is desirable from a water quality perspective. Any further alignment of wells to the east is not considered desirable since:

- \* this will increase the impact of abstraction on the ecologically significant wetlands at the top of the mound (eg. Bartram Rd Complex);
- \* it will increase the impacts around System 6 area M94 and remnant phreatophytic vegetation near Jandakot Airport;
- \* the impacts on the Beelihar wetlands are considered acceptable:

The impact on Thomsons Lake will result in a water regime closer to that desired by CALM. The impacts on North, Bibra and Yangebup Lakes will be desirable in reducing artificially high water levels. Kogalup Lake will be influenced by water level management associated with the PER and the South Jandakot Drainage Management Programme. The levels in this lake will be those considered desirable by both CALM and the EPA, as indicated in the PER (Pg 46). The impacts on Lake Banganup were addressed in Section 9.5.1 of the PER. Due to the unacceptable nature of those impacts, the Water Authority proposed an artificial maintenance scheme be investigated to maintain water levels over critical periods. That scheme would be developed in consultation with CALM and the University of WA and will be the subject of an Environmental Management Study.

This submission also pointed out that several recommendations from a specialist consultants report (Vol. 2 pg 24-25) had been ignored. These included:

R1: Requirement for Rare Flora Survey; the Water Authority has acted on this recommendation in 1989 by undertaking a literature survey for rare and endangered flora located in the area. The results included as Part F of Volume 2 and in Section 5.2.2 of Volume 1. Due to CALM's preference, the sites of rare flora are not identified in the PER but they were taken into account in designing the scheme and the criteria relating to rare flora have been met.

R2: Botanical Survey Required of all Remnant Vegetation; The PER includes a vegetation mapping of the Jandakot area (Section 5.2.2) and maps of the vegetation around the major wetlands (Appendix 8). These were based on literature and mapping studies coupled with field transect surveys which were established at appropriate sites. The Water Authority did not consider it necessary to consolidate the State Herbarium Records, or produce more detailed maps of the remnant vegetation and wetlands than those presented in the PER, as is requested in this Submission. The Authority believes that given the nature of the proposal and the criteria set to prevent unacceptable drawdowns, the information presented in the PER is sufficient to allow informed judgement on the proposal.

R3: Realignment of Stage 2 wells; this point was addressed above.

R4: Review Effects of Water Quality on Wetland Vegetation; This recommendation was based on a previous suggestion by the consultants that drainage water be used to artificially maintain wetland water levels. This suggestion has not been adopted in the PER except where drainage water quality is suitably high. Some use of groundwater, abstracted from close to the wetlands and injected directly into the wetland is proposed to maintain water levels. The effects of this type of artificial maintenance on wetland water quality are addressed in Section 6.8.6. These impacts are explained more fully below (Submission 4.9). Any scheme which are established for Twin Bartram Swamp, Lake Banganup and Solomon Rd Swamp will be subject to preliminary studies and monitoring to more accurately determine these impacts, as indicated in the PER and in the Table of Commitments (36 & 37).

R5: Drainage discharge for supplementing wetlands; this was dealt with, in part, above. Since the proposed groundwater scheme management does not involve diversion of drainage water into wetlands as a preferred option it was considered inappropriate to review that information in this PER. A review of the implications of running drainage water into natural and artificial wetlands, and the associated nutrient budget implications, was undertaken for DPUD's South Jandakot Drainage Management Plan (SJDMP). This Management Plan was jointly prepared by WAWA. Where drainage water will enter wetlands, as part of the SJDMP, it will pass through artificial, constructed wetlands designed to reduce pollutant loads. The SJDMP has been approved by the EPA, CALM and WAWA and the Minister for the Environment.

R6: Review of Long-term changes in water quality & quantity and affects on fringing vegetation; The Authority recognised the need to examine the long-term effects of variation in water levels on fringing vegetation. To this end a research project was established by WAWA, the EPA and AWRAC to determine the effect of water level variation on fringing vegetation of wetlands. That project is being conducted by scientists at Murdoch University and is due to be completed in 1992. One reason for stressing the flexibility of the proposed management strategy in the PER is to allow incorporation of the results from this type of research.

### Submission 2.2

This submission proposes that desalination be considered as an alternative source of potable water. Desalination and other alternative water supply options have been raised in Section 3.4.2 of the PER. The Authority agrees that desalination is probably the ultimate alternative source. However, at the present time the economic considerations of developing desalination suggest that the community at large are unlikely to support this option. The power requirement for such a proposal will have associated environmental impacts and the Authority believes that while relatively economic sources can be developed in environmentally acceptable ways, desalination should remain a future option.

## 3 CONSULTATION

### Submissions 3.1, 3.2

Submission 3.1 refers to interventionist and expensive management proposals put forward by CALM. The EPA have advised that the submission refers to water level control in wetlands through artificial maintenance and drainage systems, particularly in relation to the Beelihar wetlands. Therefore, Submissions 3.1 and 3.2 are dealt with together.

Criteria 9-12 and 13-18 are water level criteria for Thomsons Lake and Lake Forrestdale respectively. The objection to these criteria is based on the perception that they were developed without consultation with the public or the agencies involved in developing the Beelihar Park Management Programme (CALM, EPA and DPUD). In fact, the criteria established in the PER are based on advice from these same agencies through work done for previous studies of wetlands in the area, their participation in the Steering Committee and informal advice. Expert advice was also obtained from researchers through the studies that form the technical appendix and research projects currently being funded by the EPA and the WAWA. Public consultation was entered into through the Jandakot Groundwater Discussion Group (pg 124, Vol 1 of PER) and several meetings with representatives of the Conservation Council (3 Oct, 1990; 20 Nov, 1990; 4 April, 1991). A special meeting was also called to specifically address the criteria for Thomsons Lake and was attended by researchers from CALM, Murdoch University and CSIRO.

The criteria in question have been developed on the basis of CALM's preferred management strategy for Thomsons and

Forrestdale Lakes and the recommendations of EPA Bulletin 371. The Conservation Council appears to differ in its views with CALM and expert scientists from CSIRO and Murdoch University in regard to the most desirable water level regime for Thomsons Lake. Given that CALM are the current managers of the wetlands and that their recommendations for management are supported by the EPA, the Water Authority was prepared to accept the validity of those recommendations as a basis for developing criteria. In making that decision the Water Authority took into account that interventionist approaches are the only efficient ones in areas where the hydrologic regimes have already been altered. As indicated previously however, the interim status of the criteria allows for future modification should it become apparent that the basis for management is inappropriate.

### Submission 3.3

The first part of this submission has been addressed above. The second part of this submission objects to the emphasis placed on waterbird values of Thomsons Lake and the subsequent development of criteria for other Beelihar wetlands based on this value. For Thomsons and Forrestdale Lakes, the emphasis for management has been placed on waterbird habitat. This is consistent with CALM's management objectives for the Lakes and their importance as RAMSAR wetlands. The environmental management criteria for the other wetlands are linked to the water level criteria and are not based solely on waterbird usage of those wetlands. Section 7.4.2 of the PER, detail the management objectives for the wetlands on which the criteria were based. These objectives are partially derived from EPA Bulletin 374 while many of the criteria developed to achieve these objectives are derived from Bulletin 371. Only a small fraction of these relate to waterbird usage.

## 4 ENVIRONMENTAL IMPACTS

### Submission 4.1

The Authority agrees that it is important to have benchmark data before instigating any abstraction. To this end a series of vegetation transects have been established to provide benchmark data. A commitment has been given in the PER to undertake detailed habitat surveys around major wetlands on a triennial basis. It will be ensured that first survey will be undertaken before abstraction commences.

### Submission 4.2

While the interactions between groundwater, wetlands and habitats are not fully understood, the current knowledge is sufficient to allow reasonable assessment of likely interactions of these factors in relation to the proposal. However, the Authority is aware that more information than is currently available will greatly assist in refining the interim criteria established in the PER. To this end a study was initiated in 1989 by WAWA, the EPA and AWRAC to specifically examine the interaction between the unconfined aquifer and wetlands. This study is being undertaken by the CSIRO.

A second project being undertaken by Murdoch University is examining the interaction of wetland water levels and fringing vegetation. Along with several other wetland-ecology oriented studies, these projects will provide a better understanding of the groundwater-wetland-habitat interactions that will allow appropriate evolution of the criteria presented in the PER.

The PER proposes that habitat shifts will be determined triennially from aerial photography. This component of the management strategy is outlined in Section 10.6.2 of the PER. While the most desirable situation would be to monitor all the wetlands very regularly, the reality is that resources are not available to allow that. Recent experience on the Gngangara Mound, however, indicates that it may be necessary to monitor more frequently than triennially, particularly in the first few years of operating the GWS. Therefore, the Water Authority will determine an appropriate frequency and incorporate this into the EMP.

### Submission 4.3

The Water Authority concurs with this comment and fully supports the intention of the Draft Environmental Protection Policy to protect the remaining wetlands of the Swan Coastal Plain. The PER is not intended to condone wetland degradation and if that perception is created, then it is entirely unintended. The emphasis of the strategy proposed in the PER is to reduce wherever possible the degree of impact that the proposal will have on the environment. However, some impact is unavoidable if groundwater schemes are to be developed. The distinction between 'natural' and 'degraded' wetlands is only made to facilitate the establishment of criteria. In some instances wells will need to be placed close to wetlands or in an area such that significant drawdown will occur at a wetland. Where this is unavoidable, the well has preferentially been placed near a 'degraded' wetland rather than a 'natural' wetland since 'Natural' wetlands have more varied habitat structure and greater ecological value. However, the value of 'degraded' wetlands is also recognised. While specific criteria are not set for placement in relation to degraded wetlands, it is intended that the general drawdown and vegetation criteria will protect these wetlands.

The impact of the groundwater scheme on degraded wetlands must be evaluated against existing, and probably on-going degradation. Most of the degraded wetlands are on cleared pastoral land and suffer significant habitat destruction and

higher water levels than would naturally occur under vegetated conditions. Some of the wetlands which will be impacted on are within future urban areas. In the absence of proposals to rehabilitate these wetlands, it seems appropriate to set stricter criteria for the protection of natural wetlands than for degraded wetlands.

It is worth noting that although some wetlands will be affected by the groundwater abstraction others will have much greater security as a result of commitments made by the Water Authority to artificially maintain them.

#### Submission 4.4

This response indicated unacceptable impacts on a number of wetlands. These wetlands and the anticipated drawdowns are:

Banganup Lake	0.20 m
Beenyup Rd Swamp	0.25 m
Gibbs Rd Swamp	0.00 m
Lake Balmanup	0.50 m
Russel Rd Swamp	0.35 m
Solomon Rd Swamp	1.10 m
Twin Bartram Swamp	0.90 m

Banganup Lake was addressed in detail in Section 9.5.1 of the PER. The Authority accepts that the predicted impact is probably unacceptable although much is unavoidable if Thomsons Lake is to be managed in accordance with CALM's desire for lower water levels. However, it was proposed in the PER that an artificial maintenance scheme could be developed to reduce this impact. That scheme will be developed in consultation with CALM and the University of WA and will be the subject of an Environmental Management Study.

The following points are worth considering in relation future water levels in Lake Banganup:

- \* if, as CALM have indicated, Thomsons Lake was historically drier than it currently is then Lake Banganup would also have been drier. The principal cause of the current high water levels in both wetlands is probably rural drainage into Thomsons Lake;
- \* the desire to maintain the status quo in Banganup Lake ignores the basic ecological processes in wetlands which ultimately see a drying of wetlands due to sedimentation and detrital accumulation;

Beenyup Rd Swamp will have an estimated maximum drawdown of 25 cm. The conservation values of this wetland were identified by Semenuik et al. (1987) as habitat preservation. The criteria established in the PER in relation to this wetland relate specifically to habitat preservation (Criteria 19-22). The criteria set permissible changes. In the case of this wetland, those criteria are met.

Gibbs Rd Swamp has been located by the Water Authority on advice from the RAOU as north of Gibbs Rd between Nicholson and Taylor Rds. As indicated in the PER, there is no anticipated drawdown of water levels in this area: there will be no impact of the Scheme on this wetland. In the past, there has been some confusion over the location of Gibbs Rd Swamp. It is possible that this submission refers to a different wetland since it refers to an unacceptable impact on the wetland. In contrast to the suggestion in this Submission, Gibbs Rd Swamp was not referred to by Semenuik et al. (1987) as having rare habitats worthy of conservation. Nonetheless, it is true that this wetland is extremely important for waterbird habitat.

Lake Balmanup has been extensively modified for market gardening. As such, the value of this wetland for the conservation of rare types of habitat, flora and fauna is debatable. Semenuik's survey of the area (Gold Estates Report, 1987) did not identify this wetland as having any potentially important conservation values.

Russell Rd Swamp will experience drawdowns of about 0.35m at ultimate development of the scheme. The Authority's response to this comment is as for Beenyup Rd Swamp (above).

Solomon Rd Swamp will also be significantly affected by the proposal. The main value of the Solomon Road Wetland area is as a refuge and feeding and breeding area for non-aquatic species of invertebrates. The impacts on this wetland were dealt with in detail in the PER and are likely to include:

- o water levels being lowered by up to 1.1 metres,
- o the South Jandakot Urban Development, and
- o the southward extension of the Kwinana Freeway.

It is unlikely that the environmental values of Solomon Road Wetland can be maintained due to the number and range

of likely impacts. To reduce the impact would require a large quantity of water to be forgone from the proposed Stage 2 GWS plus private abstraction may have to be limited in the area. This would significantly increase the financial cost to the community. Relocation of the wells would increase the environmental impacts in other areas, and it could be argued that some have higher environmental value.

Artificial maintenance has been examined but is not considered a reasonable option because of the cost associated with either pumping large quantities of groundwater or trying to maintain a perched water table. Also, given that the impact of the proposed groundwater abstraction on Solomon Rd Swamp is as great as predicted, it may be impossible to artificially maintain the wetland without also ceasing to draw water from the area for the GWS. However, should Solomon Rd Swamp maintain some of its environmental values despite the effects of urbanisation, the Water Authority will examine options for actively managing soil moisture levels.

Twin Bartram Swamp would need to be artificially recharged, via a spur pipeline running from the nearby collector main, to meet the criteria. A study is proposed to look at the effectiveness of such a strategy for Twin Bartram Swamp. The Water Authority has commenced monitoring of Twin Bartram Swamp in anticipation of commissioning a hydrogeological study and providing the EPA with details of its proposals as part of the EMP.

The Authority believes that, overall, the environmental impacts of this proposal are acceptable. It is recognised that in some area, such as twin Bartram and Solomon Rd Swamps, significant impacts will occur. However, if the groundwater Scheme is to be developed, then some small degree of impact must be accepted. In terms of the overall benefits of the scheme, the Authority believes these impacts are acceptable.

#### Submission 4.5

The Authority completely agrees that the Jandakot area is an integrated environment and not merely a few outstanding features. This concept is the principal determinant of the 'Wetland System' criteria as indicated in Section 7.5 of the PER. The wetland criteria are specifically designed to ensure that the diversity of habitats associated with the wetlands is maintained throughout the area. Ensuring the maintenance of wetland habitat diversity should ensure that less sensitive habitats are also protected.

Rare flora and fauna in the area have been addressed by two consultants reports for the PER (see Volume 2). The location of rare flora sites is not indicated in the PER, however the general results of the mapping are included as both technical appendices and in Sections 5.2.2, 5.2.4 and 5.2.5. The vegetation survey conducted for the PER is presented in the Volume 2 and summarised in Section 5.2.2 of the PER.

The need to conduct 'complete flora and fauna surveys of this area prior to any development' is a broad and not necessarily justifiable suggestion. Certainly, some development proposals would require this depth of survey due to the nature of the expected impacts. In this case, the potential impacts will be habitat loss/change resulting from changes in groundwater level. A complete list of species in the area is not required to judge on the acceptability of this proposal if the criteria to which the project must comply will protect the habitats. The Water Authority believes that more detailed species composition lists for the habitats than those presented in Section 5.2.2 would not enable better evaluation of the criteria being used.

#### Submission 4.6

The breach of criteria referred to in this comment is acknowledged in Section 9.5.7 of the PER. The justification for permitting this breach is also presented.

Wells have been placed closer than 300 metres to five seasonal wetlands. Four of the five wetlands are within the area proposed for future urban development and are likely to be severely degraded, if not totally destroyed. Well J240 was closer than 300m to one of these wetlands but has since been relocated to the north and now meets the criteria. Well J210 is slightly less than 300m from a natural sumpland which is outside the proposed urban area. Preliminary land-use proposals for the Jandakot area are being developed as part of the Jandakot Land Use and Water Management Study. Under those proposals the wetland in question will be adjacent to an area zoned urban with some of the wetland located in the alignment for the Kwinana Freeway extensions. In this case, the habitat values of the wetland will be severely diminished and it is proposed that the Well site remain unmoved.

One well (J380) is 300m from a natural wetland and so strictly meets the criteria. While it is preferable to increase this distance, this would require moving the well either to the south or east. A shift south would bring the well closer to the Jandakot industrial area and so this option is rejected. A move to the east would involve significant financial cost and would also place the well closer to areas of phreatophytic vegetation.

#### Submission 4.7

The Water Authority is supportive, in principle, of a Jandakot Botanical Park to secure adequate reserves of Banksia woodland. To this end the Minister for Water Resources requested that the relevant government agencies expedite a decision on the boundaries for the proposed Botanical Park in a letter to the Minister for the Environment dated 3 January,

1991. Since that time, DPUD, CALM and the Conservation Council have initiated discussions. To this Authority's understanding, preliminary boundaries are currently being determined to the satisfaction of the various groups and which DPUD will rezone under the MRS to Parks and Recreation. DPUD has advised the Water Authority that these boundaries will be made public in the near future.

The Authority believes that the declaration of the Botanical Park should alleviate concerns over adequate representation of southern Banksia woodland in the conservation estate. At this stage it appears that the woodland near the intersection of Lyon/Gaebler Rds is not included in the park. This woodland is in an area zoned future urban and is on the Kwinana Freeway extensions alignment. The protection of this area of woodland from the impacts of the proposed groundwater scheme were specifically addressed in criteria 4 and 5 (Table A12.2) and are justified in Section 7.2.1 of the PER. The Authority believes that these criteria will adequately protect the woodland.

Drawdowns in the area of the Botanical Park are generally less than 0.5 m and in many areas are less than 0.25 m. Although some greater drawdowns are expected near Lyon and Gaebler Rds, the phased introduction of the pumping will allow a period to evaluate the effect of this drawdown. Should this strategy prove unacceptable, necessary alterations will be initiated. A study being undertaken into the deaths of Banksia vegetation on the Gngangara Mound will provide further information on how to manage groundwater abstraction to avoid unacceptable tree stress.

#### Submission 4.8

The importance of minor and ephemeral wetlands to the ecology of the Jandakot Region is not disputed. Several sections of the PER and several criteria address this precise issue. Section 6.10 of the PER details the approach used in developing criteria and emphasises the importance of all elements of the environment in contributing to the total habitat diversity of the Jandakot area. However, as explained in Section 6.3 of the PER, it is not possible to set criteria which specifically address every component of the Jandakot environment. This is due partly to a lack of detailed data but also due to a belief that by satisfying a number of carefully chosen criteria, comprehensive protection can be provided. This was the approach used by the EPA when recommending criteria for the Gngangara Mound Water Resources ERMP. As in that case, the Water Authority believes that protection of major and several minor wetlands in the Jandakot area from regional drawdown will protect much of the surrounding habitats.

#### Submission 4.9

The potential impacts of artificial maintenance on wetland water quality are likely to be:

**TEMPERATURE:** When the wetland is thermally stratified, recharge water will reside on the bottom possibly resulting in stratification of up to 2°C m<sup>-1</sup>. Under typical conditions the wetland will probably mix fully once or twice a day. For typical artificial recharge rates, the addition of water will not alter the temperature differential from top to bottom since the bottom layer would normally consist of cooler groundwater. However, a marginally thicker layer of 'cool' water will form in the bottom of the wetland during the stratification phase. Once the lake mixes, the temperature of the lake may be up to 0.1 °C lower than it would otherwise have been. This effect is minor compared to the magnitude of other heat inputs.

**NUTRIENT CONCENTRATIONS:** Nutrient levels are likely to improve because the major wetlands have considerably higher concentrations of nutrients than Stage 2 groundwater. This relatively clean groundwater will be added to the wetlands when nutrient levels are rising due to evapoconcentration. However, since any recharge water that contains even small amounts of nutrients will add to the overall nutrient loading of a wetland it is important that only groundwater of a suitably high quality is used.

**SALINITY:** Dissolved salt concentrations are likely to improve because the freshest of the major wetlands, has around 500 milligrams per litre concentration while the Stage 2 groundwater has an average of less than 300 milligrams per litre.

**pH REDUCTION:** Groundwater from the Stage 2 GWS will have an average pH of 5 to 6 whereas the major wetlands are alkaline with pHs of 7 to 9 (EPA, 1987b). It may be necessary to correct the pH of incoming groundwater if it is likely to significantly alter the pH of a wetland.

The Authority believes that while the precise extent of the impacts from artificial maintenance cannot be predicted, scientific knowledge and practical experience from operation of maintenance schemes on the Gngangara Mound are sufficient to justify this management strategy. Again it must be reiterated, that due to the time lag expected before full abstraction and impacts occur, there will be ample time to monitor the effects of the management strategy and adjust practices as required.

#### Submission 4.10

Jandakot Stage 2 would become uneconomical if, as a consequence of its development, drawdowns are to be limited to 0.5m in areas with significant wetland and woodland areas. This is because the quota for this scheme will require to be at least halved. The cost to the community of halving the quota will be approximately \$16 million present value total.



This is due to the need to bring more expensive projects forward on the Sources Development Timetable. All alternative sources will also have some degree of environmental impact associated with them.

Also, nearly all of the significant wetland and woodland areas in the vicinity of the Stage 2 wells will be affected by the following:

- . urbanisation of land east of Thomsons Lake
- . proposed Special Residential development
- . further development of land already zoned industrial
- . expansion of existing sand mining activities.

Upon completion of the above developments, very little pristine wetland and woodland areas will remain in the immediate vicinity of the proposed Stage 2 wells.

#### **Submission 4.11**

This submission is correct in that no allowances are made for potential drawdowns due to the Greenhouse Effect in predicting the impact of the proposal. However, Section 6.8.4 of the PER does address climatic variability. Past climatic variability has been built into the impact assessment by applying the climatic record for the past 75 years to the model predicting future drawdown. It is acknowledged in the PER that long-term climatic effects will need to be taken into account in the future. The omission of these factors at this stage was for two reasons. Firstly, the criteria set out in the PER are short-term in their nature. They will be adjusted as new information becomes available in the future including the observable effects of any Greenhouse changes. Secondly, predicting the impacts of long-term climatic changes can be extremely difficult, as is reflected in the splintered views of the scientific community on the issues such things as sea-level rises. The impact of global warming on groundwater levels is even more complicated to predict. Given this, it is felt that any criteria at this stage would be little more than a 'stab-in-the-dark'.

Should monitoring reveal that the impact of climate on groundwater levels is significantly different from the past 75 years, then the management criteria will need to be adjusted accordingly. This strategy was implemented on the Gngangara Mound when it became apparent that recent climatic condition had resulted in lower than normal groundwater levels and subsequent vegetation stress. In response, the Authority ceased groundwater abstraction from three wells in environmentally sensitive areas to prevent any additional stress this may have placed on the vegetation.

#### **Submission 4.13**

Hydrographs from monitoring bores in the vicinity of the existing Jandakot Stage 1 wells indicate that pumping from the southern wells has resulted in pressure reductions of up to 5m in the lower part of the superficial aquifer. Outside the immediate drawdown cones of the Stage 1 wells, Water Authority monitoring indicates drawdowns in the order of 0.2-1.8 metres at the surface of the aquifer. However, during winter the water levels recover to about the same level each year. Monitoring also indicates that drawdowns in the upper part of the aquifer are less than at the base of the aquifer. This difference is due to the presence of finer sediments or coffee rock layers in the upper part of the aquifer which, in places, inhibits the vertical movement of groundwater. Where the coffee rock is poorly cemented or absent, drawdowns of about 1m have resulted.

The Water Authority is currently investigating tree deaths on both the Gngangara and Jandakot Mounds. At this stage it appears that the recent deaths are due to extreme temperatures experienced during the previous summer, lower than average recharge rates over the past two winters and the cumulative effect of these factors with localised drawdowns due to groundwater abstraction. The results of this investigation will be presented to the EPA once complete.

#### **Submission 4.14**

The monitoring which is proposed as part of the management of the groundwater scheme is detailed in the PER along with the reporting and review mechanisms. It is assumed that as the proponent, the Water Authority is responsible for conducting those parts of the monitoring it is competent to perform, and would engage specialist consultants or other government agencies to perform monitoring which requires special expertise. The suggestion that all monitoring be conducted by agencies other than the Water Authority, if accepted, would be unusual. It would place resource demands on other agencies at a time when many are operating with limited resources. This would seem unnecessary when the Water Authority can conduct monitoring and provide regular reviews to the EPA and other agencies such as CALM and the Beeliar Park Management body for comment.

It is an unavoidable inference that the basis of this submission is mistrust of the Water Authority as either a competent or trustworthy monitoring agency. The Authority is prepared to stand on its record in this respect.

#### **Submission 4.15**

The Water Authority welcomes the offer from CALM to contribute to various surveys and monitoring planning as outlined

in this submission. Input from CALM and other agencies will be sought during the formulation of an Environmental Management Programme (EMP) for the Groundwater Scheme. As indicated elsewhere in this response, the need for rare and restricted fauna and flora and vegetation complex mapping in excess of those already conducted as part of the PER is questionable. However, it is probably appropriate that this issue be raised in formulating the EMP.

#### **Submission 4.16 - 4.18**

These three responses are addressed similarly.

The Water Authority is conscious of the complexity of management issues in the Jandakot area. This requires that the formulation of management programmes involve all relevant agencies, and where appropriate, community input. CALM's role in managing Thomsons Lake and Lake Forrestdale, its role in managing the Beeliiar Park and its historical involvement in developing the South Jandakot Drainage Management Plan makes it a central agency in the management of the Jandakot area. The Water Authority is committed to maintaining a close working relationship with CALM, particularly in the Jandakot area, and welcomes the suggestions and recommendations proposed in these three submissions.

### **5 TECHNICAL ISSUES**

#### **Submission 5.1**

The recharge figure stated in Groundwater Resources of the Swan Coastal Plain, 1981 was arrived at using limited data at specific sites and by estimating the chloride content in rainfall. Since 1981, the Perth Urban Water Balance Study, the Gnangara Mound ERMP and further studies by CSIRO have all indicated that the recharge rate is higher and varies according to land use, vegetation cover, depth to water table and rainfall. The recharge rate can range from 0% under dense pine forests to 50% under pastures and heavily irrigated market gardens, with about 20% being an average rate.

#### **Submission 5.2**

CALM's criteria for management of the Beeliiar Wetlands were criticised in Submissions 3.1 and 3.2. The Water Authority's response to those submissions therefore addresses Submission 5.2. In addition however, it must be pointed out that CALM's criteria were not developed in isolation from other agencies. The EPA has implicitly supported the criteria through the release of Bulletin 371. The Water Authority considers the criteria acceptable and implicitly supports them by adopting them for the PER. In a recent meeting between the Conservation Council, WAWA and a number of independent researchers from Murdoch University (4/4/91), it was apparent that specialist wetland ecologists also support the general concepts behind the criteria. None of the above agencies, including CALM, would claim that the criteria will not need to be refined in the future. However, they represent the considered view of CALM at this time and appear to be the most reasonable basis for management of the wetlands. The Water Authority has no intention of preventing discussion on the criteria and welcomes constructive alternatives to the criteria of CALM. However, until constructive alternatives, or criticism, of the existing criteria are presented, it seems appropriate to accept the views of the State's conservation agency.

#### **Submission 5.3**

Stage 1 of the Jandakot groundwater scheme has been operating since 1979. The main environmental impact to have arisen in that time has been a decline in water levels in the area. Regular monitoring indicates that the minimum water levels in 1991 are generally between 0.2 and 1.2 metres lower than the minimum levels prior to operation of the wellfield. In some isolated areas however, the drawdowns have been up to 2 metres.

The last annual report to the EPA on the operation and impacts of Stage 1 was submitted in 1988. At that Stage there no significant or unacceptable impacts were identified however this was due in part to a lack of baseline data against which changes could be compared. Since that time a vegetation monitoring programme has been initiated. The results of that monitoring will be reported on a triennial basis in conjunction with the reporting for the Stage 2 scheme.

During the last 2 years there has been an increase in the reports of Banksia deaths in areas adjacent to the wellfield. This was not noticed in the ten years to 1989. As mentioned in response to Submission 4.13 the Water Authority is currently investigating tree deaths on both the Gnangara and Jandakot Mounds. The recent deaths appear to be attributable to a combination of factors including extreme climatic conditions in recent years together with localised drawdowns due to groundwater abstraction. At this stage, the Authority is reviewing the environmental impacts of Stage 1 of the Scheme in light of the extreme climatic conditions experienced recently. The EPA will be informed of the results of both the tree death investigation and the management review.

Monitoring sites in close proximity to the Jandakot Stage 1 wellfield were utilised in order to calibrate, on a regional basis, the groundwater model used in the PER. A good match between the simulated and recorded water levels was obtained, and this is reflected in the degree of correlation between the actual and predicted water levels in the area shown in the

PER (Figure A11.2, p142).

#### Submission 5.4

The response to this submission is as for Submissions 4.16-4.18.

## 6 OTHER POLICIES

### Submissions 6.1 and 6.6

These 2 comments are essentially similar and can be addressed as a single issue. The comments purport that the criteria set out in the PER are inadequate and are inconsistent with EPA Bulletin 374, the State Conservation Strategy and the Draft EPP on Swan Coastal Plain Wetlands. The Water Authority believes that the criteria are acceptable, especially given that they are based on the best available information. However, they are also considered interim criteria and will be adjusted as new information becomes available. The position stated in the Authority's response comment to 1.1 applies to this comment.

In relation to inconsistencies with the other documents and policies:

Bulletin 374; this Bulletin provides guidelines for the evaluation and management of wetlands. That evaluation process was used in the PER. The Bulletin also indicates the management category for a number of the wetlands. These categories have been used in the PER to define the detailed management objectives for those wetlands in the Jandakot area for which information is available. It is these objectives that were considered when developing the criteria set out in the proposal. The Authority can see no inconsistency between the PER and the approach recommended in Bulletin 374 for wetland management.

Draft EPP; the draft Policy proposes measures to prevent further filling, mining, excavation or drainage of wetlands on the Swan Coastal Plain. To effect this all proposals for those activities must be referred to the EPA for formal assessment. As a government agency and DMA, the Water Authority is already obliged to refer those types of activity to the EPA. To the knowledge of the Water Authority, the provisions of the EPP in relation to drainage refer to direct drainage and do not relate to groundwater abstraction schemes. Irrespective of this however, the implication of the EPP is that, were groundwater abstraction viewed as direct drainage to or from a wetland, then it would need to be referred to the EPA for formal assessment. In this case that has been done, and so the Water Authority again can see no inconsistency between the two documents.

State Conservation Strategy; the State Conservation Strategy is a necessarily broad document and does not specifically deal with any particular component of the environment. It provides an overall strategy to increasing the application of sustainable development to activities in the State. The Strategy defines conservation as "The management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations...". The Strategy goes on to define the objectives as: to maintain the essential ecological processes and life support systems; to preserve genetic diversity; to ensure the sustainable utilisation of species and ecosystems.

This PER presents a proposal which balances developing a water resource for the benefit of the Perth community at large with protection of the essential ecological functions of the Jandakot area. The water resource is to be managed in a sustainable manner so that it is available in perpetuity for both Public Water Supply and the environment. Where appropriate, the proposal has shown support for proposals that would enhance this, such as the Botanical Park, the Beeliar Regional Park Management Plan and CALM's and the EPA's preferred management objectives. From the Authority's point of view, the proposal is not inconsistent with any of these objectives. The impacts of the proposal are generally acceptable and where they are considered unacceptable, management strategies have been proposed to reduce that impact. The proposal should have no significant impact on genetic diversity since the criteria are designed to protect the habitat diversity that sustains genetic diversity. The Authority considers this proposal to be an example of sustainable utilisation of an environment, and it is therefore consistent with the State Conservation Strategy.

Finally, the Authority cannot accept the argument that 30 wetlands will be destroyed and 30 will be seriously degraded. In the total area in which drawdown will occur there will be about 90 wetlands. Thirty of these are within the area zoned to become urban and will be significantly impacted on by that development. Of the remainder, the majority are already degraded wetlands in cleared, or partially cleared land and therefore have water levels which are probably higher than would naturally occur. The Authority believes that the majority of the wetlands in the area affected will experience earlier drying during summer than is presently the case, but will not suffer significant loss of habitat. While there will be an effect on most of these wetlands, they will persist as functional ecological units, and in some cases, a slight decline in water levels will probably reflect a more natural situation.

### Submissions 6.2, 6.4 and 6.5

These 3 comments are essentially similar and can be addressed as a single issue.

These submission generally state that until a number of other planning and management strategies for the Jandakot area are completed, including the Jandakot Land Use and Water Management Strategy, the Jandakot Mound EPP, the Jandakot Botanical Park planning study and the Beeliar Regional Park Management Plan, the Groundwater Scheme should not be given approval since correct criteria cannot be developed. While there is obvious value in having the studies in place, the Water Authority feels justified in proposing the Stage 2 groundwater scheme at this time.

During preparation of the PER, the Water Authority was fully aware of these other strategies and believes the PER is consistent with them. The criteria established in the PER have been developed in consultation with all of the agencies that would contribute to the above studies. Those departments are aware of the implications of the above planning strategies etc. for the Jandakot area and presumably took these into account when reviewing the PER and providing advice. It is unlikely that the criteria contain significant flaws or that the above studies would require dramatic changes to this proposal. Many of the above studies are underway and the results will be available to incorporate into the Environmental Management Programme of this proposal (Botanical Park; Land Use and Water Management Study). However, the Jandakot EPP is a long way from complete and the completion date is currently unknown. To delay the proposal until other studies are completed will delay establishment of the groundwater scheme and would necessitate the early development of alternative sources. This will impose a significant financial burden on the community, that in the final analysis may well be unnecessary. It should also be noted that water development is a legitimate part of any multiple land use.

As mentioned previously, the predicted impacts of the scheme indicated in the PER will not be realised until well into the next century. This provides a further justification for development of the scheme at this time since ample time will be available to monitor the effects of a gradually increasing groundwater abstraction and changing land use strategy in the area. It will be possible to adjust management of the scheme in accordance with environmental or other planning requirements. In recognition of the yet to be defined management strategies for the area the Authority has deliberately emphasised the interim nature of the criteria and management strategy proposed in the PER.

### Submission 6.3

The concept of sustainable urban development is strongly supported by the Water Authority. To that end the Authority has endorsed the principles detailed in the Water Resources Council report on Water Sensitive Urban Design and along with other agencies is contributing to preliminary planning studies for the urban corridors proposed by DPUD.

The responsibility for planning future urban development in Perth rests with DPUD who, in turn, responds to Government policy regarding such issues as population growth and decentralisation. The Water Authority is charged with supplying and managing water resources in the State, including the provision of water supply to urban areas. Thus while supporting the principle of sustainable urban development, the decision to follow a strategy of decentralised urbanisation is not the Water Authority's to make. As a decision making Authority the Water Authority would contribute to such plans in whatever capacity is appropriate.

### Submission 6.7

The following response is the Water Authority's view and is in no way intended to reflect the view of the EPA.

The Water Authority has stated that appropriately planned urban development poses less of a threat to groundwater resources than existing land uses on the Jandakot Mound. This is in view of the high nutrient leaching and pesticide intensive activities that currently occur in rural and special rural zones on the Mound. As such the Authority is not necessarily opposed to urban development on the Jandakot Mound and this is reflected in the Authority's Priority Source Protection Policy.

The majority of the Mound is classified as Category 2 or Restricted Groundwater Source Protection Area. These are catchment areas in which water production has a high priority but not necessarily an over-riding one in terms of land planning. Limited land development can be tolerated but the Authority will oppose intensive or inappropriate development unless it complies with a land and water management plan for the area. Management of these areas is aimed at ensuring the level and risk of pollution is not unduly increased. The preferred land use in Category 2 areas is parks and passive recreation areas. Urban development is not a preferred land use but limited and properly managed urban development may occur in appropriate sectors of the landscape.

The Authority has defined the minimum requirements that constitute properly designed urban development and in some cases, this may be preferable to existing land use. However, residential development will still have an impact on the groundwater resources which is greater than other land uses such as passive recreation. The Authority would therefore prefer, but not necessarily insist on, land uses for the area other than urbanisation.

## 7. SUGGESTIONS

### Submissions 7.1

Where possible, the proposed wells have been placed in cleared land. Five wells were originally located in uncleared land (J230, 240, 380, 390 and 420). Well J230 is in a proposed urban area which will probably be cleared in the future. Well J240 was located in remnant wetland vegetation. This well has consequently been moved about 250 m north into cleared pastoral land. This leaves a total area to be cleared for Well sites of less than 1 hectare. While it would be desirable to clear no remnant vegetation, the Authority considers the amount proposed to be acceptable.

The option of omitting the wells closest to Twin Bartram and Solomon Rd Swamps as a means of reducing the impact on these wetlands has been examined. Removing these wells would result in a loss of 3/4 of a million cubic metres per year from the Scheme (ie close to 20%). This would reduce the drawdown in Twin Bartram Swamp from about 0.9 m to 0.4 metres and in Solomon Rd Swamp from about 1.1 to 0.4 metres.

The Water Authority decided not to remove the two wells for a number of reasons:

- \* the loss of water from the Scheme will cost the community significantly in terms of the need to bring more expensive sources forward;
- \* the impact of the Scheme on Twin Bartram Swamp can be significantly reduced by developing an artificial maintenance scheme while still allowing the draw of groundwater from the nearby well. A commitment to investigate an appropriate supplementation scheme, preceded by a hydrogeological study for the area, was given in the PER.
- \* even with no groundwater abstraction it is unlikely that the environmental values of Solomon Rd Swamp will be maintained. Impacts that will affect this wetland are detailed in the response to Submission 4.4. However, the Authority has committed itself to examining management techniques that will reduce the impact of groundwater abstraction if it is apparent that the area will maintain significant habitat value despite these other impacts.

The development of a groundwater scheme must have some impact on the environment. The Water Authority believes that the impact on Twin Bartram Swamp can be minimised and made acceptable. The impact on Solomon Rd Swamp will be significant, but this must be viewed in the light of the other impacts that will affect it.

### Submission 7.2

This comment was addressed above (4.10).

### Submission 7.3

The Water Authority has undertaken to conduct the monitoring proposed in this suggestion. This is detailed in Section 10.6 of the PER and includes water, vegetation, fauna and social monitoring. The Water Authority will provide annual compliance reports and triennial review reports of the Jandakot Scheme to the EPA. The Authority has undertaken to advise the EPA immediately upon becoming aware specific environmental criteria have been, or are likely to be, breached. As a responsible environmental manager, the Authority would seek the advice of, and keep informed, all relevant government agencies when implementing measures to alleviate any effects from breaches of criteria. In all cases, the EPA will be made aware of the proposed measures to reduce the impact as soon as practicable.

### Submission 7.4

It is pleasing to see an increasing awareness among the public of water conservation issues. Section 3.3 and 3.4 were intended to serve as a summary of the water conservation strategy which the Water Authority is currently pursuing. While the strategy is dealt with only briefly, this does not infer a lack of attention for the issue.

The Water Conservation Strategy has targeted several sectors including domestic, industrial, commercial and institutional, irrigation and rural users of water. Most of the points raised in this Submission relate to the domestic use of water. The Authority, as general policy, supports and encourages the use of water efficient appliances such as dual flush and dry composting toilets. For example, as of January 1st, 1990 all new cisterns fixed are required to be dual flush. The Water Authority realises however that regulation will only achieve so much in water conservation strategies and for that reason has an ongoing education campaign which targets the whole community. The Water Resources Council has recently published a report on Water Sensitive Urban Design which is supported by the Water Authority, although again, it is a matter of increasing awareness of conservation among developers and planners to achieve the benefit of these recommendations.

The Authority generally agrees with the suggestions contained in Submission 7.4. However, the following comments are made in regard to some specific elements of the Submission:

(d) the Water Authority does not believe that water is scarce to the point that constant restrictions should be placed on its use. The primary motivation for conservation of water at this stage is the economic and environmental cost to the

community of supplying that water. Adequate water sources are available to meet the predicted demands of Perth for at least the next 50 years by sustainable development of surface and groundwater resources in the vicinity of Perth. Desalination remains the long-term option.

(e) licensing of private bores is already used for rural and special rural private water users in many areas licensing of domestic bores may be considered to improve our knowledge of water usage. There are no plans to meter or charge for private domestic groundwater use. Such action would require large administrative and capital cost and the Water Authority believes that those costs can be better used in other areas of water resource management.

(f) the Water Authority neither discourages nor recommends the use of rain water tanks. The average annual usage of water by a household is approximately 350 cubic metres/annum. To store this volume would require 3 or 4 large rainwater tanks at a cost probably in excess of \$25 000. It is unlikely that householders would wish to pay the cost either financial or in terms of land space to maintain such tanks. Thus, while the Water Authority has no objection to the use of properly maintained rainwater tanks, it can see no need to recommend use of tanks, given the cost involved, while ample water resources are available for use on a sustainable basis.

(g) the Water Authority cannot justify the provision of direct financial incentives for the establishment of native gardens. It is felt that the community at large would not support this use of public funds and the Authority considers that there is a significant financial disincentive in establishing European-style gardens. That disincentive should be sufficient to promote greater use of native species.

#### **Submission 7.5**

The Water Authority agrees that if the metropolitan community rapidly adopted water conservation strategies, then the immediate need for the development of the Jandakot Groundwater Mound would be reduced. However, while promoting the Water Conservation measures, the Authority has an obligation to supply water to the community in anticipation of realistic increases in demand. In the long-term, population growth will necessitate the development of water resources, even if urban design and water demand strategies are effective. While other sources could be developed in preference to Jandakot Stage 2 in the short-term it will be at considerable expense to the community and the scheme will still be required in the long-term.

#### **Submission 7.6**

The impacts of the Stage 1 wellfield has been analysed on an annual basis since the Scheme was initiated in 1979. These reviews have shown that the actual impact on the groundwater level has generally been significantly less than that originally predicted. The impacts of that Scheme were taken into account in modelling the effects of Stage 2 of the groundwater scheme by using them to calibrate and verify the drawdown model. In addition, the Water Authority is undertaking a review of the Stage 1 Scheme over the winter of 1991 to determine whether adjustments are required to the management strategy for the Scheme. The results of that review will be used in the development of a detailed Environmental Management Programme for the Stage 2 Scheme.

The effects of the Jandakot South Wellfield and the Proposed urban developments in the Jandakot area have been taken into account in the PER. The projected impacts which are detailed in document (Scenarios 2 and 3) are for Stage 2 with a fully developed Jandakot South Groundwater Scheme and full urban development. In assessing the PER therefore the impacts of urbanisation and the southern groundwater scheme on groundwater levels will also be assessed, as requested in the Submission.

#### **Submission 7.7**

This submission calls for the deepening of existing wetlands or the creation of new wetlands to compensate for the loss/change of habitat resulting from drawdowns. The Water Authority believes that the change in habitat due to the proposal will be minimal and acceptable. However, should monitoring or future studies indicate that the impacts will be unacceptable then appropriate measures will be taken to prevent that impact.

Deepening existing wetlands and creating new wetlands are two of several strategies that could be used to ameliorate drawdown impacts and while worthy of consideration they both illustrate the types of considerations that will need to be taken into account in proposing such strategies. Deepening of existing wetlands involves removal and/or disturbance of the sediment profiles. This is both costly and can be detrimental to the functioning of the sediments as nutrient cycling pools. Creation of new wetlands as compensation for loss of existing wetlands is an acceptable approach where loss of natural wetlands is unavoidable. However, the Water Authority would prefer to employ management strategies aimed at preserving existing wetland values, rather than promoting an ethic of replacement with artificial, and possibly ecologically simplistic, wetlands.

#### **CONCLUSION**

In conclusion, the Water Authority reiterates the points raised in the response to Submission 1.1 and 1.2.

This proposal has been developed in anticipation of the most likely demand for potable water in the Perth Metropolitan

Region. It will be required by October 1993. The nature of the anticipated impacts have been identified in developing a proposal that the Water Authority believes is environmentally acceptable. The principal impacts relate to drawdown of the watertable and are both manageable and reversible. Further, these impacts will not be realised for about 10-15 years. This allows sufficient time to monitor the impacts of increasing abstraction and adjust the management of the system accordingly. For that reason the whole management strategy is designed to be flexible and adaptable as new information becomes available.

The management strategy is centred around a set of management criteria which have been clearly identified as interim. The criteria will be adjusted in response to monitoring and further studies. The impacts of the Scheme are clearly identified in the PER; they are minimal and in all except a small number of cases the criteria established for managing those impacts have not been breached. In those cases where the criteria have been breached it is anticipated that the ecological value of the areas will be significantly affected by proposals for future urbanisation.

Given the above, the Water Authority believes that the proposal for the Jandakot Groundwater Scheme Stage 2 is environmentally acceptable. The Authority is aware, through consultation and the public submission process, that some sections of the community are not of that opinion. Many of the objections to the proposal are not based on an intrinsic disagreement with the proposal. They originate from a dissatisfaction with the delay in releasing a number of planning documents for the Jandakot area. Since submitting the PER for comment, negotiations between the Water Authority, Department of Planning and Urban Development and the Conservation Council have been aimed at reconciling some of those differences. The Water Authority believes that the principal objections to the Scheme are being resolved by the DPUD-Conservation Council negotiations for the Jandakot Botanical Park and the Minister for Water Resources request that the Jandakot Land Use and Water Management Strategy be released as soon as possible by DPUD.

The Water Authority now seeks the judgement of the acceptability of the proposal from the Minister for the Environment, based on the advice he receives from the EPA. The Authority requests both the Minister and the EPA to take into consideration its responses to the Public Submissions in arriving at their conclusions.

10/10/92  
INVESTIGATION OF THE JANDAKOT GROUNDWATER SCHEME  
STAGE 2  
WATER AUTHORITY