Thomsons Lake Urban Development and South Jandakot Drainage Management Plan, deferral of construction of the South Jandakot Branch Drain

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Western Australian Planning Commission

Proposed change to Environmental Conditions

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 824
June 1996

THE PURPOSE OF THIS REPORT

This report contains the Environmental Protection Authority's environmental assessment and recommendations to the Minister for the Environment on the environmental acceptability of the proposal.

Immediately following the release of the report there is a 14-day period when anyone may appeal to the Minister against the Environmental Protection Authority's report.

After the appeal period, and determination of any appeals, the Minister consults with the other relevant ministers and agencies and then issues his decision about whether the proposal may or may not proceed. The Minister also announces the legally binding environmental conditions which might apply to any approval.

APPEALS

If you disagree with any of the contents of the assessment report or recommendations you may appeal in writing to the Minister for the Environment outlining the environmental reasons for your concern and enclosing the appeal fee of $10.

It is important that you clearly indicate the part of the report you disagree with and the reasons for your concern so that the grounds of your appeal can be properly considered by the Minister for the Environment.

ADDRESS

Hon Minister for the Environment
12th Floor, Dumas House
2 Havelock Street
WEST PERTH WA 6005

CLOSING DATE

Your appeal (with the $10 fee) must reach the Minister's office no later than 5.00 pm on 19 July 1996.

Environmental Impact Assessment Process Timelines

Date	Timeline commences from receipt of full details of proposal from proponent for public review	Time (weeks)
13/11/95	Proponent document released for public comment	
11/12/95	Public comment period closed	4
27/12/96	Issues raised during public comment period summarised by EPA and forwarded to the Proponent	2
22/1/96	Proponent response to the issues raised received	4
5/7/96	EPA reported to the Minister for the Environment	23

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Summary and recommendations

This report and recommendations provides the Environmental Protection Authority's advice to the Minister for the Environment on the environmental acceptability of the proposal to defer construction of one component of the South Jandakot Drainage Management Plan ie the South Jandakot Branch Drain.

The South Jandakot Drainage Management Plan was associated with the Thomsons Lake urban development and in 1987 was formally assessed by the Environmental Protection Authority, and Environmental Conditions were set by the Minister for the Environment. Any substantial change to the Drainage Management Plan was deemed to require assessment by the Environmental Protection Authority. The proposed deferral of the South Jandakot Branch Drain is the subject of this assessment.

The Environmental Protection Authority identified the main environmental topics requiring detailed consideration as:

- impacts on waterbirds;
- impacts on water levels of the Beeliar Wetlands;
- impacts on water quality of the Beeliar Wetlands.

Due to the Ramsar-listing of Thomsons Lake, the Environmental Protection Authority considers the effects on waterbirds to be a significant issue. This issue is directly related to the management of water levels and water quality in the Beeliar Wetlands. Consequently, the objectives relating to the effect on waterbirds are addressed through the assessment of these issues.

The proposal is to defer construction of the South Jandakot Branch Drain until construction of the Thomsons Lake Main Sewer commences, which is dependent on the rate of urban development. The drain and the sewer are to be located within the same excavation within the Beeliar Regional Park. The co-location of the drain and sewer represents an environmental benefit in terms of reducing vegetation disturbance. Similarly, a delay in construction of the Branch Drain (and the sewer) would facilitate the Water Corporation's continuing investigation into the most appropriate method of ultimate disposal of drainage water. The approved method of disposal is into Cockburn Sound, although the Water Corporation is investigating other options which may provide a net environmental benefit.

The Environmental Protection Authority is aware that the proposed deferral could result in increased water levels which could have significant impacts on the function of the Beeliar Wetlands. Given that lake water levels are dependent on a number of environmental variables it is difficult to predict water levels, although the Water Corporation presented potential water levels within Thomsons Lake for various rainfall scenarios. The Environmental Protection Authority accepts that the wetlands may experience high water levels during the deferral period, but that contingency plans will be prepared by the Water Corporation to avoid repeated years of high water levels as described below.

The Environmental Protection Authority considers that the water level criteria should not be exceeded for two consecutive years. If water level criteria are exceeded for one year, contingency plans to mitigate the consequential environmental impacts should be prepared. If the criteria are exceeded for a consecutive year, the measures outlined in the plan should be implemented, or the drain constructed.

The information provided by the Water Corporation regarding water quality suggested poor water quality would most likely occur in conjunction with high water levels. Consequently, the Environmental Protection Authority considers management of water levels would address water quality. In addition, if the water quality criteria are exceeded for one year, contingency plans to mitigate the consequential environmental impacts should be developed. If the criteria are exceeded for a consecutive year then the measures outlined in the plan should be implemented, or the drain constructed.

The Environmental Protection Authority view is that it would be environmentally unacceptable for either the water level or water quality criteria to be exceeded for three consecutive years.

Following evaluation of the major issues, the Environmental Protection Authority has concluded that the proposal meets the Environmental Protection Authority's objectives subject to the recommendations in this assessment report.

Recommendation No.	Summary of recommendations
1	The Environmental Protection Authority recommends that the proposed deferral of commencement of construction of the South Jandakot Branch Drain until the 31 December 1999 with construction being completed by 31 May 2000 can be managed to meet the Environmental Protection Authority's objectives subject to the Environmental Protection Authority's recommendations contained in this report.
2	If during the period of the deferral the maximum water level criteria and / or water quality criteria are exceeded for one year, the Water Corporation should prepare a contingency plan to mitigate the consequential environmental impacts to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority. If during the period of the deferral, the water level and / or water quality criteria are exceeded for a consecutive year, then the measures outlined in the contingency plan should be implemented, or the branch drain should be constructed.
3	That, if the Minister for the Environment approves the implementation of this proposal then the proposal be subject to the recommended procedures set out in Section 6 of this report.

1. Introduction and background

1.1 Purpose of this report

This report and recommendations provides the Environmental Protection Authority's (EPA) advice to the Minister for the Environment on the environmental acceptability of a proposed change to Environmental Conditions set on the Thomsons Lake Urban Development and the associated South Jandakot Drainage Management Plan. The proposed change is a modification to one aspect of the South Jandakot Drainage Management Plan, ie the South Jandakot Branch Drain is to be delayed beyond its proposed starting date of 1996.

1.2 Background

In 1987 the Environmental Protection Authority formally assessed a proposal by the then State Planning Commission for urban development of land with a high water table in the South Jandakot area (refer Figure 1). The land requires substantial drainage management to allow development and could impact on important wetlands.

Note: The proponent for the proposal is the Western Australian Planning Commission (WAPC), although the Water Corporation has assumed responsibility for drainage management and has acted as project manager for this assessment. Where reference is made to Water Authority of Western Australia (WAWA), the Water Corporation has now assumed the role that the Water Authority had in regards this proposal.

The key considerations in the 1987 assessment were the potential for impacts on the Jandakot groundwater mound and the chain of environmentally significant Beeliar wetlands, particularly Thomsons Lake which is a Ramsar-listed wetland primarily because of its international importance for waterbirds.

The proposal was found to be environmentally acceptable subject to a number of Environmental Conditions (refer Appendix 1). Environmental Conditions 1 & 2 required the preparation of a Drainage Management Plan to the satisfaction of the Minister for the Environment, with advice from the Environmental Protection Authority, the Water Authority of Western Australia and the Department of Conservation and Land Management (CALM). There was a high level of public interest in the proposal, and the Drainage Management Plan was to be available for public comment. On approval of the Drainage Management Plan, it was to be implemented progressively and adaptively in parallel with each subdivision stage, including monitoring, as required by Environmental Condition 3.

On behalf of the Western Australian Planning Commission, G B Hill and Partners prepared a Preliminary Drainage Management Plan for the South Jandakot Area (G B Hill and Partners Pty Ltd 1988). Following the receipt of public submissions and advice from other agencies and a Technical Advisory Group, (EPA 1989a) the Environmental Protection Authority recommended to the Minister for the Environment that the Drainage Management Plan did not meet the requirements of the Environmental Conditions (EPA, 1989b).

A revised Drainage Management Plan was submitted by the Water Authority in 1990 and the EPA considered that it was environmentally acceptable subject to a number of recommendations (EPA, 1990). One of these required the preparation of an Environmental Management Programme, which would clarify the commitments contained within the Drainage Management Plan, and how they would be implemented.

Following the submission of the Environmental Management Plan (WAWA, 1991a), the Minister for the Environment cleared Environmental Condition 2 which allowed land to be rezoned for urban purposes and the wetland areas to be reserved for Parks and Recreation as part of the Beeliar Regional Park.

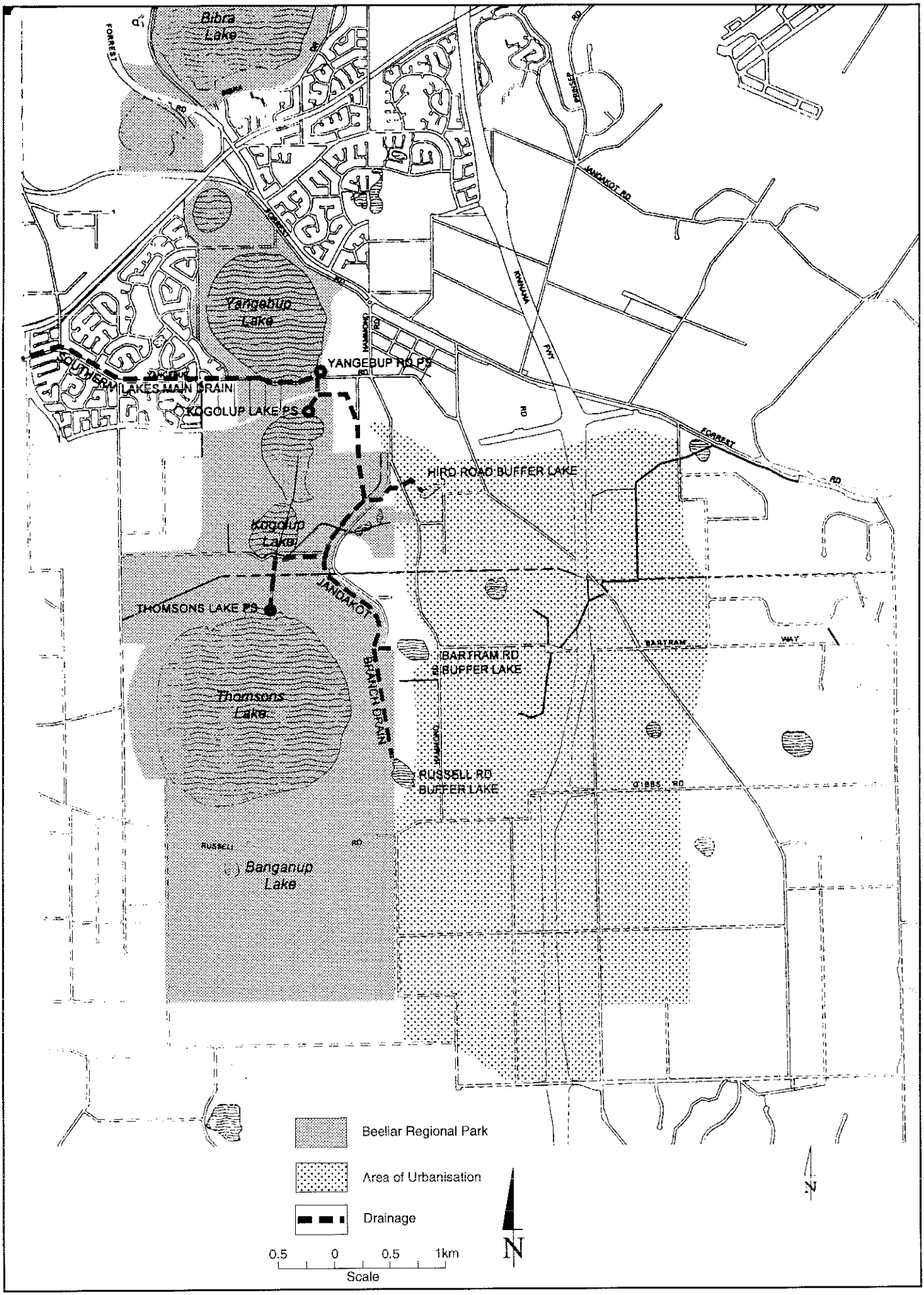

Figure 1. Location of area of urbanisation, South Jandakot Drainage Scheme and Beeliar Regional Park. (Source: Water Authority, November 1995)

A major component of the Drainage Management Plan is the South Jandakot Branch Drain (refer Figure 1), which is designed to divert the majority of drainage flow from the urban development past Thomsons and Kogolup Lakes into a main drain which may discharge into Cockburn Sound, although investigation of other disposal options is continuing. The Environmental Management Plan indicated that the South Jandakot Branch Drain would be constructed at the same time and in the same excavation as the Thomsons Lake Main Sewer. The co-location of the sewer and the branch drain would serve to reduce impacts on terrestrial vegetation within the Beeliar Regional Park, as well as represent significant cost savings to the Water Corporation due to a single excavation.

Construction of the branch drain was scheduled to be completed in 1996, year 4 of the drainage infrastructure programme. The proposed timing was based on the anticipated rate of urban development and construction of the Thomsons Lake Main Sewer. Due to the reduced rate of urban development the Thomsons Lake Main Sewer is now not expected to be required until at least May 1998, approximately 2 years later than predicted in the Environmental Management Programme. The Water Corporation, on behalf of Western Australian Planning Commission, has therefore requested approval for the deferral of construction of the Branch Drain such that it would be programmed for completion by May 1998, at the same time as the Main Sewer.

The Environmental Protection Authority determined that such a change to the Environmental Conditions is substantial and should be assessed under Section 46 of the *Environmental Protection Act* 1986.

1.3 Structure of this report

This document has been divided into 7 sections.

Section 1 describes the historical background to the proposal and its assessment, and describes the structure of this report. Section 2 briefly describes the proposal; more detail is provided in the Environmental Review Document (WAWA, 1995). Section 3 explains the method of assessment and provides a summary of submissions received. The topics raised throughout the process, including those raised in submissions, are reviewed to determine if further Environmental Protection Authority evaluation is required.

Section 4 includes the evaluation of the key environmental issues associated with the proposal. In each sub section, the objectives of the assessment and the policy and technical framework relating to that issue are defined. The likely effect of the proposal, the advice to the Environmental Protection Authority from submissions, and the proponent's response to submissions are discussed.

The adequacy of the proponent's response is considered in terms of achieving an acceptable outcome. The Environmental Protection Authority's evaluation with respect to the identified issues are contained in this section.

Section 5 summarises the conclusions and presents the Environmental Protection Authority's recommendations. Section 6 describes the recommended procedures. References cited in this report are provided in Section 7.

2. Summary description of proposal

The Water Corporation, on behalf of the Western Australian Planning Commission, proposes to defer construction of one component of the drainage scheme outlined in the South Jandakot Drainage Management Plan. The proposal is to defer the construction of the South Jandakot Branch Drain.

The Water Corporation has requested approval for the deferral of construction of the branch drain until at least May 1998 and possibly later depending on actual rates of urban development in the area (WAWA, 1995). The fact that the deferral was requested until at least May 1998

suggests that the Water Corporation may in the future seek deferral beyond May 1998 if the rates of urban development were not achieved and the Main Sewer was not scheduled for construction to commence in 1998. To avoid the scenario where a further Section 46 assessment by the Environmental Protection Authority is required, the Department of Environmental Protection, after consultation with the Water Corporation, considered it appropriate that the proposal be redefined to allow for deferral beyond 1998. The Environmental Protection Authority in this assessment is therefore considering the environmental acceptability of deferring the commencement of construction of the South Jandakot Branch Drain to no later than 31 December 1999, so that construction is completed no later than 31 May 2000.

3. Identification of environmental issues

3.1 Method of assessment

The purpose of the Section 46 amendment of Environmental Conditions is to determine whether the proposed change to Environmental Conditions is environmentally acceptable, or under what conditions it could be environmentally acceptable.

The process was initiated by the Minister for the Environment requesting the Environmental Protection Authority, under Section 46 of the *Environmental Protection Act* 1986, to report to him on the proposed change to the Environmental Condition.

The first step in the assessment method was the identification of the potential environmental issues requiring consideration. A list of topics (or possible issues) was identified by the Department of Environmental Protection, on behalf of the Environmental Protection Authority, through the preparation of guidelines. These guidelines were referred to the Water Authority, relevant agencies and interest groups for comment prior to being given to the proponent in a final form.

At this point in time the Department of Environmental Protection was of the understanding that the proposal included the construction of interim drainage management measures. The Water Authority had not, however, proposed these measures, and considered they should not be addressed within the environmental review document. Following the Department of Environmental Protection's agreement on this matter, the environmental review document was then submitted to the Department of Environmental Protection for review and revision to ensure that the agreed significant topics had been discussed in sufficient detail prior to its release for public and government agency comment. The Water Authority's environmental review document was available for public review for four weeks between 13 November 1995 and 11 December 1995, during which eight submissions were received.

Following completion of the public review period, the responses received were summarised by the Department of Environmental Protection. This process can raise additional environmental topics to be considered by the proponent.

The Water Corporation was invited to respond to matters raised in the summary of submissions. Appendix 3 contains the summary of the submissions and the proponent's response to those submissions. The list of submitters is included in Appendix 4.

By this stage in the assessment 15 topics had been identified, of varying environmental significance. The Environmental Protection Authority considered all the topics and identified those that were considered to be of environmental significance. These topics were considered to be issues that required further evaluation. The remaining topics did not require further evaluation principally because these topics were not influenced by the proposal or were outside the scope of this proposal, which is for the deferral of construction of the branch drain.

For each environmental issue, the environmental impacts of the proposal, were evaluated in the context of the Environmental Protection Authority's assessment objective and relevant policy and technical information. Where the proposed change to Environmental Conditions has

unacceptable environmental impacts, the Environmental Protection Authority can either advise the Minister for the Environment against the change proceeding or make recommendations to ensure the change is environmentally acceptable.

Limitation

This evaluation has been undertaken using information currently available. The information has been provided by the proponent in the environmental review document and supplementary documentation, by Department of Environmental Protection officers utilising their own expertise and reference material, by utilising expertise and information from other State government agencies, information provided by members of the public and contributions from Environmental Protection Authority members.

The Environmental Protection Authority recognises that further studies and research may affect the conclusions.

3.2 Public and agency submissions

Comments were sought on the proposal from the public, interest groups and local and State government agencies. During the public review period eight submissions were received. A summary of these submissions was forwarded to the Water Authority for their response (Appendix 3). Submissions received by the Environmental Protection Authority were within the following categories:

- 1 from members of the public;
- 4 from groups and organisations; and
- 3 from State and other government agencies.

The principal points of concern raised in the submissions included:

Biophysical Impacts

- Potential for impacts on waterbirds as a result of above average rainfall and elevated water levels within the wetlands;
- Impacts on important wetlands resulting from high water levels due to above average rainfall;
- Continued loss of wetland and associated fringing dryland vegetation;
- Impacts on terrestrial vegetation;
- Rehabilitation;

Pollution Potential

- Impacts on ecosystem resulting from decreased water quality;

Social surrounds

- Drainage within Thomsons Lake urban area;

Other

- Cost; and
- Alternative options.

The Environmental Protection Authority has considered the submissions received and the proponent's response as part of the proposal.

3.3 Review of topics

3.3.1 Identification of Issues

In total, fifteen topics were raised during the environmental impact assessment process including those topics identified in the guidelines for the environmental review document, subsequent consultations and the submissions described above. These topics are discussed below and those that require further evaluation by the Environmental Protection Authority are identified. Table 1 summarises this discussion.

Biophysical Impacts

- Impacts on waterbirds:

  An increase in water levels or a decrease in water quality in the wetlands could have implications for the wetlands as waterbird habitat. The impact on waterbirds is a key issue that will be addressed through the management of water levels and water quality. The discussion on these key issues (refer Section 4.2 and 4.3) is linked closely to the protection of waterbird habitat.

  This topic requires further evaluation by the Environmental Protection Authority (refer Section 4.2 and

  , Issue 1).

- Impacts on water levels:

  Deferral of construction of the branch drain will extend the period that drainage water from the area proposed for urban development flows into the regionally significant Beeliar wetlands for up to four years. This could result in increased water levels and impacts on wetland and associated fringing dryland vegetation, and is a key issue in the assessment of the proposal.

  This topic requires further evaluation by the Environmental Protection Authority (refer Section 4.1 and Table 4, Issue 2).

- Impacts on terrestrial vegetation;

  A number of submitters were concerned that important remnant bushland within the Beeliar Regional Park would be lost through construction of the Thomsons Lake main sewer (and the branch drain).

  The proposal and the Environmental Protection Authority's assessment is concerned only with the impacts which may result from the deferral of construction of the branch drain. The proposed location of the sewer is outside the scope of this assessment. The Environmental Protection Authority supports, in principle, the co-location of the branch drain and the main sewer, as it will reduce impacts on terrestrial vegetation.

  In addition, the Environmental Protection Authority considers the co-location of the sewer and branch drain represents an environmental benefit in terms of reducing impacts on the terrestrial vegetation in the Beeliar Regional Park. The building of the drain prior to the sewer would result in greater disturbance to terrestrial vegetation in the Beeliar Regional Park.

  This topic does not require further evaluation by the Environmental Protection Authority.

- Rehabilitation:

  Public submissions suggested that the restoration of the wetlands to their original water levels may result in *Typha orientalis* displacing *Baumea articulata* and that the Ramsar listing of Thomsons Lake requires the prevention of such displacement.

  The Water Corporation considers that if water levels remain within the current regime, there is unlikely to be any net change in the amount of *Typha orientalis*. It is only when water levels drop ie when the branch drain is fully constructed and operational, that *Typha orientalis* may dominate the lake bed. The Water Corporation believes that the deferral will

not have any effect on the growth of *Typha orientalis* as the process and the outcome will be the same whether the Branch Drain is in place in 1996, 1998, or later.

The proposal and the Environmental Protection Authority's assessment is concerned only with the impacts which may result from the deferral of construction of the branch drain. Given the advice from the Water Corporation, it appears the deferral will not have an impact on the displacement of *Baumea articulata*. This topic is, therefore, outside the scope of this assessment.

This topic does not require further evaluation by the Environmental Protection Authority.

- Dieback hygiene

The Environmental Protection Authority guidelines for the proposal identified dieback hygiene as a topic which should be addressed within the Environmental Review Document. At this time it was understood that the then Water Authority would be constructing interim drainage measures to prevent excessively high water levels. It has become clear, however, that the proposal does not include interim measures, but only deferral of construction of permanent drainage. If, interim measures are required at a later stage, dieback hygiene may need to be addressed.

On this basis, deferral of the drain is not expected to have implications for the management of dieback as no additional construction activities are proposed. The deferral of the drain to allow the co-location of the drain and sewer would serve to minimise the impacts on the terrestrial vegetation and minimise the risk of dieback spread.

In addition, any construction works within the Thomsons Lake A Class Reserve would be done under the supervision of the Department of Conservation and Land Management who manage the reserve on behalf of the National Parks and Nature Conservation Authority. It would be expected that the Department of Conservation and Land Management would have dieback hygiene requirements.

This topic does not require further evaluation by the Environmental Protection Authority.

- Interim drainage measures

This topic was raised as part of the guidelines. It was understood that the Water Corporation would need to construct temporary drainage measures, for example, a pump station and associated pipes and drainage works. The Water Corporation have advised that there are no plans for interim drainage measures.

This topic does not require further evaluation by the Environmental Protection Authority.

<u>Pollution Potential</u>

- Water quality

Deferral of construction of the branch drain will extend the period that drainage water from the catchment flows into the regionally significant Beeliar wetlands for up to four years. This could result in a decrease in water quality and is a key issue in the assessment of the proposal.

This topic requires further evaluation by the Environmental Protection Authority (refer Section 4.2 and Table 4, Issue 3).

- Noise

The Environmental Protection Authority guidelines for the proposal raised the topic of noise resulting from construction of interim pumping stations or from operation and decommissioning of the pumping stations. At this time it was understood that the then Water Authority would be constructing interim management measures to ensure the values of the wetlands are protected. It has become clear, however, that the proposal does not include interim measures, but only deferral of construction of permanent drainage. No greater noise impact is expected as a result of the proposed deferral. If, interim measures are required at a later stage, noise issues may need to be addressed.

This topic does not require further evaluation by the Environmental Protection Authority.

- Dust

  This topic was also raised in the guidelines in relation to dust emanating from the construction of any interim measures for the period if deferral. As the proposed deferral does not include interim measures, this topic is not relevant to this assessment. If interim measures are required at a later stage, dust issues may need to be addressed.

  This topic does not require further evaluation by the Environmental Protection Authority.

Social Surroundings

- Visual impacts

  The EPA guidelines raised this topic in relation to the construction of any interim measures for the period if deferral. As discussed above, the proposal does not include any interim measures. If interim measures are required at a later stage, visual amenity may need to be addressed.

  This topic does not require further evaluation by the Environmental Protection Authority.

Other

- Cost

  A public submission raised the point that the deferral will save the government money, but that the environment will bear the cost of high water levels and resultant impacts. The Environmental Protection Authority is not able to consider the cost of the proposal. The environmental aspects of the deferral will be assessed through the evaluation of issues in section 4.

  This topic does not require further evaluation by the Environmental Protection Authority.

- Drainage within the Thomsons Lake urban area

  Concern was raised regarding the possibility of localised drainage and flooding problems in the urban area. In their response to submissions the Water Corporation stated that the deferral will have no impact on the local drainage system serving the Thomsons Lake urban development. This matter would be best resolved between the Water Corporation and the City of Cockburn.

  This topic does not require further evaluation by the Environmental Protection Authority;

- Alternative options

  A public submission suggested that an alternative route for the main sewer and drain be investigated. This is outside the scope of this assessment.

  This topic does not require further evaluation by the Environmental Protection Authority.

Procedure

- Responsibility for drainage management

  The WAPC is the nominated proponent for the proposal although has no actual responsibilities in ongoing management of drainage.

  The drainage requirements for the South Jandakot Drainage Scheme are twofold:

  - local drainage to cater for surface runoff and to control groundwater levels in areas of shallow water table; and
  - main drainage to convey water from the catchment.

  The Water Corporation is responsible for main drainage, including the branch drain. The City of Cockburn is largely responsible for the local drainage. The WAPC imposes conditions on subdivision approvals requiring local drainage to be designed and constructed to the satisfaction of the Local Authority. Environmental Condition 3 (refer Appendix 1) states that if monitoring shows undesirable environmental impacts, further

stages of the proposal shall not proceed until changes to the Drainage Management Plan or the development proposal are made to the satisfaction of the Environmental Protection Authority. In the event of undesirable impacts it would, therefore, be the responsibility of the WAPC to not approve further subdivision in the area, until such time the Environmental Protection Authority considered environmental impacts could be mitigated.

The Water Corporation and the WAPC requested that the Minister for the Environment's statement of environmental conditions acknowledge the responsibilities of the agencies in the implementation of the proposal. This can be achieved through the development of procedures within the Minister's statement (refer Section 6, Recommended procedures, procedures 3 and 4).

This topic does not require further evaluation by the Environmental Protection Authority as it relates to procedures rather than environmental impacts.

- Future modifications to the Drainage Management Plan and Environmental Management Programme

  The Drainage Management Plan was required through Environmental Condition 1, and subsequently approved subject to the preparation of an Environmental Management Programme which addressed how the Drainage Management Plan would be implemented, and clarified the commitments made by the Water Authority.

  Environmental Condition 4 required the establishment of reporting mechanisms for monitoring of the Drainage Management Plan which included annual reports and triennial reports. To assist in this process, a Technical Review Committee was formed, which has an advisory role to involved agencies, including the Environmental Protection Authority.

  The Water Corporation has indicated that the Triennial Review and Report, as required by Environmental Condition 4, will assess the adequacy of the Drainage Management Plan and Environmental Management Programme in meeting environmental objectives for the Beeliar Wetlands. If necessary, changes to the Drainage Management Plan or Environmental Management Programme may be suggested. It is expected, that in addition, the water level and water quality criteria will be reviewed.

  Should WAPC or the Water Corporation propose modifying the Drainage Management Plan, the Environmental Management Programme or the criteria, the Environmental Protection Authority would advise the Minister on the significance of the change and of the need for environmental assessment. A substantial change may require Environmental Protection Authority assessment, public review and Ministerial approval.

  It is likely the Environmental Protection Authority will seek advice from the Technical Review Committee on the acceptability of any change, particularly in relation to the water level and water quality criteria.

  This topic does not require further evaluation by the Environmental Protection Authority.

3.3.2 Summary

Table 1 summarises the process used by the Environmental Protection Authority to evaluate the topics raised during the environmental impact assessment process. The table identifies the topics, the relevant proposal characteristics, and comments received from specialist government agencies and the public. If a topic is considered environmentally significant it becomes an issue and is further evaluated by the Environmental Protection Authority (as summarised in Table 4). Section 4 of this report provides the detail of this evaluation.

The issues identified in Table 1 as requiring further evaluation by the Environmental Protection Authority are:

- impacts on waterbirds;
- impacts on water levels; and
- impacts on water quality.

TOPIC	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY COMMENTS	PUBLIC COMMENTS	IDENTIFICATION OF ISSUES
Biophysical				
Waterbirds	Potential for increased wetland water levels may lead to loss of fringing habitat for waterbirds.	Ramsar-listing obliges manager of wetland to prevent stands of Baumea articulata being replaced by Typha orientalis.	It is not environmentally responsible to defer the drain and put important wetlands and the habitat they provide for waterbirds at risk.	EPA EVALUATION REQUIRED Refer table 4 (Issue 1)
Water levels	Potential for increased wetland water levels may lead to loss of fringing vegetation and habitat for birds and other fauna.	Deferral may result in water levels which can not be managed by pumping at the other lakes or through increased groundwater abstraction. Drainage Management Plan has failed to meet CALM's water level criteria for Thomsons Lake and deferral suggests this will continue until construction of branch drain. The greater depth of the Lake will not affect temperature enough to reduce the probability of algal blooms.	Suitable mitigation measures for impacts associated with high water levels at Thomsons Lake should be outlined. Deferral would place unacceptable risks on internationally important wetlands. Fringing vegetation around Kogolup will die if flooded for an extended period.	EPA EVALUATION REQUIRED Refer table 4 (Issue 2)
Terrestrial vegetation	Impacts of clearing vegetation required for infrastructure based on an assessment of the significance of the vegetation to be cleared.		Document does not address the impact of the gravity sewer on some of the best remaining bushland on the western side of Lake Yangebup.	Deferral of the drain does not involve the construction of interim drainage management measures and is therefore not expected to have impacts on terrestrial vegetation. The drain will be constructed in the same excavation as the main sewer, which represents an environmental benefit in terms of reducing impacts on terrestial vegetation. No further evaluation by EPA required.

Table 1. Identification of issues requiring Environmental Protection Authority evaluation

TOPIC	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY COMMENTS	PUBLIC COMMENTS	IDENTIFICATION OF ISSUES
Rehabilitation	Deferral of the drain is not expected to have an impact on the displacement of *Baumea articulata* by *Typha orientalis* as water levels are likely to be within CALM criteria.	In rehabilitation of the wetland the proponent should be aware that the Ramsar-listing requires prevention of stands of *Baumea articulata* being replaced by *Typha orientalis*.	Restoration of wetlands to original water levels may result in dispacement of *Baumea articulata*.	Deferral of the drain is not expected to have an impact on the displacement of *Baumea articulata* by *Typha orientalis* as water levels are likely to be within CALM criteria. In addition, rehabilitation is not the responsibility of WAPC or Water Corporation No further evaluation by EPA required..
Dieback hygiene	Construction and operation activities could encourage spread of dieback.	Identified as a topic in EPA guidelines when it was understood that interim drainage measures were to be constructed. Proposal does not, however, involve interim measures.		Deferral of the drain does not involve the construction of interim drainage management measures and is therefore not expected to have implications for the management of dieback. In addition, the drain will be constructed in the same excavation as the main sewer. No further evaluation by EPA required.
Interim drainage measures	Construction of temporary drainage measures could impact on the values of the Beeliar Regional Park.	Identified as a topic in EPA guidelines when it was understood that interim drainage measures were to be constructed. Proposal does not, however, involve interim measures.		Deferral of the drain does not involve the construction of interim drainage management measures. No further evaluation by EPA required.

Table 1. Identification of issues requiring Environmental Protection Authority evaluation (cont'd)

TOPIC	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY COMMENTS	PUBLIC COMMENTS	IDENTIFICATION OF ISSUES
Pollution				
Water quality	Deferral will extend the period drainage water from the catchment flows into the wetlands.	Continued high water levels in Thomsons Lake will contribute to the Lake's eutrophication problems. Nutrient mass balance should be carried out for the catchment and the wetlands, detailing nutrients entering the drainage system and the lakes for the current situation and that expected for the duration of the deferral.	Increase in nutrients entering wetland chain may cause enrichment, with devastating effects on waterbirds. Wetland ecosystems could be further degraded if we receive heavy rains next winter and if the buffer lakes are unable to contain the nutrient load. Contingency plans necessary to handle poor water quality in Thomsons Lake if it results from this deferment.	EPA EVALUATION REQUIRED Refer table 4 (Issue 3)
Noise	Noise could be generated from the construction and operation of the interim drainage measures.	Identified as a topic in EPA guidelines when it was understood that interim drainage measures were to be constructed. Proposal does not, however, involve interim measures.		Deferral of the drain does not involve the construction or operation of interim drainage management measures and is therefore not expected to have implications for the management of noise. No further evaluation by EPA required.
Dust	Dust could be generated during construction of interim drainage measures.	Identified as a topic in EPA guidelines when it was understood that interim drainage measures were to be constructed. Proposal does not, however, involve interim measures.		Deferral of the drain does not involve the construction of interim drainage management measures and is therefore not is not expected to have implications for the management of dust. No further evaluation by EPA required.

Table 1. Identification of issues requiring Environmental Protection Authority evaluation (cont'd)

TOPIC	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY COMMENTS	PUBLIC COMMENTS	IDENTIFICATION OF ISSUES
Social Surrounds				
Visual impacts of interim drainage measures	Visual impacts resulting from construction of interim drainage measures.	Identified as a topic in EPA guidelines when it was understood that interim drainage measures were to be constructed. Proposal does not, however, involve interim measures.		Deferral of the drain does not involve the construction of interim drainage management measures and is therefore not is not expected to impact on visual amenity. No further evaluation by EPA required..
Other				
Cost	Deferral will save the government money, but the environment will bear the cost of high water levels and resultant impacts.		It is more important to protect the Beeliar wetlands than it is to defer the drain and save money for the government. The cost of rehabilitation (if flooding) may be equivalent to the money saved by the Water Authority through the deferral.	This topic is not within the EPA's jurisdiction. No further evaluation by EPA required.
Drainage within Thomsons Lake urban area	Deferral could result in localised drainage and flooding problems in the urban area.	Above average winter rainfall combined with summer storm event prior to construction of the branch drain could result in localised drainage and flooding problems. This has not been addressed within proponent document.		Water Corporation has stated that the deferral will have no impact on the local drainage system serving the Thomsons Lake urban development. This matter is best resolved between Water Corporation and City of Cockburn. No further evaluation by EPA required.
Alternative Options	Route proposed not affected by the deferral.		Water Corporation should consider alternative route for the drain.	The scope of the Section 46 assessment does not address alterations to alignment, only deferral of construction. No further evaluation by EPA required.

Table 1. Identification of issues requiring Environmental Protection Authority evaluation (cont'd)

TOPIC	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY COMMENTS	PUBLIC COMMENTS	IDENTIFICATION OF ISSUES
Procedure				
Responsibility for drainage management	WAPC are proponent, but Water Corporation have been responsible for drainage management on their behalf.	WAPC and Water Corporation have requested that the Environmental Conditions acknowledge the responsibilities of the agencies in the implementation of the proposal.	No public comment as the matter was not raised in the proponent document or during public review.	The intent of the WAPC and the Water Corporation can be met though the addition of a procedure to the Environmental Conditions. No further evaluation by EPA required.
Future modifications to the Drainage Management Plan (DMP) and the Environmental Management Programme (EMP)	The DMP was required through Environmental Conditions, and subsequently approved subject to the preparation of an EMP which would address how it would be implemented. The Conditions set up reporting mechanisms for monitoring of the EMP, including detailed review of progress after 3 years (Triennial Review and Report, due this year).	Water Corporation have indicated that the Triennial Review and Report undertaken by them, on behalf of WAPC, will assess the adequacy of the EMP and DMP in meeting environmental objectives for the Beeliar Wetlands. If necessary, changes to the DMP or EMP may be suggested. These changes may include review of water level and water quality criteria.	No public comment as the matter was not raised in the proponent document or during public review.	Should WAPC or the Water Corporation propose modifying the DMP or EMP which could have a significant impact on the environment, the EPA would advise the Minister on the significance of the change and of the need for environmental assessment. A substantial change may require EPA assessment, public review and Ministerial approval. The EPA / DEP may seek advice from the Technical Review Committee on the acceptability of change, particularly in relation to the water level and water quality criteria. No further evaluation by EPA required.

Table 1. Identification of issues requiring Environmental Protection Authority evaluation (cont'd)

4. Evaluation of issues

4.1 Impacts on waterbirds

Objective

To maintain the ecological integrity of the Beeliar wetlands (in particular Thomsons, Yangebup and Kogolup Lakes) as a habitat for waterbirds.

Policy information

There are a number of policies, mechanisms and strategies relevant to the protection of the Beeliar wetlands. These include the System 6 Study, the Beeliar Regional Park: Proposals for Establishment, Administration and Use, and the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992. The vesting, land ownership and management in most of the area ensures long term protection of the park. The relevant policies are discussed below.

The Environmental Protection Authority's strategy on conservation relies largely on the Conservation Through Reserves study undertaken by the Conservation Through Reserves Committee, which has been endorsed by Government. This study divided the State into 12 regions or Systems and culminated in recommendations for the reservation of land for conservation and recreation purposes. System Six, or the Darling System, covers the highly populated areas in and around Perth and the South West of the State, and is the area subject to the most development pressure.

The System Six Report recommends the reservation of specific localities on the Coastal Plain and the Darling Range (Department of Conservation and Environment, 1983). The report recommended that the eastern chain of Cockburn Wetlands (North, Bibra, South, Little Rush, Yangebup, Kogolup, Thomsons, Banganup and Wattleup Lakes) be designated as Regional Park and that the Ministry for Planning consider reserving areas not already reserved for Parks and Recreation (Department of Conservation and Environment, 1983).

These recommendations were implemented through the reservation of land for Parks and Recreation as part of the Beeliar Regional Park. Much of the land within the park is State owned and managed. The then Department of Urban Development indicated that the conservation values of the wetlands predicate that a large proportion of the regional park should be managed by the Department of Conservation and Land Management, although suggested that a Regional Parks Authority would also be appropriate (DPUD, 1992).

Thomsons Lake is an "A" Class Nature Reserve and is vested in the National Parks and Nature Conservation Authority and managed by the Department of Conservation and Land Management. Thomsons Lake is jointly listed with Forestdale Lake under the Ramsar Convention, which recognises its international significance as waterbird habitat. These wetlands are the only wetlands which are Ramsar listed within the Perth metropolitan area. Thomsons Lake has been identified as a major migration stop-over and drought refuge area for waterbirds (Australian Nature Conservation Agency, 1993).

The Department of Conservation and Land Management's stated objective is to protect the ecological character of the lake and, in particular, its importance as a waterbird habitat (WAWA, 1991). The strategies listed to achieve the objectives are:

1. *Lake levels must remain linked to the natural course of events associated with the environmental attributes of the catchment. The main determinant of the process is that the link between lake levels and the natural rainfall patterns must be maintained.*
2. *Lake levels must reflect the natural seasonal patterns. That is highest in winter, dropping over summer and lowest, usually dry, in late summer or autumn. Water levels are not to be held at an artificial and constant level.*
3. *To minimise sudden rises in water levels due to artificial sources of water. If such rises are in conflict with either 1 or 2 above, the excess water shall be removed as soon as possible.*

4. *To prevent any increases in nutrient input into the lake and where possible, reduce nutrient input (WAWA, 1991).*

In addition, Thomsons, Kogolup and Yangebup Lakes are protected under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992, which prohibits activities which may cause the destruction and degradation of lakes. The policy considers the following activities can cause lakes to be degraded or destroyed:

- the filling in of lakes with materials;
- the carrying out of excavation or mining operations in lakes;
- the discharge or disposal of effluent into lakes; and
- the drainage of water into or out of lakes.

Thomsons Lake is also included on the Register of the National Estate.

Technical information

The technical information related the protection of waterbird habitat is largely the information on water level criteria and, to an extent, water quality criteria. These issue are covered within the assessment of impacts on water levels and water quality in sections 4.2 and 4.3 below.

Comments from key agencies / interest groups

Protection of waterbird habitat was considered an important point in the majority of submissions. It was generally felt that the wetlands, in particular Thomsons Lake, and the habitat they provide for waterbirds should not be put at risk of further degradation.

Response from the proponent

The Water Corporation considers that impacts on waterbirds would not be expected in below average or average rainfall years, but could occur in the event of above average rainfall. If above average rainfall was experienced, the Water Corporation suggested that, as waterbirds are opportunistic, they will use wetlands which meet their requirements at a particular time or season. If high water levels disadvantage any waterbird species it is likely the preferred habitat will be available at other wetlands such as Forrestdale Lake.

Environmental Protection Authority Evaluation

The protection of waterbird habitat will be addressed through the issues in sections 4.2 and 4.3 which are concerned with impacts on water levels and water quality. If the objectives for these issues are met, it is expected that there will be no significant impact on waterbirds.

4.2 Impacts on water levels

Objective

Ensure that water levels of the Beeliar wetlands (in particular Thomsons, Yangebup and Kogolup Lakes) reflect natural seasonal patterns so as not to compromise the integrity of the Beeliar Regional Park.

Policy information

Refer also to Section 4.1 for a description of relevant policies.

In its assessment of the Jandakot groundwater scheme stage 2, the Environmental Protection Authority discussed wetland criteria (EPA, 1991). In relation to water levels, it was stated that the objective was to ensure that the proposal does not result in the minimum and maximum values being exceeded and the optimum value being mimicked as closely as possible. The implicit assumption was 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.

Technical information

In 1989 the Environmental Protection Authority established a Technical Advisory Group to provide advice on the ability of the Drainage Management Plan to protect the Beeliar wetlands. The Technical Advisory Group report to the Environmental Protection Authority was released as a bulletin for public information (EPA, 1989a). The information contained in the report was reviewed by the Environmental Protection Authority in the process of reporting to the Minister for the Environment on the acceptability of the preliminary Drainage Management Plan.

The Technical Advisory Group report suggested permissible maximum water levels to protect the values of the Beeliar wetlands and ensure that no flooding occurs. The criteria for Thomsons Lake were prepared by the Department of Conservation and Land Management as the wetland is an A class nature reserve which is managed by the Department of Conservation and Land Management.

Water level criteria for Thomsons Lake

The Department of Conservation and Land Management has recommended water level criteria for Thomsons Lake which have served as interim criteria. The criteria were listed in Environmental Protection Authority Bulletin 371 (EPA, 1989a) and clarified in a letter to the then Water Authority in 1990 (WAWA, 1991).

Table 2. Water level criteria for Thomsons Lake, as prepared by CALM

	Winter/Spring Max.	Summer/ Autumn Min.	Visual Impact	% Frequency
wet years	>13.3	>11.8	Lake does not dry	10
medium years	12.8	11.3 - 11.8	Lake dries out between January and April	80
dry years	>12.3	10.8 - 11.3	Lake dry by January	10
never		<10.8		0

All water levels are in metres AHD (Source: WAWA, 1991b)

The criteria recognised three rainfall scenarios ie wet years, medium years and dry years, and predicted the frequency of each type of rainfall year occurring. For each scenario CALM suggested maximum water level criteria for winter / spring and minimum criteria for summer / autumn. The criteria state that in the wettest 10% of years, the maximum water level could be expected to exceed 13.3mAHD, and in the driest 10% of years could be expected to fall below 11.3mAHD. For 80% of years (medium years) maximum water level could be around 12.8mAHD and the minima would be between 11.3 and 11.8mAHD.

Water level criteria for the other wetlands - Kogolup and Yangebup Lakes

The wetlands for which criteria were developed by the Technical Advisory Group and are relevant to this assessment are Yangebup Lake and Kogolup Lake. The suggested interim maximum water levels for Yangebup and Kogolup Lakes are presented in Appendix 5, table 2.

To date, the Technical Advisory Group criteria have served as interim criteria, and although not formally endorsed by the Environmental Protection Authority, were subsequently utilised as environmental criteria in the Public Environmental Review for the Jandakot Groundwater Scheme Stage 2 (WAWA, 1991b).

It is expected that the Water Corporation's Triennial Review and Report will review the suitability of the criteria. Any amendment to the interim criteria will necessitate Environmental Protection Authority involvement and review. It is believed also that the Environmental

Protection Authority will seek the advice of the Technical Review Committee on the acceptability of the proposed changes.

Comments from key agencies / interest groups

The Department of Conservation and Land Management was concerned that the deferral may result in increased water levels in Thomsons Lake which can not be managed by pumping at the other lakes or through increased groundwater abstraction. It was recognised that such an occurrence is unlikely because it would require very wet seasons or a particularly bad summer storm event before the drain is constructed.

The Department of Conservation and Land Management highlighted the fact that the Drainage Management Plan has substantially failed to meet the water level criteria for Thomsons Lake, and concluded that the deferral suggests criteria will not be met until the branch drain is completed. If water levels continue to be high and the lake does not dry out for periods over summer the Department of Conservation and Land Management suggests that the Lake may experience further eutrophication. The environmental review document states that increased depth of Thomsons Lake will result in cooler water and will reduce the probability of algal blooms, but the Department of Conservation and Land Management considers that the greater depth of the lake will not affect temperature enough to reduce the probability of algal blooms. The issue of water quality is dealt with in Section 4.3.

The majority of submissions emphasised the high conservation value of the wetlands, in particular Thomsons and Kogolup Lakes, and recognised the potential for impacts upon these important areas. It was considered that the Beeliar wetlands should not be further degraded, and that if the deferral was to be approved, the Water Corporation should be required to prepare contingency plans to deal with high water levels and poor water quality.

A number of submitters were concerned about the condition of fringing vegetation around Kogolup Lake due to current high water levels. It was felt that continued high water levels will lead to loss of fringing vegetation if flooded for an extended period.

The City of Cockburn requested that the assessment consider the reduction of the maximum water level criterion for Yangebup Lake. The aim would be to improve water quality within the Lake by reducing water levels and thus increasing oxygenation of nutrient rich sediments in the lake.

Response from the proponent

The approach adopted within the environmental review document was to summarise the likely impacts from three broad scenarios: low, average and above average rainfall. It was under the above average rainfall scenario that adverse environmental impacts could be expected to occur.

In the event of above average rainfall it is expected that the pumping from Yangebup and Kogolup Lakes would assist in lowering water levels in these wetlands. Possible amelioration measures for Thomsons Lake include the operation of the Jandakot Groundwater Scheme Stage 2 wells to limit drainage from parts of the catchment, and the installation of a temporary pumping station at Thomsons Lake in the event of an extreme rainfall event or season causing a significant rise in the water level.

The Water Corporation provided a comprehensive response to the summary of submissions, which provided information additional to that contained within the environmental review document. The response included a table showing potential water levels in Thomsons Lake under various rainfall scenarios (refer Appendix 3). Extracts from this table, and CALM's suggested maximum water levels are shown below.

Table 3. Extract from Water Corporation response to submissions showing potential water levels in Thomsons Lake and CALM's water level criteria

	Potential water level in Thomsons Lake (mAHD)		Winter / spring maximum water level in mAHD
Rainfall scenario	Maximum 1996	Maximum 1997	(CALM criteria)
Average summer 95/96, above average winter 1996	12.8 - 13.3	12.8 -13.3	wet years - 13.3
Average 1996, above average winter 97	12.8 - 13.3	12.8 - 13.3	medium years - 12.8
Average 1996, 100 year ARI Feb/Mar 97	12.8 - 13.3	>13.3	dry years - 12.3

The Water Corporation stressed that lake levels will depend on the combination of factors including the amount, intensity and frequency of rainfall, the state of the aquifer at the time of rainfall, temperatures particularly over summer, the amount and pattern of groundwater abstraction from both private and public bores and other catchment characteristics. It was also considered that the reliability of the above predictions is dependent on the reliability of rainfall predictions.

Notwithstanding the above, the predictions made by the Water Corporation provide an indication of how future water levels could compare to the CALM criteria. The figures show that the combination of an average summer and an above average winter (ie wet year) could result in a water level in Thomsons Lake of between 12.8 and 13.3 mAHD. This would fall within the criteria recommended for maximum water levels (13.3 m AHD) for a wet year. Similarly, it can be seen from Table 3 that an average 1996 and an above average winter 1997 is predicted to be within the water level criteria.

The third scenario presented in Table 3 is comprised of an average rainfall year in 1996, and the occurrence of a 1 in 100 year summer rainfall event in 1997. It is predicted that in this situation the water level would be above 13.3 mAHD, and would exceed the water level criteria. It is, however, unlikely that another 1 in 100 year rainfall event would be experienced within the period of the deferral.

In response to the comments contained within the summary of submissions regarding the continued loss of fringing vegetation the Water Corporation stated that high water levels have been experienced in the area for some years and pre-date the Water Corporation's involvement in the South Jandakot Scheme. In order to ameliorate impacts on *Melaleuca* and *Eucalyptus* species fringing the wetlands the Water Corporation installed a pumping facility to pump water from Kogolup Lake during 1995. The aim of the pumping facility was to lower water levels in Kogolup Lake to a level that would not stress fringing vegetation. Monitoring of water levels in Kogolup Lake has shown that the pumping is already having an effect on water levels.

Elevated water levels could have a significant impact on wetland vegetation. This would have short term implications for some waterbird communities, but is a situation which has occurred in the past due to climatic conditions and it has been reversible.

Environmental Protection Authority Evaluation

The Environmental Protection Authority considers the co-location of the sewer and branch drain represents an environmental benefit in terms of reducing impacts on the terrestrial vegetation in the Beeliar Regional Park. The building of the drain prior to the sewer would result in greater disturbance to terrestrial vegetation in the Beeliar Regional Park.

The deferral also provides the Water Corporation with the opportunity to review the implementation and performance of the Drainage Management Plan to date and recommend any changes which could improve its operation. As part of the Triennial Review and Report (due in 1996) it is expected that the Water Corporation will review the water level (and water quality) criteria. Any amendments to the interim criteria will necessitate Environmental Protection Authority involvement and review following advice from the Technical Review Committee and the Department of Conservation and Land Management, where appropriate. At this time the Environmental Protection Authority would also consider a request by the City of Cockburn to reduce the water levels for Yangebup Lake.

An additional benefit of the deferral of construction of the branch drain would be the extension of time for the Water Corporation to consider the most appropriate method of ultimate disposal of the drainage water. The proposed, and approved, method of disposal is via a main drain into Cockburn Sound. The Water Corporation is aware that other disposal options may provide a net environmental benefit, and have commissioned a study to investigate a number of options in order to select an option which is both financially and environmentally acceptable. The outcomes of the study, which was committed to in the Drainage Management Plan, will be reported to the Department of Environmental Protection and the Environmental Protection Authority.

The Environmental Protection Authority is aware that the proposed deferral could result in increased water levels which could have significant impacts on the function of the Beeliar Wetlands. The Water Corporation informed the Department of Environmental Protection that the lake water levels will depend on a combination of factors including rainfall, the state of the aquifer at the time of rainfall, temperatures, amount and pattern of groundwater abstraction from bores, and other catchment characteristics. Given the number of variables, including rainfall, it is difficult to predict future water levels. The Environmental Protection Authority accepts, however, that it is possible that the wetlands will experience high water levels during the period of deferral. It should be noted that since 1993, water levels have generally decreased within Thomsons Lake (refer Figure 2). The Water Corporation consider this could be a function of the operation of the Jandakot Groundwater Scheme Stage 2.

The criteria for Thomsons Lake provide maximum water levels as well as predicted frequency of the three rainfall scenarios. The frequency, as stated by the Department of Conservation and Land Management is for 80% of years the maximum (winter / spring) water level would be around 12.8mAHD. It is, however difficult to calculate 80% of years when the proposed deferral is for between two and four years. For this reason the Environmental Protection Authority has adapted the frequency criteria such that exceedance can be easily determined. The amended table which shows winter spring maximum water levels for wet, medium and dry years is provided in Appendix 5, table 2.

The criteria for Yangebup and Kogolup Lakes do not differentiate between winter / spring and summer / autumn, and do not define frequency for meeting the criteria (refer Appendix 5, table 1).

In order to maintain the integrity of the wetlands and the habitat for waterbirds the Environmental Protection Authority concludes that the maximum water levels (Appendix 5) should not be exceeded for more than two consecutive years. In the event of exceedance of the interim criteria for one year, contingency plans to manage the water levels should be prepared. If the criteria are exceeded for a consecutive second year, the measures outlined in the plan should be implemented, or the branch drain should be constructed. It would be environmentally unacceptable for the criteria to be exceeded for three consecutive years.

4.3 Impacts on water quality

Objective

Ensure that the water quality of the Beeliar wetlands (in particular Thomsons, Yangebup and Kogolup Lakes) meets the interim criteria and does not compromise the integrity of the Beeliar Regional Park and its function as waterbird habitat.

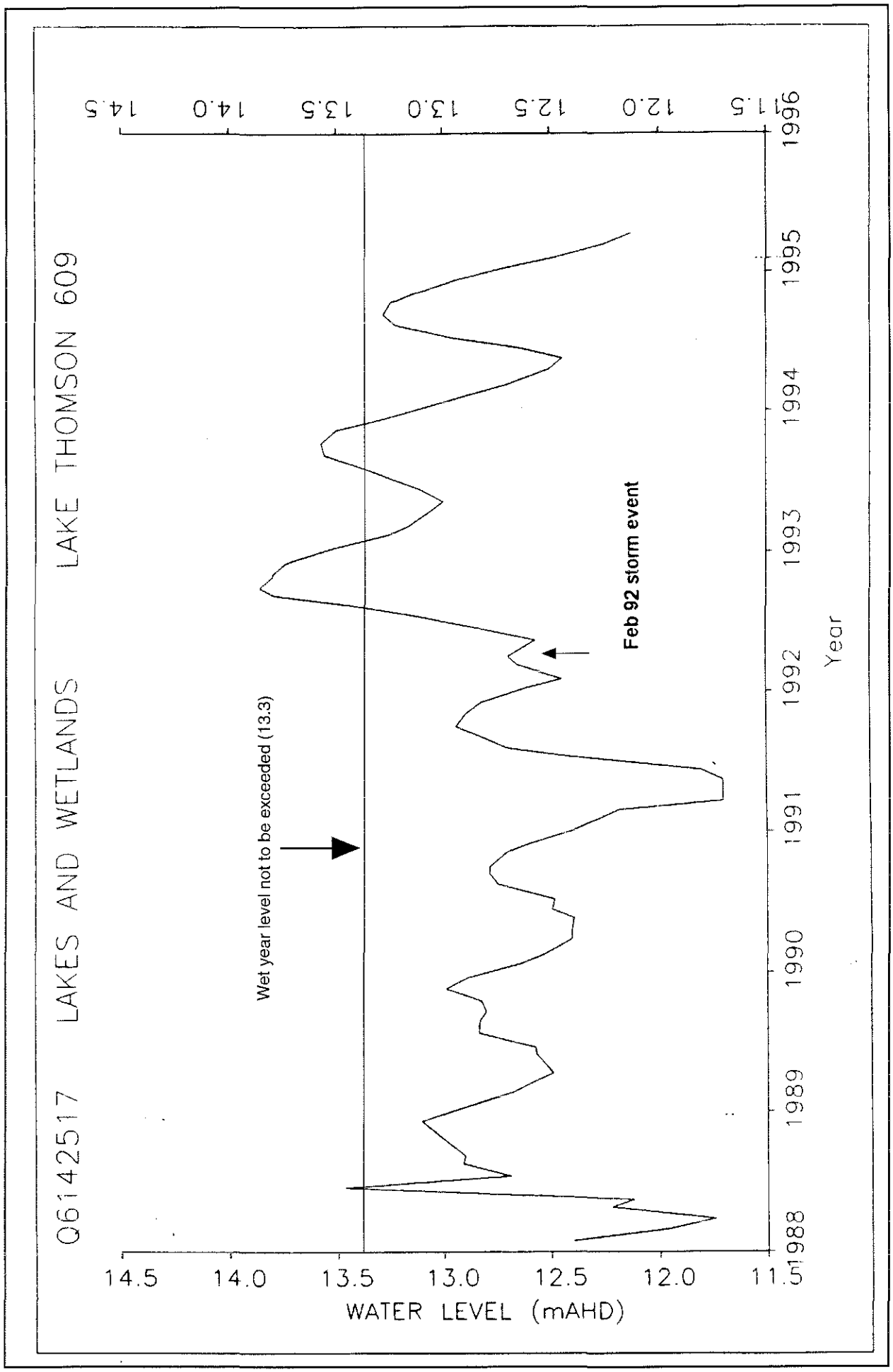

Figure 2. Hydrograph for Thomsons Lake (1988 - 1995). (Source: Water Authority, November 1995.)

Policy information

Refer also to Section 4.1 for a description of relevant policies.

The Environmental Protection Authority approach to water quality within the Beeliar Wetlands has been stated in previous bulletins published by the Environmental Protection Authority (EPA, 1987, 1989b and 1990), including the Technical Advisory Group report (EPA, 1989a) which is discussed below.

Technical information

Existing criteria

The Technical Advisory Group to the Environmental Protection Authority recommended that the Department of Conservation and Land Management's metropolitan water quality criteria be adopted for the Beeliar wetlands (EPA, 1989a). These criteria are shown in Appendix 5.

In addition, the Technical Advisory Group considered that the input of phosphorus to wetlands is a critical determinant of algal growth and water quality and, therefore, provided further detailed criteria for each wetland (Appendix 5).

The Technical Advisory Group believed the criteria should be adopted as interim criteria and that the management body proposed for the Beeliar Regional Park should give further consideration to water quality criteria (EPA, 1989a).

It is expected that the Water Corporation's Triennial Review and Report will review the water quality and water level criteria. This would necessitate Environmental Protection Authority involvement and review following advice from the Technical Review Committee.

Comments from key agencies / interest groups

The Department of Conservation and Land Management's submission suggested that water quality in Thomsons Lake is affected by the frequency of drying, as discussed in Section 4.2 above. The submission stated that research has found that the Lake will handle a given level of nutrient better if it dries over most summers and that without frequent drying water quality could deteriorate. It was also considered that the greater depth of the lake is not sufficient to lower temperature such that the probability of algal blooms is reduced.

Submissions also considered that a nutrient mass balance should be carried out for the catchment and the wetlands, detailing nutrients entering the drainage system and the lakes for the current situation and that expected for the duration of the deferral.

A number of submitters were concerned that wetland ecosystems could be further degraded if heavy rainfall was received next winter and buffer lakes were unable to contain the nutrient load. This could lead to nutrient enrichment of the wetlands which could have devastating effects on waterbirds.

To ameliorate poor water quality in Thomsons Lake, which may result from the deferral, a number of submissions considered the Water Corporation should be required to prepare contingency plans.

Response from the proponent

The then Water Authority has predicted that in below average rainfall conditions annual nutrient loads to Thomsons Lake are likely to be similar to 1992/1993 and 1993/1994 levels ie 290 kg phosphorus (WAWA, 1995). Modelling predicted that if average rainfall is experienced approximately 320 kg of total phosphorus would enter Thomsons Lake from surface drainage. This nutrient loading is within the limits suggested by the Technical Advisory Group as shown in Appendix 5, table 4. A higher nutrient load of up to 720 kg total phosphorus could be expected in the event of very high annual inflow ie above average rainfall (WAWA, 1995) and would most likely exceed limits recommended by the Technical Advisory Group.

Monitoring at Kogolup Lake has indicated that the surface drainage phosphorus load is relatively low and that water quality within the lake is generally better than at either Yangebup or Thomsons Lakes (WAWA, 1995). The Water Corporation considers that the high colouration of Kogolup Lake reduces the likelihood of algal blooms and considers that the potential for significant water quality changes in Kogolup Lake during the period of the deferral is low (WAWA, 1995). The Water Corporation predicted that the deferral of the Branch Drain will have no adverse impact on the water quality at Yangebup Lake.

The Water Corporation recognises there is some evidence to suggest that periodic drying of lake beds has the effect of improving water quality. Thomsons Lake was dry in April 1996 and with below average or average rainfall conditions it is likely that it will dry in subsequent years of the period of the deferral.

Notwithstanding the above, the Water Corporation considers that it is unlikely that significant water quality improvements would be experienced during the period of the deferral, given the catchment characteristics. The past rural land uses in the catchment have resulted in poor water quality within the catchment and an accumulated store of nutrients in the sediments in the lakes. Within the period of the deferral it is unlikely that the stored nutrients in the catchment and the lake sediments could be removed through natural processes, although some gradual reduction in the input of nutrients from areas previously used for rural purposes is expected. In the long term the Water Corporation considers that the diversion of drainage water from the Beeliar wetlands will result in water quality improvements in the wetland.

With regard to the need for a nutrient mass balance for the catchment and wetlands, the Water Corporation considered that this information is provided through the reporting of monitoring results in the environmental review document and the annual reports to the Environmental Protection Authority. The quantification of nutrients will also be addressed in the Triennial Report and Review to the Environmental Protection Authority which is due in 1996.

Water quality monitoring in the wetlands and the buffer lakes has shown a gradual improvement, presumably due to changes in land use ie from rural to urban. The Department of Environmental Protection considers, however that it should be noted that the long term impacts of urban development on water quality are unknown at this stage.

Environmental Protection Authority Evaluation

The Environmental Protection Authority evaluation of this issue is very closely linked to the evaluation of water levels. From the information provided throughout the assessment it appears that for the short to medium term nutrient loads into the lakes will be primarily determined by the amount of run off from the catchment. The change in land use from rural to urban, combined with the operation of the buffer lakes, is expected to result in gradual reduction in the input of nutrients, although for the period of the deferral this would not be significant. It is expected that for the period of the deferral up to 10% of the catchment will be urbanised.

The Water Corporation predicted that in the event of dry and medium rainfall years, total phosphorus entering Thomsons Lake will be within Technical Advisory Group criteria. In the event of a high rainfall year, nutrient loadings into the lakes could exceed limits suggested by the Technical Advisory Group, and it is likely that water levels would also exceed the water level criteria.

Given the relationship between water quality and water levels the Environmental Protection Authority considers that a similar approach be taken in the evaluation of these issues.

The Environmental Protection Authority, therefore, concludes that the interim water quality criteria should not be exceeded for more than two consecutive years. In the event of exceedance of the interim criteria for one year, contingency plans to manage water quality should be prepared. If the criteria are exceeded for a consecutive second year, the measures outlined in the plan should be implemented, or the branch drain should be constructed. It would be environmentally unacceptable for the criteria to be exceeded for three consecutive years.

ISSUES	OBJECTIVE	EVALUATION FRAMEWORK	PROPONENT'S RESPONSE	EPA EVALUATION	EPA RECOMMENDATION
Biophysical					
1 Waterbirds	To maintain the ecological integrity of the Beeliar wetlands (in particular Thomsons, Yangebup and Kogolup Lakes) as a habitat for waterbirds.	Beeliar wetlands are subject to System 6 recommendation, are within Beeliar Regional park, and are protected under the Swan Coastal Plain Lakes EPP. Thomsons Lake is Ramsar-listed and on Register of the National Estate.	Impacts on waterbirds could occur if above average rainfall, in which case they may seek habitat at other wetlands such as Forrestdale Lake.	It is expected that the control of water levels and water quality within the wetlands will maintain the ecological integrity of the wetlands as waterbird habitat.	This issue is addressed by recommendations for issues 2 and 3. NO NEED FOR EPA RECOMMENDATION.
2 Water Levels	Ensure that water levels of the Beeliar wetlands reflect natural seasonal patterns so as not to compromise the integrity of the Beeliar Regional Park (and its function as waterbird habitat).	CALM recommended water level criteria which have consistently been referred to as interim criteria (refer attachment 4). The criteria will be reviewed as part of the triennial report by the Water Corporation.	Three rainfall scenarios - low, average and above average years. Impacts could be expected in event of above average rainfall. Pumping from Yangebup and Kogolup would assist in lowering water levels in these wetlands. Installation of pumping facility at Kogolup Lake has resulted in a lowering of water levels within the wetland. If a significant rise in water level at Thomsons Lake, possible amelioration measures are adapting the operation of the Jandakot Groundwater Scheme Stage 2 wells, and installation of temporary pumping station to pump water from Thomsons Lake.	Deferral provides Water Corporation with opportunity to review the DMP and recommend any changes. Also, provides opportunity to consider most appropriate method of ultimate disposal of the drainage water. Water levels generally decreasing since 1993 which could be a function of the operation of the Jandakot Groundwater Scheme Stage 2. Pumping from Kogolup and Yangebup assist in alleviating high water levels in these wetlands. CALM criteria for Thomsons Lake specify desired frequency for meeting stated water levels. EPA considered the frequency should be adapted for the deferral (refer Appendix 5). EPA concludes that it would be environmentally unacceptable for water level criteria to be exceeded for three consecutive years.	The proposed deferral of commencement of construction of the South Jandakot Branch Drain up to the 31 December 1999 with construction being completed by 31 May 2000 can be managed to meet the EPA's objectives subject to the successful implementation of the EPA's recommendations. If during the period of the deferral, the maximum water level and / or water quality criteria (specified in the interim criteria) are exceeded for one year, the Water Corporation should prepare a contingency plan to mitigate the consequential environmental impacts to the requirements of the Minister on advice of the EPA. If during the period of the deferral, the water level or water quality criteria are exceeded for a consecutive year, then the measures outlined in the contingency plan should be implemented or the branch drain should be constructed.

Table 4. Summary of issues and Environmental Protection Authority recommendations

ISSUES	OBJECTIVE	EVALUATION FRAMEWORK	PROPONENT'S RESPONSE	EPA EVALUATION	EPA RECOMMENDATION
Pollution					
3 Water Quality	Ensure water quality of the Beeliar wetlands meets the interim criteria and does not compromise the integrity of the Beeliar Regional Park (and its function as waterbird habitat).	Interim criteria referred to by Technical Advisory Group, includes CALM's criteria for metropolitan water quality. Triennial Review and Report undertaken by Water Corporation will review criteria.	Nutrient loads determined primarily by amount of runoff from catchment. Potential for significant water quality changes in Kogolup Lake during period of deferral is low. Impacts on water quality at Yangebup Lake not expected. If average or below average rainfall, nutrient loadings into Thomsons Lake expected to be within criteria. If very high annual rainfall it is likely nutrient load could exceed criteria. Monitoring has shown water quality in wetlands and buffer lakes gradually improving presumably due to change in land use.	Change in land use will lead to gradual improvements in water quality in the short term (as monitoring to date has shown). Given the relationship between water quality and water levels the EPA considers a similar approach be taken in the evaluation of these issues. EPA therefore concludes that it would be environmentally unacceptable for water quality criteria to be exceeded for three consecutive years.	The proposed deferral of commencement of construction of the South Jandakot Branch Drain up to the 31 December 1999 with construction being completed by 31 May 2000 can be managed to meet the EPA's objectives subject to the successful implementation of the EPA's recommendations. If during the period of the deferral, the maximum water level and / or water quality criteria (specified in the interim criteria) are exceeded for one year, the Water Corporation should prepare a contingency plan to mitigate the consequential environmental impacts to the requirements of the Minister on advice of the EPA. If during the period of the deferral, the water level or water quality criteria are exceeded for a consecutive year, then the measures outlined in the contingency plan should be implemented or the branch drain should be constructed.

Table 4. Summary of issues and Environmental Protection Authority recommendations (cont'd)

5. Conclusions and recommendations

Following review of the Water Corporation environmental review document, the issues raised in the public submissions, advice received from government departments and relevant literature the Environmental Protection Authority concludes that the proposed deferral of construction of the South Jandakot Branch Drain by the Water Corporation can be managed to meet the Environmental Protection Authority's objectives.

The Environmental Protection Authority is satisfied that, using information currently available, the following recommendations may be made to the Minister for the Environment.

Recommendation 1

The Environmental Protection Authority recommends that the proposed deferral of commencement of construction of the South Jandakot Branch Drain up to the 31 December 1999 with construction being completed by 31 May 2000 can be managed to meet the Environmental Protection Authority's objectives subject to the successful implementation of the Environmental Protection Authority's recommendations contained in this report.

Recommendation 2

If during the period of the deferral the maximum water level criteria and / or water quality criteria are exceeded for one year, the Water Corporation should prepare a contingency plan to mitigate the consequential environmental impacts to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

If during the period of the deferral, the water level or water quality criteria are exceeded for a consecutive year, then the measures outlined in the contingency plan should be implemented, or the branch drain should be constructed.

Recommendation 3

That, if the Minister for the Environment approves the implementation of this proposal then the proposal be subject to the recommended procedures set out in Section 6 of this report.

6. Recommended procedures

1 Unless otherwise specified, the Department of Environmental Protection is responsible for assessing compliance with the conditions and procedures contained in this statement and for issuing formal clearance of conditions and procedures.

2 Where compliance with any condition or procedure is in dispute, the matter will be determined by the Minister for the Environment.

South Jandakot Branch Drain

The South Jandakot Branch Drain is a major component of the Drainage Management Plan (refer condition 1, Minister's statement published on 27 October 1988, copy at Appendix 1), but its construction may be deferred, depending on maintenance of water levels and / or water quality.

3 The Western Australian Planning Commission, through the subdivision process, and the City of Cockburn will ensure that the provision of local drainage is consistent with the Drainage Management Plan and the Environmental Management Programme for the South Jandakot Drainage Scheme (Water Authority of Western Australia, January 1991).

4 The Water Corporation will be responsible for and construct main drainage (as outlined in the Drainage Management Plan and the Environmental Management Programme) and will report on implementation of the Drainage Management Plan.

5 The Water Corporation, subject to continued monitoring of water levels and quality as specified in the Drainage Management Plan and the Environmental Management Programme, and unless constructing the South Jandakot Branch Drain as a consequence of procedure 8, may defer commencement of construction of the South Jandakot Branch Drain until 31 December 1999, but should complete construction by 31 May 2000.

6 If during the period of deferral (see procedure 5), the water level and / or water quality requirements are not achieved for one year, then the Water Corporation will prepare a contingency plan to mitigate the consequential environmental impacts, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

7 The water level and water quality requirements will be reviewed through the Water Corporation's Triennial Review and Report and may be amended from time to time, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority. [A copy of the interim (as at June 1996) requirements is at Attachment A - see Appendix 5.]

8 If during the period of deferral (see procedure 5), the water level or water quality requirements are not achieved for two consecutive years, then the Water Corporation will either implement the measures outlined in the contingency plan referred to in procedure 6, to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection; or will construct the South Jandakot Branch Drain.

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Appendix 1

Environmental conditions,
Statement 45, published 27 October 1988

Ass # 103

Bull # 277

State # 045

MINISTER FOR ENVIRONMENT

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

THOMSONS LAKE URBAN STRUCTURE STUDY AND SOUTH JANDAKOT DEVELOPMENT WATER RESERVES MANAGEMENT PLAN

STATE PLANNING COMMISSION
(as proponent for the rezoning under the Metropolitan Regional Scheme)

The proposed urban zoning and Parks and Recreation reservation as generally contained in the Thomson Lake Urban Structure Study Option 1 (Map 10) may be implemented, subject to the following conditions:

1. Prior to the initiation of rezoning and reservation proposals, the proponent shall outline, to the satisfaction of the Minister for Environment a proposal for a drainage management plan for the South Jandakot area, which shall establish a package of mechanisms (including monitoring) to control water levels:

   (1) In the proposed urban areas, which is acceptable to the Water Authority of Western Australia.

   (2) In the Thomson Lake open space area and other wetlands within the proposed Beeliar Regional Park, which is acceptable to the Environmental Protection Authority, Department of Conservation and Land Management and the Water Authority of Western Australia;

   this outline of the proposal shall be made available to the public by the proponent, prior to the rezoning being advertised.

...2/

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27 OCT 1988

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2. Finalisation of the proposed rezoning and reservation shall not occur, until the drainage management plan referred to in condition 1 has been prepared to the satisfaction of the Environmental Protection Authority, Water Authority of Western Australia and the Department of Conservation and Land Management.

3. Once the drainage management plan has been prepared and approved, it shall be progressively and adaptively implemented in parallel with each subdivision stage, including monitoring of the effects of each stage of the drainage management plan. This condition is intended to only require that part of the drainage management plan to be implemented which relates to the portion of land to be subdivided and not for the whole drainage plan to be constructed at once.

   Where the Environmental Protection Authority believes that monitoring shows undesirable environmental impacts are occurring, further stages of the proposal shall not proceed, until changes to the drainage management plan, or development proposal are made to the satisfaction of the Environmental Protection Authority.

4. Prior to subdivisional approval being granted, reporting mechanisms (to the satisfaction of the Environmental Protection Authority, Department of Conservation and Land Management and the Water Authority of Western Australia) for monitoring of the drainage management plan shall be established. These should provide for reporting on the progress of the development, the functioning of the drainage plan and the impact on the wetland eco-systems. The reporting shall be as follows:

   . annual reports

   . detailed review of progress after three years, with decisions to be taken at that time on whether or not and under what conditions further subdivision can proceed.

   These reports shall be submitted by the proponent (or any other agency which has accepted this responsibility) for review to:

   . Department of Conservation and Land Management

   . Water Authority of Western Australia

   . Environmental Protection Authority, and

   with advice from these agencies forming the basis for adjustment or continuation of the drainage management plan.

5. (1) Prior to the finalisation of urban rezoning amendments, the proponent shall provide commitments to the satisfaction of the Minister for Environment, for the reduction in hydrogen sulphide levels associated with the Water Treatment Plant of the Water Authority of Western Australia, to levels acceptable to the Environmental Protection Authority.

...3/

5. (2) Prior to subdivisional approvals being granted, the level of hydrogen sulphide emitted by the Water Treatment plant must be reduced to a level acceptable to the Environmental Protection Authority.

6. A buffer area, to the satisfaction of the Environmental Protection Authority (within which residential development shall not occur) shall be established around the existing Water Authority of Western Australia water treatment plant.

   This buffer is required to ensure that:

   . no residential development occurs within the one in one million risk contour associated with chlorine use and storage at the plant;

   . no residential development occurs in areas where levels of hydrogen sulphide associated with the plant are unacceptable to the Environmental Protection Authority for residential uses.

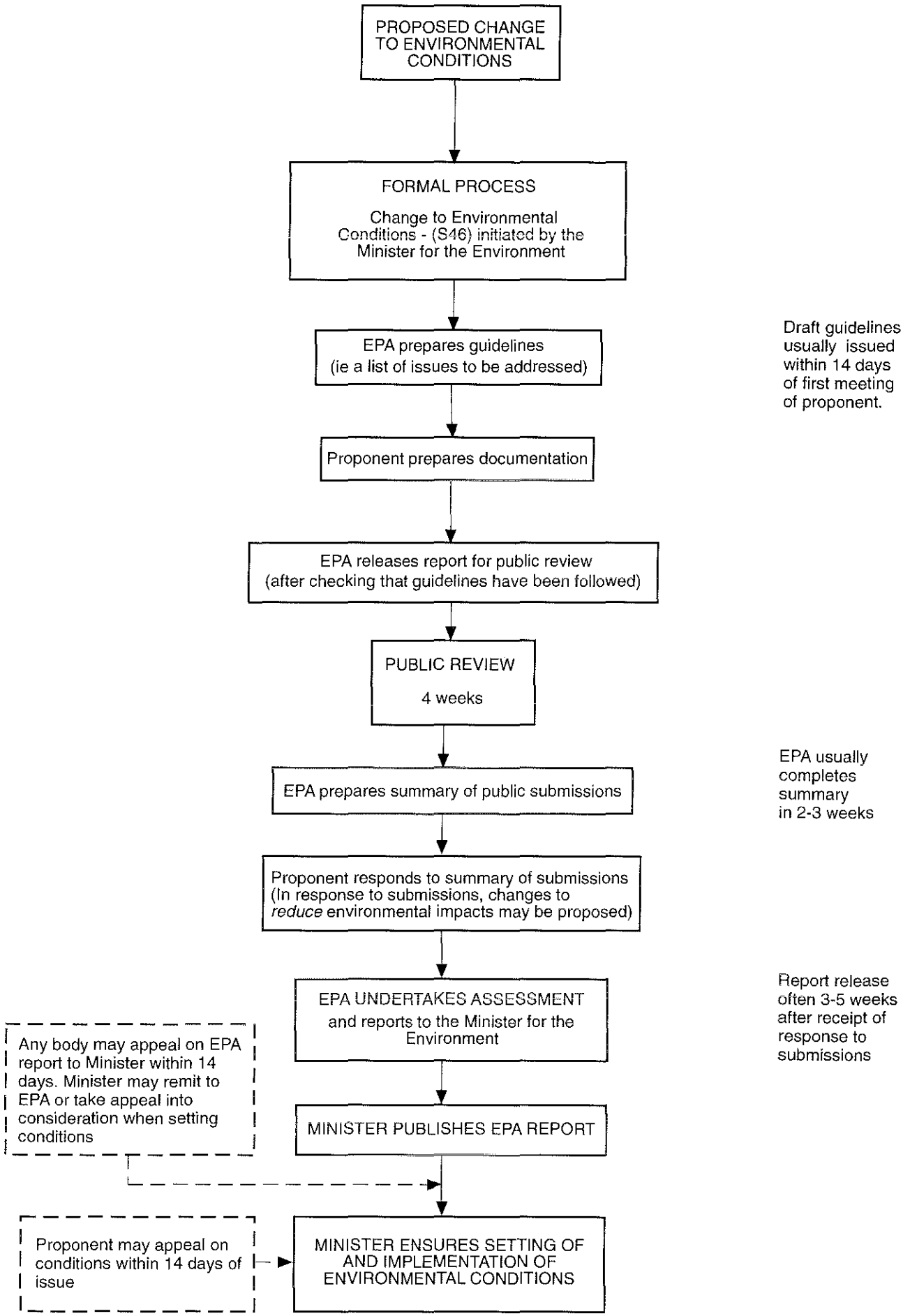
7. Monitoring of groundwater quality shall be undertaken within the groundwater control area by the Water Authority of Western Australia. If undesirable levels of pollution are detected the Environmental Protection Authority may impose conditions on future development in the area. If necessary, controls shall be imposed by the Water Authority of Western Australia on land use practices within the existing urban area.

Barry Hodge, MLA
MINISTER FOR ENVIRONMENT

Appendix 2

Environmental Impact Assessment flow chart

SECTION 46 CHANGE TO ENVIRONMENTAL CONDITIONS PROCESS FLOW CHART



Appendix 3

Summary of submissions and proponent's response

BIOPHYSICAL

Impacts resulting high water levels due to above average rainfall

The document acknowledges the potential for increased wetland water levels in the event of above average rainfall. No quantification is given. It would be useful for the Water Authority to provide more information regarding 'water volume balance' for the catchment, including likely volumes of water as runoff, storage capacity of buffer lakes and additional volumes entering the wetlands. It should be indicated how this will translate into changes in water levels in the wetlands. These calculations should be done for a range of rainfall scenarios ie average and above average. It should also take into account groundwater discharge from the Hird Road buffer lake.

Suitable mitigation measures for impacts associated with high water levels at Thomsons Lake are not detailed. The Water Authority should outline the amelioration measures that could be undertaken in the event of excessively high water levels within the wetlands.

Contingency Plans should be submitted in writing before this proposal is approved.

The deferral of the construction of the branch drain beyond 1998 and the possibility of increased water levels for an extended period would place unacceptable risks on the internationally important wetlands.

Continued loss of fringing vegetation

Thomsons Lake and Lake Kogolup are important conservation reserves that have already been damaged due to runoff from nearby urban development. In particular, some fringing vegetation around Kogolup Lake has been killed. If the fringing vegetation is flooded for an extended period as a result of the deferment of the drainage scheme, it will probably die.

Potential for impacts on waterbirds as a result of above average rainfall

Thomsons Lake is a Ramsar listed site and should be managed accordingly. It is not environmentally responsible to defer the drain and put these important wetlands and the habitat they provide for waterbirds at risk.

Rehabilitation

The Section 46 report states that the restoration of the wetlands to their original water levels will probably lead to *Typha orientalis* becoming the dominant species with the possible complete displacement of *Baumea articulata* over time, possibly within two drying periods. WAWA should be cognisant of the obligation to meet the ecological character of the Ramsar-listed wetland, in particular the need to prevent stands of *Baumea articulata* being replaced by Typha orientalis (refer also CALM submission, point 8).

POLLUTION

Impacts resulting from decreased water quality

Whilst acknowledging the uncertainty of the future effectiveness of the buffer lakes, it is important that a nutrient mass balance be carried out for the catchment and the wetlands. This should detail nutrients entering the drainage system and the lakes for the current situation and that expected for the duration of the deferral.

Impacts resulting from decreased water quality (continued...)

An increase in nutrients entering the wetland chain may cause enrichment of these wetlands and bring with it ecological imbalances, leading to increases in nuisance insects, botulism and algal blooms. There has not been a large botulism outbreak at Thomsons Lake since 1984, but if the nutrient load is increased, another outbreak could occur with devastating effects on waterbirds.

The wetland ecosystems could be further degraded if we receive heavy rains next winter and if the Bartram Road buffer lakes are unable to contain the nutrient load.

Thomsons Lake is a wetland of international importance and it must not be degraded just to save 3 million dollars for wealthy developers. Contingency Plans must be put in place to handle poor water quality in Thomsons Lake if it results from this deferment. These plans should be submitted in writing before this proposal is approved.

SOCIAL SURROUNDS

Cost

The eastern chain of the Beeliar wetlands: Thomsons Lake, Kogolup Lake and Yangebup Lake are recognised as having significant conservation value, and Thomsons Lake is recognised internationally for its importance for waterbird habitat. It is more important to protect these wetlands than it is to defer the drain and save money for the Government. The cost of rehabilitating the area if it floods may be equivalent to the money saved by the Water Authority through the deferral.

Drainage within Thomsons Lake urban area

The report does not address the impact of the deferral on the functioning of urban drainage serving the developed Thomsons Lake area. Should above average winter rainfall be experienced following a summer storm event (such as that of Feb 92), prior to the installation of the branch drain, it is possible localised drainage and flooding problems could be experienced in the Thomsons Lake urban area.

OTHER

Alternative options

The Water Authority should consider an alternative proposal: Creating an open drain from the south east corner of Thomsons Lake via Russell Rd Buffer Lake then south through UWA's Harry Waring Reserve (parallel to east fence) then east at Gaebler Rd to Banjup Lake which is connected to the drainage system of the Peel-Harvey catchment area of which the main drain runs through the Spectacles wetland, and Bollard Bullrush Swamp to Peel Harvey Estuary Inlet (total distance approx 5.5 km). This proposal is only viable if level at Thomsons Lake is higher than at Banjup Lake.

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Our Ref: SR: 17/03
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The Chairman
Environmental Protection Authority
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PERTH WA 6000

Attention: K Sanders

PROPOSED DEFERRAL OF CONSTRUCTION OF SOUTH JANDAKOT BRANCH DRAIN

This Department is concerned that the proposed deferral of construction of the South Jandakot Branch Drain may result in water levels which can not be managed by pumping at the other lakes or through increased groundwater abstraction. This is likely to occur if we receive very wet seasons or a particularly bad summer storm event before the drain is constructed.

It is recognised that this is unlikely to happen. Nevertheless, should it occur then it is unlikely we can do anything about the impact on birds using the site at the time but it would probably also increase the spread of *Typha*. WAWA should be required to fund control works in that eventuality.

Additionally CALM has the following comments to make on the detail in the proposal document. Comments based on information not provided in the document are in italics.

1. p.2, line 3: The reduction in volume of drainage water flowing into the key wetlands is principally a result of extraction from the Jandakot Groundwater Scheme Stage 2, rather than reflecting a reduction in surface flow because of urban development. *Furthermore, pumping from Bibra, Yangebup and Kogolup (which are north of Thomsons and at higher elevation) has reduced the amount of groundwater moving into Thomsons Lake.* If the borefield needs to be closed down for any reason, drainage flow will increase and water levels in wetlands may be affected. It is stated (p.23, para.4, lines 3-6) that the elevated levels in Kogolup Lake are largely the result of urban development.

2. p.11, Table 1: The rainfall figures suppled here are misleading, although the footnote does recognise this. The annual yield should not be related to rainfall because the figures for Perth Airport can be very different from local rainfall; the effect of changing land use etc. may be masked by using rainfall figures from inappropriate stations. Common sense suggests that Stage 2 of the Groundwater Scheme is having a significant effect on yield.

3. p.16 "Nutrient concentrations", lines 2-4: Bulking samples into weekly composite samples may reduce the apparent load by dissociating high peak-flow concentrations and volumes. Is this likely to have caused significant under-estimation?

4. p.17 para.2, lines 7-12: The method of measuring retention times is strongly biased towards producing a favourable result. It ignores the possibility of short-cutting. No convincing evidence is presented that the EMP criteria are being met.

093304 INFO

5. p.17 para.3, lines 4-5; Why do urbanised catchments have a greater proportion of particulate phosphorus?

6. p.19 and subsequently: Hird Road Buffer Lake is a ground water discharge point, so that volumes and nutrient load of the outflow exceed those of the inflow. While it is possible that the Lake does take up some nutrients, surely a buffer lake should discharge lower volumes than it receives. What is being done in the long term to rectify the situation? What guarantee is there that converting high nutrient groundwater to surface flow and discharging it into Kogolup Lake does not increase nutrient loads in the Beeliar wetlands? No figures are presented on nutrient concentrations of groundwater currently entering the Beeliar Lakes. It is recognised that the swamp at Hird Road has been discharging groundwater to Kogolup Lake via the City of Cockburn drain for a long time, so that deferral of construction of the Branch Drain merely prolongs an existing situation. The problem would be solved, however, by construction of the Branch Drain and continued discharge is a cost of deferral. Similar comments apply to the pesticide data. It appears that Hird Road Buffer Lake adds pesticides to the Beeliar lakes, although the sparse data presented show that Hird Road may be accumulating some pesticide as well.

7. p.25 "water levels" and Fig.7: Given the paucity of data in the early years, the data points should not be connected until regular monitoring began in 1971. It is worth pointing out that 1955 was a very wet year but, without more information about drainage, it is difficult to compare water levels in Thomsons Lake across years.

8. p.26, Table 18: To date the DMP has failed to meet CALM's water level criteria for Thomsons Lake and the application for deferral suggests this will continue to be the case until the South Jandakot Branch Drain and a pump station are in place *although 1995 data show that the criteria are being met this year. Despite meeting the criteria this year, insufficient attention is being paid to the obligation to meet the ecological character of this Ramsar-listed wetland, in particular the need to prevent stands of Baumea articulata being replaced by Typha orientalis (see p.27).*

9. p.29-30 "Water Quality": Water quality in Thomsons Lake is affected by the frequency of drying and Davis *et.al.* (1993) found that the Lake will handle a given level of nutrient better if it dries briefly over most summers. This was the reason CALM's water level criteria were based on frequent drying. The water quality problems experienced in Thomsons Lake in recent years, and referred to in the Deferral Application and Balla and Davis (1993), are caused by the Lake not drying over summer. Continued high water levels in Thomsons Lake will contribute to the Lake's eutrophication problems.

10. p.30, para.3, lines 9-11: The greater depth of the Lake will not affect temperature enough to reduce the probability of algal blooms.

11. p.36, para.3, lines 5-9: When did the EMP require the first waterbird survey? Monitoring should have been implemented by now.

Syd Shea
EXECUTIVE DIRECTOR

21 December 1995

KMCN:RM LETTERS\DRAIN

RESPONSE BY THE WATER CORPORATION TO SUMMARY OF SUBMISSIONS

NB The proposal to defer construction of the South Jandakot Branch Drain was referred to the EPA by the Water Authority. From the 1 January 1996, the Water Corporation and the Water and Rivers Commission assumed the responsibilities of the former Authority. In the following response, reference to the Water Corporation can also be taken to refer to the Water Authority prior to 1/1/96.

BIOPHYSICAL

Impacts resulting from high water levels due to above average rainfall

Extensive modelling of the catchment was undertaken in the development of the Drainage Management Plan (GB Hill 1990). This included estimates of the volumes of surface run-off and groundwater flows and of wetland water levels under average conditions as well as for storm events up to a 100 year ARI event. The document prepared for the Section 46 referral did not repeat this information but referenced the Drainage Management Plan and the Environmental Management Programme (GB Hill 1991). Monitoring to date has indicated that the modelled predictions are reasonable for planning purposes as they are conservative (ie they tend to overestimate rather than underestimate the potential drainage flows.

Reference to the Drainage Management Plan therefore provides the information requested in this submission. As there are many combinations of conditions possible (initial lake levels, rainfall levels and patterns, groundwater abstraction strategies etc), the document summarised the likely impacts from three broad scenarios: low rainfall, average rainfall and high rainfall. As explained in the document, it is the latter case in which environmental impacts could potentially be detrimental. In describing the impacts to be expected under these conditions the worst case scenario is therefore considered. Any other set of conditions will produce less environmental impacts.

Water levels are already being controlled in Yangebup and Kogolup Lakes through pumping. The Water Corporation has outlined in the document the possible amelioration measures for Thomsons Lake. These are operation of the Jandakot Groundwater Scheme Stage 2 wells to limit drainage from parts of the catchment not limited by environmental criteria related to minimum groundwater levels, and the installation of a temporary pumping station at Thomsons Lake in the event of an extreme rainfall event or season causing a significant rise in the level of Thomsons Lake.

The groundwater scheme is already being operated in this manner, and will continue to be operated in this way in the interests of the efficient use of the water resource. The Water Corporation indicated its willingness to install a temporary pumping facility at Thomsons Lake if required. The Corporation also indicated that the most feasible option would be to install a temporary pump which would transfer water from Thomsons Lake to Kogolup Lake (then to Yangebup Lake and hence to the soakage basins). It is likely that this would have more significant detrimental impacts than the elevated water levels in Thomsons for reasons discussed in the report; ie elevated water levels at Kogolup are affecting fringing tree species which are less dynamic and will take longer to re-establish than the fringing sedges which are affected at Thomsons Lake, and water quality at Kogolup is likely to be adversely impacted by the addition of water from Thomsons Lake.

The probability of a similar rainfall event to that experienced in February 1992 (which was greater than a 100 year ARI rainfall event) is low although it is not impossible. If such an event was to occur in the current season (summer 1995/96), then water levels in Thomsons Lake could rise to around the levels experienced subsequent to February 1992; ie a rainfall event of over 170mm over 24 hours could result in water levels in winter 1996 reaching about 13.6 - 13.8mAHD (depending on the amount of winter rainfall). Without such an extreme event in the current summer the lake is expected to dry by about April/May 1996. This is based on the most recent (Nov/Dec 1995) readings and comparison with the rates of decline in previous years over the period November to May. The actual rate of decline and the final level will of course be affected by the nature of the weather in the next few months. An exceptionally hot summer (as experienced in 1990/91) could see the lake dry earlier; a cooler summer with occasional light rain could result in the lake only partially drying.

If average to below average conditions prevail for the 1995/96 summer and the lake dries as expected, then even a wet winter in 1996 is unlikely to cause a repeat of the high water levels. After drying in the summer of 1990/91, the above average rainfall in 1991 (901mm cf long term average from 1975 to 1994 of 737mm) resulted in an end-of-winter water level of 12.9mAHD. As described earlier, it was the exceptional rainfall event in the following summer which caused the levels to rise to more than 13.3mAHD. So the "second worst case" scenario would be for Thomsons Lake to dry by May 1996, for a higher than average rainfall in 1996 to take the level back to around 12.9 - 13mAHD by the end of winter 1996, and then an exceptional (100 year ARI) rainfall event in late winter or in summer 1996/97. This could see Thomsons Lake levels by the end of winter 1997 in the region of 13.6 - 13.8mAHD again. The actual levels reached would again depend on a number of factors including the amount of rainfall, the groundwater levels in the catchment, and the amount of run off.

The accompanying table attempts to summarise the potential lake levels in Thomsons Lake for a range of possible climatic patterns. It must be stressed that lake levels will be affected by many factors including the amount, frequency and timing of rainfall, groundwater levels within the catchment at the time of rainfall, and by the temperatures experienced particularly over summer. The reliability of the predicted levels are obviously limited by the reliability of climatic predictions. With this in mind, the table indicates that under most scenarios, Thomsons Lake is likely to be dry or very shallow in late summer for at least one of the next three years.

The Section 46 document did propose that any deferral of construction beyond 1998 should be subject to annual assessment by the Department of Environmental Protection as to the potential environmental risks.

Continued loss of fringing vegetation

The Water Corporation's document discussed the impacts of elevated water levels on vegetation at both Kogolup and Thomsons Lakes. In summary, high water levels have been experienced for some years and pre-date the Water Corporation's involvement in the South Jandakot Scheme. Around Kogolup Lake high water levels over several years have affected *Melaleuca* and *Eucalyptus* species and the Water Corporation has responded to this by installing a pumping facility during 1995. This is in operation and it is expected that water levels will be within an acceptable range by the end of the 1995/96 summer. The major threats to the re-establishment of fringing vegetation at Kogolup Lake are then likely to be continued disturbance of the lake margins, including that by horses. This will need to be addressed by the managing agency.

As detailed in the document, the different bathymetry and vegetation distribution at Thomsons Lake means that fringing macrophytes are most affected by the high water levels at this wetland. While this has short term implications for some waterbird communities, it is a situation which has occurred in the past due to climatic conditions and it has been reversible.

The likelihood of lake levels rising sufficiently at Thomsons Lake to inundate mature trees is extremely low. Levels would need to rise by about 1.5m above those currently experienced. Even in the remote likelihood that this did occur (a series of exceptional rainfall events when the catchment groundwater levels were high would be required), the inundation would not be of sufficient duration to cause the deaths of mature trees.

Typha and *Baumea* occupy similar water depth regimes. The fact that *Typha* generally occupies a niche closer to the center of the lake than *Baumea* is primarily an historical artefact: there were dense stands of *Baumea* around Thomsons Lake prior to the high water levels of the late 1960s. During those high water levels aerial photography shows that there was little fringing sedge community. The drop in water levels during the 1970s allowed *Baumea* to recolonise the lake margins, but also coincided with the introduction to the wetland of *Typha orientalis.* The latter occupied the drying lake margins not already populated by *Baumea articulata* and was able to maintain this niche by virtue of the fact that it can re-colonise at a rate 2 to 3 times greater than *Baumea articulata.*

While water levels remain at their present levels, there is unlikely to be any net change in the relevant proportions of *Typha* and *Baumea* communities. As water levels drop when the Branch Drain is fully

operational, it is likely that the same pattern of re-colonisation as occurred in the 1970s will be seen; ie *Typha orientalis*, which already occupies the lower niche in areas around the lake and has the faster vegetative growth rate, will expand into the center of the lake. In areas where *Baumea articulata* forms healthy stands, it too will re-colonise the exposed lake bed if it is not out-competed by *Typha*. The process and the outcome will be the same whether the Branch Drain is in place in 1996, 1998 or later. The only limit on *Typha* spread at the moment is high water levels.

It is believed that the high vegetative growth rate of *Typha orientalis* may be assisted by high nutrient levels. As referred to in the section 46 document, drainage water has been discharged into Thomsons Lake for most of this century, and reference to early histories of the area indicate that land uses during that time have included intensive market gardens and piggeries. If no more drainage water was to enter Thomsons Lake from today, the Water Corporation believes that the monitoring conducted to date on wetland and groundwater nutrient levels indicates that there would be sufficient residual nutrients to ensure that *Typha* growth rates were not limited in any way. This is likely to continue to be the case for some years, and reinforces the Water Corporation's view that the timing of construction of the Branch Drain will have no net impact on the relative proportions of *Typha* and *Baumea* communities.

Potential for impacts on waterbirds as a result of above average rainfall

The document discussed potential impacts on waterbird habitat in some detail. With above average rainfall in the period of the deferral it is acknowledged that water levels may be higher than they would have been had the Branch Drain been fully operational. The document shows however that these levels would still be within those experienced historically at Thomsons Lake. The evidence indicates that waterbirds are opportunistic and will use wetlands which meet their requirements at a particular time or season. If above average rain causes Thomsons Lake levels to disadvantage any waterbird species which require shallow water and exposed mud flats, these habitats are likely to be available at other wetlands such as Forrestdale Lake. When levels then fall at Thomsons Lake, an increased area of this habitat will then be available. Other waterbird species such as divers will be favoured if water levels at Thomsons Lake are high during this period.

Rehabilitation

The document discussed the changes which have taken place at Thomsons Lake over nearly three decades and the displacement of *Baumea* by *Typha* which commenced in the 1970s (Froend and McComb 1994). As discussed above, the continued displacement of *Baumea* is not due to high water levels *per se*, but to the competitive advantage that *Typha* has over this species. The document pointed out that as water levels fall, it is expected that *Typha* may colonise the exposed lake bed more rapidly than *Baumea*. Therefore the end result will be the same regardless of the timing of construction of the Branch Drain.

Because it had no involvement in or responsibility for changes to the wetland in earlier decades, and because the timing of the Branch Drain is not the cause of either the introduction of *Typha* to the wetland or its continued displacement of *Baumea*, the Water Corporation does not accept that it has the responsibility for reversing this process. Moreover, in developing water level criteria for Thomsons Lake during the Public Environmental Review of Stage 2 of the Jandakot Groundwater Scheme, it was understood by the Water Corporation that CALM developed the criteria to favour waterbird habitat by encouraging a drier regime than had been experienced in recent years, and that in doing so it was accepted that this was likely to also favour an increasing dominance by *Typha*.

The Water Corporation is not aware of any evidence that waterbirds are less favoured by *Typha* than by *Baumea*. The Corporation is also unaware of any attempts by the managing agency to limit *Typha* spread at Thomsons Lake prior to the water levels rising in 1992 or during the recent period in which *Typha* spread has been limited by high water levels..

POLLUTION

Impacts resulting from decreased water quality

The Drainage Management Plan presented the results of the modelling of the catchment including estimated nutrient budgets for full urban development (see for example Figure 12). The Section 46 document referred to this, and also described the monitoring being undertaken under the Environmental Management Programme (EMP). The document also referenced the annual reports on the operation and implementation of the EMP which provide further detail of the monitoring. (Annual reports and data reports have been supplied to the DEP.) Tables were presented in the document showing the annual nutrient loads into Thomsons and Kogolup Lakes for the period of monitoring (see tables 4, 7, 14 and 15). Estimates of potential nutrient loads into Thomsons and Kogolup Lakes were based on this monitoring. Nutrient loads into Yangebup Lake are not affected by the proposed deferral.

The data presented indicated clearly that the nutrient loads into the lakes for the period of the deferral will be primarily determined by the amount of run off from the catchment. The catchment characteristics are not expected to change significantly in this period with urban development likely to affect only 10% of the catchment. Although some gradual reduction in the input of nutrients from areas previously used for rural purposes is expected, the section 46 document used current P and N concentrations in estimating the potential nutrient loads under low, average and high rainfall conditions. The reservations expressed earlier in this response about the reliability of predictions of rainfall and run off need to be repeated here.

Catchment source monitoring, not required under the EMP, has been conducted to try to determine more accurately the source of nutrients entering the Bartram Road buffer lake. This monitoring, which has been reported in the annual reports to the EPA on the implementation of the EMP, included instantaneous sampling of flows and nutrient concentrations within the drains at a number of points within the catchment. The results indicated that the urban development was contributing less than 5% of the total nutrient load on each of the sampling occasions.

Comments are provided in the next section on the funding arrangements for this scheme.

SOCIAL SURROUNDS

Cost

The funding of the South Jandakot Drainage Scheme, including infrastructure development, operation and environmental monitoring, is through a headworks charge against each lot. The headworks charge was calculated by determining the costs of the scheme including the concurrent construction of the Branch Drain and the Main Sewer. Any additional costs imposed on the scheme which cannot be met by the headworks charges will become a cost on the Water Corporation and its customers. The proposed deferral will not "save 3 million dollars for wealthy developers" or for the Water Corporation.

Drainage within Thomsons Lake urban area

The proposed deferral will have no impact on the local drainage system serving the Thomsons Lake urban development.

OTHER

Alternative options

Banjup Lake lies to the east of Thomsons Lake at a higher groundwater gradient. The proposal is therefore not feasible. Apart from this, 5.5km of additional earth works would be a high financial and environmental cost, and discharge into the Peel-Harvey system is unlikely to be compatible with the Environmental Protection Policy for that catchment.

CALM'S SUBMISSION

Comments were provided earlier in this response on the response of *Typha* to lower water levels.

Specific comments

1. The document attributes the lower drainage input to the lake since urbanisation of the catchment commenced to the lower rainfall that has been experienced and to the operation of the groundwater scheme. It also differentiated between catchments which are fully developed (eg the Yangebup - South Lake catchment) and the Bartram Road catchment which is likely to be less than 10% urbanised by the time of construction of the Branch Drain. Kogolup levels have, it is believed, been affected by urbanisation of the Yangebup catchment and the corresponding rise in the level of Yangebup Lake. As CALM has noted, pumping by the Water Corporation is controlling the levels of Bibra, Yangebup and Kogolup Lakes and limiting the groundwater flow into Thomsons.

   The Jandakot wellfield is more likely to be shut down if groundwater levels were so low as to present an unacceptable environmental risk through continued operation. In such circumstances the drainage flow to all the lakes would be considerably reduced. The Water Corporation has already indicated its intent to operate the groundwater scheme to complement the drainage requirements.

2. Rainfall is measured at a station within the Bartram Road catchment. However, because there are no figures from this station prior to its establishment in 1994, figures for Perth are used and acknowledged as such in the document. While there can be differences between sites, it is considered more accurate to use the figures from a continuous site when comparing average annual rainfall.

3. The automatic sampling method adopted and approved by the Technical Review Committee is triggered by time and by stage height. Thus samples are taken every two hours throughout the week and at each 50mm stage increment. This ensures that additional samples are obtained from the beginning to the peak of each flow event.

   Although the monitoring methodology is considered to be "state of the art", it is subject to continuous review by the Technical Review Committee who determined at the end of winter 1995 that some additional data analysis and error estimations will be undertaken in the current monitoring period, including manual determination of peak flow concentrations and loads for comparison with the automated sampler. Obviously this cannot be done until the drains are flowing.

4. The method used for calculating the retention time is a standard method which was used in the annual report to the EPA. The Bartram Road buffer lake was constructed to the specifications approved in the EMP. The Water Corporation has supported Edith Cowan University to undertake studies during 1995 into the efficiency of the buffer lake, including more detailed study of the retention times. The results of that study were not available at the time of preparation of the document but discussions with the authors of the study indicated that EMP criteria were met in most flow conditions. The Water Corporation will consider any recommendations arising from the report when it is available.

5. The comment in the document is based on the data from several studies of the quality of run off from catchments with different land uses and different levels of urbanisation. It appears that the greater area of impervious surfaces (roads, roofs etc) in urban catchments contributes the particulates, which may include organic matter.

6. The Hird Road wetland does appear to be a groundwater discharge point and the most feasible way to limit this is through the operation of the groundwater production bores to restrict groundwater flows in the area. This is being done within the constraints of meeting other environmental commitments in the area (ie restricting groundwater drawdown under phreatophytic vegetation). It is not clear what this submission means by the question "what guarantee is there that converting high nutrient groundwater to surface flow and discharging it into Kogolup Lake does not increase nutrient loads in the Beeliar wetlands?".

Groundwater in the vicinity of Hird Road will continue to discharge into Kogolup Lake as it has done for some years. The data presented in the document and in the reports on the EMP indicate that the urbanisation of the catchment are providing no additional nutrient input, most of the loading evidently being derived from rural and other prior intensive land uses.

7. The earlier monitoring was more sporadic and it would be more correct if earlier points are not joined, but under the data system used to store these levels the plots are generated automatically in this format. The levels recorded are not in dispute however and it is quite valid to compare current levels with earlier levels. Although the drains have not been monitored there is historical evidence to show that the drain has been in operation for many decades.

8. It is unrealistic to suggest that the DMP water level criteria could have been met from day one of the commencement of the urban development, particularly as the drainage scheme and the EMP were clearly to be implemented progressively, and because CALM's criteria were intended to favour a much drier water regime than had been experienced for some years prior to urban development in the Thomsons Lake catchment. In both the PER document for the Jandakot Groundwater Scheme and the EMP for the South Jandakot scheme it was made clear that the frequency with which lake levels fell within CALM's criteria would increase but that it was unlikely to reach 100%.

   As stated earlier, in the absence of an exceptional summer rainfall event in the next two to three months, Thomsons Lake will dry this year. The comments on *Typha* and *Baumea* were addressed earlier.

9. It has been suggested that frequent drying may assist in improving water quality although this has not been clearly proven to the best of the knowledge of the Water Corporation. Drying of the lake bed is clearly not going to be a panacea for other improvements, particularly control of catchment activities. Forrestdale Lake, for example, dries most years but experiences significant water quality and midge problems. It may be expected that other water quality problems may be associated with lowered water levels in Thomsons Lake for some period even after the completion of the Branch Drain (see the comment under point 10 below.)

10. The dismissal of the possibility of temperature being affected sufficiently to affect eutrophication is at odds with the certainty attached to some other comments in this submission. With lower water levels there is the potential for increased evapo-concentration of nutrients in early to mid-summer, together with higher temperatures and light penetration through a greater proportion of the water column. This may allow algal blooms to occur within the first few years of lower water levels.

11. Waterbird surveys were not required under the drainage EMP but were required triennially under the Groundwater EMP. As has previously been discussed and agreed between CALM officers and the Water Corporation, there is little monitoring value in the programme which was suggested in the EMP. The (then) Water Authority recognised that the objectives of the monitoring could be met more reliably through increasing the habitat and vegetation monitoring to look at the impacts of both increasing and decreasing water levels in wetlands. A number of vegetation transects around wetlands across the Jandakot mound, including at Thomsons and Kogolup Lakes, were therefore established.

    As a consequence of the re-structuring of the Water Authority, the responsibilities for various aspects of the monitoring associated with projects has been split between the Water Corporation and the Water and Rivers Commission. The Water and Rivers Commission is coordinating the waterbird and vegetation monitoring with the Water Corporation providing financial support proportional to the Corporation's responsibility for the impacts of drainage or groundwater abstraction. It is understood that this will result in waterbird monitoring commencing in 1996 rather than 1995 as was stated in the Groundwater Scheme EMP.

	Potential water level in Thomsons Lake (mAHD) *					
Rainfall conditions	Minimum 95/96	Maximum 1996	Minimum 96/97	Maximum 1997	Minimum 97/98	Maximum 1998
100 year ARI Feb/Mar 96, average rainfall thereafter	Dry - 12.2m (depends on timing of rain event)	> 13.3	> 11.8 (lake does not dry)	> 13.3	> 11.8 (lake does not dry)	Depends on 97/98 runoff and whether Branch Drain is completed
100 year ARI Feb/Mar 1996, high rainfall 1996	Dry - 12.2 (depends on timing of rain event)	> 13.3	> 11.8 (lake does not dry)	> 13.3	> 11.8 (lake does not dry)	As above
Average summer 95/96, above average rain winter 1996	< 11.8 (dry by April)	12.8 - 13.3	> 11.8 (lake does not dry)	12.8 - 13.3	< 11.8 (lake dry by April)	As above
Average 1996, 100 year ARI Feb/Mar 97	< 11.8 (dry by April)	12.8 - 13.3	Depends on timing of rain event; lake may not dry	> 13.3	> 11.8 (lake does not dry)	As above
Average 1996, above average winter 97	< 11.8 (dry by April)	12.8 - 13.3	< 11.8 (dry by April)	12.8 - 13.3	lake may not dry	As above
Average 1996, above average winter 97, 100 year ARI Feb/Mar 98	< 11.8 (dry by April)	12.8 - 13.3	< 11.8 (dry by April)	12.8 - 13.3	> 11.8 (lake does not dry)	As above
Average until summer 98, 100 year ARI Feb/Mar 98	< 11.8 (dry by April)	12.8 - 13.3	< 11.8 (dry by April)	12.8 - 13.3	depends on timing of rainfall event; lake may not dry	As above

* As stated in the text, the lake levels will depend on the combination of a number of factors, including the amount, intensity and frequency of rainfall, the state of the aquifer at the time of rainfall, temperatures particularly over summer, the amount and pattern of groundwater abstraction from both private and public bores, and other catchment characteristics. The reliability of predictions is obviously greatly dependent on the reliability of rainfall predictions. The table therefore refers to levels which were included in CALM's criteria (<11.8, 11.8 - 12.8 etc) rather than absolute levels. The predicted minimum level in 1995/96 is based on recent monitoring (on 10/1/96 the level was 12.34mAHD) and comparison with previous rates of decline between January and May.

Appendix 4

List of submitters

List of submitters

Conservation Council of Western Australia (Inc)
Department of Aboriginal Affairs
Department of Conservation and Land Management
Department of Minerals and Energy
Department of Resources Development

Appendix 5

Water quality and water level criteria

Table 1. Suggested Interim Maximum Water Levels for the Beeliar Wetlands

Wetland	Maximum Level (mAHD)
Yangebup Lake	16.5
Kogolup Lake	14.8
Thomsons Lake	refer table 2

Source: EPA, 1989a

Table 2. Water level criteria for Thomsons Lake, as prepared by CALM and adapted by the EPA

	Winter / Spring Maximum (mAHD)	Summer / Autumn Minimum (mAHD)
wet years	>13.3	>11.8
medium years	12.8	11.3 - 11.8
dry years	>12.3	10.8 - 11.3
never		<10.8

All water levels are in metres AHD (Source: WAWA, 1991b)

Table 3. ***CALM Metropolitan Water Quality Criteria***

pH	7 to 9
Salinity	< 1.5 ppt
Dissolved 0_2	≥ 5 mg/L (mixed conditions). No limits where stratification occurs.
Stratification	Summer stratification acceptable provided water does not become nutrient enriched beyond the criteria set.
Turbidity	< 25 Jackson Turbidity Units.
Nutrients	Total P not to consistently exceed 100 µg/L Chlorophyll A < 100 µg/L (max) Total N < 10 000 µg/L (max)
Pesticides	Chlordane < 0.1 µg/L (in water) DDT < 0.01 µg/L (in water) Dieldrin < 0.03 µg/L (in water) Heptachlor < 0.01 µg/L (in water) Chlorpyrifos < 0.1 µg/L (in water) Temephos < 1 µg/L (in water)
Oil and Petro - chemicals	No spills leaving surface film.
Other	No floating debris other than that which occurs naturally.

Source: EPA, 1989a

WETLAND	LAKE SURFACE AREA (ha)	MAX P LOADING* kg yr $^{-1}$	MAXIMUM PERMISSIBLE SURFACE WATER INFLOW 000 m3 AT FLOW WEIGHTED MEAN CONCENTRATIONS mg l $^{-1}$ INDICATED			RECOMMENDED INTERIM MAX WATER LEVELS AS DETERMINED BY TAG	LAKE VOLUME AT RECOMMENDED WATER LEVELS 1000 m^3 (from graphs)
			0.2 mg $_{l}$-1p	0.4 mg $_{l}$-1p	0.6 mg $_{l}$-1p		
North Lake	50	100	333	166	111	14.9	500
Lower Swamp	12	24	80	40	26		
Roe Swamp	5	10	33	17	11		
Horse Paddock	3.4	7	226	113	75		
Bibra Lake	148	296	986	493	328	15.0	1470
South Lake	23	46	153	77	51	13.8	
Little Rush Lake	9	18	60	30	20	15.9	
Yangebup Lake	78	156	520	260	173	16.5	2050
Kogolup Lake	44	88	293	146	97	14.8	350
Thomsons Lake	253	506	1686	843	561		

Table 4. Maximum permissible phosphorus loadings in the main Beeliar Wetlands. * Surface and groundwater inflow.