Proposed Victoria-Bickley Redevelopment Scheme

Water Authority of Western Australia

Report and Recommendation
of the
Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 418 January 1990

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ISSN 1030 0120
ISBN 07309 34322

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Summary and Recommendation

The Water Authority of Western Australia proposes to redevelop the existing Victoria Reservoir on Munday Brook, approximately 20 kilometres east of Perth. This is considered necessary by the Water Authority of Western Australia due to the age and condition of the existing dam, and timely in view of the current residential and rural development pressures being placed on the associated water catchments.

Redevelopment of the Victoria Reservoir would involve the creation of a new larger dam to replace the existing structure to gain additional water yield. Associated with this also is the development of a pumpback water supply on the existing Bickley Brook Dam, using additional capacity available in the new Victoria Reservoir to store the winter flows from the lower Bickley catchment. The land included within the Victoria catchment area proposed to be flooded by the creation of the new dam is gazetted for water catchment.

Water contained within the new Victoria Reservoir would provide a supplement to Perth's existing water supply. Associated with this would be a new gravity outlet main from the new dam to the Perth metropolitan water supply system.

Following initial discussions with representatives from the Water Authority of Western Australia in October 1988, the Authority determined that the proposal should be assessed under Part IV of the Environmental Protection Act as a "Notice of Intent", now referred to as a "Consultative Environmental Review" (CER). This report was completed in October 1989. Comment was sought from the City of Armadale, the City of Gosnells, the Shire of Kalamunda, the Department of Conservation and Land Management, the Department of Sport and Recreation, and local interest groups. A public information day was also held on 4 December 1989 at the Shire of Kalamunda Library to discuss the redevelopment scheme with members of the public interested in obtaining further information about the proposal.

This assessment report was prepared following consideration of the CER, submissions received, and comments raised at the public information day. The Authority also took into consideration commitments undertaken by the Water Authority of Western Australia in relation to catchment management policies and plans, recreational management within the Victoria and Bickley catchment areas, minimising impact associated with the dam construction and landscape and rehabilitation plans for the project area, as listed in Appendix 2 of this assessment report.

Recommendation 1

The Environmental Protection Authority recommends that the proposal to remove the existing dam wall at Victoria Reservoir and to build a new dam upstream; to build a new pumpback station at the Bickley Dam and pump water back up to the new Victoria Reservoir; and to build a gravity outlet main from the new dam into the metropolitan water supply system as described in the Consultative Environmental Review is environmentally acceptable subject to commitments made by the Water Authority of Western Australia in Appendix 2 of this Report.

1. Introduction

The Victoria Reservoir, first constructed in 1891 for Perth's water supply, is Perth's oldest dam. Due to its age, the design and condition of the dam wall does not meet current Australian standards for large dams, and it is not considered to be technically or economically feasible to bring the dam into compliance with required standards. The Water Authority of Western Australia therefore proposes to build a new, bigger dam upstream of the existing site, in order to provide for a larger safer reservoir. In addition to the new reservoir, the Water Authority of Western Australia propose to pumpback water from winter flows from the existing Bickley Dam into the Victoria Reservoir. Water contained within the New Victoria Reservoir would then provide a supplement to Perth's existing water supply.

Following initial discussions with representatives from the Water Authority of Western Australia in October 1988, the Authority determined that the proposal should be assessed under Part IV of the Environmental Protection Act as a "Notice of Intent", now referred to as a "Consultative Environmental Review" (CER). This report was completed in October 1989, and comment was sought from the City of Armadale, the City of Gosnells, the Shire of Kalamunda, the Department of Conservation and Land Management, the Department of Sport and Recreation, and local interest groups. A public information day was also held on 4 December 1989 at the Shire of Kalamunda Library to discuss the redevelopment scheme with members of the public interested in obtaining further information about the proposal.

This assessment report was prepared following consideration of the CER, submissions received, and comments raised at the public information day.

2. Background

Victoria Reservoir is located upstream of Bickley Dam, on Munday Brook, a tributary of Bickley Brook (see Figure 1). The dam was constructed in 1891 and was Perth's first water supply dam. The dam presently has a storage capacity of 0.86 million cubic metres, a surface area of 18 ha and a yield of 2.9 million cubic metres.

Bickley Brook Dam is situated on the Bickley Brook approximately 1.6 kilometres downstream of the confluence with Munday Brook, and was constructed in 1921. This dam has a storage capacity of 0.106 million cubic metres. However, due to poor water quality associated with land use within the catchment area, the dam has not been used for water supply since 1936. Since 1944 it has provided a regional recreational facility for residents in the area, including a focus for activities such as swimming and canoeing.

The CER states that redevelopment of the Victoria Reservoir is necessary due to the age and condition of the existing dam structure. Redevelopment is also considered timely in view of the current residential and rural development pressures being placed on associated water catchments (CER: 3).

Redevelopment of the Victoria Reservoir would also allow room for the harvesting of water from Bickley Brook by the pumping back of water from the Bickley Dam to the Victoria Reservoir during winter months. The Victoria Reservoir would then provide a "service reservoir" to supplement Perth's water supply, via a new gravity outlet main.

3. Description of project

The proposed Victoria-Bickley redevelopment scheme can be divided up into three components.

3.1 New Victoria Reservoir

This is proposed to be a concrete dam, located approximately 300 metres upstream of the existing dam. The dam wall would extend 36 metres above existing ground level, with a full supply level of 202 metres AHD. Storage capacity is expected to be 10 million cubic metres. The reservoir is expected to produce a yield to the metropolitan water supply system of 4.7 million cubic metres per annum.

The existing dam wall is proposed to be partially demolished, leaving a remnant structure as an historical reminder of Perth's first major storage dam (see Figure 2). Material from the demolished dam is proposed to be disposed of in the new reservoir basin below full supply level.

Construction of the dam would involve the upgrading of the current Water Authority of Western Australia access road between the dam site and Masonmill Road, and Masonmill Road as far as Canning Road. These roads would be widened to provide for construction traffic, dam operation and controlled public access to the new dam location. Construction access to the dam wall work area would involve the upgrading of an existing forest track to the reservoir basin upstream of the site. This track is proposed to be rehabilitated following construction.

The capital cost of dam construction is expected to be $21.6 million. The Water Authority of Western Australia proposes to complete construction of the new dam in May 1991, to allow for water to store in the winter of 1991.

3.2 Bickley pumpback facility

The existing Bickley Brook Dam is a 13 metre high concrete dam with a reservoir volume of 106,000 cubic metres. The existing pipeline is proposed to be used to pump winter water flows from the Bickley Dam to storage in the new Victoria Reservoir. No water would be pumped from the dam during summer months. A major upgrade of the water treatment plant is also planned. Water pumped back from the Bickley Dam is expected to provide an additional system yield of 1.7 million cubic metres per annum.

Associated with upgrading of the pumpback scheme, Hardinge Road would require upgrading to allow for construction and operational access between White Road and the Ministry of Sport and Recreation Camp.

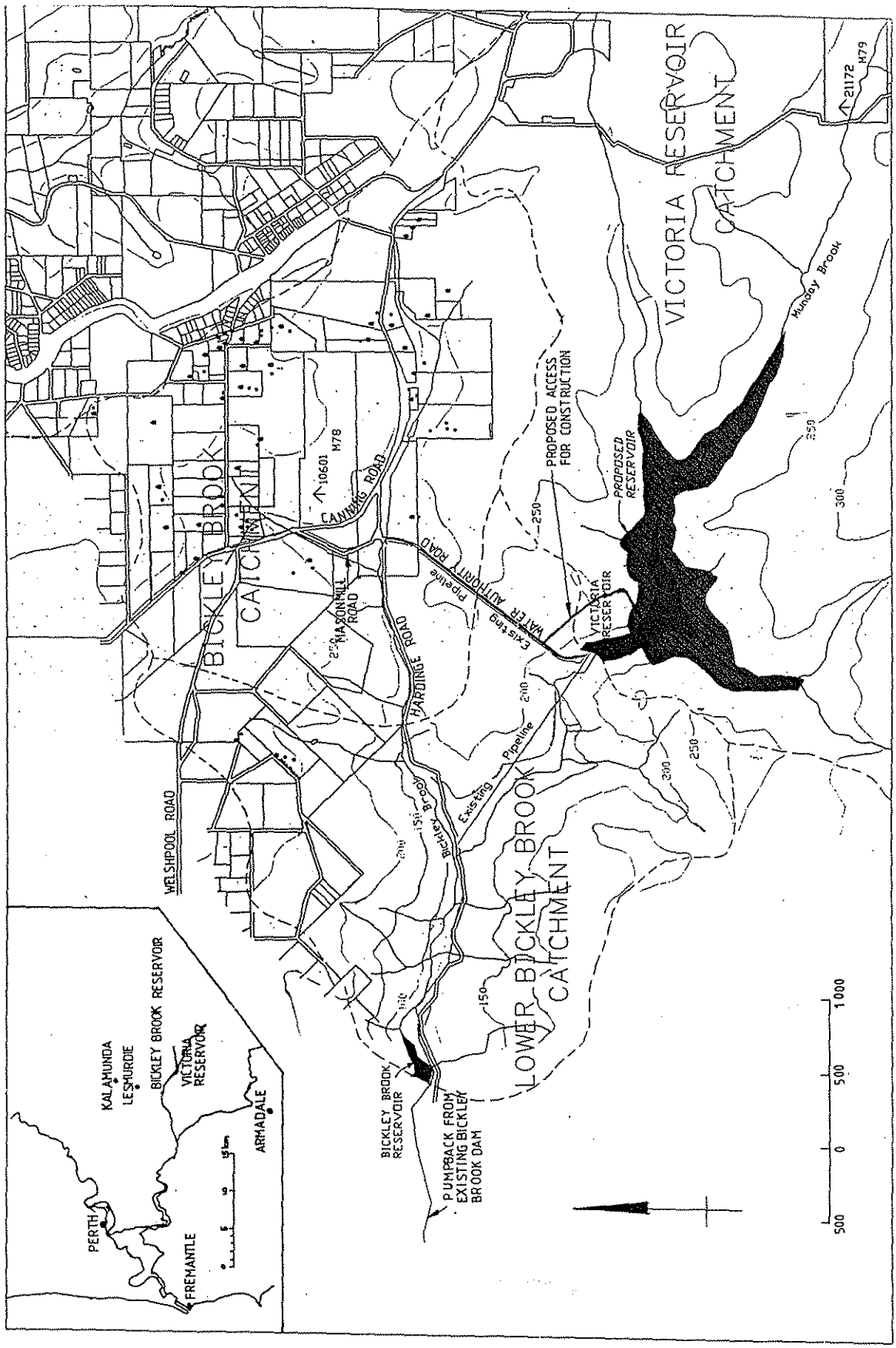

Figure 1: Location of the existing Victoria Reservoir and Bickley Dam in relation to the Perth metropolitan area
(Source: WAWA (1989) Victoria-Bickley Redevelopment Scheme - Consultative Environmental Review)

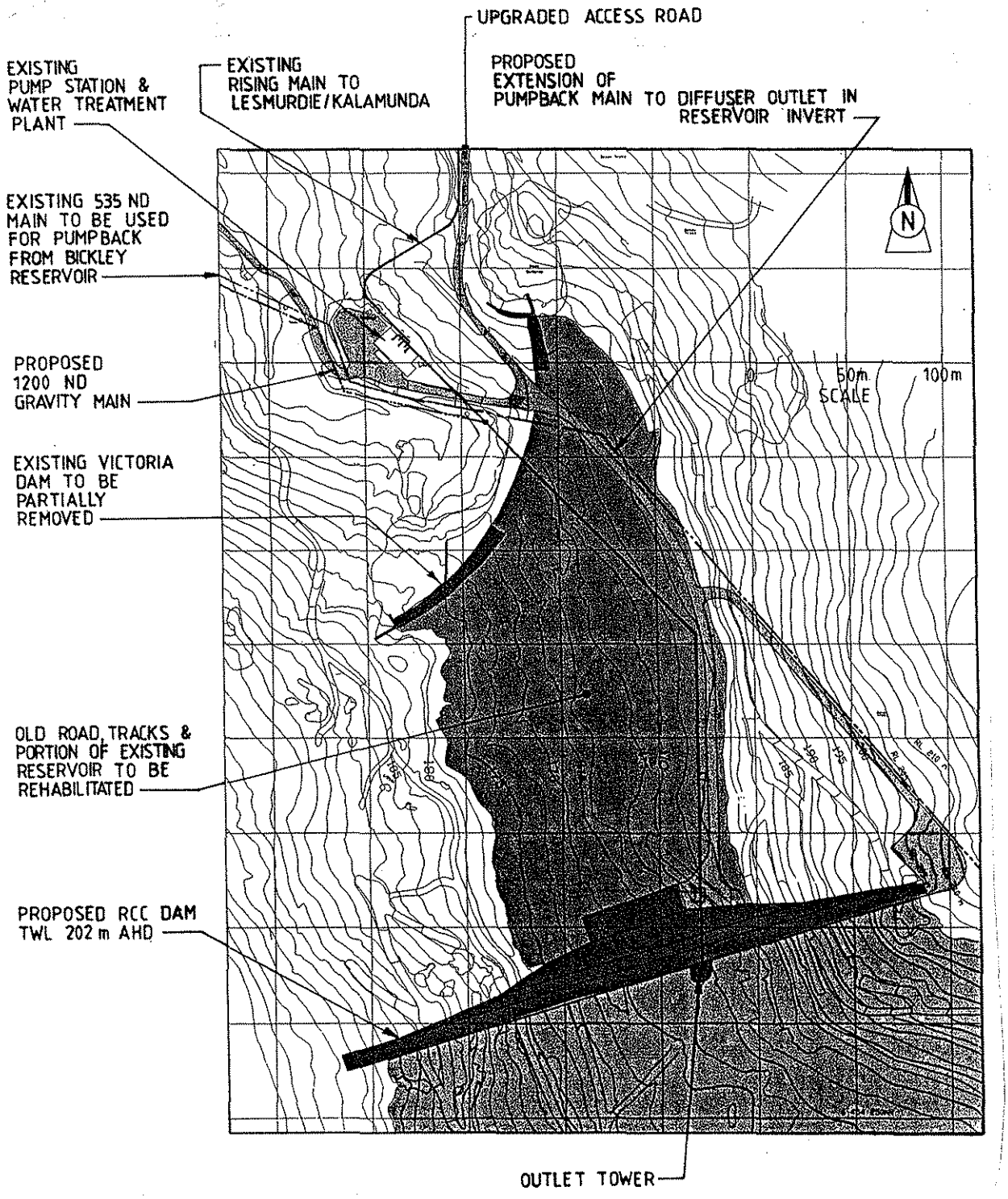

Figure 2: General arrangement of the new Victoria Dam, indicating location of old and proposed new dam walls

(Source: WAWA (1989) Victoria-Bickley Redevelopment Scheme - Consultative Environmental Review)

The capital cost of upgrading the pumpback and water treatment facility is expected to be $2 million. The Water Authority of Western Australia anticipate that work on the pumpback facility would commence in October 1992, and be completed by April-May 1993. Major upgrading of the treatment plant is proposed to be undertaken in 1996.

3.3 New gravity outlet main

The Water Authority of Western Australia propose to lay a new water pipeline parallel to the existing pipeline to deliver the larger water scheme yield to the watertrunk main from Canning Dam. This is proposed to be laid in two stages. Stage 1 involves four kilometres of pipeline to the existing pipeline at Bickley Dam. Stage 2 involves the extension of the new high capacity pipeline to connect with the watertrunk main near Tonkin Highway. Final design details of the pipeline have yet to be determined. However, it is likely that the pipeline would be buried.

4. Review of public submissions

Submissions were received from the City of Armadale, the City of Gosnells, the Shire of Kalamunda, the Ministry of Sport and Recreation, the Department of Conservation and Land Management and two members of the public.

The following list is a summary of the issues raised in the submissions, and during the public information day.

Noise and dust associated with construction of new pipeline:

- Laying of the pipeline between Victoria Reservoir and Bickley Dam will generate noise and dust, and the operation of heavy machinery in close proximity to young children using the Bickley Outdoor Recreation Centre may be dangerous.

Impact on recreational activity in the area:

- There was no mention made in the CER of the Scout Association lease around the gauging weir approximately 500 metres upstream of the Bickley Outdoor Recreation Centre. Use of this area by the scouts would be affected by the proposed development;
- A management plan should be prepared for recreational activities on the Bickley Dam and surrounding areas, in consultation with the Ministry of Sport and Recreation, the Water Authority of Western Australia and other appropriate authorities, to control public usage and protect the natural environment in the area; and
- The Water Authority of Western Australia should liaise with relevant local government authorities regarding the management of recreational activities in the vicinity of the Bickley Dam.

Land use within the Bickley catchment:

- Land owners in the Upper and Lower Bickley Brook Catchment areas will be severely restricted in terms of land use if the proposed development programme proceeds. Redevelopment of the Bickley pumpback scheme will also have an adverse impact on the rights and privileges of holders of freehold titles within the catchment.

Pumpback facility on Bickley Dam:

- The development of a pump station at the Bickley Dam is not considered to be worthwhile or feasible by some nearby landowners as construction of the new Victoria Reservoir would obviously increase the water holding capacity of the dam, which will have the effect of reducing downstream water flow, previously supplying the Bickley Dam. It is therefore considered that money to be spent on the Bickley Dam and new pumpback scheme as proposed in the CER would be better spent on developing other water supply sources.

Alternative water sources:

- The Water Authority of Western Australia should give more serious consideration to the development of alternative water sources, such as the tapping of underground aquifers, to supplement Perth's water supply.

Public health risks:

- Water contained in the Bickley Dam is susceptible to amoeba contamination. This problem needs to be managed carefully, and people using the reservoir need to be informed of these dangers.

Loss of wildlife habitats and riparian vegetation:

- Good quality vegetation exists along creeks which discharge into the existing Victoria Reservoir. This type of vegetation is becoming scarce in the northern jarrah forest, and this may be contributing to the loss of habitats for bird species such as Red-eared Firetails *Emblema oculata,* White-breasted Robins *Eopsaltria georgiana,* and Red-winged Fairy-wrens *Malurus elegans.* Also a healthy community of *Astroloma foliosum* in the furrow leading from the old sluice gate on Munday Brook would be inundated. This species has an extremely restricted distribution in the Darling Range; and
- The Water Authority of Western Australia should do its utmost to rehabilitate the area downstream of the proposed new dam wall with species which would be inundated by construction of the new reservoir. The downstream area should be developed as a prime example of Darling Range riparian habitat.

Public access to the Victoria reservoir catchment:

- The existence of the Water Authority of Western Australia catchments in the Darling Range have provided refuges within which threatened animal and plant species have been

able to survive despite the degradation of forest outside those catchments. The Water Authority of Western Australia should continue to restrict public access to the Victoria catchment area to the same extent as it is presently restricted upstream of the existing reservoir to counteract the negative impact of the loss of protected catchment caused by the building of the new reservoir.

These issues have been addressed by the Water Authority of Western Australia. A copy of their response to these issues is incorporated in Appendix 1 of this assessment report.

5. Environmental impact

5.1 Dam construction

Environmental impact associated with dam construction primarily relates to construction traffic.

The Water Authority of Western Australia have undertaken a commitment to minimise the adverse impact of project construction (Appendix 2, Commitment 5). This commitment includes provision for Water Authority of Western Australia officers to discuss times of road use by traffic associated with dam construction with relevant local authorities prior to construction, in order to minimise impact on local residents.

All materials required for dam construction are proposed to come from existing commercial sources.

5.2 Reservoir environment

Construction of the new Victoria Reservoir would result in the loss of 64 ha of forest.

Vegetation and fauna studies commissioned by the Water Authority of Western Australia indicate that stream zone riparian vegetation and associated faunal communities would be the most affected by construction of the new reservoir. This would add to the cumulative loss of riparian habitat in the Darling Range and northern jarrah forest and would impact on some species "in need of special protection". However, none of these species are restricted to the habitat within the project area. The Water Authority of Western Australia have made a commitment to implement strategies to reduce the impact of the dam on riparian vegetation, fauna and water quality as much as possible during the construction phase and as part of a proposed management plan for the area following construction (CER: 29, Appendix 2, Commitment 3).

5.3 Downstream environment

The proposal is not expected to have any affect on the water flows downstream of either Bickley Dam or Victoria Reservoir.

The Water Authority of Western Australia have undertaken to rehabilitate the disturbed area downstream of the new dam site to self sustaining vegetation typical of the area (Appendix 2, Commitment 4). This area would be landscaped, and include a passive recreation and observation area available to members of the public.

Impact of the proposal on the downstream environment is therefore considered to be acceptable by the Authority.

5.4 Land use within catchment

Both the Victoria and Bickley Catchments are declared under the Water Authority of Western Australia Act as water catchment areas. The present aims of the various planning agencies involved in the management of these catchments is to maintain the current rural setting and water quality, while still allowing some scope for subdivision and development based on lot size and land capability via a rural strategy (CER: 14).

5.4.1 Victoria catchment

The Victoria Catchment covers a total area of 3711 ha, 2% (82 ha) of which is privately owned (11 lots). The Water Authority of Western Australia is opposed to any further land development in the catchment, however it is not averse to the present private lots remaining as current land use on them is unlikely to affect water quality.

5.4.2 Bickley catchment

The Bickley Catchment covers a total area of 1436 ha, 60% of which is controlled or owned by the State. The remaining 40% is in private ownership and is used for orchards, horticulture, pasturing and other activities including horse agistment.

The Water Authority of Western Australia have a policy to purchase private land within the catchment for rehabilitation, and have been opposed in the past to any further land subdivision. A Draft Policy on the management of rural land use was released by the Department of Planning and Urban Development in 1989. Following release of that document, the Water Authority of Western Australia are now prepared to consider further limited land development in gazetted catchments provided the land is found to be capable of coping with additional pollution loads, and that local authorities administer additional land use policies.

The CER states that the principle of the Water Authority of Western Australia in managing this area is to preserve the current rural setting and water quality standards of the area while still allowing scope for land subdivision. Within this context, the Water Authority of Western Australia are working closely with the Shire of Kalamunda and the Department of Agriculture in revising the existing Hills Orchard Study, originally prepared in 1988, to formulate guidelines for future land use, development and subdivision of privately owned land. Once finalised and approved by the Department of Planning and Urban Development,

these will be incorporated within the Shire's Town Planning Scheme.

The Water Authority of Western Australia are presently preparing a management plan for privately owned land in both the Victoria and Bickley catchments in association with the Shire, the Department of Agriculture and individual land owners to ensure that land use does not have an adverse affect on water quality (Appendix 2, Commitment 6). This includes controlled fertilizer use, and strict control of on-site storage of chemical and petroleum products. Further, the Water Authority of Western Australia have undertaken a commitment to 'continue to review catchment management policy for the Bickley catchment in order to facilitate "reasonable" land development within the assimilative capacity of the environment and its capacity to yield water of acceptable standards' (Appendix 2, Commitment 1).

The proposed development is therefore not considered to have an adverse affect on land use within the catchment beyond already existing and proposed land use controls.

5.5 Recreation

The project area experiences a high level of recreational activity due to the close proximity of suburban areas, in particular to Bickley Dam. This activity is mostly passive, and includes swimming and bushwalking. However, horseriding and off-Road Vehicle (ORV) driving is becoming increasingly popular.

The Water Authority of Western Australia have undertaken to prepare a plan for the management of recreational activities on the Bickley Dam (Appendix 2, Commitment 2). This plan would be expected to place additional control measures on recreational use of the dam, following consultation with the Local Authority, Department of Sport and Recreation, and the Department of Conservation and Land Management. This would include discouraging swimming at any times within the dam due to the risk of infection, in particular from amoebic meningitis, and would prohibit any direct body contact with water from the Dam during pumpback times. This is not expected to have a significant recreational impact as this would only take place during winter months. Camping would be permitted within the catchment by agreement. However, more stringent control of horseriding and ORVs may be implemented.

The proposal is not expected to have an affect on existing recreational use within the Victoria Catchment. Camping and bushwalking areas would continue to be controlled, and horseriding restricted to specified areas.

The Authority concludes that the proposal would not have an unacceptable impact on recreational activities within the catchment areas.

6. Conclusion

Following consideration of the CER and submissions received, the Authority has concluded that the proposal is environmentally acceptable subject to the following recommendation.

Recommendation 1

The Environmental Protection Authority recommends that the proposal to remove the existing dam wall at Victoria Reservoir and to build a new dam upstream; to build a new pumpback station at the Bickley Dam and pump water back up to the new Victoria Reservoir; and to build a gravity outlet main from the new dam into the metropolitan water supply system as described in the Consultative Environmental Review is environmentally acceptable subject to commitments made by the Water Authority of Western Australia in the CER.

7. Reference

Water Authority of Western Australia (1989) Victoria-Bickley Redevelopment Scheme - Consultative Environmental Review (Report No WP 77)

Appendix 1

Proponent's response to issues raised in submissions

WATER AUTHORITY
of Western Australia

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LEEDERVILLE W.A.
Postal Address: P.O. Box 100 Leederville
Western Australia 6007
Telephone: (09) 420 2420 Telex: AA 95140
Facsimile: (09) 328 2619

Your Ref 109/89
Our Ref 10 A 20844 G
Enquiries Mr R. Wark
Tele Direct 420 2929

Director
Evaluation Division
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

Attention; Ms E Bunbury

VICTORIA BICKLEY REDEVELOPMENT SCHEME

In reply to your letter of December 19, 1989 I enclose the Water Authority's responses to the public commentary.

As part of the process of obtaining authorisation to construct works, the Water Authority Act requires that a notice and plan describing the proposed works be published in newspapers and the Government Gazette, with copies distributed to all affected landowners and Government Departments. As this process can take some time, the Water Authority intends proceeding with advertising the notice of intention to construct. This notice will include a comment to the effect that the project is still being considered by the EPA. Final approval from the Minister will not be sought until the EPA has reported on the project.

R. J. Wark
A/Manager Water Resources Planning
28th December 1989

032186 Info.

✓ noted Eve Bunbury 1.9.90.

VICTORIA BICKLEY REDEVELOPMENT SCHEME
CONSULTATIVE ENVIRONMENTAL REVIEW

RESPONSES TO PUBLIC COMMENT

1. Noise and dust associated with pipeline construction

Most of the proposed pipeline construction will take place in areas well clear of people and human habitation. Noise and dust are not expected to be a major problem in these circumstances and normal construction practices should minimise any problems. With regard to the laying of pipe adjacent to the Bickley Outdoor Recreation Centre, the Water Authority has had vast experience in constructing such works in much more heavily urbanised areas. The Water Authority will adopt appropriate safety precautions and construction techniques to minimise the likelihood of any problems occurring. Construction in the vicinity of the centre would last only a week or so and if necessary the centre could be closed for the duration.

2. Impact on recreational activity in the area

The Water Authority is aware that the Scout Association has a lease over the area it uses upstream of the Bickley Reservoir. As part of the process for the preparation of a management plan for recreation on the catchment and the reservoir to which it is committed (section 5.1.5) the Water Authority will, in conjunction with CALM, the Ministry for Sport and Recreation and the Shires consult with other interest groups such as the Scout Association, the Girl Guide Association and the local historical groups. The Water Authority agrees that its interests are best served by controlling public useage and preserving the natural environment in the area.

3. Land use within the Bickley Catchment

The Bickley and Victoria Catchments have been declared water supply catchments for well in excess of 60 years and landowners will have been aware of the Water Authority's management activities over the years. The problem raised is not unique to this area, as significant portions of other hills catchments contain privately owned land. Management of rural lands in water catchments is a topic which is under active consideration by the planning agencies and this topic is referred to in the CER (section 5.1.3). The proposed redevolopment should not affect the current land use activities of the local landowners. In conjunction with other planning agencies the new zoning policy which is being developed should permit some limited land

development while still preserving the current water quality levels for public water supply purposes.

4. Pump back facility on Bickley Reservoir

The planning studies which have been carried out indicate that the pump back scheme will yield 1.7 million cubic metres of water a year on average (Appendix 1). Appendix 3 indicates that abandoning this resource would cost the Water Authority $12 million in finding a replacement scheme.

5. Alternative Water Sources

The detailed consideration of alternative sources is contained in the reference given in the report (Source Development Plan; Mauger, 1989) and a summary table of the proposed developments is given in Appendix 2. This table clearly shows that 31% of the current system yield is obtained from groundwater sources. This proportion rises to 33% by the turn of the century. Future decisions on the balance between surface and groundwater sources are made on a range of factors, including economic and environmental parameters, to ensure that the correct planning decisions are made.

6. Public Health Risks

The Water Authority agrees that there is a considerable risk of infection from pathogenic organisms due to swimming in unchlorinated waters (see section 5.1.5). This risk will not be increased by the Water Authority's proposed method of operating the reservoir as the storage will remain full at the end of the pumping season. This issue will be addressed in the recreation management plan.

7. Loss of wildlife habitats

The Water Authority's objective with the rehabilitation downstream of the New Victoria Dam will be to recreate some of the habitat which will be lost when the enlarged reservoir is constructed and the comments made will be of considerable help in planning this work. Studies carried out by the RAOU for the North Dandalup project (unpublished) suggest that the Red Eared Firetail may in fact have a much wider range than the creek lined vegetation suggested in the comment. This could mean that the impact will in fact be less than might otherwise have been perceived.

8. Public access to the Victoria Reservoir Catchment

Although the Water Authority proposes that the Victoria Catchment become a class 2 catchment, this will mean that activity on the catchment will change very little from the present. The highly restricted area within a class 2 catchment would fall within the natural drainage from the surrounding hills and extend up as far as Canning road. This is very close to the area which is currently highly restricted. This philosophy will be incorporated in the catchment plan when it is drawn up.

Appendix 2

List of proponent's commitments

A number of specific practices can be adopted to minimise adverse impact on the environment and maximise benefits from the project. These are summarised below.

1 The Water Authority of Western Australia will continue to review catchment management policy for the Bickley catchment in order to facilitate reasonable land development within the assimilative capacity of the environment and its capacity to yield water of acceptable standards, to the satisfaction of the Department of Planning and Urban Development.

2 The Water Authority of Western Australia will, in consultation with appropriate authorities prepare a plan for the management of recreational activities on Bickley Reservoir, to the satisfaction of the Environmental Protection Authority.

3 The Water Authority of Western Australia will develop environmental protection guidelines and incorporate these in contracts for the construction of all works associated with this redevelopment scheme. Principal contractors will be briefed on the environmental guidelines prior to commencing work. These guidelines will be aimed at minimising impact of the construction of the project on vegetation, fauna and water quality, and will be prepared to the satisfaction of the Environmental Protection Authority.

4 The Water Authority of Western Australia will develop an integrated landscape and rehabilitation plan for the project area, incorporating public access and use. Clearing and rehabilitation prescriptions will be prepared for all areas to be disturbed by the project, including:

- the new pipeline from Victoria Dam;
- the existing Victoria Dam site upstream to and incorporating the new Victoria Dam;
- all project dedicated works areas not ultimately to be inundated by the new reservoir;
- the reservoir basin; and
- all road construction and upgrading.

This plan will be prepared to the satisfaction of the Environmental Protection Authority.

5 The Water Authority of Western Australia will minimise adverse impact and utilise opportunities created by project construction, by:

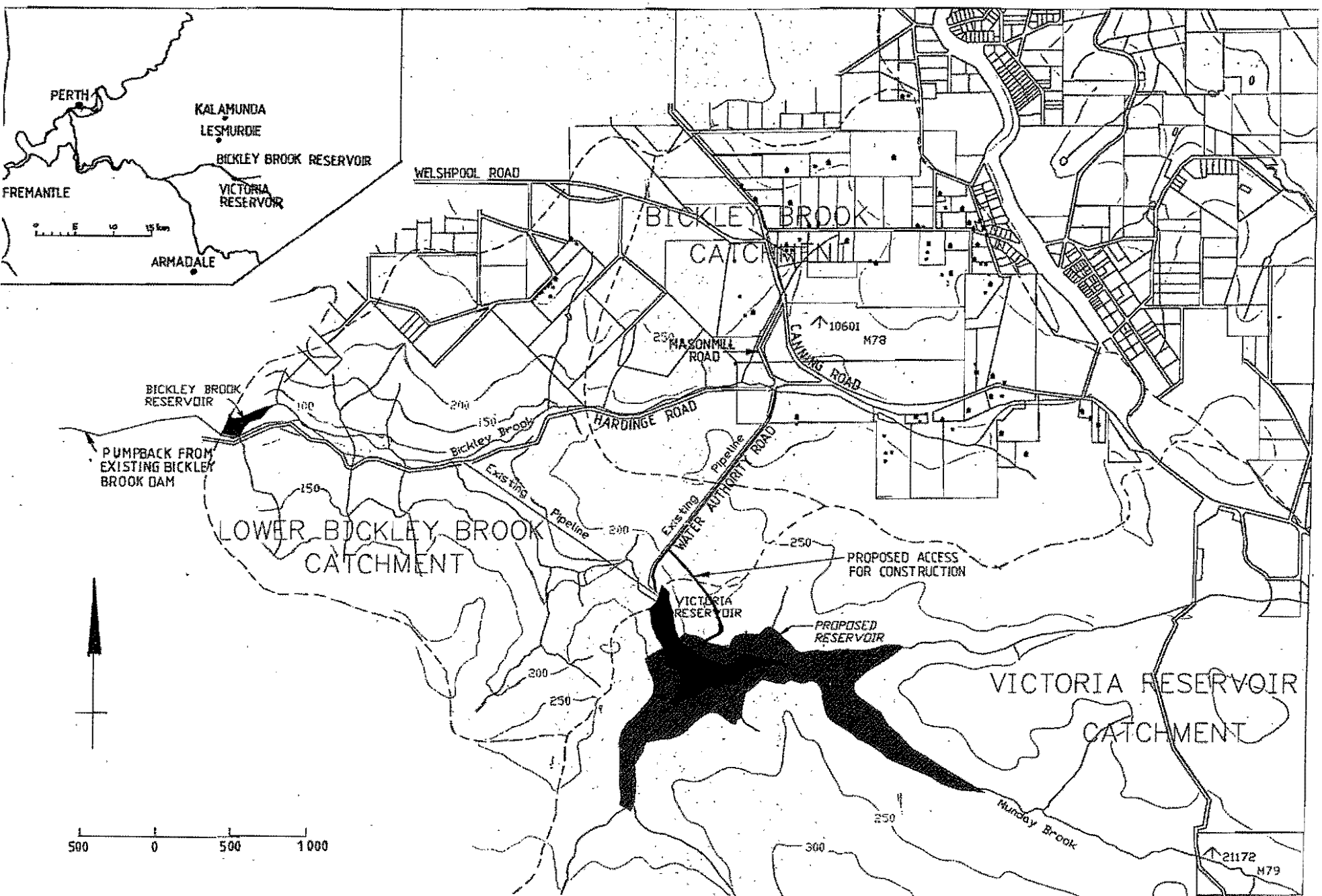
- facilitating efficient forest product utilisation during essential clearing, this includes early advice to and consultation with the Department of Conservation and Land Management;
- consultation with the Kalamunda and Gosnells Shires to minimise impact of construction traffic;
- sealing access roads which would cause dust nuisance to residents;
- informing all effected residents of any blasting operations; and
- disposing of all rubbish in accordance with local Council by-laws.

This will be undertaken to the satisfaction of the Department of Mines, the Environmental Protection Authority and the Shire of Kalamunda.

6 The Water Authority of Western Australia will prepare catchment management plans for both Bickley and Victoria Catchments including the following objectives:

- managing the catchment to protect water quality whilst recognising the potential to contribute to conservation of natural features of the Darling Range and Northern Jarrah Forest;
- within practical limits minimise vegetation and fauna disturbance associated with dam, pipeline and reservoir operation;
- wherever feasible, protect and if possible enhance habitat values of the catchment; and
- within the powers of the Water Authority of Western Australia incorporate specific details for the management of the two reserves C10601 and C21172 subject to System 6 Recommendations M78 and M79.

These plans will be prepared to the satisfaction of the Environmental Protection Authority.


PERTH
KALAMUNDA
LESMURDIE
BICKLEY BROOK RESERVOIR
VICTORIA RESERVOIR
FREMANTLE
ARMADALE
WELSHPOOL ROAD
BICKLEY BROOK CATCHMENT
MASONMILL ROAD
CANNING ROAD
10601
M78
BICKLEY BROOK RESERVOIR
HARDINGE ROAD
Bickley Brook
PUMPBACK FROM EXISTING BICKLEY BROOK DAM
Existing Pipeline
Existing WATER AUTHORITY Pipeline
LOWER BICKLEY BROOK CATCHMENT
PROPOSED ACCESS FOR CONSTRUCTION
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PROPOSED RESERVOIR
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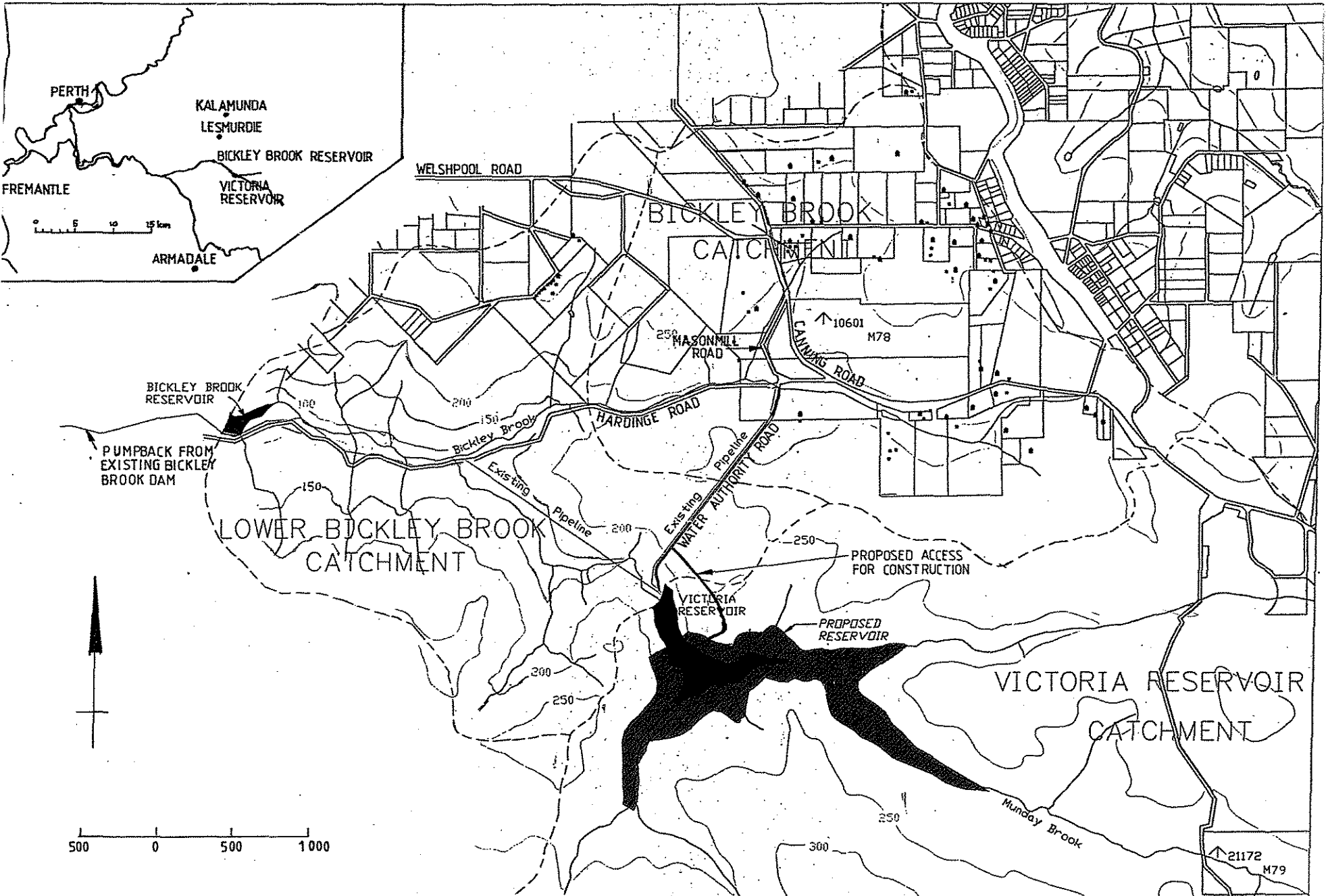
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