Residential/commercial subdivision, Pt Lot 402 Rae Road, Cockburn Sound Location 16, Rockingham.

Allied Land Company Pty Limited

Report and recommendations
of the Environmental Protection Authority

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Summary and recommendations

Allied Land Company Pty Ltd, the proponent, proposes to subdivide Part Lot 402, Rae Road, Rockingham into residential and commercial lots and cede the Parks and Recreation and Controlled Access Highway Reserve to the Crown.

The proposal will occur adjacent Lake Richmond, which has been identified in the System Six Report (Area M102). Pt Lot 402 includes the south east corner of Lake Richmond, which is reserved for Parks and Recreation (P&R), with the balance zoned either Urban or reserved for Controlled Access Highway (Garden Island Expressway) in the Metropolitan Region Scheme (MRS).

This report provides the Environmental Protection Authority's (EPA) advice and recommendations to the Minister for the Environment on the environmental factors, conditions and procedures relevant to the proposal.

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

Relevant environmental factors

Although a number of environmental factors were considered by the EPA in the assessment, it is the EPA's opinion that the following are the environmental factors relevant to the proposal, which require detailed evaluation in the report:

i) Vegetation Communities - loss of Vegetation Community 19.

ii) P&R Reserve - indirect impacts.

iii) Wetlands - adequacy of buffers to Lake Richmond

iv) Surface Water Quality - impact of stormwater disposal.

v) Thrombolites - indirect impacts.

The EPA has also provided 'other advice' in relation to:

i) Vegetation Community 19;

ii) Garden Island Expressway; and

iii) Water Corporation drains.

Conclusion

The EPA, in consideration of all available information, concludes that the proposal by Allied Land Company to subdivide Pt Lot 402 can be managed and modified to meet its objectives through:

- an Environmental Management Plan (EMP) which will address the factors P&R Reserve and Thrombolites;
- a Drainage and Nutrient Management Plan (DNMP) which will address the factor Surface Water Quality; and
- modification of the P&R Reserve which will address the factor Wetlands.

The EPA makes the following conclusions regarding the Other Advice provided in Section 5:

- the Western Australian Planning Commission (WAPC), City of Rockingham, Department of Defence, Mains Roads Western Australia and Department of Transport should review the need for and alignment of the Garden Island Expressway;

- the Department of Conservation and Land Management (CALM) should undertake a regional assessment of Vegetation Community 19 remnants and where appropriate these should be included in the draft Perth Bushplan;

- The Water Corporation, in conjunction with CALM and Water and Rivers Commission (WRC), should undertake a study to examine alternatives to using Lake Richmond as a compensation/infiltration basin; and

- The Water Corporation should, as a priority, plan and implement a water and sediment quality monitoring program before the proposal commences. This program should continue to be implemented while Lake Richmond is being used as a compensation/infiltration basin.

It is the EPA's conclusion, on advice from the Department of Environmental Protection (DEP) and CALM, that development of a small (3-5 ha) remnant of Vegetation Community 19 located on the land proposed for subdivision will not threaten the long term survival of this community type.

Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister considers the report on the relevant environmental factors of Vegetation Communities, P&R Reserve, Wetlands, Surface Water Quality and Thrombolites;
2. That the Minister notes that the EPA has concluded that the proposal can be managed to meet the EPA's objectives, and thus not impose an unacceptable impact on the environment, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Section 4;
3. That the Minister imposes the conditions and procedures recommended in Appendix 3; and
4. That the Minister endorses the Other Advice in Section 5 and takes appropriate action to ensure those agencies responsible are aware of this advice.

Conditions

The EPA recommends that the following conditions, which are set out in formal detail in Appendix 3, be imposed if the subdivision proposal by Allied Land Company is approved:

a) the proponent shall fulfil the commitments in the Consolidated Commitments statement set out in Appendix 3;

b) the proponent shall prepare and implement an EMP which addresses, impacts on the P&R Reserve from residents and visitors and indirect and direct construction impacts on P&R Reserve;

c) the proponent shall prepare a DNMP which addresses design, construction, water quality objectives and criteria, monitoring and contingency; and

d) the P&R Reserve shall be modified to generally include land west of the Fisher Street extension and north of the Water Corporation drain, while degraded land within the southern portion of the P&R Reserve should be available for subdivision. If necessary flexibility with respect to Public Open Space contribution should be considered. Figure 3 should be used as a guide to finalising the P&R Reserve.

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1. Introduction and background

Allied Land Company Pty Ltd, the proponent, proposes to subdivide Part Lot 402, Rae Road, Rockingham into residential and commercial lots and cede the Parks and Recreation and Controlled Access Highway Reserve to the Crown (Figure 1).

Pt Lot 402 includes the south east corner of Lake Richmond, which is reserved for Parks and Recreation (P&R) with the balance zoned either Urban or reserved for Controlled Access Highway (Garden Island Expressway) in the Metropolitan Region Scheme (MRS). The portion of Lot 402 reserved for P&R will be bought by the Government and managed for conservation and recreation purposes. The Garden Island Expressway is designed to service the Navy's Garden Island facility and a previously deleted container port at Mangles Bay. At its narrowest point the Highway is within 50 metres of Lake Richmond.

Land proposed for subdivision is mostly cleared and represents 7.7% of the catchment of Lake Richmond.

The key environmental characteristics of Lake Richmond are that it:

- is a fresh water lake with an area of approximately 40 ha and a maximum depth of 15 metres;
- has good water quality, with a low concentration of nutrients in the water column (total nitrogen 0.667 mg/L and total phosphorus 0.02 mg/L), but the nutrient status of the sediments is not known;
- is a flora and fauna reserve and was also identified in the System Six Report (Area M102): Area M102 (Lake Richmond) is consistent within the boundaries of the P&R Reserve;
- is an Environmental Protection (Swan Coastal Plain Lakes) Policy lake and Conservation category wetland (EPA Bulletins 374 and 686);
- has riparian vegetation which is in good condition and the Lake has records of over 103 birds species, many of which are migratory;
- supports a well developed microbialite (thrombolite) community which is identified by the Department of Conservation and Land Management (CALM) as a 'threatened ecological community': recent advice from Water and Rivers Commission (WRC) indicates the thrombolites are alive and growing.

The P&R Reserve contains remnants of Vegetation Community 19 (sedgelands in holocene dune swales) (Gibson *et al.* 1994) which has also been identified by CALM as a 'threatened ecological community'.

In 1968 the Water Corporation constructed a network of drains in the Rockingham area. These drains collect surface water, dewater the shallow aquifer and have facilitated the urban development of the Rockingham area by lowering the water table by 1.0-2.0 metres and hence mitigate possible flooding. These drains flow into the eastern side of Lake Richmond. An outflow drain is located in the north-west corner of Lake Richmond, which flows into Mangles Bay (Figure 2).

On 31 January 1997 the EPA required a Consultative Environmental Review (CER) be prepared for the subdivision proposal to identify and manage the potential environmental impacts.

The public submission period for the CER was 4 weeks. A total of 13 submissions was received, 9 from government and 4 from individuals or community groups. A list of submitters is included as Appendix 1. Following assessment of submissions, the proponent was required to undertake additional work, to address specific issues and confirm with a high degree of scientific certainty the conclusions made in the CER. This additional work was circulated to the Water Corporation, CALM, Water and Rivers Commission (WRC) and City of Rockingham for additional comment, for a period of 3 weeks.

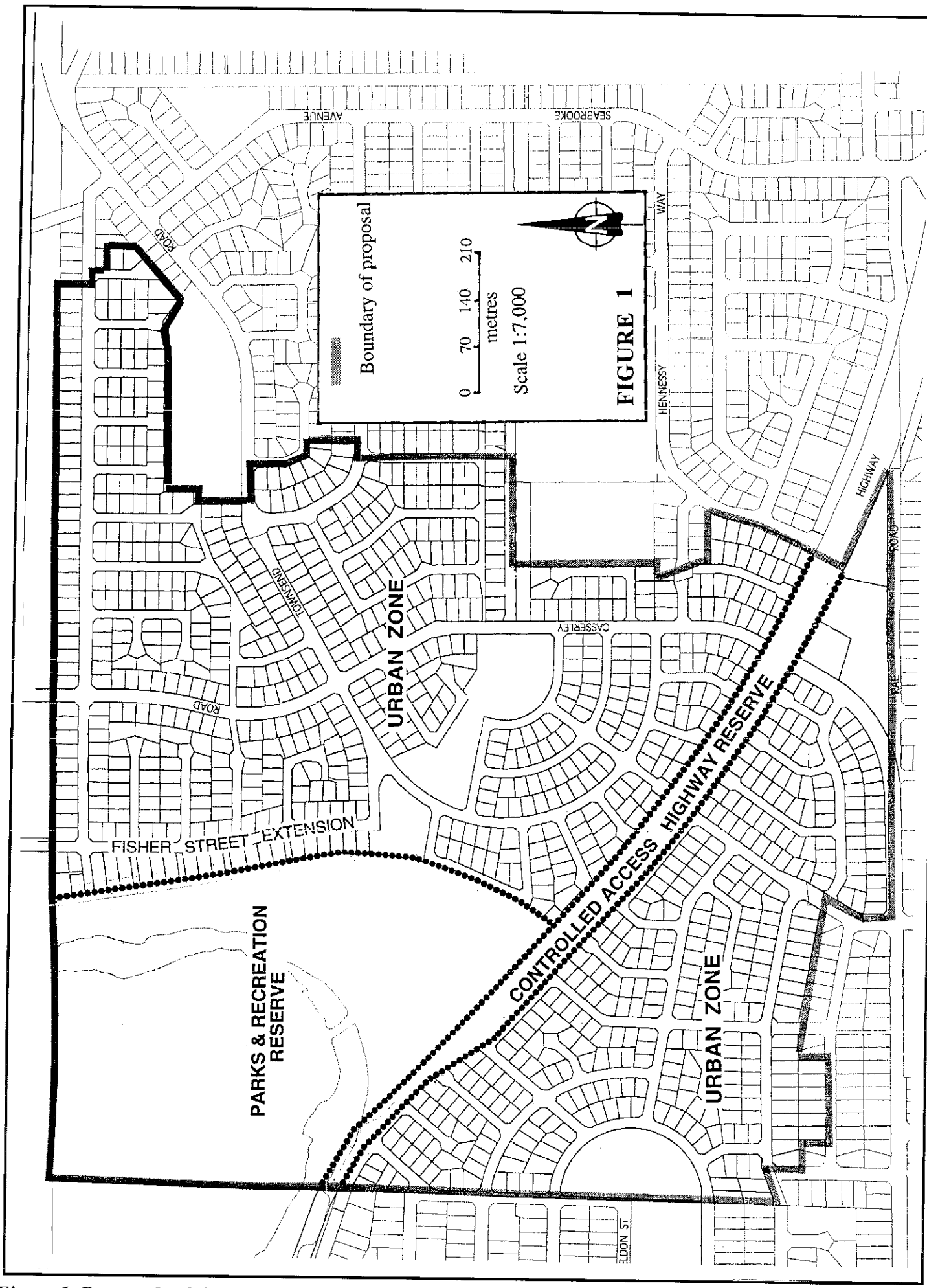

Figure 1. Proposed subdivision.

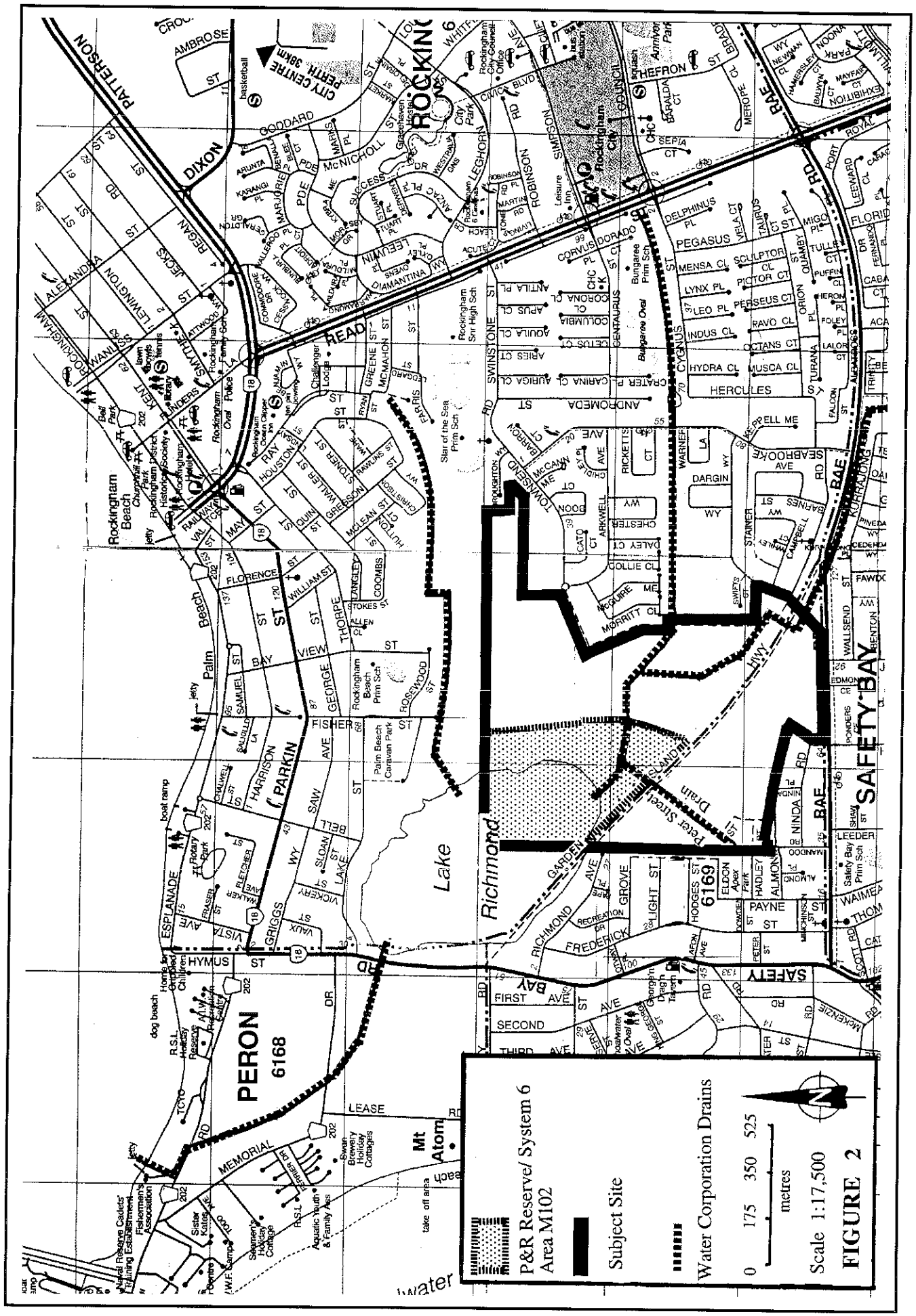

Figure 2. Location of proposal.

The EPA also wrote to CALM and WRC seeking further clarification and more information regarding two specific issues: wetland buffers and Vegetation Community 19. WRC responded and provided phosphate transport modeling by CSIRO. CALM responded and included information on Vegetation Community 19.

Further details of the proposal are presented in Section 2 of this Report. Section 3 discusses environmental factors relevant to the proposal. Conditions and procedures to which the proposal should be subject if the Minister determines that it may be implemented are set out in Section 4. Section 5 provides Other Advice by the EPA. Section 6 presents the EPA's conclusion and Section 7 the EPA's recommendations.

References are listed in Appendix 2, and recommended conditions and proponent's commitments are provided in Appendix 3.

The DEP's summary of submissions and the proponent's response to those submissions has been published separately. Also included in this document is the additional advice from WRC and CALM.

2. The proposal

The proposal is located approximately 40 kilometres south-west of the Perth Central Business District, and approximately 1.5 kilometres west of the Rockingham city centre (Figure 2). Allied Land Company Pty Ltd, the proponent, proposes to subdivide Part Lot 402, Rae Road, Rockingham into residential and commercial lots and cede the Parks and Recreation and Controlled Access Highway Reserve to the Crown. The proposal will ensure all storm events up to 1:10 years and 20 minute to 48 hour duration storm of 100 year (average return index(ARI)) are retained on-site using infiltration basins located in Public Open Space (Figure 3).

The land is zoned Urban in the MRS and Residential under the City of Rockingham Town Planning Scheme. The subdivision is an extension of land previously developed for urban uses, and forms part of the Comprehensive Development Plan for the Cape Peron Estate. Land in the proponent's ownership in the north west portion of Part Lot 402 includes the south east portion of Lake Richmond and its surrounds, which is reserved for P&R under the MRS. This land does not form part of the subdivision proposal and in due course will be acquired by the Western Australian Planning Commission (WAPC).

Table 1. Summary of key proposal characteristics

Proposal Characteristic	Description
Total site area (Pt Lot 402)	115 Ha
Area proposed for subdivision	86 Ha
Area of Controlled Access Highway Reserve	6 Ha
Area of P&R Reserve	23 Ha
Drainage	Water run off from roads generated by storm events up to 1:10 years and 20 minute to 48 hour duration storm of 100 year ARI are retained on-site using infiltration basins within Public Open Space (Figure 3). Water Corporation drains will be used when storm events exceed these criteria. Run off from houses will be disposed of in soakwells or surface infiltration on each lot. The Peter Street Drain (Figure 2) will be upgraded and storm water recharged to a infiltration basin within Public Open Space (Figure 3).
Sewerage	The proposal will be connected to reticulated sewerage. Sewage pump stations will meet DEP criteria for 'sensitive areas' (DEP 1995).
Interface of proposal with P&R Reserve	The proposal will provide pedestrian access points between the development area and P&R Reserve including the provision of gates or other structures which will prevent unauthorised vehicle access to the Reserve. The proponent will prepare a Construction Management Plan which will incorporate procedures to prevent access of construction vehicles to the Lake Richmond P&R Reserve, and the control of noise, dust, fire and fuel storage within the development area.

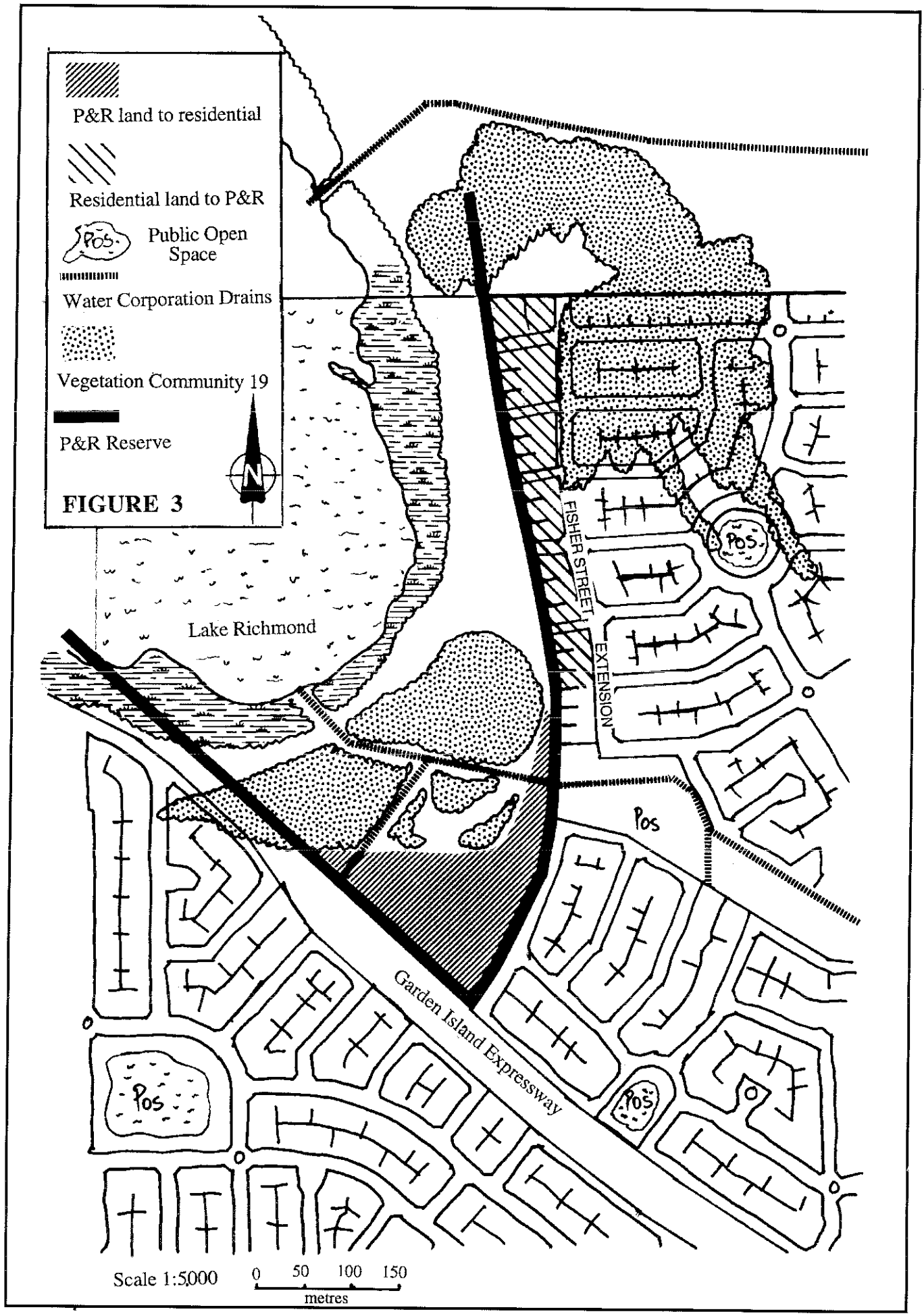

Figure 3. Recommended P&R reserve modification and location of Vegetation Community 19.

3. Environmental factors

3.1 Relevant environmental factors

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

It is the EPA's opinion that the following are the environmental factors relevant to the proposal, which require detailed evaluation in this report:

i) Vegetation Communities - loss of Vegetation Community 19.

ii) P&R Reserve - indirect impacts.

iii) Wetlands - adequacy of buffers to Lake Richmond.

iv) Surface Water Quality - impact of stormwater disposal.

v) Thrombolites - indirect impacts.

The above relevant factors were identified from the EPA's consideration and review of all environmental factors (preliminary factors) generated from the CER document and the submissions received, subsequent correspondence and discussion, the adequacy of the proponent's response and commitments and the effectiveness of current management. On this basis, the EPA considers that the environmental factors Declared Rare and Priority Flora and Fauna, Groundwater, Heritage (indigenous and non-indigenous) and other issues raised in the submissions do not require further evaluation by the EPA. The identification process is summarised in Table 2.

The relevant environmental factors are discussed in Sections 3.2 to 3.6 of this report.

3.2 Vegetation communities - loss of Vegetation Community 19

Description

Vegetation Community 19 (sedgelands in holocene dune-swales), a wetland plant community, has been identified on CALM's 'threatened ecological community' database.

Based on additional flora surveys by the proponent, CALM and DEP it has been concluded that Vegetation Community 19 is located within the P&R reserve (6 ha) and a small remnant (3-5 ha) is located in the north-western corner of the site, adjacent the Fisher Street extension (Figure 3).

This parcel of remnant vegetation is in fair condition with some weed invasion, frequent history of fires, clearing, rubbish dumping and damage due to maintenance of firebreaks.

This remnant is not explicitly identified in the draft Perth Bush Plan and was not identified as one of the 242 wetlands in the "Wetlands of the City of Rockingham -Their Classification Significance and Management" (V&C Semeniuk Research Group, 1991).

CALM has estimated that the total original area covered by Vegetation Community 19 is likely to be 200 to 300 hectares and today is represented by approximately 200 occurrences in 100 hectares, normally small sumplands and damplands. On this basis, approximately 30% of Community remains.

The largest secure reserve which contains Vegetation Community 19 is the Port Kennedy Scientific Park. The Park has an approximate area of 400 hectares. Port Kennedy is considered to have the best examples of Vegetation Community 19, with a consecutive age sequence spanning the contemporary period to 5,000 years before present (BP). The age sequence at Lake Richmond is also represented at Port Kennedy. Larger remnants of Vegetation Community 19 in better condition and greater conservation value are located in

Hillman/Challenger and adjacent Port Kennedy Scientific Park (V&C Semeniuk Research Group, 1991), north and south of Lake Richmond respectively.

Assessment

The area considered for assessment of this factor is Swan Coastal Plain

The EPA's objective in regard to this environmental factor is to "maintain the abundance, species diversity, geographic distribution and productivity of vegetation community types".

Although this remnant of Vegetation Community 19 has conservation value, the EPA believes that, because of its size, condition, secure representation elsewhere and urban context it does not require reservation. In this regard CALM has advised that the Vegetation Community 19 remnant is small and somewhat modified, the Community type is well conserved further south within the Port Kennedy Scientific Park and the best examples in the Lake Richmond area are likely to be conserved in the P&R Reserve.

Having particular regard to the:

a) size, condition and urban context of the Vegetation Community 19 remnant;

b) the proportion remaining of Vegetation Community 19 in the Rockingham Region;

c) the protection of 6 ha of Vegetation Community 19 within the P&R reserve;

d) representation and secure protection of Vegetation Community 19 within the Port Kennedy Scientific Park; and

e) the potential to secure more valuable remnants on the Rockingham Becher Plain.

it is the EPA's opinion that the proposal does not compromise the EPA's objective.

The EPA has provided 'Other Advice' (Section 5.0) with respect to Vegetation Community 19.

3.3 P&R Reserve - indirect impacts

Description

The proposal creates 1,121 lots for 3,000 residents directly adjacent the conservation estate. Residents will create impacts (eg. uncontrolled access, increased fire risk, litter and rubbish dumping)

All the agencies' comments regarded the level of management proposed in the CER, at the interface of the development and the P&R Reserve, as being inadequate. The proponent has maintained that management responsibility for the reserve rests with CALM and the City of Rockingham and that through the payment of Council rates it has fulfilled its obligations.

Assessment

The area considered for assessment of this factor is the P&R Reserve.

The EPA's objective in regard to this environmental factor is to ensure that the conservation values of System 6 recommended areas (P&R Reserve) are not compromised and to ensure that the thrombolites and Community 19 are adequately maintained and protected.

While management of Lake Richmond will ultimately be the responsibility of CALM and the City of Rockingham, the EPA believes that the proponent has some responsibility to manage the impacts created by the proposal, particularly during the release of each subdivisional stage. This position is consistent with coastal and estuary developments adjacent foreshore reserves (WAPC Policy DC 6.2).

CALM, DEP, WRC, Ministry for Planning and City of Rockingham have advised that given additional impacts from visitors and residents, the proponent should plan and implement strategies to minimise impacts. These should include boardwalks, fencing, signage, pathways, general management and revegetation within the P&R Reserve.

The EPA considers the proponent has responsibility to manage impacts created by the proposal. In the absence of a relevant commitment, an appropriate Environmental Management Plan (EMP), consistent with the advice of CALM, WRC, DEP, Ministry for Planning and City of Rockingham, should be prepared and implemented by the proponent.

Having particular regard to the:

a) impacts on the P&R Reserve that could result from the proposal; and

b) the responsibility of the proponent to manage impacts;

it is the EPA's opinion that for the proposal to meet the EPA's objective the proponent needs to prepare and implement an EMP. This plan should address issues such as boardwalks, fencing, signage, access, pathways, general management and revegetation.

3.4 Wetlands - adequacy of buffers to Lake Richmond

Description

The P&R Reserve contains Lake Richmond and its riparian and dryland vegetation. The setback from the development to Lake Richmond's high water mark is 70 to 370 metres (average 160 metres) (Figure 3). This may not provide an adequate buffer to the Lake and the thrombolites within the Lake.

In the CER and response to the submissions, the proponent has provided the following information in relation to the adequacy of the existing P&R Reserve boundary as a satisfactory buffer from Lake Richmond for hydrogeological and groundwater quality reasons:

- Of the total flow of water into Lake Richmond the Water Corporation drains represent 10-40 times more input than groundwater inflow (groundwater inflow 30,875 m^3/yr, surface water inflow 1,176 544 m^3/yr). Therefore the dominate feature which will influence Lake water quality is the drains;

- The proposal will ensure run off from roads and carparks generated by storm events up to 1:10 years and 20 minute to 48 hour duration storm of 100 year ARI are retained on-site using infiltration basins within Public Open Space. Infiltration basins are at least 300 metres from Lake Richmond. Run off from houses will be disposed of in soakwells or surface infiltration on each lot. The proposal will only use the Water Corporation drains when storm events exceed this criteria;

- The water level in Lake Richmond is controlled by the invert level of the outlet drain to Mangles Bay. Therefore the maximum level of Lake Richmond is fixed;

- The Peter Street Drain (Water Corporation) (Figure 2) will be upgraded and drainage water recharged to groundwater, leading to a decrease in drain flow of 56,000m^3. The CER estimated a reduction in phosphorus and nitrogen loads to Lake Richmond of 1.68 kg/yr P and 29.54 kg/yr N based on the difference in nutrient concentrations found in the Water Corporation drains and groundwater beneath existing residential development;

- Following development the local water table could rise 0.25m (therefore no upconing of saltwater is expected) with a slight increase in groundwater inflow to Lake Richmond;

- The proposal will be serviced by reticulated sewerage; and

- There is no significant difference (95% confidence) in phosphorus and total nitrogen between Lake Richmond and drain water, sewered groundwater, non-sewered groundwater and undeveloped groundwater. There was however a higher level for phosphorus, total nitrogen and carbonate in pore water (groundwater seepage collected after it has passed through the lake sediments) within the thrombolite zone compared to sewered residential groundwater. This result is consistent with accepted limnological theory where Lake sediments are a store for nutrients and therefore it is expected seepage through these nutrient enriched sediments will pick up extra nitrogen and phosphorus.

Submissions by the WRC and CALM questioned the adequacy of the existing P&R Reserve as a buffer to protect the water quality and thrombolites in Lake Richmond.

Assessment

The area considered for assessment of this factor is Lake Richmond and surrounds.

The EPA's objective in regard to this environmental factor is to ensure wetlands are protected and key ecological functions are maintained.

CALM has recommended a buffer of 200 metres and advised that Lake Richmond supports the only known living occurrence of this type of thrombolite community (cyanobacteria genus *Dicothrix*). CALM has stated that "*If wrong decisions are taken and this occurrence dies, a fascinating and scientifically significant piece of Western Australia's biological diversity will be lost forever. Every reasonable care should be taken to ensure this does not happen.*". CALM believes that on first principles a larger buffer is more desirable than a smaller one and as such provides greater protection (thrombolites and Vegetation Community 19), space for management and as a general safeguard.

Computer modelling by CSIRO suggests that at the point of entry to the Lake, in 300 to 1,200 years, groundwater from beneath the proposal area would have 0.01 to 0.02 mg/L phosphorus. This is less than or equal to present Lake water quality and about one eighth to one quarter of the phosphorus concentration of seepage (pore water) into the thrombolite zone.

WRC has advised that the buffer can be less than 200m, provided management of drainage water is consistent with best environmental practice (water sensitive design), a more uniform buffer is achieved by modifying the P&R Reserve to the east of Lake Richmond so that it reflects an ecological rather than cadastral boundary and there is revegetation of degraded areas within the P&R Reserve.

In considering this factor the EPA is also cognisant of previous decisions, policies, guidelines and other publications. The most relevant of these is:

- Guidelines for Environment and Planning (EPA Preliminary Policy No.33);
- Final criteria of environmental acceptability for land use proposals within the catchment of Lake Clifton (EPA Bulletin 864); and
- Guidelines for design of effective buffers for wetlands on the Swan Coastal Plain (Davies and Lane 1995).

Policy No.33 recommends 50 metres as a minimum buffer. It states that "*50 metres or 1 metre AHD higher than the furthermost extent of the wetland vegetation which ever is the largest, would be the minimum dryland buffer*". To that extent it is unlikely that the current P&R Reserve boundary (where the buffer is narrowest) in the north-west portion of the proposal, adjacent Fisher Street, would meet this guideline.

Bulletin 864 is particularly relevant given the occurrence of thrombolites within Lake Clifton. This bulletin recommends that horticultural and rural residential developments be setback a minimum of 150 metres from the highwater mark of the lake.

While the EPA acknowledges the Davies and Lane paper, it also recognises that this paper is unpublished and has not been subject to peer review. Notwithstanding this, the paper recommends "*an adequate buffer zone for maintenance of ecological processes and major food webs is recommended at 20 to 50 metres*", further it also states "*the recommended buffer zone for protection of nutrients inputs range from 100 metres in non-sandy soils to 200 metres on sandy soil*". A number of submissions cited this part of the Davies and Lane paper and recommended a 200 metre buffer.

To place the paper's recommendation in perspective, as it relates to Lake Richmond, it is also important to appreciate the footnote it contained, which states "*assumes nutrients are not entering the wetland via a drain*". In this regard the paper also states "*if a drain runs through the buffer zone, the effectiveness of the zone would be minimised*" and "*Drains into wetlands*

effectively 'short circuit' any buffer zone and allow nutrients to rapidly enter without the ameliorating effects of the buffer zone (Peterjon and Correl 1984). In these cases the control of water quality entering a wetland would be need to be considered in an overall drainage management strategy"

Based on all the information, the specific circumstances with respect to Lake Richmond and the proposal, the EPA concludes that the buffer should be increased on the eastern margin of Lake Richmond to achieve a minimum 100 metre setback between the development and the riparian (wetland dependent) vegetation. There is the opportunity to achieve this without significantly reducing the area available for development by exchanging current P&R Reserved land, which is cleared, next to the Garden Island Expressway, with land to the west of Fisher Street (Figure 3).

Having particular regard to the:

a) the limited effect of groundwater because of the influence of the Water Corporation drains on Lake Richmond;

b) proposal for on-site disposal of stormwater and use of reticulated sewerage;

c) predicted impact of residential development on groundwater quality;

d) role of lake sediments in affecting groundwater quality;

e) intention to upgrade the Peter Street drain;

f) the necessary Reserve space required to manage indirect impacts; and

g) previous EPA Bulletins and other reports;

it is the EPA's opinion that the objective can be met subject to the modification of the P&R Reserve in accordance with the notional land exchange occurring, as depicted in Figure 3.

3.5 Surface water quality - impact of stormwater disposal

Description

The proposal is up-gradient of Lake Richmond. The proposal will ensure run off from roads and carparks generated by storm events up to 1:10 years and 20 minute to 48 hour duration storm of 100 year ARI are retained on-site using infiltration basins within Public Open Space. Infiltration basins are at least 300 metres from Lake Richmond. Run off from houses will be disposed of in soakwells or surface infiltration on each lot. The proposal will only use the Water Corporation drains when storm events exceed this criteria. The proposal has potential to alter groundwater quality which flows to Lake Richmond.

The proposal will be serviced by reticulated sewerage. Failures in pumping stations may cause overflows either directly or indirectly to enter Lake Richmond.

From the CER and response to the submissions the proponent has provided the following information in relation to the ability to manage surface water quality, such that it does not have significant impact on ground and Lake water quality:

- A net reduction of nutrients to Lake Richmond is anticipated because the Peter Street Drain will be upgraded and drainage water recharged to groundwater, with an estimated reduction in nutrient loads of 1.68 kg/yr P and 29.54 kg/yr N, while additional loading of nutrients (eg. fertilisers) from proposed subdivision is expected to be 0.46 kg/yr P and 2.2 kg/yr N;

- Computer modelling by CSIRO estimates that at the point of entry to the Lake, in 300 to 1,200 years, groundwater from beneath the proposal area would have 0.01 to 0.02 mg/L phosphorus. This is less than or equal to present Lake water quality and about one eighth to one quarter of the phosphorus concentration of seepage (pore water) in the thrombolite zone.

- There is no significant difference (95% confidence) in phosphorus and total nitrogen between Lake Richmond and drain water, sewered groundwater, non-sewered groundwater and undeveloped groundwater. There was however a higher level for phosphorus, total nitrogen and carbonate in pore water (groundwater seepage collected after is has passed through the lake sediments) within the thrombolite zone compared to sewered residential groundwater. This is consistent with accepted limnological theory where Lake sediments are a store for nutrients and therefore it is expected that seepage through these nutrient enriched sediments will pick up extra nitrogen and phosphorus.

The proponent has made a commitment to ensure sewage pump stations meet DEP criteria (overflow storage, location, capacity and emergency backup) for 'sensitive areas' (DEP 1995).

A number of submissions considered that the CER and response to submissions had not provided sufficient detail regarding the drainage scheme, including design (water sensitive design principles), construction, management, monitoring, criteria, contingency plans, responsibilities, funding and review.

Several submissions believed the Water Corporation drains should be diverted around Lake Richmond within the Garden Island Expressway Reserve or the proponent should improve the drains by constructing detention basins and/or artificial wetlands to filter nutrients from the entire Lake catchment. The Water Corporation drains are not part of the proposal and it is not the proponent's responsibility or obligation to modify their design or alignment.

Assessment

The area considered for assessment of this factor is Lake Richmond.

The EPA's objective for this environmental factor is to maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected.

In view of the acknowledged conservation value of Lake Richmond and the thrombolites, the EPA considers that the drainage scheme should be implemented according to best practice. It is essential that the proponent demonstrate that the scheme, once implemented, achieves water quality objectives and criteria. The publication "The Urban Stormwater Quality Management Manual for Western Australia" by the WRC may be a useful tool in this regard.

Having particular regard to the:

a) commitment for disposal of stormwater on-site;

b) commitment to ensure pump stations meet DEP criteria for sensitive areas;

c) limited impact of residential development on groundwater; and

d) proposed upgrading of Peter Street drain;

it is the EPA's opinion that the proposal can meet the EPA's objective provided the proponent prepares and implements a Drainage and Nutrient Management Plan (DNMP). This plan should address issues such as design, construction, water quality objectives and criteria, monitoring, and contingency plans if criteria are exceeded.

The EPA has provided 'Other Advice' in Section 5 with respect to these drains.

3.6 Thrombolites - indirect impacts

Description

Lake Richmond supports a well developed microbialite (thrombolite) community on the Lake's periphery which has been identified by CALM as a 'threatened ecological community'. Thrombolites are formed by a living benthic microbial community, made up predominantly of the photosynthetic cyanobacterium *Dichotherix* and a variety of diatoms. The formation of the thrombolite structures is attributed to calcium carbonate precipitation. Thrombolites require a

constant source of carbonate and bicarbonate ions, via groundwater, to maintain this precipitation. Changes in water levels, turbidity, salinity and nutrients are considered important factors affecting thrombolite survival. Direct physical impacts, such as trampling of thrombolites, loss of fringing vegetation, erosion and smothering by rubbish or macro algae also threaten thrombolite survival (English et al 1997).

The proposal has potential to alter ground and surface water quantity and quality and therefore impact the thrombolites.

A number of submissions have made the following points:

- that the CER has a number of errors regarding thrombolites;
- the relationship between the survival of thrombolites and groundwater level or quality has not been investigated;
- smothering from sediment is not discussed adequately in the CER;
- the effect of detention basins on water balance of Lake Richmond and groundwater mineral flows for thrombolites needs had not been adequately demonstrated in the CER; and
- indirect impacts from future residents damaging thrombolites (physical crushing) has not been adequately addressed.

The proponent considers:

- that a serious investigation of the thrombolites has taken place and considers the additional work undertaken (response to submissions) supports the conclusions made in the CER, that is, the Water Corporation drains are the single biggest factor which influence Lake Richmond's water quality and hence thrombolites; a factor which is beyond the control of the proponent;
- no significant change in groundwater quality/quantity is expected, because Lake Richmond's maximum water level is fixed, on-site disposal of stormwater is proposed, the planned upgrading of the Peter Street drain and groundwater sampling results;
- smothering is not an issue because stormwater in most events will be disposed of on-site into infiltration basins; and
- a slight increase in groundwater flow is expected to Lake Richmond, therefore calcium carbonate flow needed by thrombolites will be maintained and possibly increased.

Assessment

The area considered for assessment of this factor is Western Australia.

The EPA's objective in regard to this environmental factor is to ensure that thrombolite survival and growth is not adversely impacted by maintaining or improving the existing quantity and quality of ground water and surface water flows into the lake and preventing physical impacts.

The WRC has recently advised the EPA that the thrombolites are still living and that the benthic microbial community currently associated with the structures has been present throughout the formation of the structures and is therefore responsible for their accretion (growth).

The EPA is satisfied that the proposal represents no significant threat to the thrombolites through changes in groundwater and/or Lake water quality, based on its assessment in Section 3.4 and 3.5 and provided the proponent prepares and implements the DNMP and EMP identified above.

Having particular regard to the:

a) provisions for a EMP and DNMP set out in Section 3.3 and 3.5; and

b) proponent's commitments

it is the EPA's opinion that the proposal can meet the EPA's objective. However, for the survival of thrombolites there may be a need for catchment-based contingency plans to maintain appropriate ecological conditions, in particular sediment quality. This is addressed under Other Advice (Section 5.3)

4. Conditions

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

In developing recommended conditions for each project, the EPA's preferred course of action is to have the proponent provide an array of commitments to ameliorate the impacts of the proposal on the environment. The commitments are considered by the EPA as part of its assessment of the proposal, and following discussion with the proponent the EPA may seek additional commitments.

The EPA recognises that not all of the commitments are written in a form which makes them readily enforceable, but they do provide a clear statement of the action to be taken as part of the proponent's responsibility for and commitment to continuous improvement in environmental performance. The commitments, modified if necessary to ensure enforceability, then form part of the conditions to which the proposal should be subject if it is to be implemented.

The EPA may, of course, also recommend conditions additional to that relating to the proponent's commitments.

Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions which the EPA recommends be imposed if the proposal by Allied Land Company to subdivide Pt Lot 402 Rae Road, Cockburn Sound Location 16, Rockingham is approved. These conditions are presented in Appendix 3.

Matters addressed in the conditions include:

a) the proponent shall fulfil the commitments in the Consolidated Commitments statement set out in Appendix 3;

b) the proponent shall prepare and implement an EMP which addresses, but is not limited impacts on the P&R Reserve from residents and visitors and indirect and direct construction impacts on P&R Reserve;

c) the proponent shall prepare a DNMP which addresses design, construction, water quality objectives and criteria, monitoring and contingency plans; and

d) the P&R Reserve shall be modified to generally include land west of the Fisher Street extension and north of the Water Corporation drain, while degraded land within the southern portion of the P&R Reserve should be available for subdivision. If necessary flexibility with respect to Public Open Space contribution should be considered. Figure 3 should be used as a guide to finalising the P&R Reserve.

5. Other advice

5.1 Garden Island expressway

During consideration of this proposal and its potential impact on Lake Richmond, Vegetation Community 19, and the thrombolites it became evident to the EPA that the Garden Island

Expressway, which is reserved in the MRS and City of Rockingham Town Planning Scheme, has the potential, if constructed, to impact significantly on the environment. In the context of submissions on the CER, advice from the DEP and in view of existing EPA policies, statements and guidelines regarding appropriate buffers, it is the EPA's view that the need for and alignment of this road should be reviewed.

The EPA recommends that the WAPC, City of Rockingham, Department of Defence, Mains Roads Western Australia and Department of Transport undertake a study to assess the future need of this road and possible alternatives.

5.2 Vegetation Community 19

This assessment has highlighted the value and need to conserve significant remnants of Vegetation Community 19 on the Rockingham Becher Plain, not currently within secure reserves. The ongoing management of Vegetation Community 19 is being undertaken by CALM through its 'threatened ecological community' program. A 'Recovery Team' has been established which published the *Draft Interim Recovery Plan - Sedgelands Holocene Dune Swales (1997)*. One of the aims of the Recovery Team is to identify other occurrences of the Community and conserve as many of them as possible.

The EPA is also aware that CALM, WRC, Ministry for Planning and DEP are preparing the draft Perth Bushplan, a document that will identify regionally significant bushland within the Perth Metropolitan Region and make appropriate recommendations for conservation and management.

On this basis, the EPA recommends that CALM, through the Recovery Team, identify and prioritise the remaining remnants of Vegetation Community 19 not within secure reserves. This information should then be assessed against accepted regionally significant criteria as a basis for inclusion in the draft Perth Bushplan, which will then be available for public comment.

5.3 Water Corporation drains

Despite low nutrient concentrations in Lake Richmond, the EPA considers the use of this important wetland, as a detention/compensation basin is inconsistent with current best environmental practice, that is, Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 and EPA Bulletin 683 (EPA submission on the South-west Corridor Structure Plan Review). The EPA is concerned that little or no water quality and sediment monitoring is being undertaken by the Water Corporation with respect to impacts created by the drains. Given the dominant water flow is from drains (1,176,544 m^3/yr) compared with groundwater (30,875 m^3/yr) the EPA is also concerned that nutrient loads entering the Lake may be very high and as such the assimilative capacity of the sediments may be exceeded, resulting in a deterioration in water quality and hence threat to the thrombolites.

On this basis the EPA recommends that the Water Corporation, in conjunction with CALM and WRC, should undertake a study to examine alternatives (eg. by-passing Lake Richmond). The Water Corporation should, as a priority, plan and implement a water and sediment quality monitoring program before the proposal commences. This program should be integrated and complementary to the DNMP undertaken by the proponent. The program should continue to be implemented while Lake Richmond is being used as a detention/compensation basin.

The CER highlighted the possibility that the Rockingham Central Branch drain, which enters the south-east corner of Lake Richmond and is within a 2.6 ha parcel of Public Open Space could be developed as a multiple use corridor. In the short to medium term , the EPA supports this proposition, on the basis the drain could be modified within the Public Open Space (Figure 3) to remove nutrients and other pollutants through sedimentation. The modification could also improve the amenity, safety and environmental values of the drain. Accordingly, it is recommended that the Water Corporation and proponent should commence negotiations to achieve this objective.

6. Conclusions

The EPA, in consideration of all available information, concludes that the proposal by Allied Land Company to subdivide Pt Lot 402 can be managed and modified to meet its objectives through:

- an EMP which will address the factors P&R Reserve and Thrombolites;
- a DNMP which will address the factor Surface Water Quality; and
- modification of the P&R Reserve which will address the factor Wetlands.

It is the EPA's conclusion, on advice from the DEP and CALM, that development of a small (3-5 ha) remnant of Vegetation Community 19 located on the land proposed for subdivision will not threaten the long term survival of this community type.

The EPA makes the following conclusions regarding the Other Advice provided in Section 5:

- the WAPC, City of Rockingham, Department of Defence, Mains Roads Western Australia and Department of Transport should review the need for and alignment of the Garden Island Expressway;
- CALM should undertake a regional assessment of Vegetation Community 19 remnants and where appropriate these should be included in the draft Perth Bushplan;
- The Water Corporation, in conjunction with CALM and WRC, should undertake a study to examine alternatives to using Lake Richmond as a compensation/infiltration basin; and
- The Water Corporation should, as a priority, plan and implement a water and sediment quality monitoring program before the proposal commences. This program should continue to be implemented while Lake Richmond is being used as a compensation/infiltration basin.

7. Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister considers the report on the relevant environmental factors of Vegetation Communities, P&R Reserve, Wetlands, Surface Water Quality and Thrombolites set out in Section 3;
2. That the Minister notes that the EPA has concluded that the proposal can be managed to meet the EPA's objectives, and thus not impose an unacceptable impact on the environment, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Section 4;
3. That the Minister imposes the conditions and procedures recommended in Appendix 3; and
4. That the Minister endorses the Other Advice in Section 5 and takes appropriate action to ensure those agencies responsible are aware of this advice.

Appendix 1

List of submitters

Government

Ministry for Planning

Water and Rivers Commission

Water Corporation

Department of Conservation and Land Management

Main Roads Western Australia

City of Rockingham

Australian Heritage Commission

National Parks and Nature Conservation Authority

Conservation Reserve and Foreshore Management Advisory Committee (City of Rockingham)

Individuals and Community Groups

Friends of Lake Richmond

Rockingham Regional Environment Centre (inc)

Kwinana/Rockingham/Mandurah Branch of the WA Naturalist Club (Inc)

Conservation Council of Western Australia

Appendix 2

References

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Appendix 3

List of recommended ministerial conditions and procedures and proponent's consolidated commitments.

Statement No.

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

RESIDENTIAL/COMMERCIAL SUBDIVISION, PART LOT 402 RAE ROAD, COCKBURN SOUND LOCATION 16, ROCKINGHAM

Proposal: The subdivision of Part Lot 402, Rae Road, Rockingham for residential and commercial purposes and the ceding of the Parks and Recreation Reserve and the Controlled Access Highway Reserve to the Crown, as documented in Schedule 1 and generally depicted in Figure 1 of this statement.

Proponent: Allied Land Company Pty Ltd

Proponent Address: PO Box 481 West Perth 6872

Assessment Number: 1077

Report of the Environmental Protection Authority: Bulletin 892

The proposal to which the above report of the Environmental Protection Authority relates may be implemented subject to the following conditions and procedures:

1 Implementation

1-1 Subject to these conditions and procedures, the proponent shall implement the proposal as documented in Schedule 1 of this statement.

1-2 Where, in the course of implementing the proposal, the proponent seeks to change any aspect of the proposal as documented in Schedule 1 of this statement in any way that the Minister for the Environment determines, on advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

2 Proponent Commitments

2-1 The proponent shall implement the consolidated environmental management commitments documented in Schedule 2 of this statement.

2-2 The proponent shall implement subsequent environmental management commitments which the proponent makes as part of the fulfilment of conditions and procedures in this statement.

3 Parks and Recreation Reserve Environmental Management Plan

3-1 Prior to subdivision, the proponent shall prepare an Environmental Management Plan for the portion of Part Lot 402 to be set aside for Parks and Recreation Reserve purposes, the boundary of which shall be consistent with Procedure 6 below, to the requirements of the Department of Environmental Protection on advice of the Department of Conservation and Land Management and the City of Rockingham.

This Plan shall address:

1 the protection of the conservation values of the Parks and Recreation Reserve including the protection of thrombolites, wetlands, terrestrial fauna and Vegetation Community 19;

2 the impacts of residents and visitors;

3 the impacts of construction activities;

4 the provision of facilities such as fencing, boardwalks, signage and accessways;

5 revegetation;

6 maintenance and responsibilities for maintenance; and

7 timing of actions required.

3-2 The proponent shall implement the Environmental Management Plan required by condition
3-1 to the requirements of the Department of Environmental Protection on advice of the Department of Conservation and Land Management and the City of Rockingham.

4 Drainage and Nutrient Management Plan

4-1 Prior to subdivision, the proponent shall prepare a Drainage and Nutrient Management Plan for the site to the requirements of the Department of Environmental Protection on advice of the Water and Rivers Commission and the City of Rockingham.

This Plan shall address:

1 water quality objectives and criteria;

2 drainage design;

3 construction;

4 management;

5 monitoring;

6 contingency planning; and

7 timing of actions required.

4-2 The proponent shall implement the Drainage and Nutrient Management Plan required by condition 4-1 to the requirements of the Department of Environmental Protection on advice of the Water and Rivers Commission and the City of Rockingham.

5 Land to be Excluded

5-1 The proponent shall not subdivide nor develop for residential or commercial purposes the land which is generally west of the proposed extension of Fisher Street, as shown on Figure 1 in Schedule 1 of this statement, unless the subdivision is consistent with the outcome of Procedure 6.

5-2 The proponent shall take appropriate actions to achieve the protection of the land referred to in 5-1, to the extent that this is consistent with the outcome of Procedure 6 and Condition 3.

6 Modified Parks and Recreation Reserve

6-1 The Minister for the Environment on advice of the Department of Environmental Protection and the Ministry for Planning will identify a modification to the Parks and Recreation Reserve to protect the environmental values of Lake Richmond.

To achieve this objective:

1 the boundary of the Parks and Recreation Reserve on the eastern side of Lake Richmond shall be no less than 100 metres from the outermost extent of the wetland dependent vegetation; and

2 the Parks and Recreation Reserve may exclude the degraded land in the southern portion of the Parks and Recreation Reserve shown in Figure 1 in Schedule 1 of this statement;

as shown in principle in Figure 3 in Schedule 1 of this statement.

7 Proponent

7-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the Environmental Protection Act is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person in respect of the proposal.

7-2 Any request for the exercise of that power of the Minister referred to in condition 7-1 shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the proposal in accordance with the conditions and procedures set out in the statement.

7-3 The proponent shall notify the Minister for the Environment of any change of proponent contact name and address within 30 days of such change.

8 Commencement

8-1 The proponent shall provide evidence to the Minister for the Environment within five years of the date of this statement that the proposal has been substantially commenced.

8-2 Where the proposal has not been substantially commenced within five years of the date of this statement, the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment will determine any question as to whether the proposal has been substantially commenced.

8-3 The proponent shall make application to the Minister for the Environment for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement.

8-4 Where the proponent demonstrates to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority that the environmental parameters of the proposal have not changed significantly, then the Minister may grant an extension not exceeding five years for the substantial commencement of the proposal.

9 Compliance Auditing

9-1 The proponent shall submit periodic Performance and Compliance Reports, in accordance with an audit program prepared in consultation between the proponent and the Department of Environmental Protection.

9-2 Unless otherwise specified, the Department of Environmental Protection is responsible for assessing compliance with the conditions contained in this statement and for issuing formal clearance of conditions.

9-3 Where compliance with any condition or procedure is in dispute, the matter will be determined by the Minister for the Environment.

Schedule 1

The proposal

Allied Land Company Pty Ltd, the proponent, proposes to subdivide Part Lot 402, Rae Road, Rockingham into residential lots, commercial lots, roads and land for parks and recreation purposes, as generally depicted in Figure 1 below.

The main characteristics of the proposal as modified during the environmental impact assessment process under the Environmental Protection Act 1986 are summarised in Table 1 below.

Table 1. Summary of key proposal characteristics

Proposal Characteristic	Description
Total site area (Pt Lot 402)	115 ha (approx.)
Area proposed for subdivision	86 ha (approx.)
Area of Controlled Access Highway Reserve	6 ha (approx.)
Area of Parks and Recreation Reserve	23 ha (approx.)
Drainage	Water run off from roads generated by storm events up to 1:10 years and 20 minute to 48 hour duration storm of 100 year ARI are retained on-site using infiltration basins within Public Open Space (Figure 3). Water Corporation drains will be used when storm events exceed these criteria. Run off from houses will be disposed of in soakwells or surface infiltration on each lot. Condition 4 requires the preparation and implementation of a Drainage and Nutrient Management Plan. The Peter Street Drain (Figure 2) will be upgraded and storm water recharged to an infiltration basin within Public Open Space.
Sewerage	The proposal will be connected to reticulated sewerage. Sewage pump stations will meet Department of Environmental Protection criteria for 'sensitive areas' (DEP 1995).
Interface of proposal with Parks and Recreation Reserve	The proposal will provide pedestrian access points between the development area and Parks and Recreation Reserve including the provision of gates or other structures which will prevent unauthorised vehicle access to the Reserve. Condition 3 requires the preparation and implementation of a Parks and Recreation Reserve Environmental Management Plan. The proponent will prepare a Construction Management Plan which will incorporate procedures to prevent access of construction vehicles to the Lake Richmond Parks and Recreation Reserve, and the control of noise, dust, fire and fuel storage within the development area.

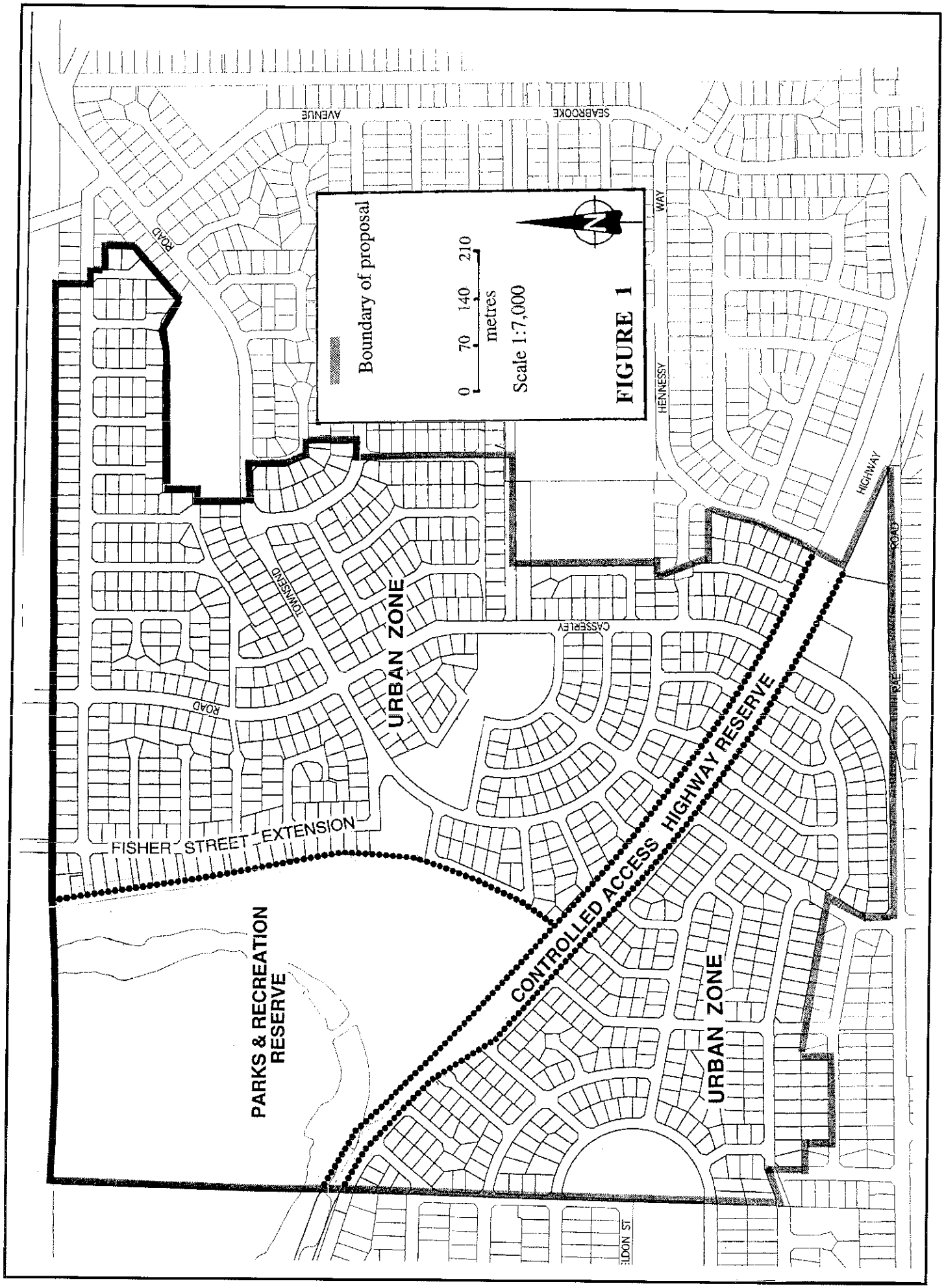


Figure 1. Proposed subdivision.

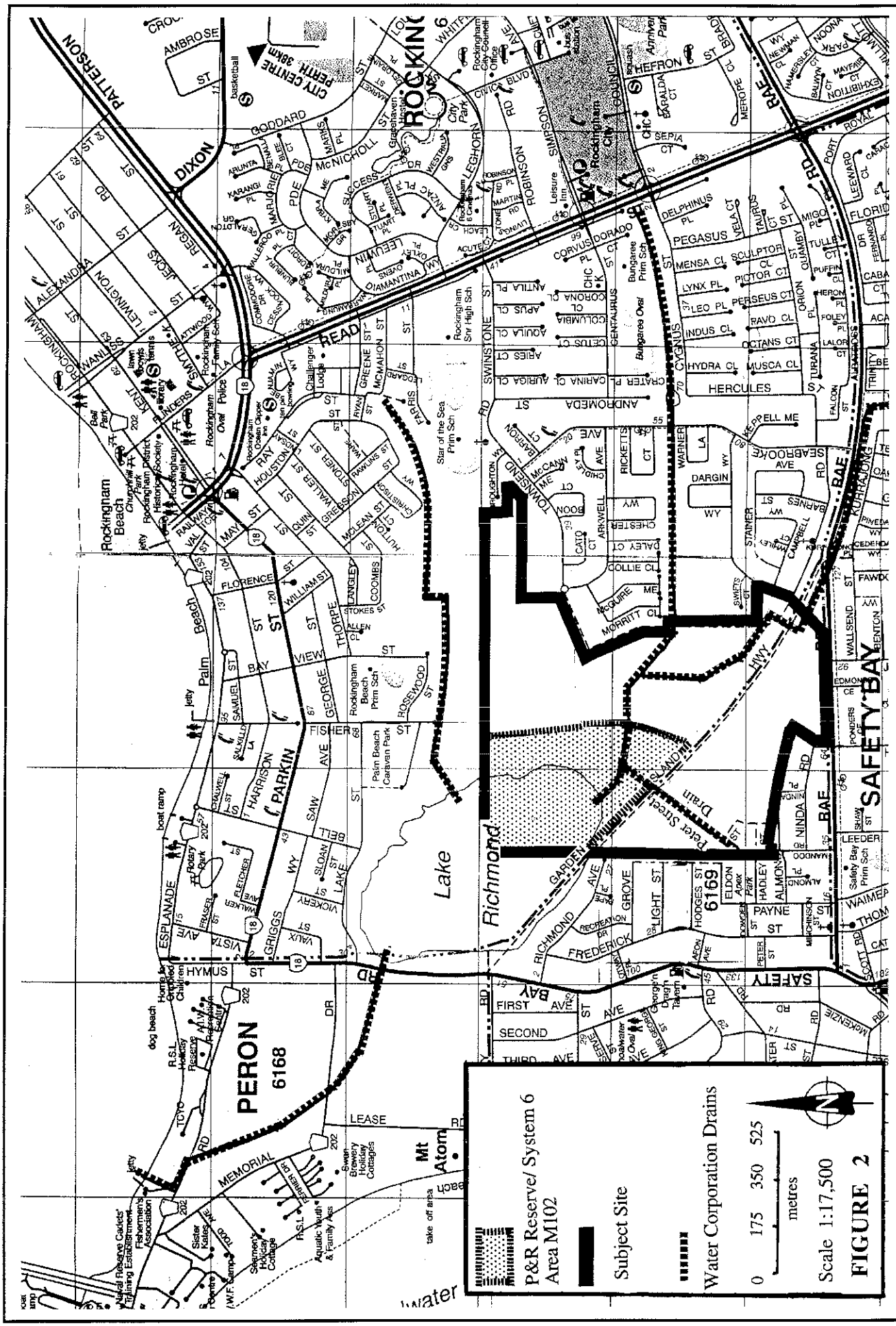


Figure 2. Location of proposal.

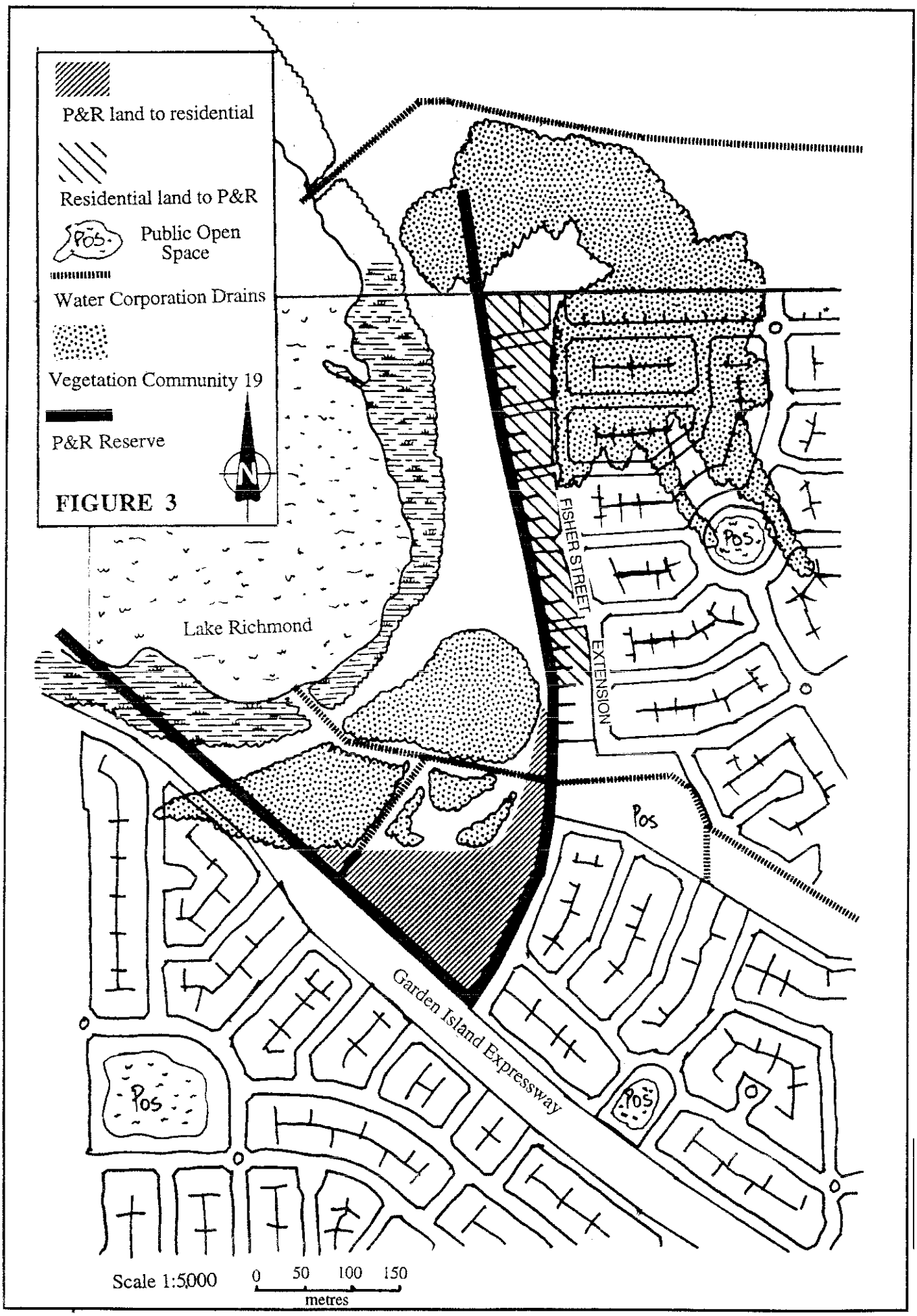


Figure 3. Recommended P&R reserve modification and location of Vegetation Community 19.

Schedule 2

Proponent's Consolidated Environmental Management Commitments

April 1998

RESIDENTIAL/COMMERCIAL SUBDIVISION, PART LOT 402 RAE ROAD, COCKBURN SOUND LOCATION 16, ROCKINGHAM.

Assessment Number: 1077

Proponent: ALLIED LAND COMPANY PTY LTD

1 Prior to commencement of construction, Allied Land Company Pty Ltd will undertake detailed design of sewer pumping stations to ensure the requirements of the Department of Environmental Protection are met.

2 Prior to the commencement of construction, Allied Land Company Pty Ltd will develop a Construction Management Plan which will incorporate procedures to prevent access of construction vehicles to the Lake Richmond Parks and Recreation Reserve, and the control of noise, dust, fire and fuel storage within the development area, to the satisfaction of the City of Rockingham and in consultation with the Department of Environmental Protection and the Department of Conservation and Land Management.

3 Prior to commencement of construction, Allied Land Company Pty Ltd will inform the project construction workforce of the requirement to refer uncovered Aboriginal archaeological materials to the WA Museum, in accordance with the provisions of the Aboriginal Heritage Act 1972.

Table 2. Identification of relevant environmental factors

PRELIMINARY ENV. FACTOR	PROPOSAL CHARACTERISTIC	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Vegetation Communities	Clearing on land proposed for development may contain Vegetation Community 19.	• The flora list is incomplete with no recognition of CALM's Threatened Communities (Vegetation Community 19).	**This factor requires further EPA evaluation**
P&R Reserve	The proposal will create approximately 1,100 lots for 3,000 residents directly adjacent the P&R Reserve. Residents will create impacts (eg. uncontrolled access, increased fire risk, litter and rubbish dumping)	• There is no commitment to help manage Lake Richmond itself. The developer needs to give a commitment to provide for such management. • A more careful and thorough Management Plan should be prepared and implemented before this project takes place. • The commitment by the proponent to establish management control boundaries and access to the Reserve is inadequate. A financial contribution towards management should be regarded as a minimum. • All the natural resource management agencies commented that the level of management proposed in the CER commitments was not adequate.	**This factor requires further EPA evaluation.**
Declared Rare and Priority Species	Declared Rare and Priority species may be cleared land proposed for development.	• Full flora surveys have not been completed for all the land, this should be undertaken.	• The proponent undertook full flora surveys of all the land and found no Declared Rare or Priority species. **This factor does not require further EPA evaluation**
Declared rare fauna	The proposal will involves clearing of remnant vegetation on land proposed for development which could be habitat for Declared Rare and Priority fauna.	• Full fauna surveys have not been completed for all the land, this should be undertaken. • Under Appendix C of the CER, 'Threatened Fauna' no mention is made of the Quenda or Southern Brown Bandicoot (Isodon obesulus). This threatened species has been located in the area. • The CER states the Peregrine Falcon is a rare visitor. This is not true: the Peregrine Falcon is a frequent visitor to Lake Richmond.	• Additional survey work undertaken in September 1997. Viable habitat is restricted to the P&R Reserve. On the land proposed for development no Declared Rare or Priority species, including the Southern Brown Bandicoot were recorded • The proponent accepts that the Peregrine Falcon is a visitor to Lake Richmond, which is an issue for the management of the P&R Reserve. **This factor does not require further EPA evaluation.**
Wetlands	The P&R Reserve contains Lake Richmond and its riparian and dryland vegetation. The setback from the development to Lake	• The CER incorrectly uses Davies and Lane 1996 unpublished document on Guidelines for design of effective buffers for wetlands on the Swan coastal plain. The CER puts forward 20 to 50 metres as being recommended by Davies and Lane.	**This factor requires further EPA evaluation.**

PRELIMINARY ENV. FACTOR	PROPOSAL CHARACTERISTIC	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
	Richmond is 70 to 370 metres. This may not provide an adequate buffer to the Lake.	• A number of submissions recommended a buffer of 200 metres.	
Groundwater	Lake Richmond is down gradient from the proposal. Most of the site is already cleared, however limited clearing of native vegetation will occur. The proposal has potential to alter the quantity of groundwater flow to Lake Richmond, through changes to groundwater recharge from 'hard' surfaces to stormwater infiltration basins which provides calcium carbonate required for thrombolite growth.	• Can detention basins hold a 1:10 ARI storm event in winter when groundwater levels are at there highest? This has not been adequately demonstrated in the CER. • The CER does not address the draw down of groundwater resulting from bore use and the upconing of the saltwater interface. Should the lake become saline as a result of the upconing, the thrombolite community is unlikely to survive.	Based on data in the CER and response to submissions the following points can be made: • Most of the land proposed development site is cleared and represents 7.7% of the catchment of Lake Richmond. • In 1968 the Water Corporation constructed 4 drains which collect surface water and dewaters the shallow aquifer, which then drains into Lake Richmond. These drains facilitated the development of the Rockingham area by lowering the water table by 1.0-2.0 metres. • Of the total flow of water into Lake Richmond the drains represent 10-40 times more, than groundwater inflow. (groundwater inflow 30,875 m^3/yr surface water, inflow 1,176 544 m^3/yr), therefore any change to groundwater hydrology due to the development will be insignificant compared with surface water flow (drains). • The water level in Lake Richmond is controlled by invert level of the outlet drain to Mangles Bay. Therefore the maximum level of Lake Richmond is fixed. • The proposed development will retain all storm events up to 1:10 years on-site and 20 minute to 48 hour duration storm of 100 year ARI. The Peter Street Drain will be upgraded and drainage water recharged to groundwater (decrease flow in drains by 56,000m^3). Following development the local water table could rise 0.25m (therefore no upconing of saltwater is expected) with a slight increase in groundwater inflow to Lake Richmond. **This factor does not require further EPA evaluation**

PRELIMINARY ENV. FACTOR	PROPOSAL CHARACTERISTIC	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Thrombolites	Lake Richmond also supports a well developed microbialite (thrombolite) community on the Lake's periphery which has been identified by CALM as a 'threatened ecological community'. The proposal has potential to alter ground and surface water quantity and quality flows and impact on the survival of the thrombolites.	• The CER compares the nutrient status of Lake Richmond with that of lakes in the metropolitan area claiming that the levels are lower. This is the case, however, these other lakes do not support thrombolites. The cyanobacteria that form thrombolites do not require nutrient inputs for growth, in fact thrombolites and stromatolites generally occur in nutrient poor environments. • The CER has a number of errors regarding thrombolites. The reference to Moore 1993 has been misquoted. Carbonate precipitation has not been attributed to the diatoms present in the benthic microbial community. • The relationship between the survival of thrombolites and groundwater level or quality has not been investigated. • The thrombolites are under some threat of smothering from sediment, as noted in the CER, but this threat is not discussed further in the document. • The effect of detention basins on water balance of Lake Richmond and groundwater mineral flows for thrombolites needs to be established this has not been adequately demonstrated in the CER. • Indirect impacts from future residents will damage thrombolites (physical crushing).	**This factor requires further EPA evaluation**
Surface Water Quality	The proposal is up gradient of Lake Richmond and will dispose of stormwater using local infiltration basins. The proposal has potential to alter groundwater quality which flows to Lake Richmond. The proposal will be serviced by reticulated sewerage, failures in pumping stations may cause overflows either directly or indirectly may enter Lake Richmond	• This development will lead to higher nutrient loadings in the existing drain and groundwater, as it has done in most Perth suburbs, (eg. Bibra Lake, Thomsons Lake, Lake Kogolup). • The detention basins for this development will treat nutrients in the stormwater runoff by soakage alone. If this is the case, nutrients from the proposed development will be transmitted through the groundwater to Lake Richmond unless efficient and effective nutrient attenuation is achieved by the infiltration/detention basins.	**This factor requires further evaluation by the EPA.**

PRELIMINARY ENV. FACTOR	PROPOSAL CHARACTERISTIC	GOVERNMENT AGENCY AND PUBLIC COMMENTS	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
		• The drainage system should be designed with use of wetland species to increase nutrient and pollutant uptake and create a habitat for fauna, this has not been addressed in the CER. • The CER does not adequately address or detail how the drainage system will be in accord with water sensitive design principles. • The proponent needs to address the long term management of drainage system, that is water monitoring, criteria, contingency plans, responsibilities, funding and review. • The southern and northern drains on the east side of Lake Richmond should be diverted to prevent polluted water entering Lake Richmond. This includes diverting the drainage to the Cape Peron outfall. • The proponent should improve the southern and northern drains on the east side of Lake Richmond. A catchment detention basin should be located on the Northern Branch drain before entry to the lake to filter nutrients from the entire catchment area and ensure all events are catered for.	
Heritage (Indigenous and non-indigenous)	Lake Richmond is a significant wetland and as such may have significant ethnographic or archaeological value.	• There is no mention of the Native Title Claim in the CER, nor is there mention of the remnants of Aboriginal fish traps in Lake Richmond.	• The proponent has met the EPA's guidelines regarding this factor, including ethnographic and archaeological investigations. • The proponent has made a commitment to ensure that prior to commencement of construction the project construction workforce of the requirement to refer uncovered Aboriginal archaeological material to the WA Museum, in accordance with the provisions of the Aboriginal Heritage Act 1972. **This factor does not require further EPA evaluation**

Table 3. Summary of relevant environmental factors

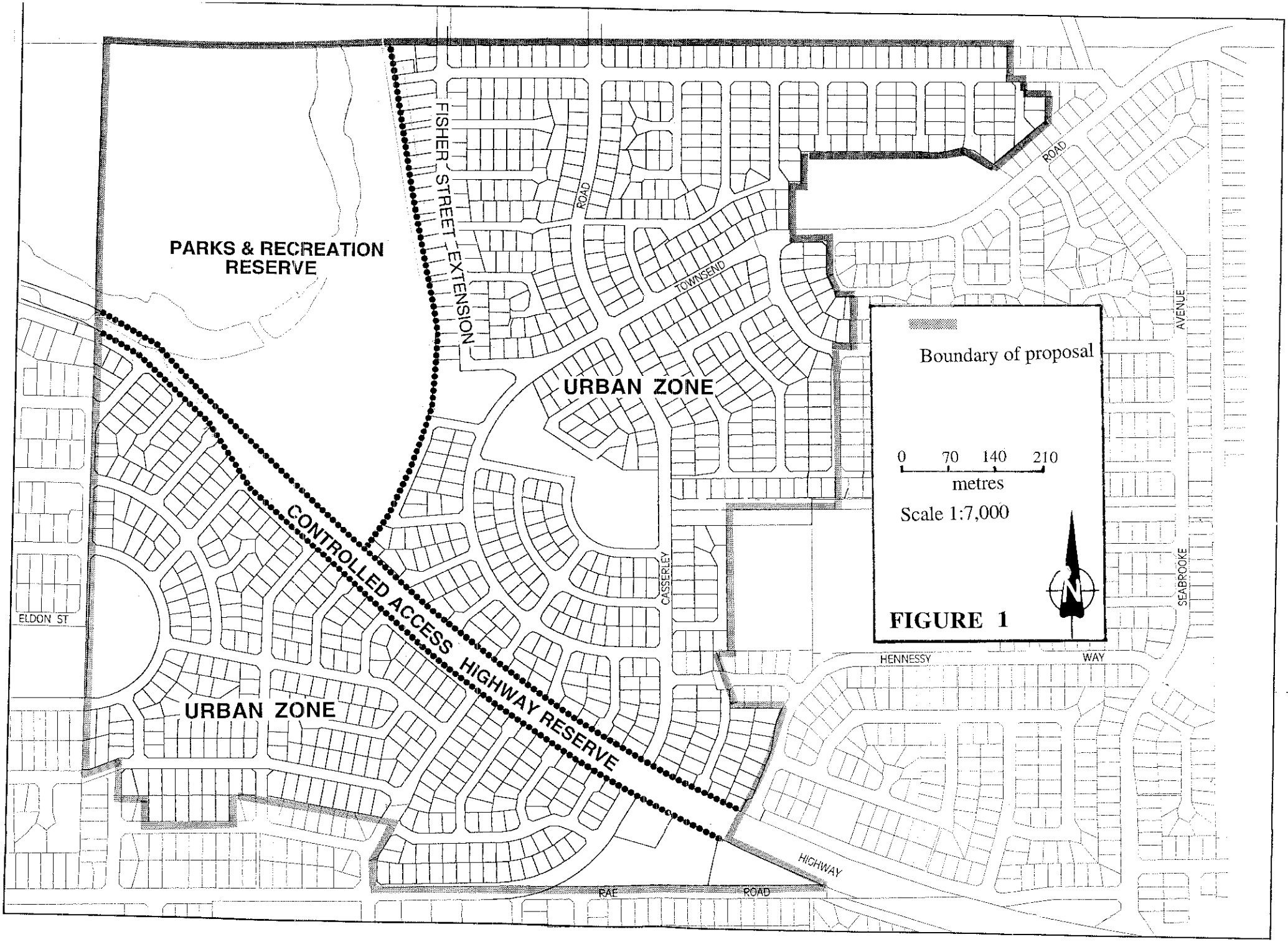
RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVE	EPA ASSESSMENT	EPA ADVICE
Vegetation Communities loss of Vegetation Community 19	Swan Coastal Plain	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation community types.	• Additional flora surveys undertaken in September 1997 for the whole site indicated that the Vegetation Community 19 is located within the P&R Reserve. • Based on the combination of species and habitat characteristics which define Vegetation Community 19, additional site inspections by CALM it is concluded that part of the land proposed for development supports Vegetation Community 19. The estimated size of the remnant is 3-5 hectares. • This parcel of remnant vegetation is in fair condition with some weed invasion, frequent history of fires, clearing, rubbish dumping and damage due to maintenance of firebreaks. This remnant is not explicitly identified in Perth Bush Plan. • At a regional perspective, and while it is impossible to estimate the total original area covered by the Community, it is unlikely to have been much over two to three hundred hectares. Today the Community is currently represented in something under 200 occurrences, normally they are small sumplands and damplands. Without a detailed assessment it is likely that approximately 100 hectares of Vegetation Community 19 remains. • The largest secure reserve which contains Vegetation Community 19 is the Port Kennedy Scientific Park, which has a total area of approximately 400 hectares. Port Kennedy it considered to have the best examples of Vegetation Community 19 with a consecutive age sequence spanning the contemporary period to 5,000 years BP. The age sequence at Lake Richmond is also represented at Port Kennedy.	Having particular regard to the: a) size, condition and urban context of the Vegetation Community 19 remnant; b) the proportion of the whole of Community 19 remaining in the Rockingham Region; c) the protection of 5 ha of Vegetation Community 19 within the P&R reserve; d) representation and secure protection of Vegetation Community 19 within the Port Kennedy Scientific Park; and e) the potential to secure more valuable remnants on the Rockingham Becher Plain. it is the EPA's opinion that the proposal does not compromise the EPA's objective. The EPA is also aware that CALM, WRC, Ministry for Planning and DEP are preparing the draft Perth Bushplan, a document that will identify regionally significant bushland within the Perth Metropolitan Region and make appropriate recommendations for conservation and management. On this basis, the EPA recommends that CALM, through the Recovery Team, identify and prioritise the remaining remnants of Vegetation Community 19 not within secure reserves. This information should then be assessed against accepted regionally significant criteria as a basis for inclusion in the draft Perth Bushplan, which will then be available for public comment.

RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVE	EPA ASSESSMENT	EPA ADVICE
P&R Reserve indirect impacts	Lake Richmond	Ensure that the conservation values of System 6 recommended areas are not compromised. Ensure that regionally significant flora and vegetation communities, including thrombolites in the P&R Reserve are adequately protected.	• The proposal creates approximately 1,100 lots for 3,000 residents directly adjacent the conservation estate. • The proponent provided a number of commitments regarding the interface of the development and the P&R Reserve, pedestrian access points between the development and the reserve and construction management. All the agencies comments regarded this level of management as being inadequate. In response the proponent has maintained that management responsibility for the reserve rests with CALM and the City of Rockingham and through the payment of Council rates has fulfilled their obligations. • Management of Lake Richmond will ultimately be the responsibility of CALM and City of Rockingham, however the proponent has some short to medium term responsibility to manage the impacts created by the proposal, particularly during the release of each subdivisional stage. This position is consistent with the principle that the proponent creating the impact should manage it ('polluter pays') and is a standard requirement for coastal and estuary developments adjacent foreshore reserves. (WAPC Policy DC 6.2) • The proponent has provided a commitment to prepare a Construction Management Plan to control access, dust, fire, noise impacts and fuel storage. • The cleared area to the south could be released in exchange for land on the eastern side of Lake Richmond for extra buffer.	Having particular regard to the: a) impacts on the P&R Reserve that could result from the proposal; and b) the responsibility of the proponent to manage impacts; it is the EPA's opinion that for the proposal to meet the EPA's objective the proponent needs to prepare and implement an Environmental Management Plan (EMP). This plan should address issues such as boardwalks, fencing, signage, access, pathways, general management and revegetation.

RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVE	EPA ASSESSMENT	EPA ADVICE
Wetland buffers adequacy of buffers to Lake Richmond	Lake Richmond	Wetlands are protected and key ecological functions are maintained.	• In responding to the submissions the proponent supports the conclusions made in the CER regarding the P&R Reserve as a satisfactory buffer from Lake Richmond (70m to 370m, average 160m) for hydrogeological and groundwater quality reasons. • CALM advised a larger buffer of about 200m was desirable but recognised WRC was best placed to provide advice. • WRC recent advice was that the buffer can be less than 200m, provided the focus should be on managing drainage water and providing some additional buffer, through a land exchange, to the east of Lake Richmond. • In consideration of this advice from CALM and WRC that the buffer should also be adequate to manage indirect impacts and based on first principles that a larger more uniform buffer is more desirable than a smaller irregular buffer, it is recommended that a notional land exchange occur to increase the buffer to the east of Lake Richmond.	Having particular regard to the: a) the limited effect of groundwater because of the influence of the Water Corporation drains on Lake Richmond; b) proposal for on-site disposal of stormwater and use of reticulated sewerage; c) predicted impact of residential development on groundwater quality; d) role of lake sediments in affecting groundwater quality; e) intention to upgrade the Peter Street drain; f) the necessary Reserve space required to manage indirect impacts; and g) previous EPA Bulletins and other reports; it is the EPA's opinion that the objective can be met subject to the modification of the P&R Reserve in accordance with the notional land exchange occurring, as depicted in Figure 3.

RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVE	EPA ASSESSMENT	EPA ADVICE
Surface Water Quality impact of stormwater disposal.	Western Australia	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA, 1993)	Based on data in the CER and response to submission the following points can be made: • There is no significant difference (95% confidence) between Lake water quality and drain water quality. There is no significant difference in phosphorus between existing sewered residential and land proposed for development. • The Peter Street Drain will be upgraded and drainage water recharged to groundwater. A reduction in phosphorus and nitrogen loads is expected (1.68 kg/yr P and 29.54 kg/yr N) • Additional loading of nutrients to Lake Richmond resulting from groundwater flow from beneath the proposed residential development can be expected. (0.46 kg/yr P and 2.2 kg/yr N) • There is a higher level for phosphorus, total nitrogen and carbonate in the thrombolite zone (pore water) compared to sewered residential groundwater. • The proposed development will be serviced reticulated sewerage • This data indicates the proposed development will not have a significant impact on groundwater or surface water quality and in fact there may be a reduction in nutrient loadings to Lake Richmond provided the drainage scheme is design and constructed according to best practice. • The proponent has not provided sufficient detail regarding the drainage scheme, including design, construction, management and monitoring, however did provide a commitment in the CER to provide greater detail during the implementation of the proposal.	Having particular regard to the: a) commitment for disposal of stormwater on-site; b) commitment to ensure pump stations meet DEP criteria for sensitive areas; c) limited impact of residential development on groundwater; and d) proposed upgrading of Peter Street drain; it is the EPA's opinion that for the proposal to meet the EPA's objective the proponent needs to prepare and implement a Drainage and Nutrient Management Plan (DNMP). This plan should address issues such as design, construction, water quality objectives and criteria, monitoring, and contingency plans if criteria are exceeded.

RELEVANT FACTOR	RELEVANT AREA	EPA OBJECTIVE	EPA ASSESSMENT	EPA ADVICE
Thrombolites indirect impacts	Western Australia	Ensure Thrombolite survival and growth is not adversely impacted by maintaining or improving the existing quantity and quality of ground water and surface water flows into the lake; and preventing physical impacts (eg. crushing).	• The proponent disagrees that a serious investigation of the thrombolites has not taken place and considers the additional work undertaken supports the conclusions made in the CER, that is Water Corporation drains are the single biggest factor which influence Lake Richmond's water quality and hence thrombolites; a factor which is beyond the control of the proponent. • The proposed development is expected to result in small increase in groundwater levels (0.25m). Lake Richmond's maximum water level is controlled by the invert level of the outflow to Mangles Bay. Considering the development will dispose of all drainage water on-site, the upgrading of the Peter Street drain and groundwater sampling no significant decrease in groundwater quality is expected. • Given drainage will be disposed of on-site smothering of thrombolites by sediments is not considered an issue. • A slight increase in groundwater flow is expected to Lake Richmond, therefore calcium carbonate flow needed by thrombolites will be maintained.	Having particular regard to the: a) requirements for and EMP and DNMP identified in Section 3.4 and 3.5; and b) proponent's commitments it is the EPA's opinion that the proposal can meet the EPA's objective.


PARKS & RECREATION RESERVE
FISHER STREET EXTENSION
ROAD
TOWNSEND
ROAD
AVENUE
URBAN ZONE
Boundary of proposal
0 70 140 210
metres
Scale 1:7,000
N
FIGURE 1
CONTROLLED ACCESS HIGHWAY RESERVE
CASSERLEY
SEABROOKE
ELDON ST
HENNESSY
WAY
URBAN ZONE
HIGHWAY
RAE
ROAD