Metropolitan Region Scheme Amendment 950/33 and North-East Corridor Structure Plan

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A submission and informal advice by the Environmental Protection Authority on the North-East Corridor Amendment by State Planning Commission, and comments regarding the North-East Corridor Structure Plan prepared by the Department of Planning and Urban Development

Environmental Protection Authority
Perth, Western Australia
Bulletin 754
September 1994

THE PURPOSE OF THIS REPORT

This report is the Environmental Protection Authority's advice and submission to the State Planning Commission regarding the North East Corridor Structure Plan and the major Amendment to the Metropolitan Region Scheme No. 950/33.

This submission is not a report under Part IV of the Environmental Protection Act, and there are no provisions for appeals against the Authority's views expressed in this submission.

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This Bulletin contains the Environmental Protection Authority's advice to the State Planning Commission on the North-East Corridor Structure Plan and Metropolitan Region Scheme Amendment Number 950/33. It covers two broad types of environmental issues:

- those confined specifically to the corridor; and
- those having broader regional implications.

Three issues are of concern to the Environmental Protection Authority at the regional level: protection of groundwater resources, protection of the Swan River, and Perth's air quality. Site specific issues include urbanisation of Priority 2 groundwater areas, roads across Priority 1 groundwater areas, protection of wetlands and protection of System Six areas.

The Environmental Protection Authority received considerable public feedback on many of the issues related to the corridor and its planning. Many of the 93 submissions on the Public Environmental Review for the Perth-Darwin Highway provided comment on the Amendment and Structure Plan. In addition, many letters and phone calls were received, and meetings were held with representative groups from the community.

The Environmental Protection Authority concludes that there is insufficient information on which to provide sound environmental advice on many site specific issues and on all of the regional issues related to the North-East Corridor.

Consequently, urban development of land within the North East Corridor should not proceed until further work has been completed. Without this work the Environmental Protection Authority cannot provide sound environmental advice, especially on how developments in the North-East Corridor would impact upon regional environmental issues facing the urban expansion of the Perth Metropolitan Region and how those impacts should be managed.

The Environmental Protection Authority acknowledges that this position, if accepted by Government, will have implications for land availability in the metropolitan region. However, the Environmental Protection Authority is concerned that allowing the land to be re-zoned to Urban Deferred would create the expectation that urbanisation would follow irrespective of the outcome of the studies, in particular, if those studies show that urban development in these areas is environmentally unacceptable.

The Environmental Protection Authority advises, therefore, that if the nominated studies show unacceptable risks then the proposal to lift the Urban Deferred zoning should be referred to the Environmental Protection Authority for assessment.

Whilst the Environmental Protection Authority recognises that much work has been done on a number of issues in the North East Corridor, there is concern that these studies are not integrated to provide a long-term view of the environment, and because the studies are not all finished. In particular, management strategies have not been developed which show how the environment will be managed and protected in the long-term. The studies need to consider the long-term impacts (50 plus years) of urban development on the environment to ensure that development will be sustainable in the long-term.

The expertise and responsibility for undertaking these studies and management strategies lies with a number of Government agencies. A project team is needed to coordinate the studies with one agency (for example, the Department of Planning and Urban Development) taking the lead. The team must have the authority and the responsibility to define the work that is to be undertaken, to adequately resource the work and to ensure that it is completed and implemented.

A Project Plan should be formulated and implemented which the proposed developments in the corridor would follow. The Project Plan should include:

- definition study,
- feasibility study,
- detailed studies,

- implementation, and
- ongoing performance evaluation.

The Environmental Protection Authority advises that prior to the lifting of the Urban Deferred zoning within the North-East Corridor, the minimum work to be undertaken should be:

- the completion of the definition and feasibility studies which would describe in detail which issues should be studied so that adequate decision making can occur;
- the completion of a report describing the methodologies for carrying out these further studies;
- the preparation of a statutory land use and water management plan for the entire Gnangara Mound, including the eastern flank where urbanisation is currently being considered, which re-evaluates the Priority 1 and 2 areas and their development potential;
- the preparation of a drainage and nutrient management strategy for the land proposed for Urban Deferred zoning; and
- a rigorous assessment of the ability of the Swan River to absorb nutrient loads and options to reduce nutrient loads from land in the North-East Corridor.

If during the course of these studies it is identified that unacceptable risks would result from urban development then the proposal to lift the Urban Deferred zoning should be referred to the Environmental Protection Authority for assessment.

The Environmental Protection Authority has in addition provided advice on 21 site specific issues in the corridor, recommending a number of important refinements to the Structure Plan and Amendment.

1. Introduction

1.1. Background

This Bulletin contains the Environmental Protection Authority's advice to the State Planning Commission on the North-East Corridor Structure Plan and Metropolitan Region Scheme Amendment number 950/33. It covers two broad types of environmental issues:

- those confined specifically to the corridor, for example, wetlands; and
- those having broader regional implications, in particular, the Swan River and Perth's air quality.

Large scale expansion to the existing urban areas in the North-East Corridor was first recommended in 1987, and was supported in subsequent planning policy documents (State Planning Commission 1987, Department of Planning and Urban Development 1990a & 1990b).

In March 1994, the State Planning Commission released the final North-East Corridor Structure Plan. At the same time it also released for comment the proposed North-East Corridor Metropolitan Region Scheme Amendment Number 950/33 (Figure 1). This Amendment together with proposals for the North-East Corridor previously assessed by the EPA - Ellenbrook (Bulletin 642) and Egerton (Bulletin 743) - would, to a large extent, implement the proposals for urbanisation in the North-East Corridor Structure Plan.

Some parts of the Amendment and Structure Plan could have significant impacts on important environmental resources, including:

- important groundwater resources,
- the Swan River,
- important wetlands,
- conservation areas, and
- air quality.

In addition, these proposals could cause conflict where residential areas are located unacceptably close to existing industrial areas.

Recently, the Environmental Protection Authority expressed concern regarding the health of the Swan River. Land the North-East Corridor Amendment is within the catchment the river and includes wetlands which drain into the Swan River.

The Environmental Protection Authority also expressed concern regarding the quality of the air over the Perth Metropolitan area. The occurrence of brown haze over Perth between April and July 1994, and the results of monitoring carried out by the Department of Environmental Protection, indicate that Perth, including the North-East Corridor, has a growing air quality problem.

In response to the various issues raised in the Amendment and Structure Plan, the Environmental Protection Authority resolved to assess and provide its advice in the following manner.

(a) North-East Corridor Structure Plan

The Structure Plan is not a statutory document but is intended to be a guide for the future development in the Corridor. A level of assessment was not set on the Plan because it is finalised and has been endorsed by the State Planning Commission and released by the Minister for Planning. However, the Environmental Protection Authority is concerned that a number of proposals in the Plan could have significant environmental impacts. Accordingly, the

Environmental Protection Authority decided to provide advice on those specific proposals where advice had not already been given.

(b) Perth to Darwin Highway and associated developments

Three proposals in the Structure Plan are of particular concern to the Environmental Protection Authority because of their potential impacts on the groundwater public water supply source protection areas. These proposals were the alignment of the Perth-Darwin Highway, the fast transit route and the associated excisions from the Priority 1 source protection area for rural and urban development. The Environmental Protection Authority required a Public Environmental Review be prepared to investigate the environmental impacts of these proposals.

The Public Environmental Review examined a number of alternative options for the Highway, including the preferred option which was shown in the Amendment. The Environmental Protection Authority's advice on these proposals is found in EPA Bulletin 753 (Environmental Protection Authority, 1994).

(c) Amendment 950/33 to the Metropolitan Region Scheme for the North-East Corridor

The Amendment was assessed at the level of Informal Review with Public Advice. The environmental issues associated with the Amendment and the Structure Plan are closely related, and the Environmental Protection Authority decide to provided its advice in a single Bulletin. This Bulletin contains that advice.

1.2. Objective and report format

The objective of this report is to provide the State Planning Commission and Department of Planning and Urban Development with advice on environmental issues associated with the North-East Corridor not covered by other Environmental Protection Authority assessments. The Environmental Protection Authority considers the advice should be provided in two parts:

(a) the site specific issues in the structure plan area with particular reference to

- groundwater protection;
- drainage and nutrient management;
- System Six and remnant vegetation;
- lakes and wetlands;
- industry and services; and
- heritage.

(b) the regional aspects of environmental issues with particular reference to

- groundwater protection;
- the Swan-Canning river system;
- wetland systems;
- remnant vegetation; and
- air quality.

The Environmental Protection Authority's conclusion and advice on the issues raised in this Bulletin is contained in Section 8. Sections 2-7 set the context for that advice. Site specific issues are dealt with in Section 5 and the regional issues are dealt with in Section 6. The Appendices contain detailed technical information in support of the information in the main part of the Bulletin.

1.3. Limitations of report

The area of the North-East Corridor considered in this Bulletin is that area bounded by the Gnangara mound in the west, the foothills of the Darling Range in the east, Guildford in the south and Muchea in the north. The area south of an east-west line through Guildford was excluded from the site specific assessment. This area is generally already developed, or individual proposals have already been considered by the Environmental Protection Authority in previous assessments (e.g Foothills Structure Plan). Ellenbrook and Egerton were both part of the Ellenbrook Amendment (Metropolitan Region Scheme Amendment No 879/33).

Proposals either currently being assessed, or recently assessed, by the Environmental Protection Authority were also excluded, namely:

(a) Ellenbrook (EPA Bulletin 642, 1992);

(b) Egerton (EPA Bulletin 743, 1994);

(c) Perth-Darwin National Highway and associated developments (EPA Bulletin 753, August 1994);

(d) Perth-Adelaide Highway (EPA Bulletin 380, 1989 & currently subject to S46 amendment);

(e) Reid Highway (EPA Bulletin 735, 1994).

Figure 1 identifies the areas in the North East Corridor covered by the earlier EPA assessments.

2. Method of assessment

The Environmental Protection Authority assesses planning proposals in the following way:

- considering geographic information from plans and maps;
- identifying areas of high environmental value, and identifying likely impacts on those areas;
- considering information in relevant reports, government documents and journals;
- reviewing existing Environmental Protection Authority policies;
- consulting with officers of the key government agencies, in particular, the Department of Planning and Urban Development, the Water Authority of Western Australia and the Shire of Swan; and
- considering issues raised by members of the public.

In each location where a major development is planned the proposal was checked for consistency with EPA policy and for impact on System Six and other areas of high conservation value. Where impacts could be significant, the relevant literature was consulted to ascertain if sufficient information was available to determine if the impacts would be acceptable.

If necessary, further clarification was then sought from officers of the relevant government agencies. The Environmental Protection Authority was briefed on the method used to identify future development proposals in the Perth Metropolitan Region. It was decided to seek a briefing on the method used because of the regional as well as local significance of the environmental issues associated with the North-East Corridor and because there was generally insufficient technical information available to provide sound environmental advice.

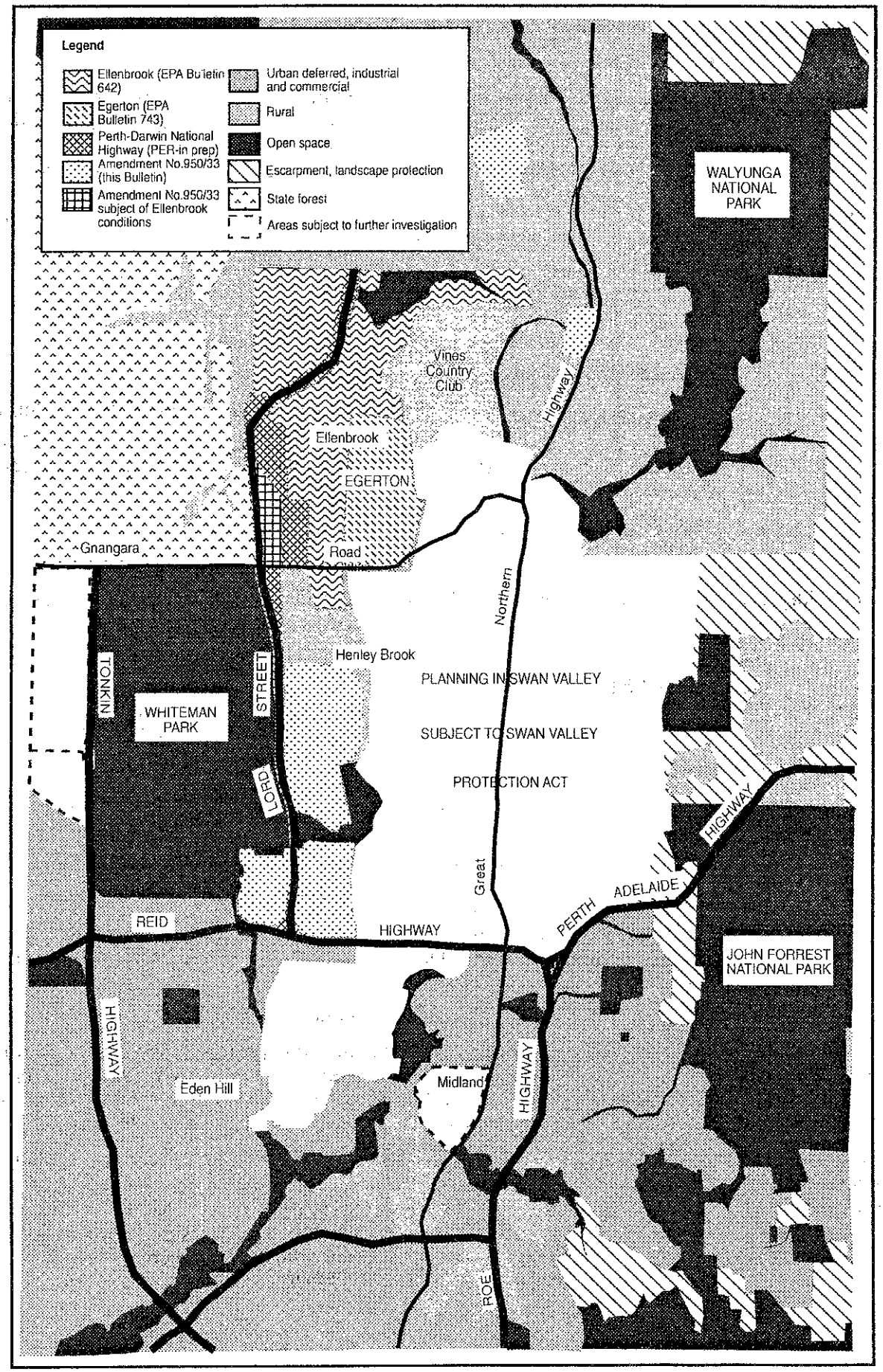


Figure 1. Areas in the North East Corridor covered by the earlier EPA assessments.

3. Previous significant decisions and advice

A history describing the planning processes and opportunities for public comment is outlined in the North-East Corridor Structure Plan (See Planning Context section of Structure Plan, pages 8 to 18). Table 1 below summarises important points relevant to this Bulletin including Environmental Protection Authority advice.

Table 1 Summary of decisions which affect regional aspects of the North-East Corridor

Year	Author	Source/Report	Significant points
1987	Review Group to the State Planning Commission	Planning for the future of the Perth Metropolitan Region	North-East Corridor identified for development; corridors proposed on both sides of the Swan Valley.
1989	Environmental Protection Authority	Comments on Planning for the future of the Perth Metropolitan Region (Bulletin 404)	The relevant EPA conclusions are: • The preferred strategy generally provides a sound basis upon which to build the final proposals for Perth's future directions subject to five areas of consideration; • Urbanisation is incompatible with wise management of groundwater resources; • Urban design guidelines to address water balance, water quality and water harvesting should be prepared; and • Proposed metropolitan regional parks should be implemented as a priority.
1990	Department of Planning and Urban Development	Metroplan	Re-stated proposals for urban development in North-East Corridor, but categorised into Category A (Relatively unconstrained) and B (Constraints to development).
1990	Department of Planning and Urban Development	Urban Expansion Policy	Re-stated proposals for urban development in North-East Corridor, but categorised into Category A (Relatively unconstrained) and B (Constraints to development).
1991	Department of Planning and Urban Development	Discussion paper outlining Planning Issues and Growth Options for the North-East Corridor.	• Options for linear or cellular growth option; • Notional plans only; and • Showed Perth-Darwin Highway options along existing Gt Northern Highway or railway line to the east.

Year	Author	Source/Report	Significant points
1991	Environmental Protection Authority	Informal advice letter	Relevant points from the letter are; • Strongly opposed road & urban developments which would affect Priority 1 groundwater; • Expressed concern about air quality; • Supported North-East Corridor environmental audit; • Sought implementation of System 6; • Drew attention to EPA lakes and wetlands strategy.
1991	Minister for Planning	Press release	In response to public concern, decides alignment of Perth-Darwin Highway on east side of Swan Valley to be removed from further consideration.
1992	Shire of Swan	Draft Structure Plan	
1993	Government of Western Australia	Swan Valley Protection Act	• Interim Swan Valley Committee established to prepare legislation.

Because of its importance, the full text containing the conclusions of Environmental Protection Authority Bulletin 404 and the informal advice prepared in 1991 appear in Appendix 1.

4. Public concerns

Many of the 93 submissions on the Public Environmental Review for the Perth-Darwin Highway provided comment on the Amendment and Structure Plan. The Environmental Protection Authority received letters and phone calls regarding the Amendment and Structure Plan, and met with representative groups from the community. It is evident that the local community has not clearly separated the various planning proposals, and that there is a strong and genuine concern with the extent and location of proposed developments in the Corridor.

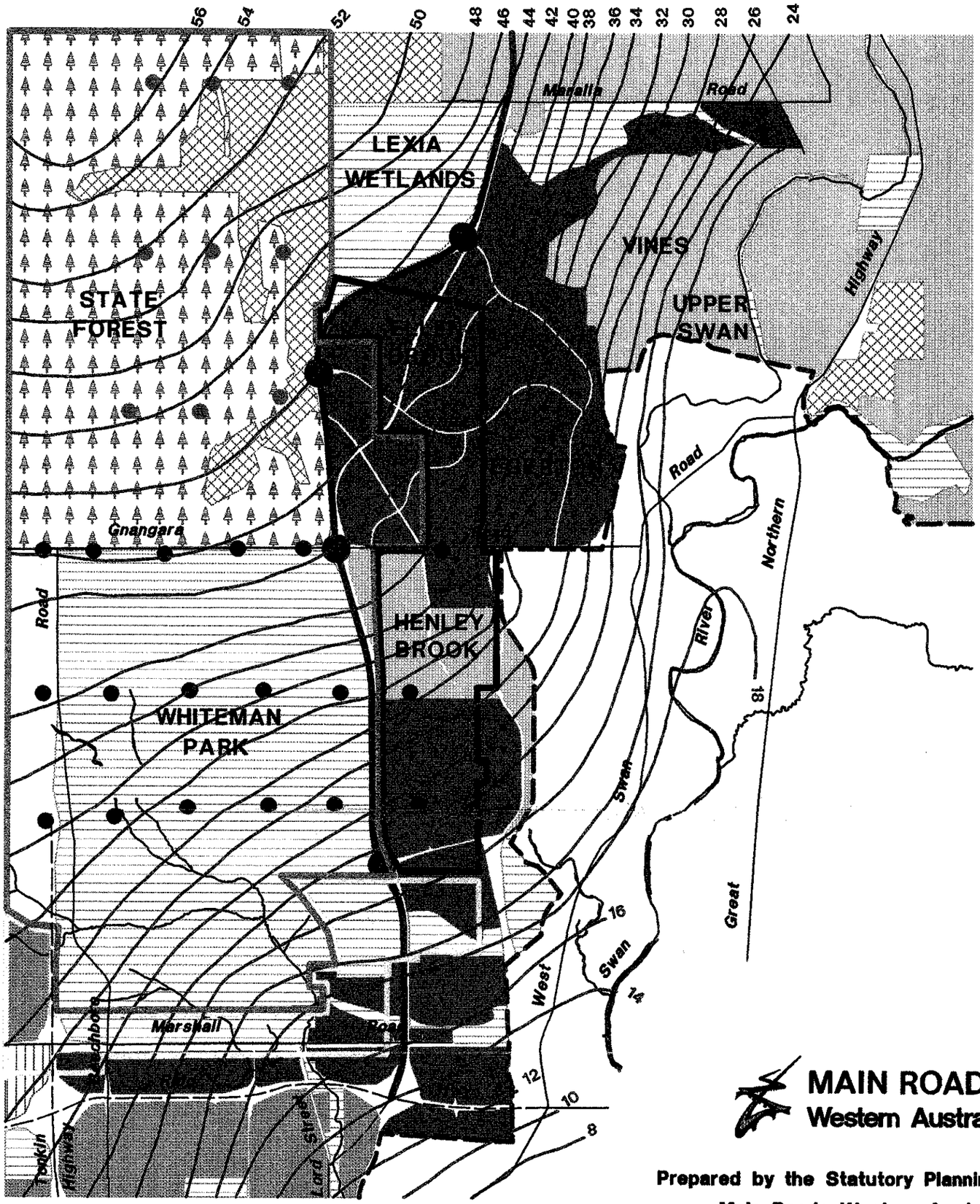
Aboriginal communities and certain individuals in those communities indicated concern at the lack of consultation and the potential impact of the planning proposals. In this instance there appears to be a close correlation between environmental concerns and heritage concerns expressed by Aboriginal groups.

Concerns raised over social and economic issues such as archaeology and ethnography, transport planning and management, and the compatibility of urban and rural developments, are the responsibility of other agencies and are not considered in this Bulletin.

5. Site specific environmental issues in the North-East Corridor

5.1. Groundwater protection — public water supply

Background technical information relating to groundwater and its protection is contained in Appendix 2. Figure 2 shows the proposed Urban and Urban Deferred areas in relation to the



MAIN ROADS
Western Australia

Prepared by the Statutory Planning Branch
Main Roads Western Australia
AUGUST 1994

LEGEND

- Urban
- Urban Deferred
- Rural (including Special Rural)
- Open Space
- State Forest
- Industrial
- Basic Raw Materials

- Gnangara Water Mound Priority 1 Source Area
- Gnangara Water Mound Priority 2 Source Area
- Gnangara Water Mound Priority 3 Source Area
- Possible Interchanges
- Existing Production Wells
- Proposed Production Wells (Lexia Scheme)
- Preferred Route Presented in the Public Environmental Review
- 18 Groundwater Contours
- Boundary of Swan Valley Policy Area (Draft Review , August 1991)

SCALE

0 1 2 3 4

Kilometers

N-E CORRIDOR STRUCTURE PLAN AND GROUNDWATER RESOURCES

FIGURE 2

groundwater resources of the region, and how those resources are a constraint to urban development in the corridor. Some of the areas below are affected by the Environmental Protection (Gnangara Mound Crown Land) Policy 1992, Statement of Planning Policy No 3 and Draft Environmental Protection Policy for Gnangara Mound Private Land Groundwater 1993.

5.1.1 Urban Deferred zoning over Priority 2 source protection area

Some of the land included in the Water Authority's Priority 2 area in the North-East Corridor has been identified for future urban development either as Category A2 Urban or Category B Urban. Land in these categories cannot be developed immediately because of certain constraints, but should become available after 10-15 years for Category A2 land, and prior to 2021 for Category B land.

The North-East Corridor Structure Plan states that:

> *"...properly managed residential development may occur in appropriate sectors of the landscape in these areas* (Priority 2) *without contamination resulting."*

and that such urban development would require

> *"...reticulated sewerage and disposal of waste-water off-catchment, strict septic tank controls, exclusion of industries and commercial activities which may pose a risk to groundwater, restrictions on intensive agricultural development and exclusion of disposal sites for polluting wastes."* (Department of Planning and Urban Development, 1994, p53,54).

The planning document assessed in this Bulletin does not provide details of how any of these measures to protect groundwater were arrived at, how they will be implemented, how they will be regulated, or how the performance of management controls are to be evaluated.

The Environmental Protection Authority questions the adequacy of the measures proposed in the Structure Plan to prevent urban development causing groundwater pollution. In particular, the Environmental Protection Authority is concerned about the proposed urbanisation of Priority 2 areas as studies indicate there is a high risk that urban development will pollute groundwater.

The terms of reference of the Select Committee of the Legislative Assembly into Metropolitan Development and Ground Water Supply indicate that the existing groundwater protection policies are under scrutiny, particularly with regard to urban development. This committee has been considering this and other related issues at the same time that the State Planning Commission proposed urban development in North-East Corridor over Priority 2 source protection areas. The Environmental Protection Authority considers it has not yet proven conclusively that urban development would be acceptable over Priority 2 source protection areas.

In its assessment of the Ellenbrook Amendment (EPA Bulletin 642, 1992) the Environmental Protection Authority said:

> *"Some parts of the Ellenbrook development area are also within Priority 2 source protection areas where urban development is not a preferred land use, but if properly managed, may be acceptable".* (Page 13).

This view is now being questioned, and further research is needed. However, it is noted that there are no existing bores in the Priority 2 source protection area in the land covered by the Ellenbrook Amendment.

Development of land over important groundwater areas requires careful management. A statutory land use and water management plan, as recommended to the Select Committee by the Department of Environmental Protection in 1994, would provide an appropriate mechanism to ensure that appropriate land use controls are put in place on land over important groundwater resources. This plan should be prepared for the entire hydrologic area, should take into account

agreed objectives for groundwater management and environmental protection, and should afford strong protection for the main recharge areas of the mounds.

5.1.2 Proposals affecting Policy Area 1 (Priority 1) groundwater area

The Environmental Protection Authority considers that where development are proposed on land in Priority 1 Source Protection Areas either the risk of groundwater contamination from that development should be negligible or the development should be prohibited.

There are four specific proposals across Priority 1 areas in the North-East Corridor that require specific comment, three of which are roads. The Environmental Protection Authority believes that the presence of existing roads across Priority 1 groundwater areas do not justify a case for new roads to be built.

Tonkin Highway

The Tonkin Highway extension to Gnangara Road shown in the North-East Corridor Structure Plan crosses the Priority 1 source protection area. In EPA Bulletin 753, 1994, the extension of Tonkin Highway was identified as environmentally unacceptable.

Gnangara and Beechboro Roads

Gnangara and Beechboro Roads are already constructed and cross the Priority 1 area. These roads must be managed to ensure pollution from traffic, including accidental spills, don't result in groundwater contamination.

The proposal in the Structure Plan to minimise the risk from bulk transport of dangerous goods through controls on the transport of goods covered by the relevant regulations over Priority 1 areas is noted. However, substances which can cause unacceptable degradation of groundwater quality are not necessarily classified as dangerous goods under the regulations. Furthermore, quantities of materials which could result in significant groundwater contamination (e.g. drums of farm chemicals) are not regulated by the Department of Minerals and Energy.

There is concern about the likely constant low level pollution from unburnt oil and lead particulates associated with roads with high volumes of traffic (ie more than 40 000 vehicles per day) as these roads currently present a risk to public water supplies.

Sewerage pipe

The Structure Plan shows a sewerage pipe following Gnangara Road. This pipe appears to be aligned close to existing bores (probably within 100m) and leakage from the pipe could contaminate groundwater.

The main contaminants of concern in sewage are nitrogen as ammonia, nitrate and nitrite, and phosphorus. Experience has shown that most sewerage pipes leak during their lifetime. However, the Environmental Protection Authority considers that engineering solutions could be put in place to ensure any leakages are quickly detected and caught in impermeable basins.

5.1.3 Area "subject to further investigation" in the Structure Plan

The Structure Plan identifies an area adjacent to and west of the proposed Tonkin Highway as an area 'subject to further investigation' (See Figure 1). This means that development could take place here provided that certain issues are resolved. The area is affected by the Environmental Protection (Gnangara Mound Crown Land) Policy 1992, Statement of Planning Policy No 3 and Draft Environmental Protection Policy for Gnangara Mound Private Land Groundwater 1993.

Any proposal not consistent with those policies should be referred to the Environmental Protection Authority.

5.2 Protection of the Swan River, lakes and wetlands

5.2.1 Drainage

The Structure Plan notes that:

> *"Regional drainage constitutes the single most important issue for urbanisation in the NE Corridor."* (Department of Planning and Urban Development 1994, p84).

The Environmental Protection Authority agrees that regional drainage is an important environmental issue. (For technical details, refer to Appendix 5.)

Proposals in the North-East Corridor previously assessed by the Environmental Protection Authority were in clearly identifiable areas and had proponents with large land holdings (See EPA Bulletin 642 and 743). In these assessments, the Environmental Protection Authority recommended that water level and water quality parameters (loads as well as concentrations) be determined to protect the environment, and that management plans be prepared to ensure the criteria are met.

The portion of North-East Corridor considered in this Bulletin has many landowners often with small holdings, and it would not be practical to address drainage management for each proposed urban development on a case-by-case basis. It is necessary, therefore, to develop a coordinated approach to the management of the regional drainage to ensure environmental concerns are adequately addressed.

The Structure Plan refers to a drainage strategy prepared by the Water Authority of Western Australia (Page 27). This strategy proposes to set aside large areas of land for the construction of detention/nutrient stripping ponds in each drainage catchment. Some of these ponds would be located in existing wetlands and some would be integrated into the existing drainage system which ultimately drains into the Swan River.

The Water Authority provided to the Department of Environmental Protection an early draft of the strategy for comment. Studies are currently in progress by the Water Authority of Western Australia before the preparation of a final regional drainage management plan.

The Environmental Protection Authority is concerned that nutrient levels in the Swan River are too high. There is a lack of experience in the Perth area with the operation of detention/nutrient stripping ponds and it is difficult to verify their effectiveness in removing nutrients from run-off in sandy urban catchments.

Should the effectiveness of these detention/nutrient stripping ponds not meet the criteria specified for an approved drainage strategy, other management options to reduce nutrient loads to acceptable criteria would need to be implemented. Many of these options, such as chemical treatment, are expensive, and the costs would have to be borne by the community through government. Urban development cannot be decommissioned.

The issues related to drainage and downstream impacts should be resolved prior to any changes in zoning of this land.

5.2.2 Sawpit Gully

As a result of the Environmental Protection Authority's assessment of the Ellenbrook proposal (EPA Bulletin 642) and implementation of environmental conditions set by the Minister for the Environment, the North-East Corridor Amendment proposes to reserve an area around Sawpit Gully for Parks and Recreation. However, Figure 23b of the North-East Corridor Structure Plan shows Sawpit Gully being utilised for regional drainage (Page 85). Such a use would affect the ecology and, therefore, the conservation value of Sawpit Gully. The Environmental Protection Authority has been advised that the Ellenbrook Drainage Plan, which supercedes the North-East Corridor Structure Plan, does not use Sawpit Gully for regional drainage.

5.2.3 Water supply and sewerage services

Possible impacts from the provision of water and sewage treatment facilities were issues considered in previous Environmental Protection Authority assessment in the region (EPA Bulletin 642 & 743). The main issues are:

- impacts of the Lexia Groundwater scheme; and
- possible on-site disposal of treated sewage.

Abstraction of groundwater in the Lexia area could affect water levels in important wetlands, and could affect dryland vegetation which uses groundwater as a source of water in the dry season.

Sewage effluent can have high levels of nutrients. On-site disposal of treated sewage would need to ensure that nutrients do not enter the groundwater and the surface water systems. Nutrient rich groundwater would not only pose a risk to public water supplies but could also impact on downstream wetlands. Nutrients entering the surface drainage system could end up in the Swan River.

The Environmental Protection Authority considers that the comments and recommendations of previous proposals in the North-East Corridor apply equally to the Amendment and Structure Plan.

5.3. System Six and remnant vegetation

5.3.1 System Six

There are four System Six areas affected by the North-East Corridor Structure Plan. Details of the policy framework regarding System Six and remnant native vegetation is contained in Appendix 3.

Area M17 (Twin Swamps and Ellenbrook Nature Reserves)

System Six area M17 includes the remaining habitat of the Western Swamp Tortoise. The Environmental Protection Authority is currently preparing a Draft Environmental Protection (Western Swamp Tortoise Habitat) Policy 1994. The aim of this Policy is to ensure that proposals and land uses on land outside the reserved area do not adversely affect the tortoise habitat.

There is growing development pressure in the reserve's catchment, and there is need to manage the catchment to ensure the Western Swamp Tortoise habitat is protected in the long-term.

Area M18 Walyunga National Park

The System Six report recommended that certain privately owned land between the Swan River and Walyunga National Park be considered for inclusion in a Regional Park. Figure 3 shows the land in question.

The Department of Planning and Urban Development recently released a draft report called *Darling Range Regional Park and landscape study: A proposal for a Darling Range Regional Park*, (Department of Planning and Urban Development, 1993). The report made recommendations for this private land which are consistent with those in the System Six report.

However, rather than recommending reservation of this land the North-East Corridor Structure Plan shows the land in an Escarpment Landscape Protection zone. The recommendations in the draft Darling Range Regional Park study are preferred.

Area M19 Swan river - Benara Road extension

The System Six report recommended that this area become a linear park to act as a fauna corridor connecting the Swan River at Guildford to Walyunga National Park. The *Darling Range Regional Park and landscape study: A proposal for a Darling Range Regional Park* supports this recommendations.

The extension of Benara Road from Lord Street to Midland could have significant environmental impacts. It could sever the linear park link and reduce its effectiveness as a corridor for fauna, affect the movement of floodwaters, affect water quality during or post construction, and be visually intrusive.

Submissions by the Aboriginal communities in the region are consistent with the environment objectives detailed in the System Six report.

Area M41 Bennett Brook - public transport reservation south of Reid Highway

The System Six recommendations for the M41 area have been partly implemented through the reservation of Bennett Brook and adjacent areas from south of Cranleigh Street to the Swan River. These areas are zoned in the Metropolitan Region Scheme for Parks and Recreation. The proposed public transport reservation south of Reid Highway crosses the M41 area at two points, and appears likely to affect the alignment of certain creeks. Construction of a railway or other public transport system in the suggested reservation could sever the linear park link which provides a vegetated corridor for fauna between Whiteman Park and the Swan River, be intrusive visually and affect water quality during or post construction. Re-alignment of the streams could affect water quality.

Submission by the Aboriginal communities in the region are consistent with the environment objectives detailed in the System Six report.

Area M41 Bennett Brook - Urban Deferred Zoning between Harrow and Cranleigh Streets

A small portion of Bennett Brook between Harrow and Cranleigh Streets is proposed to be zoned Urban Deferred by the Amendment. It would be more appropriate to have the whole of Bennett Brook and an area of dryland buffer reserved in the Metropolitan Region Scheme as Parks and Recreation.

5.3.2 Remnant vegetation

Southern River Complex vegetation - old RAAF Airstrip, Caversham

The old RAAF airstrip land in Caversham contains an area of Southern River Complex vegetation which is not well represented in conservation reserves. Several submitters responding to the Perth-Darwin National Highway Public Environmental Review document considered that this bushland had regional significance. The Environmental Protection Authority recognises that there is some preliminary evidence which suggests that the vegetation on this site has regional significance, and the site should, therefore, be included in a reserve for Parks and Recreation as proposed in the North-East Corridor Structure Plan.

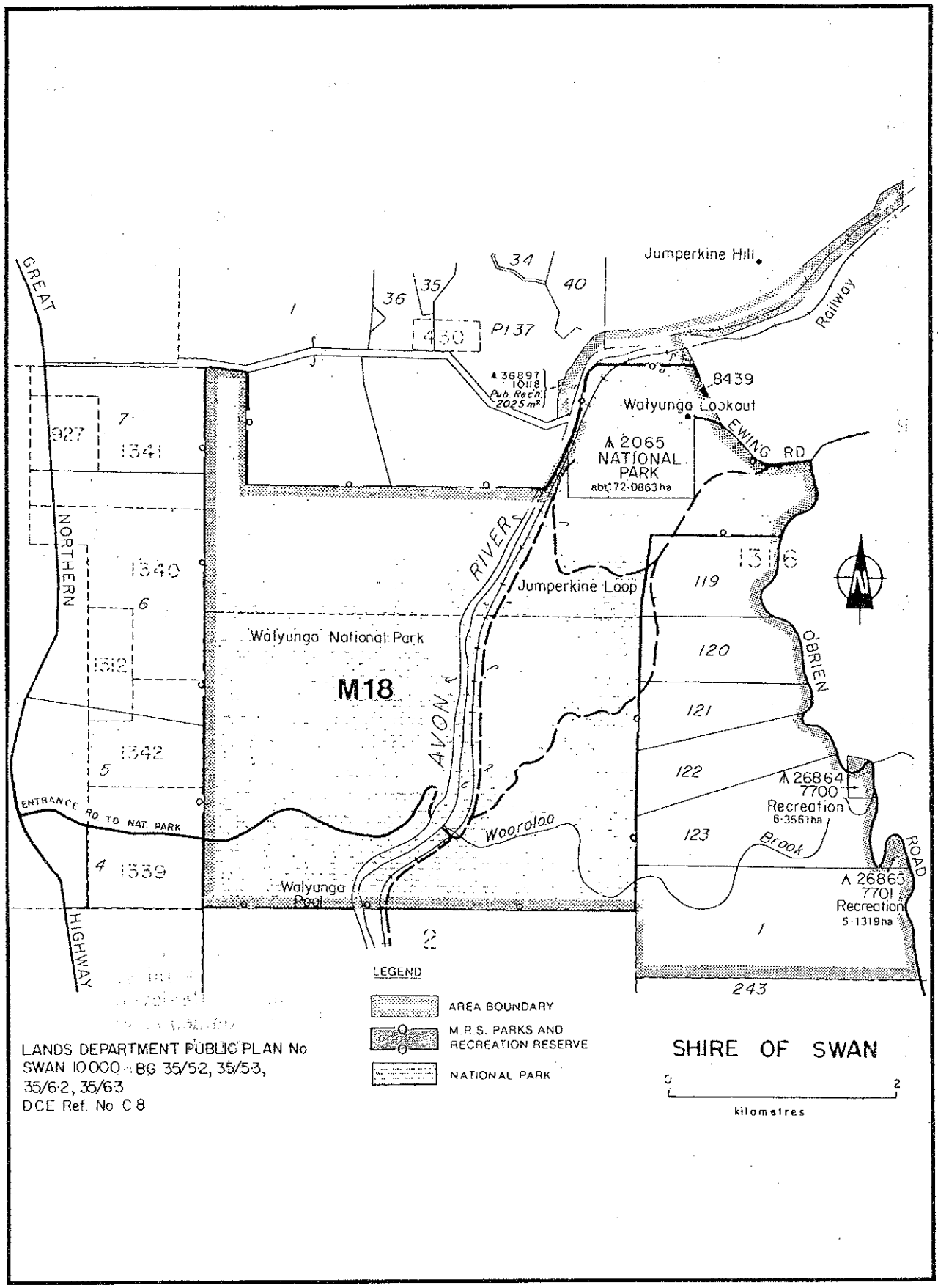


Figure 3. System 6 Recommended area M18, Walyunga National Park (from (Environmental Protection Authority 1983)

Remnant vegetation corridor linking Ellenbrook's Lexia wetlands with Melaleuca Park

A section of State Forest 65 links the Lexia wetlands conservation area to Melaleuca Park (Figure 4). This link would significantly enhance the conservation value of the Lexia Wetlands area by providing a safe corridor for fauna.

The North-East Corridor Structure Plan proposes that a portion of State Forest 65 which includes the link to the Lexia wetlands be used for basic raw materials extraction.

The issue of fauna linkages between the Lexia wetlands and Melaleuca Park was raised in the Public Environmental Review for the Perth-Darwin Highway. One of the options for the road (Option 3) cut through this proposed link, and the Environmental Protection Authority considered this option to be unacceptable partly because it would provide a barrier to fauna attempting to cross between the Lexia wetlands area and Melaleuca Park.

Any proposals which disrupt this link between the Lexia wetlands area and Melaleuca Park would be likely to be found environmentally unacceptable.

5.4. Lakes and wetlands

Details of the policy framework regarding lakes and wetlands is contained in Appendix 3.

5.4.1 Lakes covered by the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992

There are two lakes covered by the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 which do not appear to be adequately protected by the Structure Plan (Figure 5). The first one is located just north-east of the junction of West Swan Road and Great Northern Highway. This area has been designated for Basic Raw Materials in the North-East Corridor Structure Plan.

This second lake is located between Koongamia and Helena Valley and directly south-west of Goodchild Street. The boundary between land to be zoned Urban and Parks and Recreation in the Structure Plan appears to pass through this lake.

5.4.2 Other wetlands

There are numerous other wetlands in the North-East Corridor. The Environmental Protection Authority expects that these wetlands would be protected and managed in accordance with the principles outlined in EPA Bulletins 685 & 686.

Proposals which significantly affect wetlands categorised as either Conservation and Recreation, Conservation or High Conservation would likely be considered environmentally unacceptable.

5.4.3 Creeks and streams - channel wetlands

The regional drainage plan proposed in the Structure Plan plans to use many channel wetlands to carry drainage water (See Figure 23b Page 85). However, some of these channel wetland may be of high conservation value and should be conserved and not used to carry drainage water. The Structure Plan provides no information on the conservation status of these wetlands.

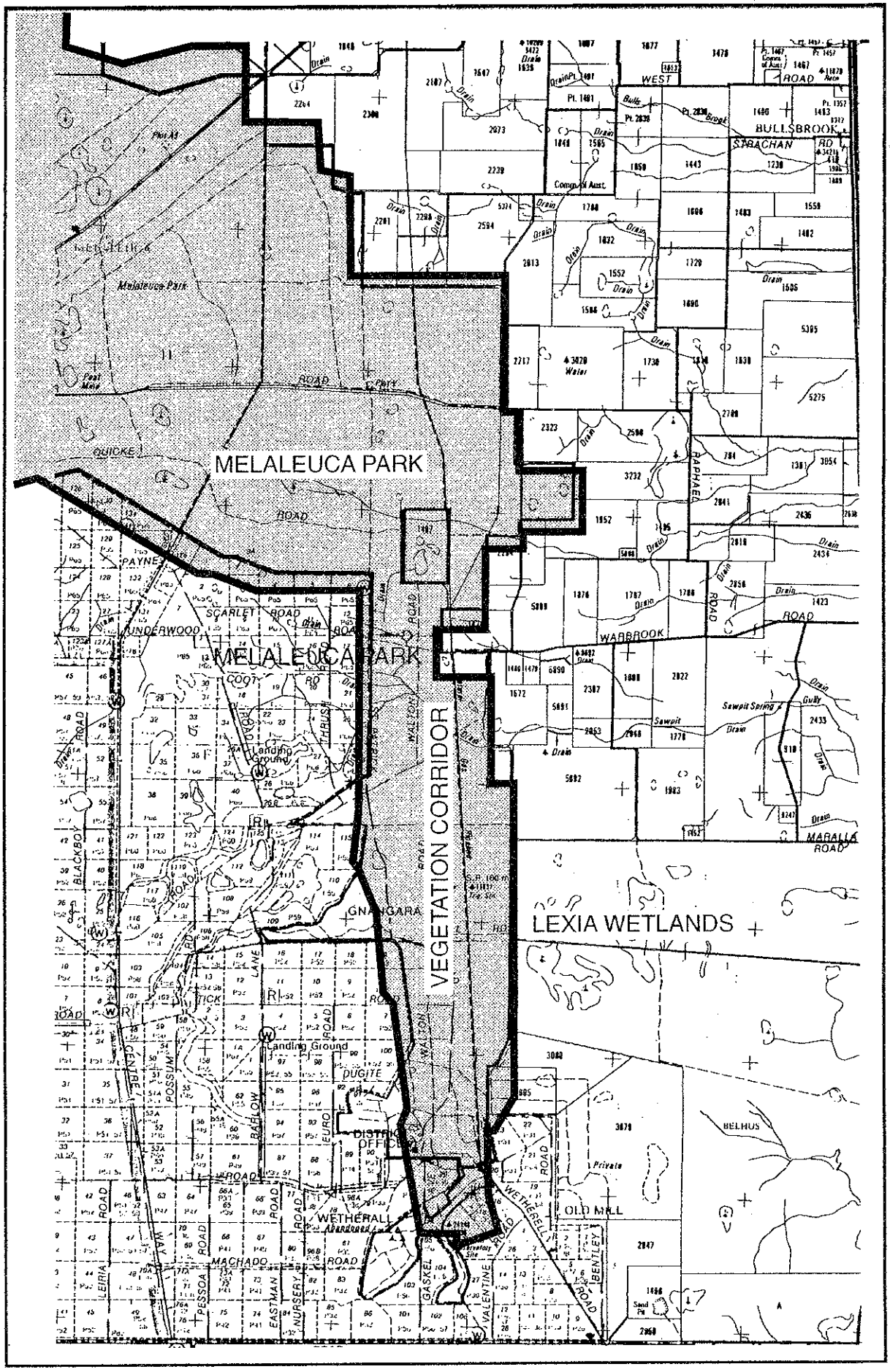


Figure 4. Remnant vegetation corridor linking Ellenbrook's Lexia wetlands with Melaleuca Park

5.5. Managing the off-site impacts of industry and services

Residential areas should not be located in areas which have reduced amenity or unacceptable levels of risk and noise from nearby industrial or commercial facilities. Urban development proposals in the North-East Corridor which may be affected by off-site impacts from industry and services include areas of land adjacent to or near:

- WANG and SECWA gas pipeline (risks and hazards);
- poultry farms (odours, noise, dust);
- Pearce and Perth Airports (noise); and
- Midland Brick (history of complaints).

5.5.1 Risks and hazards - WANG and SECWA gas pipeline

The Environmental Protection Authority has specified levels of acceptable risk from industrial facilities at the site boundary, for residential zones and for sensitive developments (See EPA Bulletins 611 & 730). The Structure Plan proposes that the pipelines be zoned as Public Utilities/Institutional. However, in the North-East Corridor Amendment the pipelines are zoned Urban Deferred. The Structure Plan notes that upgrading of the WANG pipeline would be necessary.

The Structure Plan does not refer to any risks and hazards assessment for urbanisation near these pipelines. The basis for defining adequate easement widths is not discussed, and it is not clear whether urbanisation up to the edge of the easement would be acceptable.

5.5.2 Poultry farms

There are three poultry farms in or adjacent to areas proposed to be zoned Urban Deferred. The Environmental Protection Authority normally recommends that residential areas be separated from poultry farms by a 500m buffer area.

The Structure Plan notes that the size of the buffer should be determined on a case-by-case basis rather than by adopting a blanket buffer area size. However, the methodology for this assessment has not been described.

Experience in other metropolitan areas shows that where residential development is allowed to proceed within 500 metres of a poultry farm, affected residents will complain about the odour nuisance and other impacts from the poultry operations.

Because of this, appropriate studies should be carried out, including proper air dispersion modelling to determine the specific conditions of the site, and dynamic olfactometry to determine acceptable standards of odour before a relaxation of the 500m buffer should be considered. To date, no studies of this type have been carried out in Western Australia.

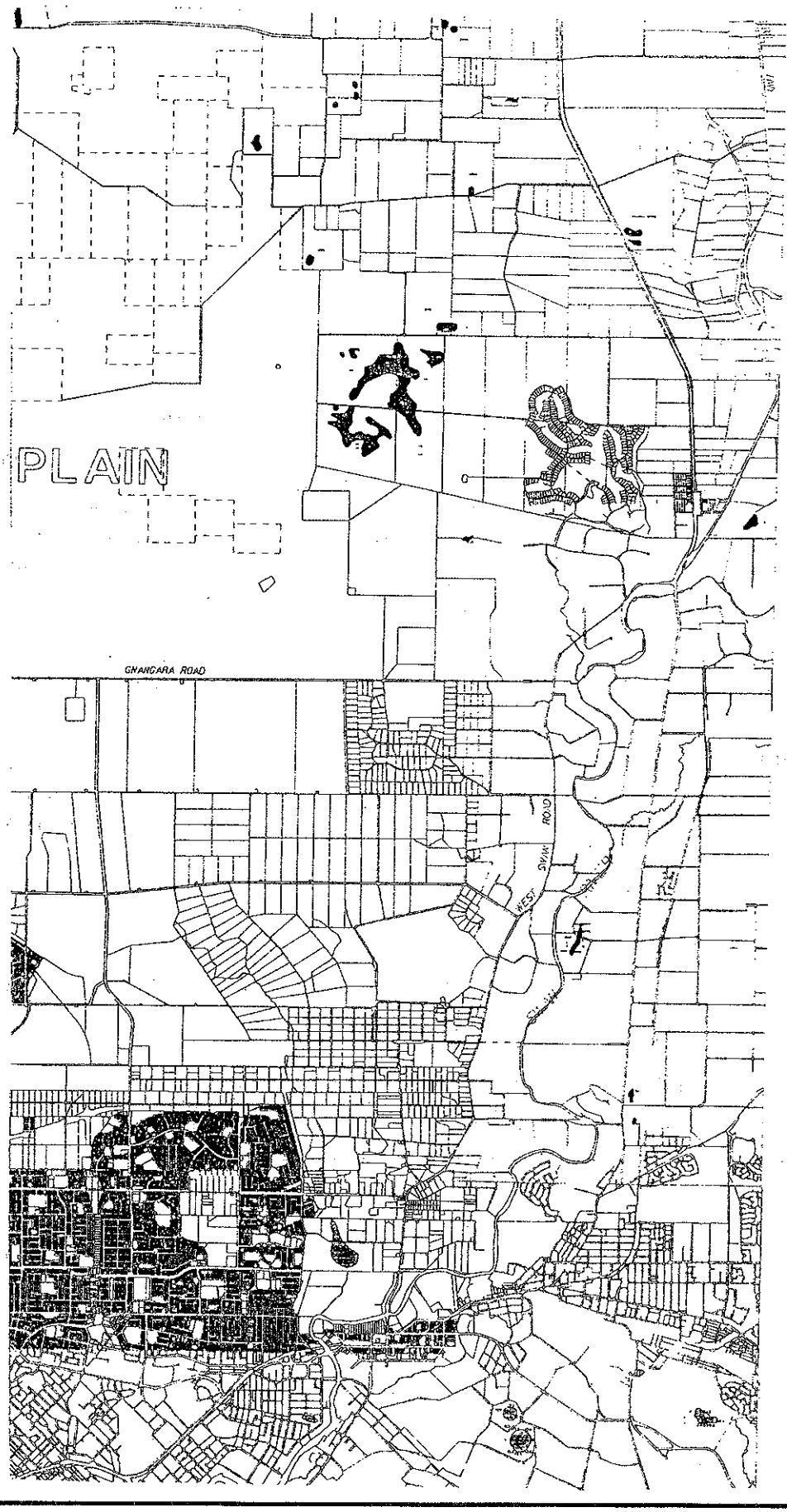


Figure 5 Lakes identified in the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992.

5.5.3 Airports

The Structure Plan uses different airport noise standards as constraints to urban development for land around the Perth Airport and Pearce Airport. Around Perth Airport, land inside the 25 Australian Noise Exposure Capacity (ANEC) contour is excluded from urban development, whereas at Pearce land within the 20 Australian Noise Exposure Forecast (ANEF) contour is excluded. Technically, both the ANEC and ANEF measurements are similar, being based on the Australian Noise Exposure Index (ANEI) methodology. The difference is that ANEC forecasts noise based on the ultimate capacity of the airport, and ANEF forecasts noise based on anticipated usage of the airport in a given year.

The Environmental Protection Authority wishes to re-state recommendations of the *Report of the working group to investigate land use planning in the vicinity of airports* which it supports;

2 (ii) That the Federal Department of Transport and Communications, in consultation with the Civil Aviation Authority, institute a monitoring program for Perth Airport, in order to verify the accuracy of noise exposure indices (ANEI).

7. That the 20 ANEC rather than the 25 ANEC ultimate capacity contour of the agreed noise concept be used for determining locational suitability for proposed new airports in relation to existing residential subdivisions.

5.5.4 Zoning around Midland and Whiteman brick factories

Emissions of fluoride compounds from local brickworks are controlled so as not to cause unacceptable damage to sensitive vegetation in neighbouring properties. However, there has been a long history of problems reported by residents living very close to Midland Brick in the Viveash and nearby areas.

The Structure Plan proposes that a portion of the factory and an area to the south of the factory be developed for urban purposes. Given the history of complaints around this factory, urban development should not be permitted within the buffer area around the factory until the factory is re-located.

5.6. Other issues

5.6.1 Urban zoning of previously assessed land

The Environmental Protection Authority notes there is a portion of land in the North-East Corridor Amendment proposed to be re-zoned from Urban Deferred to Urban which is associated with the Ellenbrook development. This re-zoning cannot take place until the environmental conditions associated with the Ellenbrook environmental impact assessment are cleared. This portion is highlighted in Figure 1.

5.6.2 Former Gnangara liquid waste disposal site

Some submissions for the Perth-Darwin Highway made reference to the former Gnangara liquid waste site. The Water Authority of Western Australia has recently installed 15 monitoring bores to investigate the water quality in the groundwater near this site. Preliminary results indicate that the old Gnangara liquid waste disposal site is the cause of an ammonia plume which extends one kilometre to the south/south-east in the direction of groundwater flow. The Water Authority has had to abandon a proposed public water supply production bore because it is located within the ammonia plume. However, the plume has not moved as far as originally thought.

The existence of this plume should not be used as an argument for allowing urban development over groundwater, instead it indicates the importance of protecting groundwater upstream of production bores.

5.6.3 Heritage

The Environmental Protection Authority notes that heritage areas have been identified in the North-East Corridor Structure Plan.

However, the Australian Heritage Commission, in correspondence to the Environmental Protection Authority of 13 May 1994, indicated that a National Estate listing for the Ellenbrook area will be gazetted late in 1994. The proposed listing is shown in Figure 6.

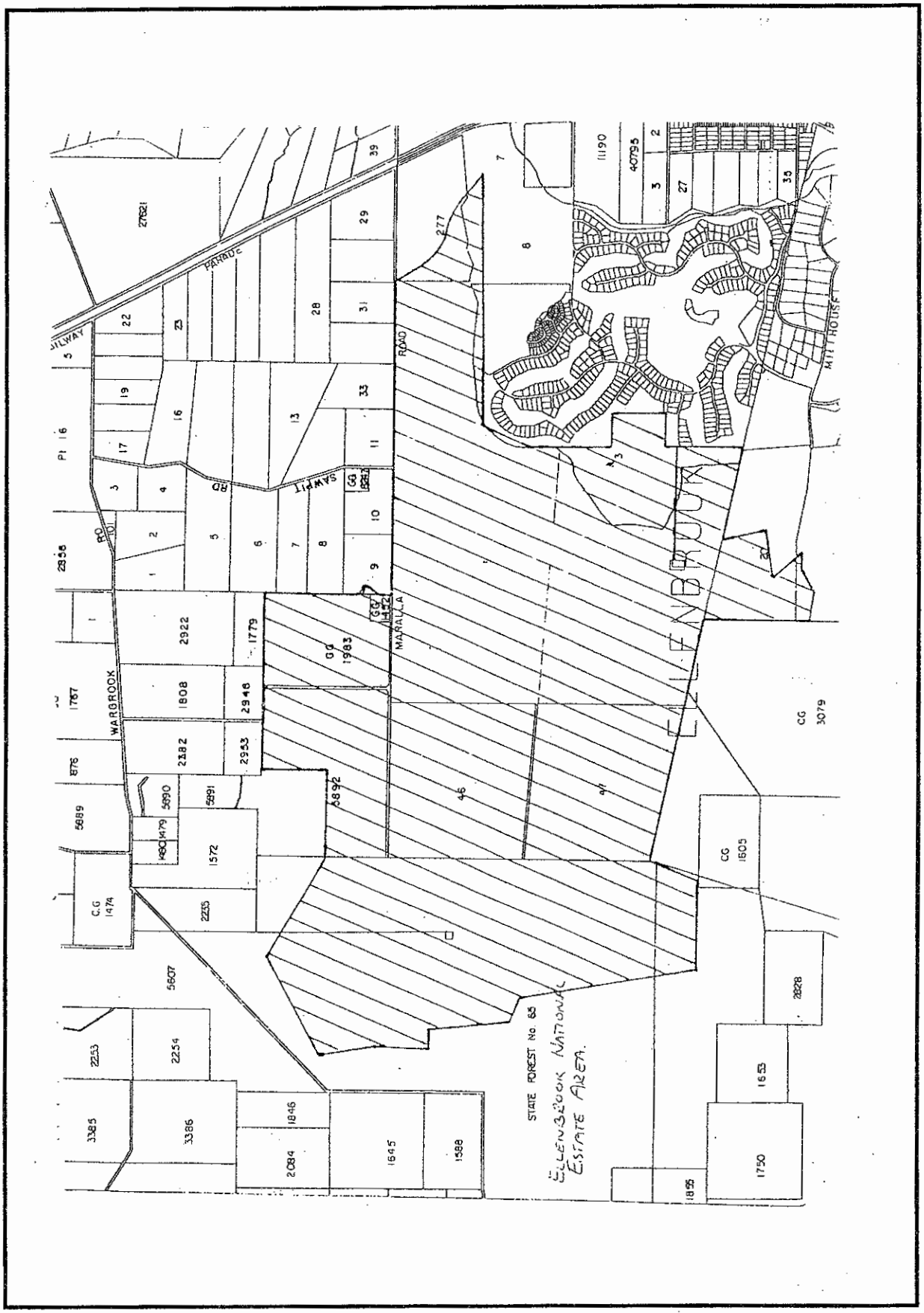


Figure 6. Proposed listing on the National Estate

6. Regional environmental issues in the North-East Corridor

6.1. Groundwater protection - public water supply

The protection of the public water supply recharge and production areas within the North-East Corridor is discussed in detail in Section 5.1. Appendix 2 provides relevant policy and technical information.

There is a need for a re-assessment of groundwater protection for the whole of the Gnangara Mound. The conclusion reached in Section 5.1.1 apply for the whole mound.

6.2. Swan-Canning River systems

Water entering the Swan River from the catchment, which include much of the North-East Corridor, must be managed to ensure that the nutrient loading in the river is at least maintained and is reduced in the long-term. Other aspects of water quality must also be maintained or improved.

The effect on nutrient loading in the Swan River of new developments in the Perth Metropolitan area, including the North-East Corridor, and existing land uses are not known. Some work has already been undertaken to address the nutrient load from specific developments in the North-East Corridor (refer to Section 5.2.1).

There appears to be two contrary views regarding whether rural or urban land uses export more nutrients. However, no report has been provided relevant to the North-East Corridor which would give information on the impacts on nutrient loads where land use changes from rural to urban.

These competing views on the effects of urbanisation on nutrient loads need to be evaluated.

Appendix 4 provides information on the current condition of the Swan River and nutrient loads from different sub-catchments of the river, and Appendix 5 provides some general information regarding the impact of urbanisation on water quality.

In the absence of a report which provides information on the likely impacts or urbanisation in the North-East Corridor on the Swan River, no assessment can be made of the environmental acceptability of this change in land use. This report should include, but not be restricted to, an analysis of the following:

- the nutrient status of the Swan River;
- an assessment of the capacity of the river to absorb nutrient loads without unacceptable impacts;
- an assessment of nutrient loads on a sub-catchment basis;
- regional drainage requirements;
- the effectiveness of retention basins/nutrient stripping ponds to remove nutrients from urban catchments on the Swan Coastal Plain; and
- best practices to manage the water quality from agricultural, urban and other land uses in the surrounding catchment.

6.3. Wetland systems

Little is known about managing the water levels, quantity and quality following development to protect the conservation values of important areas. Appendix 5 contains some information relevant to the impacts of urbanisation on wetlands.

Studies are in progress but outcomes are variable and resources need to be committed to integrate and finalise these studies. Management plans for conservation areas should be prepared before urban development to ensure that water levels and water quality changes will be acceptable and that people pressure will not degrade the conservation or recreation value of the area.

The prognosis for maintaining many of these areas in their original condition in the long term in an urban environment is poor. In some instances it is accepted that these areas have a primary recreation function and, provided the original recreation function and some conservation value is retained, some change in the environmental value is accepted in an urban environment.

6.4. Air quality

The occurrences of brown haze over Perth during the past winter months have highlighted the slow deterioration of Perth's air quality. The Environmental Protection Authority wishes to ensure that:

- emissions from transport are minimised; and
- air quality standards set as acceptable for urban residential purposes are met where such development is proposed.

Another aspect of air quality is greenhouse gas emissions. The Air Quality Consultative Committee established by the Minister for the Environment, provides preliminary results from the Perth Airshed Studies and discusses the relationship between greenhouse gas emissions and urban form.

Appendix 6 provides details of that committee's work, but the important issues relating to the regional air quality are:

- Perth's air quality is an issue of concern.
- The terms of reference for the Air Quality Consultative Committee require it to identify and seek funds for relevant studies and to recommend policy initiatives to the Minister for the Environment.
- Home fires and vehicles are major sources of emissions affecting air quality.
- Strategies should be put in place to ensure air quality in Perth meets health and environmental standards.
- Haze and ozone levels have reached unacceptable levels at most monitoring sites across Perth, not just the North-East Corridor.
- Air quality should not be considered as a constraint on a local basis, but should be considered in a regional context.
- Air quality studies are in progress. However, the analysis and recommendations have yet to be formulated from the data collected.
- It can be argued that continuation of the existing pattern of urban development, particularly with respect to photochemical smog, would not be sustainable without appropriate management.

Air quality is affected by many factors including incremental urbanisation, the transport system and urban form and is a concern for the whole metropolitan area.

The Environmental Protection Authority notes the inclusion of a public transport reservation in the North-East Corridor Structure Plan and Amendment and believes that, when constructed, this would assist in reducing emissions by reducing vehicle use.

Part of the air quality problem stems from incremental urban developments which individually have little environmental impact on the Perth Metropolitan Region but which cumulatively cause a significant effect.

The Environmental Protection Authority considers that the Perth Airshed Studies should be completed and strategies to ensure air quality is acceptable in the Perth Metropolitan Region should be developed and implemented as soon as possible. Transport and urban form would be key components of any air quality management strategy developed.

The Environmental Protection Authority notes that the Department of Planning and Urban Development has raised the issues of transport and urban form in the North-East Corridor Structure Plan. These issues have a significant impact on and strategy to minimise greenhouse gases.

7. Discussion

7.1 Sustainable development

The Environmental Protection Authority is concerned that proposed development in Western Australia should be environmentally sustainable in the long term (50 plus years) and, in assessing such development, wishes to understand the associated impacts on the environment and people living in the region.

If development in Perth is to be environmentally sustainable an integrated approach to planning and environmental management in the North-East Corridor should be adopted.

7.2. Existing incremental approach to environmental protection

The Environmental Protection Authority is aware of the government's programme to identify and provide housing land in the Perth Metropolitan Region. The Department of Planning and Urban Development has an important role in implementing environmental protection through planning. For example, the Department of Planning and Urban Development plans ensures that incompatible land uses are adequately separated, and it reserves land for Parks and Recreation in order that it be acquired and protected for conservation.

Advice from officers of the Department of Planning and Urban Development indicated that planning in the metropolitan region follows an incremental process where broad decisions at the strategic level are progressively interpreted and refined into more detailed plans and policies which are ultimately incorporated into the subdivision and development of land. The Department of Planning and Urban Development consider this staged process inevitable because of the complexities in metropolitan planning and the difficulties in determining detailed planning and technical requirements on a wide range of strategic options. Detailed environmental requirements and conditions are, therefore, normally determined at the rezoning stage and this imposes requirements prior to development and subdivision proceeding.

7.3 Need for an integrated approach to environmental protection

The Environmental Protection Authority recognises that many studies have been undertaken in the planning for Perth. These commenced with the Stephenson Hepburn plan prepared in the 1950s, the Corridor Plan and Metropolitan Region Scheme in the 60s and 70s and their review undertaken in the late 80s culminating in Metroplan, the Urban Expansion Policy and the corridor structure plans which are currently guiding the shape of Perth.

In addition, the Environmental Protection Authority is aware of the vast amount of work that has and is being undertaken by the Department of Environmental Protection, the Swan River Trust, the Water Authority of Western Australia the State Electricity Commission of Western Australia and Main Roads, particularly on the management of urban impacts on water and air pollution. Key studies currently in progress which affect either the North-East Corridor or development of the Perth Metropolitan Region include:

- the effectiveness of stormwater pollution control ponds in the Bayswater Main Drain catchment;
- development of water quality criteria in response to environmental conditions set for urban development in Ellenbrook;
- Water Authority of Western Australia regional drainage plan for the North-East Corridor;
- Department of Environmental Protection scoping exercise for Swan-Canning Rivers Environmental Protection Policy;
- Draft Environmental Protection Policy for Gnangara Mound Private Land Groundwater 1993;
- The Department of Planning and Urban Development Perth Environment Plan project;
- Perth Airshed studies; and
- Draft Environmental Protection Policy for the Western Swamp Tortoise.

The North-East Corridor Structure Plan document collates much of the existing information.

The Environmental Protection Authority is concerned that keys studies are not integrated to provide a long-term view of the environment, and are not completed. In particular, management strategies have not been developed which show how the environment will be managed and protected in the long term. The Environmental Protection Authority believes these studies should be integrated and completed, and satisfactory management strategies prepared before decisions are made about the environmental acceptability of urban development of the North-East Corridor as proposed in the Structure Plan. The studies need to consider the long term impacts (50 plus years) of urban development on the environment to ensure that development will be sustainable in the long term.

A greater level of detailed investigation is necessary before decisions are made about the environmental acceptability of current rezoning or reservation proposals for urban development.

These studies should include a consideration of the relative costs and benefits of development. For example, where development is planned, government should compare the costs for the community of managing the associated environmental issues to the benefits provided by that development for the State.

Rezoning Rural land to Urban Deferred conveys an expectation to the community that the land is fundamentally suited to urban development. The Environmental Protection Authority questions whether the community's expectations should be raised before environmental investigations have concluded, particularly if subsequent studies show that urban development may be unacceptable on environmental grounds.

If rezoning to Urban Deferred occurs prior to the completion of the nominated studies and unacceptable risks associated with urban development are identified then the proposal to lift the Urban Deferred zoning should be referred to the Environmental Protection Authority for assessment.

7.4 Management

The expertise and responsibility for undertaking these studies and management strategies lies with a number of government agencies. The overriding need is for these agencies to be coordinated and for resources to be committed to define and complete the necessary work in a timely manner. A project team is needed to coordinate the studies with one agency (for example, the Department of Planning and Urban Development) taking the lead. The team must have the authority and the responsibility to define the work that is to be undertaken, to adequately resource the work and to ensure that it is completed and implemented.

In the normal course of events the proposed developments would follow an agreed project plan which may include:

- definition study,
- feasibility study,
- detailed studies,
- implementation, and
- ongoing performance evaluation.

7.5 Funding and timing

It is understood that the population within the corridor is currently 8 200 and this is expected to reach an ultimate population of 95 000. It is estimated that the proposed development in the corridor to the west of the Swan Valley, including Ellenbrook, Egerton and the land to be zoned through the current Metropolitan Region Scheme Amendment, will house approximately 80 000 people. Preliminary estimates suggest that costs for this development, including housing, roads, sewerage, power, commercial and industrial development and community facilities would probably be the of order of $2 billion to $3.5 billion over the next 30 to 50 years. In view of the magnitude of the expenditure, the Environmental Protection Authority believes the project plan studies should be adequately funded. In setting the level of expenditure, it should be noted that large private industry operations allocate many millions of dollars on environmental studies and management, and that the level of expenditure should reflect the environmental sensitivity of the area to be developed. Often these studies take up to five years to complete.

8. Conclusion and Environmental Protection Authority advice

A. General conclusion and advice

Based on Sections 5, 6 and 7, the Environmental Protection Authority concludes that there is insufficient information on which to provide sound environmental advice on many site specific issues and on all of the regional issues related to the North-East Corridor.

In order that the Environmental Protection Authority can give appropriate advice on the environmental acceptability of development proposals in the North-East Corridor a project plan and subsequent studies are required. A properly funded project team should be established to plan and undertake all the work. It might be appropriate for the team to be lead by the Department of Planning and Urban Development.

These studies have not been completed. The time constraints that the Department of Planning and Urban Development has been required to work to has unfortunately precluded the systematic analysis of the relevant issues.

So that sound decision-making regarding proposed land-use changes in the North-East Corridor can be made, the project team would need results from at least the following:

- adequacy of current system of groundwater protection;
- the conservation status of channel wetlands;
- criteria to ensure water quality in the Swan River is protected;
- criteria to ensure long-term protection of the lakes and wetlands in the region, particularly with respect to water levels and water quality;

- a regional drainage manage plan which meets the criteria set to protect channel wetlands, the Swan River, lakes and wetlands;
- strategies to ensure the long-term protection for the Western Swamp Tortoise and Southern Brown Bandicoot; and
- strategies to manage several other minor but important issues such as risks and hazards from the gas pipeline, sewage disposal etc.

If urban development is to take place then the Environmental Protection Authority advises that to ensure that the environment is adequately protected a Plan which includes environmental management be formulated and implemented. This Plan should contains, but not necessarily be restricted to, the following elements:

- definition study,
- feasibility study,
- detailed studies,
- implementation, and
- ongoing performance evaluation.

The Environmental Protection Authority advises that as a matter of high priority, the minimum work to be undertaken should be:

- the completion of the definition and feasibility studies which would describe in detail which issues should be studied so that adequate decision making can occur;
- the completion of a report describing the methodologies for carrying out these further studies; and
- the completion of other studies as described in advice in B. and C. below.

The Environmental Protection Authority recognises that completion of this minimum level of work prior to rezoning from Rural to Urban Deferred would cause a timing problem for the finalisation the North-East Corridor Amendment. However, without this work the Environmental Protection Authority cannot provide sound environmental advice, especially on how developments in the North-East Corridor would impact upon regional environmental issues facing the urban expansion of the Perth Metropolitan Region and how those impacts should be managed. Thus the Environmental Protection Authority advises that if the nominated studies indicate unacceptable environmental risks associated with urban development then the proposal to lift Urban Deferred zoning should be referred to the Environmental Protection Authority for assessment.

B. Site specific advice

1. Urban deferred zoning over Priority 2 source protection areas - Section 5.1.1

The Environmental Protection Authority advises that:

- A statutory land use and water management plan should be prepared for the eastern flank of the Gnangara Mound which re-evaluates the Priority 1 and 2 areas and their development potential;
- Based on the need to protect Priority 1 and 2 groundwater areas and other concerns raised in this Bulletin, there is insufficient information to conclude that the proposed rezoning from Rural to Urban Deferred in the North-East Corridor could proceed and be environmentally acceptable; and
- The lifting of Urban Deferred zoning should not occur until (a) a statutory land use and water management plan and other studies noted in other Sections of this

Bulletin are completed, and (b) the results of that work demonstrate that it is either acceptable to develop the land or it is practical to put controls in place which adequately protects groundwater from unacceptable degradation.

The Environmental Protection Authority acknowledges that this position, if accepted by Government, may have implications for land availability in the metropolitan region. However, the Environmental Protection Authority is concerned that allowing the land to be re-zoned to Urban Deferred would create the expectation that urbanisation would follow irrespective of the outcome of the studies, in particular, if those studies show that urban development in these areas is environmental unacceptable.

2. Proposals affecting Policy Area 1 (Priority 1) groundwater area - Section 5.1.2

The Environmental Protection Authority advises that:

- The extension of Tonkin Highway to Gnangara Road over the Priority 1 source protection area shown in the North-East Corridor Structure Plan is environmentally unacceptable;
- A strategy be developed to ensure groundwater is protected from potential adverse impacts associated with movement of goods and vehicles over the existing Gnangara and Beechboro Roads;
- Any proposal which facilitates increased movement of goods and vehicles along Gnangara or Beechboro Roads and increases the risk of groundwater contamination should be referred to the Environmental Protection Authority for environmental impact assessment. Such proposals are likely to be considered environmentally unacceptable; and
- Any proposal to pipe sewage across the area identified within the Environmental Protection (Gnangara Mound Crown Land) Policy 1992 should be referred to the Environmental Protection Authority for environmental impact assessment. A proposal to pipe sewage may be environmentally acceptable provided that appropriate management measures are put in place.

3. Area "subject to further investigation" in the North-East Corridor Structure Plan - Section 5.1.3

The Environmental Protection Authority advises that any proposals not consistent with the Environmental Protection (Gnangara Mound Crown Land) Policy 1992, Statement of Planning Policy No 3 or the Draft Environmental Protection Policy for Gnangara Mound Private Land Groundwater 1993 within the area defined in the Structure Plan as "subject to further investigation" and adjacent to, and west of, the proposed Tonkin Highway extension should be referred to the Environmental Protection Authority for environmental impact assessment.

Proposals not consistent with these policies are likely to be considered environmentally unacceptable.

4. Drainage - Section 5.2.1

The Environmental Protection Authority advises the lifting of Urban Deferred should not occur until a drainage and nutrient management strategy for the North-East Corridor and studies noted in other Sections of this Bulletin are completed and found to be environmentally acceptable. Before finalisation, the drainage and nutrient management strategy should be publicly reviewed and referred to the Environmental Protection Authority for environmental impact assessment.

The drainage and nutrient management strategy should include, but not be limited to consideration of:

- the ability of the Swan River to absorb nutrient loads;

- the complex hydrogeology of the North-East Corridor;
- results from other retention basins/nutrient stripping ponds on the Swan Coastal Plain;
- recommended wetland water level criteria to ensure wetland values are maintained;
- water quality criteria to ensure wetland ecology does not deteriorate unacceptably;
- the impacts of the drainage strategy on channel wetlands and the levels of acceptable change in those wetlands; and
- a monitoring and management strategy to ensure that wetland water level and water quality criteria are met, and that impacts on channel wetlands are acceptable.

Water level criteria should be set for individual wetlands on a case-by-case basis.

The Environmental Protection Authority advises that the drainage strategy should not only have developed criteria to ensure the environment is protected but must also demonstrate that these criteria (particularly for the Swan River) can be met.

Once the drainage strategy is finalised, the Water Authority of Western Australia and Department of Planning and Urban Development should ensure that the various elements of the strategy are implemented at the appropriate stages of development.

5. Sawpit Gully - Section 5.2.2

The Environmental Protection Authority advises that the use of Sawpit Gully and other creeks and streams of high conservation value as a conduit for regional drainage is environmentally unacceptable.

6. Water supply and sewerage services - Section 5.2.3

The Environmental Protection Authority advises that:

- the establishment of the Water Authority's Lexia Groundwater Scheme, including the reservoir and treatment plant, will require separate environmental impact assessment to ensure potential environmental impacts associated with groundwater abstraction and siting of these facilities are managed appropriately; and
- the establishment of on-site effluent disposal facilities, if proposed, will require separate environmental assessment to ensure that the effluent is adequately managed.

Both of the above may be environmentally acceptable provided that appropriate management measures are put in place.

7. System Six area M17 Twin Swamps and Ellenbrook Nature Reserves - Section 5.3.1

The Environmental Protection Authority advises that:

- it supports the State Planning Commission's reservation of System Six area M17 as Parks and Recreation (Restricted) to protect the Western Swamp Tortoise in the North-East Corridor Amendment; and
- catchment management mechanisms through the planning process should be implemented to provide on-going protection for the Western Swamp Tortoise and its habitat.

8. System Six area M18 Walyunga National Park - Section 5.3.1

The Environmental Protection Authority advises that the action proposed for System Six area M18 in the draft *Darling Range Regional Park and landscape study* should be implemented.

9. System Six area M19 Swan river, Benara Road extension - Section 5.3.1

The Environmental Protection Authority advises that the proposed extension of Benara Road between Lord Street and Midland across System Six area M19 should be referred to the Environmental Protection Authority for environmental impact assessment. This extension may be considered environmentally acceptable provide that appropriate management measures are put in place.

10. System Six area M41 Bennett Brook, public transport reservation south of Reid Highway - Section 5.3.1

The Environmental Protection Authority advises that the proposed public transport reservation south of Reid Highway (affecting System Six area M41 and certain creek alignments) and the widening of Lord Street should be referred to the Environmental Protection Authority for environmental impact assessment. This extension may be considered environmentally acceptable provided that appropriate management measures are put in place.

11. System Six area M41 Bennett Brook - Urban Deferred Zoning between Harrow and Cranleigh Streets - Section 5.3.1

The Environmental Protection Authority advises that the proposed Metropolitan Region Scheme zonings for Bennett Brook be reviewed to ensure they are consistent the System Six recommendations for Bennett Brook (Area M41).

12. Remnant vegetation, Southern River Complex vegetation, old RAAF Airstrip, Caversham - Section 5.3.2

The Environmental Protection Authority advises that there is preliminary evidence that the Southern River Complex vegetation type has regional significance. The reservation of the old RAAF Airstrip at Caversham, which contains this vegetation type, for Parks and Recreation is supported.

The Environmental Protection Authority is concerned that this is not reflected in the North-East Corridor Amendment.

13. Remnant vegetation, corridor linking Ellenbrook's Lexia wetlands with Melaleuca Park - Section 5.3.2

The Environmental Protection Authority advises that proposals to extract basic raw materials in areas of remnant vegetation which form part of a corridor between the Lexia wetlands and Melaleuca Conservation Park should be referred to the Environmental Protection Authority for environmental impact assessment. Proposals to extract Basic Raw Materials in this area which affect the value of this vegetation and the ability of the area to act as a fauna corridor would likely be considered environmentally unacceptable.

14. Lakes covered by the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 - Section 5.4.1

The Environmental Protection Authority advises that:

- proposals affecting the lake located just north-east of the junction of West Swan Road and Great Northern Highway inconsistent with the Environmental Protection

(Swan Coastal Plain Lakes) Policy 1992 should be referred to the Environmental Protection Authority for environmental impact assessment and are likely to be considered environmentally unacceptable.

- the existing zoning of the lake subject to the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 between Koongamia and Helena Valley be further examined to ensure that all of the lake is reserved for Parks and Recreation.

15. Other wetlands - Section 5.4.2

The Environmental Protection Authority advises that other wetlands in the North-East Corridor should be protected and managed in accordance with the principles outlined in EPA Bulletins 685 & 686.

16. Creeks and streams - Section 5.4.3

The Environmental Protection Authority advises that the Department of Planning and Urban Development should coordinate development and implementation of a plan for channel wetlands which includes, but is not limited to, protection of a representative suite of channel wetlands. The Water Authority of Western Australia, Waterways Commission/Swan River Trust and Department of Environmental Protection should be involved in development of the plan.

17. Risks and hazards, the WANG and SECWA gas pipeline - Section 5.5.1

The Environmental Protection Authority advises that a risks and hazards assessment of the gas pipelines be undertaken to determine the width of the easement required before local structure planning occurs for urban development near the pipeline.

18. Poultry farms - Section 5.5.2

The Environmental Protection Authority advises that new residential zones should be separated by at least 500m from the existing poultry sheds until it can be demonstrated to the satisfaction of the Environmental Protection Authority that the impacts from the sheds (odour, noise and dust) would not adversely affect residential amenity.

19. Airports - Section 5.5.3

The Environmental Protection Authority advises that until such time that the correlation between the ANEI system and human response is tested the 20 ANEC (or ANEF) be used to identify the constraint to urban development around airports.

20. Zoning around Midland and Whiteman brick factories - Section 5.5.4

The Environmental Protection Authority advises that the pocket of Rural zoned land which includes part of the Midland Brick factory should not be re-zoned to Urban Deferred until such time as the factory re-locates and it is determined that a buffer is not required between permitted uses in the Industrial zoned land and the Urban zoned land.

In the interim, the Environmental Protection Authority advises that further urban development to the south west of the factory should referred to the Environmental Protection Authority for advice on buffer zone requirements.

21. Urban zoning of previously assessed land - Section 5.6.1

The Environmental Protection Authority advises that the portion of land in the North-East Corridor Amendment proposed to be re-zoned from Urban Deferred to Urban within the

Ellenbrook development cannot proceed until the environmental conditions associated with the Ellenbrook environmental impact assessment are cleared.

C. Advice on regional issues

1. Groundwater protection, public water supply - Section 6.1

The Environmental Protection Authority advises that:

- a statutory land use and water management plan be prepared for the entire Gnangara Mound which re-evaluates the Priority 1 and 2 areas and their development potential;
- based on the need to protect priority 1 and 2 groundwater areas and other concerns raised in this Bulletin, there is insufficient information to conclude that proposed rezoning from Rural to Urban Deferred as it affects part of the Priority 2 groundwater mound could proceed and be environmentally acceptable; and
- any proposed rezoning for urban development should not occur until (a) a statutory land use and water management plan and other studies similar to those noted in this Bulletin are completed and (b) the results of that work demonstrate that it is either acceptable to develop the land or it is practical to put controls in place which adequately protects groundwater from unacceptable degradation.

The Environmental Protection Authority acknowledges that this approach, if accepted by Government, may have implications for land availability in the metropolitan region. However, the Environmental Protection Authority is concerned that allowing the land to be re-zoned to Urban Deferred would create the expectation that urbanisation would follow irrespective of the outcome of the studies, in particular, if those studies show that urban development in these areas is environmental unacceptable.

2. Swan-Canning River systems - Section 6.2

The Environmental Protection Authority is concerned that there has been no assessment of the effects of incremental land-use change of the Swan River's Swan Coastal Plain catchments and its effect on the Swan River's water quality and ecology.

The Environmental Protection Authority is concerned that changes in land use are being proposed by the North-East Corridor Structure Plan and Amendment at a time when the Swan River Estuary is known to be nutrient enriched.

The Environmental Protection Authority advises that further land-use change should not occur before completion of a rigorous assessment of the ability of the estuary to absorb nutrient loads and options to reduce nutrient loads from land in the North-East Corridor.

The Environmental Protection Authority is concerned that there is no agency with clear responsibility and authority to ensure that that water quality and ecology of the Swan River are protected. The review of the Swan River Trust Act is expected to address this concern.

3. Wetland systems - Section 6.3

The Environmental Protection Authority advises that prior to urban development occurring in areas likely to impact on a wetland the following work should be completed:

- the wetland and associated dryland buffer should be delineated;
- appropriate zoning or land use controls established for the wetland and buffer area;

- the wetland's management category, as described in EPA Bulletin 686, 1993, should be determine;
- water level and water quality criteria set on a case-by-case basis; and
- a management plan should be developed consistent with the requirements above.

4. Air quality - Section 6.5

The Environmental Protection Authority advises that air quality management strategies should be integrated into urban and transport planning for the North-East Corridor as results of studies such as the Perth Airshed Studies become available.

The Environmental Protection Authority supports the Department of Planning and Urban Development taking a lead role in managing greenhouse gas emissions. The planning and subsequent development of Perth should include transport systems and urban forms which minimise private automobile transport needs.

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Appendix 1

Environmental Protection Authority advice

Planning for the future of the Perth Metropolitan Region (1989)

North-east corridor issues and options paper (1991)

Environmental Protection Authority
Comments on Planning for the Future of the Perth Metropolitan Region

Environmental Protection Authority
Perth, Western Australia
Bulletin 404 July 1989

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APPENDICES

PLANNING FOR THE FUTURE OF THE PERTH METROPOLITAN REGION

Comments on environmental aspects
by the Environmental Protection Authority
July 1989

1. INTRODUCTION

In 1988 the Environmental Protection Authority (EPA) considered the report "Planning For the Future of the Perth Metropolitan Region" that was released by the State Planning Commission following the review of the Corridor Plan for Perth and the Metropolitan Region Scheme. The proposals have not been assessed at a formal level. In responding to the report and its proposals, the EPA notes the following points:

- the report puts forward general rather specific proposals for the future growth of the metropolitan region. It contains a preferred strategy that will be refined through various consultative processes;

- the review process that preceded preparation of the report involved wide community consultation and as indicated above, consultation will continue during the process of finalising the strategy;

- upon finalisation of the future strategy, statutory planning processes will need to occur to put particular proposals into effect. These processes will provide the Authority with a further opportunity to assess such proposals either internally or formally; and

- revision of the planning strategy for the metropolitan region raises many fundamental and complex issues. Although environmental matters are obviously important, resolution of these issues and the inevitable conflicts that will arise will require a whole of Government approach, rather than a series of separate decision-making processes, during finalisation of the planning strategy.

The EPA has, however, considered the environmental issues arising from the preferred strategy put forward in the report "Planning for the Future of the Perth Metropolitan Region". This report reviews those issues.

2. DISCUSSION

The EPA considers that the preferred strategy has a number of positive aspects, including:

- the notion of urban consolidation which, if carefully planned and managed, can produce many environmental benefits;

- recognition of the need to preserve Perth's coast and beaches, rivers and wetlands as a matter of priority; and

- accommodation of many System 6 Recommendation areas, particularly the proposed metropolitan regional parks.

Additionally, relevant environmental issues have generally been identified although, in some instances, these have been considered somewhat superficially. Accordingly, in finalising a planning strategy for the Perth Metropolitan Region, certain environmental issues should receive further attention.

The most significant of the issues relates to water resources, in particular the consequences of urbanisation within groundwater resource areas, but also including the modification of consumption patterns through urban design and the effects of climatic change. The effects of climatic change also need to be considered in other contexts, such as changing water levels in coastal areas and in the Swan-Canning estuarine system. The need for adequate buffer zones relating to pollution and noise emissions and risks and hazards associated with certain industrial operations is another factor that could influence metropolitan form.

These issues, and also matters relating to System 6 areas, regional reserves and natural features of the metropolitan region are discussed below.

3. ENVIRONMENTAL ISSUES

3.1 GROUNDWATER

The groundwater reserves underlying the Swan Coastal Plain represent a major environmental resource for a number of consumptive and non-consumptive purposes, including:

- major public water supply schemes and abstraction for institutional uses (eg by State and Local Government authorities);
- private groundwater abstraction (eg for domestic, commercial and industrial activities, and primary production); and
- maintenance of biophysical environmental features (eg wetlands).

The land and underlying water resources of any region are directly related, particularly in an area like the coastal plain of Perth where the sandy soils provide a generally poor medium for the removal of pollutants from infiltrating waters. The existence of the coastal plain groundwater reserves was recognised as a constraint upon future development during the regional planning review. Nevertheless, the preferred strategy both confirms existing (but not yet developed) urban areas within designated groundwater areas and proposes further such urban areas. While recognising the dilemma that the existing urban areas represent for the planning process, the EPA regards the designation of additional urban areas within the designated 'primary source' groundwater areas (proposed and existing public water supply borefields and their recharge areas) as an environmentally undesirable feature of the preferred strategy.

Although experience has shown that urbanisation contributes to groundwater contamination, under some circumstances such development may represent less of a threat to the underlying groundwater than do certain noxious and nutrient releasing rural land uses that characterise much of Perth's proclaimed groundwater areas. Furthermore, urbanisation is sufficiently capital-intensive to permit the construction and operation of pollution control structures on urban drains. This contention has in fact influenced decisions regarding urban development proposals in some instances. However, the Water Authority's "Land Planning and Groundwater Resource Protection" policy argues against the establishment of urban development within the key groundwater areas ('primary source' areas) because of the potential for groundwater pollution associated with such development.

The threat to groundwater from urban development is not from pollution alone. The export of water via drainage schemes needed to render the land suitable for urban development also poses a threat both to the groundwater resource and the broader environment to which the drainage waters are discharged. Pollution and drainage related issues are arising in the South Jandakot area where a major urban cell is proposed, and will also arise if moves to establish urban development on the eastern or western sides of the Gnangara Mound proceed.

The Water Authority's policy does not absolutely preclude the possibility of urban development in groundwater areas. However, it does indicate that such should only proceed if demonstrated to be acceptable through detailed environmental assessment. The EPA endorses this position with respect to "known groundwater areas", but is opposed to urban development in "primary source" areas. The EPA believes that urbanisation in "primary source" areas should not be countenanced.

Both the Water Authority's groundwater protection policy and experience being gained with the South Jandakot area demonstrate that currently accepted development philosophies and practices are not appropriate in areas containing valuable groundwater resources. For example, the typical approach to land drainage is based on lowering the water table and exporting the resultant "waste" water off-site. The way in which domestic gardens and other recreation areas are managed also needs to be revised in view of the threat to groundwater (both in terms of water consumption and pollution) that these elements of urbanisation can represent.

The EPA considers that there can no longer be a presumption that urban development (particularly in its traditional form) will be able to proceed in areas historically thought appropriate for such development. Urbanisation is a form of development that is incompatible with wise management of the groundwater resource for the purposes of public water supply and the maintenance of environmental values. Accordingly, areas of known value for groundwater (both in a public supply, and biophysical environmental sense) should not be designated for urban development unless it is demonstrated through thorough environmental investigations and assessment that such development could proceed without jeopardising groundwater quality and quantity. The likelihood of being able to achieve this objective must be recognised as low if conventional development philosophies and practices are pursued.

Other non-urban forms of development can also contribute to the degradation of groundwater resources and, in addition to urban uses, the Water Authority's policy addresses such activities as rural, special rural, industrial, commercial and transportation. The EPA also addresses industrial activities in the following section of this report.

Within areas that contain valuable groundwater resources, or are important in terms of sustaining such resources (recharge areas for example), the environmental priority for the planning process would be to ensure that land use and development strategies were compatible with maintaining the nominated human and environmental values of the resource. It is therefore incumbent upon the planning system to devise, implement and enforce suitable planting controls that achieve the required degree of water resource protection, and avoid the cumulative costs to society of irreversible resource degradation. Acquisition and permanent protection of key areas such as parkland or conservation reserves should be given serious consideration as the safest and most cost efficient protective mechanism in the long term.

3.2 INDUSTRIAL DEVELOPMENT

In terms of groundwater protection, industrial development can be considered as an adjunct of urbanisation, although of a more severe form because of the high water demand of some industrial activities and the serious pollutants that many industrial activities generate. The transportation and storage of hazardous substances is another facet of industrial development that reinforces its fundamental inappropriateness in areas with valuable groundwater resources.

In addition to the potential of industrial development to affect groundwater resources, other environmental issues associated with such development need to be considered and accommodated in the regional planning strategy.

The Authority recognises that the review process included thorough examination of areas to accommodate industrial development. From the environmental viewpoint, the objective for regional industrial planning should be twofold:

- initially, to identify and allocate areas suitable for industrial development taking into account the biophysical effects of such development and the excluding effects industry has in terms of other uses; and

- secondly, to designate an appropriate "buffer" surrounding areas designated for industry, or any other form of noxious or environmentally impacting activity (eg water treatment plants).

The intention of the buffer is to both protect the industrial area from constraining land uses, and to protect other areas beyond the buffer from the adverse "spillover" effects from the industrial activities. The buffer area could be used to accommodate land uses unlikely to be adversely affected by the spillovers from the industrial area and unlikely to exert any adverse impacts upon the surrounding environment. Buffer areas, (ie the land-take required), should be provided <u>within</u> designated industrial zones and should be borne as a direct cost of industrial land development.

Industrial land uses may have direct impacts such as loss of vegetation and change of landform. They also have the potential to produce impacts through the pollution of air and water, and from increased noise levels. Industrial developments may produce emissions having a sustained, low impact; but they may also have the possibility of a single, high-impact event with consequent risks to people. These latter impacts are being addressed by risks and hazards assessments within the environmental impact assessment process.

The preferred industrial strategy put forward in the report "Planning for the Future of the Perth Metropolitan Region" does not explicitly address the need to provide protective buffers for areas designated for industry. The need for preparation of an "industrial land policy" which would, among other things, contain "criteria" for minimising the adverse landuse and environmental impacts of industrial development is, however, identified. The EPA endorses the need for such a policy and, in Appendix A to this report, puts forward principles relating to the location, management and control of industry that would provide a sound basis for the environmental component of this policy.

3.3 GREENHOUSE EFFECT

The report "Planning for the Future of the Perth Metropolitan Region" focusses on the environmental quality of the region as a major contributor towards the quality of life available.

The main positive environmental attributes of the Perth Metropolitan Region are identified as the wetlands, groundwater quality, coastal and bushland areas. All of these are affected by climate, especially temperature and rainfall. In addition to this, other attributes such as rural industries are also affected by climate, a fact that needs to be recognised in the planning for such areas.

In the report, these attributes are all described in terms of the present climate, based on past records. A significant concern of the EPA is that there is very little reference to the Greenhouse Effect which may result in a significant change to climate. From information so far produced by research and other organisations, the main environmental values or attributes listed in the report will be affected by such changes.

Current scenarios for the south west of the State show that there are likely to be changes in rainfall and temperature. These changes, although not yet precise, are of concern to various Government agencies. The Water Authority is considering the effect of such changes on future water supplies and groundwater, and wetland quality. Climate changes may also affect coastal processes and the retention of ecosystems within the region. The scenarios also affect rural land uses reliant on particular rainfall and temperature regimes, and availability of groundwater.

In view of the above, the EPA believes that in devising the future planning strategy for Perth, the possible effects of climatic change in terms of the use and management of land need to be considered in much greater depth and at the earliest opportunity. Factors requiring attention in this context include:

- the loss of wetland areas;
- open space planning and management (accommodation and procedures to retain natural ecosystems threatened by climate change);
- water conservation; and
- coastal management.

Other matters which should also be addressed include reducing energy usage at the domestic level (eg low energy house design and recycling of refuse) to reduce the output of greenhouse gases. Initiatives in this direction should also be devised for industry.

3.4 URBAN DESIGN AND RESOURCE CONSUMPTION

The fundamental layout and design of development in the region has meant that there has been a tendency towards excessive use of environmental resources (eg land, water and energy). The EPA supports those aspects of the preferred strategy, whether explicit or implicit, that will help reduce per capita consumption levels of the various resources. To this end the Authority strongly supports the strategy's first steps toward urban consolidation, infill and in the long-term, higher density land use.

The Authority recognises that this will not be achieved quickly, but appreciates that a plan which provides maximum opportunity for the community to live close to a well located series of employment centres is a first step in producing a potentially more energy efficient transportation system and the opportunity for more varied and appropriate urban design.

Water usage and protection of water resources (especially groundwater) are, as already indicated, major environmental issues within the Perth Metropolitan Region. These issues have been addressed elsewhere in this report, including reference to the need for a change in approach towards urban development practices. Appendix B to this report puts forward design criteria for water conservation which provide useful guidance towards the change needed.

The EPA also supports references in the preferred strategy advocating the provision of reticulated sewerage to urban areas currently dependent on septic tank/leach drain disposal systems. This and all other strategies directed towards protection of the region's groundwater and surface water resources are endorsed.

The Authority considers that there is a need for suitable guidelines to achieve more environmentally attuned subdivision and urban development in new areas, and adjacent to valuable ecological or scenic, or fragile environments. Such guidelines are urgently needed to improve the general levels of responsiveness of new developments to the environments in which they are set, and to bring about the principal environmental objectives contained in the preferred strategy for the Perth Metropolitan Region.

3.5 SYSTEM 6 AREAS, REGIONAL RESERVES AND NATURAL FEATURES

The report "Planning for the Future of the Perth Metropolitan Region" illustrates a better understanding and assessment of the natural environment of the region than does the earlier Corridor Plan for Perth.

The EPA recognises that recommended System 6 areas are well catered for in the strategic plan, by inclusion in the proposed metropolitan park system. It is further noted that the metropolitan parks proposals reflect the information and findings of the constraints mapping exercise, and therefore place an important and worthwhile emphasis on remnant native vegetation in the region, the main wetland systems, the river systems and the ocean beaches.

The EPA supports the areas proposed for inclusion in the metropolitan parks, and accepts them as an adequate basis for creating functional and ecological linkages. Additionally, however, implementation of the proposed metropolitan parks needs to be accepted as a priority. Although the actual creation of the parks is a long-term strategy, there is a short-term need (acknowledged in the report "Planning for the Future of the Perth Metropolitan Region") to establish a single authority responsible for co-ordinating the overall planning of the parks system.

4. CONCLUSIONS

The EPA is aware of some opposition to aspects of the preferred strategy put forward in the report "Planning for the Future of the Perth Metropolitan Area". This is particularly so in the outer semi-rural sectors where proposals to increase residential densities are viewed unfavourably by existing residents. This opposition is based on a number of concerns, including implications for groundwater resources, and lifestyle issues relating to the character and amenity of the areas involved.

The EPA acknowledges the concerns that have been expressed and has addressed issues relating to the groundwater resources. The lifestyle issues that have also been raised are planning rather than environmental matters and as such, are beyond the scope of the Authority's responsibilities.

Although the preferred strategy put forward in the report "Planning for the Future of the Perth Metropolitan Area" raises a number of environmental issues which, in the Authority's opinion, require further attention, it does contain a range of environmentally positive aspects. As such, the Authority believes that the preferred strategy generally provides a sound basis upon which to build the final proposals for Perth's future directions, subject to the following five areas of consideration.

In examining the outstanding issues, the EPA has endeavoured to provide guidance about what is needed to ensure the environmental acceptability of the strategies adopted for Perth's future growth.

Of the environmental issues arising from the preferred strategy, impact on the groundwater resources of the Swan Coastal Plain is regarded as the most important. In respect of this issue, the EPA concludes as follows:

(i) *There should no longer be a presumption that urban development will be able to proceed in areas of known groundwater resource value. Urbanisation is a form of development that is incompatible with wise management of groundwater resources for environmental and public water supply purposes. As a general rule areas of known groundwater value should not be designated for urban development unless such is demonstrated to be environmentally acceptable.*

In respect of the other environmental issues arising from the preferred strategy, the Authority concludes as follows:

(ii) *The need for an industrial lands policy is endorsed, and this should be prepared as a priority. In preparing this policy, environmental factors will need to be effectively considered. In this regard, the industrial location, management and control principles outlined in Appendix A of this report should be adopted.*

(iii) *The effects of climatic change need to be incorporated into long-term planning strategies. Until these effects are better known, a conservative approach on development proposals that could be adversely affected (eg coastal and estuarine foreshore proposals) should be adopted.*

(iv) *Reducing both the direct and indirect consumption of environmental resources should be an accepted priority of the regional (and more detailed) scale of planning. In this regard, urban design guidelines directed at achieving more environmentally attuned development should be prepared as a priority. Appendix B to this report could provide a useful input to these guidelines.*

(v) *Arrangements to enable implementation of the metropolitan regional parks proposed under the preferred strategy should be put in place as a priority.*

APPENDIX A

PRINCIPLES OF INDUSTRIAL LOCATION; MANAGEMENT AND CONTROL
(MODIFIED FROM ENVIRONMENTAL PROTECTION AUTHORITY, BULLETIN 257, 1986)

1. PRINCIPLES FOR LOCATION OF INDUSTRY

1.1 Industry which has the potential for adverse impacts on people or on the environment should only be located where its impacts can be assimilated or controlled. This may be achieved by siting within a properly designated and managed "industrial zone", the beneficial use of which is recognised by the community as industrial. In certain instances this may necessitate a remote location.

1.2 An "industrial zone" should contain only industry, and should also be separated from residential areas by an appropriate buffer zone.

1.3 The environmental impacts of industry should be restricted to the "industrial zone" and "buffer zone". Excursions of excessive impacts beyond the buffer zone should be rare, and should only result from atypical events (either within the industrial plant or of the environment).

1.4 Land use in the "buffer zone" should be such that it does not impact adversely on residential areas.

1.5 Land use in the "buffer zone" should be sufficiently resilient to withstand impacts from the "industrial zone".

1.6 The location of particular industries within an industrial zone should be such that impacts on other industries fall within prescribed standards for environmental risk and ongoing environmental impact.

2. PRINCIPLES OF PROJECT APPROVAL

2.1 Each new project with the potential for significant environmental impacts, or amendment to any existing project that would increase its environmental impact, should be subject to environmental impact assessment. (In some more remote country areas particular types of developments requiring assessment may be prescribed by the EPA).

2.2 It is the responsibility of the proponent to demonstrate that any proposal will not impose more than an acceptable level of risk or impact to the environment or to the health and wellbeing of the community.

2.3 A proposed new industry, or alteration to an existing industry should be designed to ensure that its environmental performance is appropriate to the prescribed standards for the zone in which it is proposed or located, and for its particular location within that zone.

2.4 Any new industry, or alteration to an existing industry should have adequate management procedures to control performance to specified levels for both the regular operation and for contingency events.

2.5 Whenever a new project is assessed, consideration should also be given to the cumulative impact with existing industries in the region.

3. PRINCIPLES OF ENVIRONMENTAL MANAGEMENT BY INDUSTRY

3.1 New industry should be constructed such that it satisfies both the conditions set at project approval, as well as the general requirements of the zone's beneficial use.

3.2 The operation of any industry should be managed such that it satisfies both the conditions set at project approval, as well as the general requirements of the zone's beneficial use.

3.3 Industry should conduct periodic reviews to ensure that it retains the ongoing capacity to control performance to specified levels for both regular operation and for contingency events. Such reviews should be subject to assessment of their environmental acceptability.

4. PRINCIPLES OF MONITORING AND REGULATION

4.1 Each industry should monitor its environmental impacts to ensure that they do not exceed the standards set for the beneficial use of the area impacted.

4.2 Industry should be required to advise Government of the likely environmental consequences as soon as practicable after the occurrence of any unforeseen event such as an accidental discharge.

4.3 Standards of performance should be enforced such that beneficial use criteria are met.

APPENDIX B

URBAN DESIGN CONSIDERATIONS FOR WATER CONSERVATION

(NOTE: Partly derived from a draft policy for water sensitive residential design - Urban Design for Water Conservation Research Group)

. BROAD OBJECTIVES FOR WATER CONSERVATION IN REGIONAL URBAN DESIGN.

- ensure that the necessary environmental information is obtained and analysed by developers, in order to achieve integration of land and water planning;

- ensure that adequate plans are prepared showing appropriate urban form, density, landscaping and infrastructure necessary to achieve water sensitive design; and

- ensure that developers adequately consider the future management responsibilities, strategies and implications for water sensitive design features.

. ENVIRONMENTAL INFORMATION NEEDS FOR ACHIEVING WATER CONSERVATION OBJECTIVES IN URBAN DESIGN.

The following information should be seen as part of the site evaluation process and will enable design options to be identified on the basis of ongoing water management requirements.

Proponents should be required to identify:

- the water balance of the locality and its relationship to the regional water body;

- the expected groundwater rise associated with clearing and urbanisation both on and off the subject site;

- the principal landscape components occurring on the site including:

  (i) wetlands, sump lands, damp lands and associated vegetation;

  (ii) streams, gullies and drainage lines;

  (iii) existing or proposed conservation reserves; and

  (iv) areas of remnant vegetation;

- the significance of these components for conservation and recreation and/or drainage and the establishment of criteria to protect their integrity;

- groundwater availability on the site and the present water quality characteristics including nutrient levels; The distribution of soil types and their infiltration characteristics; and

- the extent of buffer zones around wetlands to accommodate flood storage, nutrient stripping, conservation and recreation.

DESIGN CONSIDERATIONS TOWARD ACHIEVING WATER CONSERVATION

The following design principles are intended to assist the development of design solutions associated with determining an appropriate urban form, density, landscape and infrastructure. The application of these principles will be site specific and will be guided by the evaluation of the environmental information obtained for the site.

- Maximise in situ recharge in situations where run off is unpolluted and soil capacity permits.

- Stormwater drainage systems to be designed in a manner that enhances the environmental quality of the site.

- No direct drainage or stormwater discharge to natural wetland systems. Associated sedimentation traps and vegetation buffers to be designed to achieve nutrient stripping.

- Minimise the negative impact of possible nutrient enrichment.

- Where appropriate public open space should be designed, developed and managed using Xeric landscape principles.

- The boundaries of public open space areas incorporating wetlands to be planned to incorporate vegetation nutrient stripping buffers.

- Urban form and density to be designed in a manner that reduces private open space water demands.

SPECIFIC DESIGN FEATURES RELEVANT TO WATER CONSERVATION AND WATER HARVESTING PRACTICE. (EXAMPLES ONLY)

- Use of porous pavements for roads and carparks to retain water for slow discharge, and the use of other techniques for water retention.

- Identification of soil types and infiltration characteristics.

- Use of flush edge kerbing on appropriate soil types.

- Use of grassed or vegetated swale drains on the side of the road.

- Increase of unit density by: 1. Reduction of block size to (say) 500 m^2.
  2. Medium density home units.

- Reduction of frontage width to reduce area of road and verge.

- Retention of native vegetation where possible and use of local or water efficient species for landscaping. Zonation of species in the garden by water requirements.

- Identification of volume of recharge basin required on different soils to retain and recharge 80% (say) of all rainfall events for:

  (i) one house and associated impervious areas (eg drives);

  (ii) ten houses and associated impervious areas (including roads);

(iii) one hundred houses and associated urban areas; and

(iv) whole drain catchment.

- Restriction of the area of impermeable surfaces on house blocks to allow for required on site recharge.

- Redirection of all runoff from paved areas into lower garden beds.

- Location of local recharge basins in cul-de-sac ends, roundabouts, local open space. Design of shallow sloped multiple use recharge basins with volume calculations incorporating infiltration ability (eg if grassed x cubic metres volume, if totally landscaped y cubic metres volume). Basins planted with local species to minimise maintenance costs and water requirements.

- Linkage of local recharge basins with grassed or vegetated swale drains. Inclusion in public open space. Integration of drains to carry out drainage functions in very wet years.

- When piped stormwater drains are required use 'leaky pipe' system or alternatively use gully sumps with unsealed base below drain invert level to allow recharge from a significant number (say) 80% of rainfall events.

- For nutrient management of surface runoff, consideration of the opportunities for using nutrient stripping wetlands prior to discharge of stormwater into significant water bodies.

In Perth, climate amelioration should be considered as an essential part of planning the built environment and can significantly influence water demand and water usage patterns. Some techniques which may be applied include the following:

- Appropriate siting.

- Correct orientation.

- Canopy amelioration (reduction of glare and radiant heat by tree planting).

- Shadow effects.

- Night cooling (by means of designed planting & microjet irrigation).

- Wind channelling.

- Transpirational cooling of air.

- Consideration of the heat-sinks and reflective qualities of paved surfaces and appropriate shading.

- Dust control through planting.

Secretary
Department of Planning
and Urban Development

ATTENTION: Mr C Bulstrode

Your ref:
Our ref: 43/86/1
Enquiries: Mr I Harvey

NORTH - EAST CORRIDOR ISSUES AND OPTIONS PAPER

I refer to the above issues and options paper and offer the following comments.

System 6 areas

The 1983 System 6 Study identified 209 metropolitan and country areas of regional conservation significance and/or regional representation of biological and physical values on the Swan Coastal plain and made recommendations for their management. The general principles of Part 1 of the System 6 report were accepted by Cabinet in 1984, as well as approving the progressive implementation, as far as possible, of the detailed recommendations in Part 11 of the Report.

The Authority considers that the North-East Corridor Structure Plan should consolidate the conservation values of the System 6 areas within the planning process and provide the framework for the effective implementation of System Six recommendations. It is recognised that in some cases the areas recommended by the System 6 report are not clearly defined. It is likely, therefore, that the final boundary of these areas will need minor modifications, subject to on-going discussions with the Authority, and consideration of local factors.

Not all System 6 recommendations require that land be purchased and reserved, and avenues exist to retain land in private ownership and still be consistent with System 6 recommendations. Nevertheless, some statement in the Corridor Structure Plan should recognise the need to address these issues.

Remnant Vegetation

Conservation areas isolated by a barrier of alienated land may suffer species decline or local extinction as opportunities for recolinisation are limited. The maintenance of biodiversity cannot be achieved by the establishment and protection of conservation areas in isolation. Therefore, the protection of the remaining native vegetation within the Perth metropolitan area is of fundamental importance. Retention of native vegetation, where possible, assists in water balance management, conserves biological diversity, and provides habitat to our native fauna.

The environmental audit commissioned by DPUD is an initiative which provides a basis for the protection of native vegetation which, if incorporated within the framework of the Structure Plan, will more clearly respond to this environmental issue of concern to the public.

Wetlands

There is a growing view in the community that the remaining wetlands of the Swan Coastal Plain are essential for the maintenance of ecological systems and the time has been reached where strong action needs to be taken to protect them (EPA June 1990). The Draft Lakes Environmental Protection Authority when finalised and 'declared' by the Minister for the Environment as an Environmental Protection Policy under the Environmental Protection Act, will prevent any further filling, drainage or mining of lakes and will prevent the discharge of pollutants into lakes. A regulation is currently in place to prevent such action in the interim.

It is important to note that development around designated lakes is not restricted provided the requirements of the Policy and Regulation are accommodated. However, the incorporation of suitable buffer zones around lakes should be advocated within the plan.

Wetlands which are not designated lakes under the Draft EPP should be identified according to EPA Bulletin 374 and appropriate management provisions incorporated within any development proposal which has the potential to affect these systems.

Although the further loss and degradation of wetlands on the Swan Coastal Plain is undesirable it is recognised that some further unavoidable loss may occur. Wetland losses and degradation may be offset to some degree by a requirement for wetland restoration or construction, either on-site or off-site or of similar function or alternative function to the wetland being lost . This will ensure that there is no net loss of wetland function in the long-term (EPA Bulletin 587).

Gnangara Road

The Authority is strongly opposed to any developments which affect the Priority 1 Area of the Gnangara groundwater mound. The indication within the issues and options paper that Gnangara Road could be upgraded to arterial road standard is therefore of concern as it provides the potential for jeopardising the quality of a large component of Perth's present and future drinking water.

It is the Authority's view that this option should not be supported through the planning process and should not be presented in the Structure Plan. It is critical to the long term protection of this water supply that there is a high level of control over vehicles carrying substances which have the potential to pollute the mound in the event of transportation spills.

Perth - Darwin National Highway

The Authority is aware that options for the Perth to Darwin National Highway are being investigated further in the light of adverse community reaction to the alignments put forward in the issues and options paper. The Authority would reiterate that any options which affect the Priority 1 Area for the Gnangara groundwater mound are not considered environmentally acceptable.

As stated in the Road Reserves Review final report, "Land use and transport are inextricably bound up in a two way relationship. ...The new transport facility stimulates the urbanisation process in those areas served by it and shapes the growth of the city". This type of urban growth pattern could be encouraged on the Priority 1 groundwater area if the Perth to Darwin National highway were to proceed.

Clearly, this would be inappropriate.

Therefore, it is strongly recommended that options which do not affect the Priority 1 area be investigated and that alignments which traverse the Priority 1 area not be included in the Structure Plan or any public document.

Air Quality

The issue of air quality in the north east corridor is of concern to the Authority. Discussions have taken place between the Director of Pollution Control and David Hatt concerning this issue and I have enclosed some notes on the issue for your information. The Authority is concerned at the prospect of 140,000 people being housed in the NE corridor, as that part of the metropolitan area is likely to be the most affected by photochemical smog. The Authority considers that air quality issues may place a severe constraint on development and has recently instigated a 3 year air shed study to define the extent of the problem.

The Authority considers planning and development within the corridor could proceed during the term of the air shed study. However, future urban expansion in this corridor should be guided by the findings and recommendations of the study and the issue of air pollution should be identified within the Structure plan.

The Authority trusts this interim advice will assist you in your planning strategies for this corridor. The Authority will provide more detailed advice at subsequent stages in the planning for the north east corridor.

R.A.D. Sippe

R.A.D.Sippe
DIRECTOR
Evaluation Division

5 March 1992

Enc

NEcorridor 171291 IHA

Appendix 2

Policy and technical information

Groundwater protection - Public water supply

Appendix 2

Policy and technical information

Groundwater protection - Public water supply

Policy framework

Water Authority of Western Australia policy on catchment protection to maintain the quality of drinking water supplies

The Board of the Water Authority adopted the policy on catchment protection to maintain the quality of drinking water supplies in April 1991, and it forms the basis for catchment protection review and proposed re-writing of by-laws.

The current policy adopts a "differential protection" approach which allows development of protection objectives which include consideration of factors such as tenure, zoning, community expectations and existing land-uses. Under this approach, the Water Authority has identified three priority classifications for its present and future public water supply catchments, namely Priority 1, 2 and 3 source protection areas.

Priority 1 source protection areas are the most important for public water supplies, where water resource protection must have the highest priority in land planning and management. Priority 2 source protection areas are catchments where water production has a high priority, but is not necessarily the primary consideration for land planning. Priority 2 areas are usually in private ownership. Priority 3 source protection areas are catchment areas where other land use values predominate over water production and land use management.

Figure 2 in the main text of this Bulletin shows the Priority groundwater areas, the general location and shape of the groundwater mound and existing public water supply production bores in the North-East Corridor.

Points to note from this Figure include;

- Groundwater flows perpendicular to the groundwater contour lines. Assuming a uniform aquifer, any contamination which occurred would be expected to form a teardrop shape perpendicular to the groundwater contours;
- The Priority areas focus on cadastral rather than hydrological boundaries; and
- There are two existing public water supply bores located in the Priority 2 groundwater area which would be zoned urban deferred by the North-East Corridor Amendment.

As the North-East Corridor Amendment proposes urbanisation over Priority 2 groundwater areas, the following extract from the Water Authority policy is provided.

> *... The Water Authority will oppose any intensive or inappropriate land use development unless the development complies with a land and water management plan for the area.*
>
> *Priority 2 source protection areas recognise existing land zoning and tenure. The Water Authority accepts that some contamination may exist and there is a risk of further contamination.*
>
> *Management of Priority 2 source protection areas will primarily be effected through restrictions on land uses aimed at ensuring the level of risk of pollution in these areas is*

not unduly increased. Where possible the risks should be reduced through the reservation of parks and recreation areas. Urban development is not a preferred land use in Priority 2 Source protection areas. However, ***limited*** *and properly managed urban (residential) development may occur in appropriate sectors of the landscape in these areas without unduly affecting the level of risk or contamination in them.*

Environmental Protection (Gnangara Mound Crown Land) Policy 1992

The Environmental Protection (Gnangara Mound Crown Land) Policy 1992 boundaries generally reflect the Priority 1 source protection area boundaries nominated by the Water Authority of Western Australia. The policy was developed to protect the level and quality of groundwater and native vegetation and wetlands within the policy area. The policy specifies beneficial uses, environmental quality criteria and certain activities in the policy area that require authorisation under the Environmental Protection Act.

It should be noted that the policy applies to land held freehold by the State Planning Commission, on both sides of the existing Beechboro Road.

The policy is implemented by a number of mechanisms, including the Statement of Planning Policy noted below.

Statement of Planning Policy No. 3 Gnangara Mound Crown Land

A Statement of Planning Policy is prepared under Section 5AA by the State Planning Commission and issued with the approval of the Minister for Planning and His Excellency the Governor. The boundaries of the policy area are similar as for the Environmental Protection (Gnangara Mound Crown Land) Policy 1992.

The policy objectives are;

- to protect the quality and quantity of groundwater resources for public water supply;
- to promote sustainable use of groundwater;
- to protect wetlands and natural vegetation; and
- to encourage recharge of the groundwater resource.

The State Planning Commission and local authorities are required to give effect to the Policy. Proposals involving the use or development of land which are not in accordance with the objectives of the policy are subject to referral to the Environmental Protection Authority.

Draft Environmental Protection Policy for Gnangara Mound Private Land Groundwater 1993

The Environmental Protection Authority published the Draft Environmental Protection Policy for Gnangara Mound Private Land Groundwater in September 1993 and is currently considering public submissions about the policy before formulating a recommendation to the Minister for the Environment.

The draft policy has a similar structure to the Environmental Protection (Gnangara Mound Crown Land) Policy 1992.

In the section of the draft policy which applies to the North-East Corridor, Policy Area 2 coincides with the Water Authority Priority 2 source protection area.

In Policy Area 2, the draft policy essentially;

- recognises urban development as an activity which can cause groundwater to be degraded;

- puts the onus on public authorities to prevent or control activities which can cause groundwater to be degraded and to have due regard for declared beneficial uses when making land-use decisions; and
- seeks to protect beneficial uses by appropriate land management by land holders in the policy area.

Transport of goods over Priority 1 areas

In 1992 is was agreed to restrict dangerous goods from being carried along Gnangara Road across the Priority 1 Underground Pollution Control Area (which coincides with the Priority 1 source protection area). Routes used by vehicles carrying dangerous goods are approved under regulations administered by the Department of Minerals and Energy.

Select Committee of the Legislative Assembly of the Parliament of Western Australia - Metropolitan Development and Ground Water Supplies

The terms of reference for the above committee are;

1. That a select committee be appointed to inquire into and report on to what extent and in what manner development should be permitted on or around groundwater reservoirs in the Perth Metropolitan Region with particular regard to protecting underground water supplies whilst maximising the potential to zone and develop land for its optimum and best use inclusive of urban development;
2. That the committee have the power to send for persons and papers, to sit on days over which the House stands adjourned, to move from place to place and report from time to time; and
3. That the Committee finally report by no later than 30 November 1994.

In addition to the Terms of Reference the Committee has identified a need to

(a) assess the impact of existing land uses on environmental resources within the declared groundwater mound of the Perth Metropolitan Region including quality and quantity of groundwater;

(b) investigate the potential for future land use on the ground water mounds and provide a framework in which change in land use could occur; and

(c) identify the most appropriate mechanisms and processes that Government should use to protect future ground water supplies.

The following points from synopsis of the Department of Environmental Protection's submission to the above are relevant to the Environmental Protection Authority assessment of this proposal.

- Water, particularly groundwater, is an essential resource for the community of Perth. It is required for domestic, commercial, and industrial water supply; it is used for social and recreation purposes, and supports a range of ecological systems including wetlands, remnant native vegetation and rare flora and fauna species. Approximately 40% of Perth's potable water supplies come from groundwater, with even more being used for other purposes such as garden irrigation and commercial pursuits.
- Perth overlies a vast groundwater resource which because of its shallowness and the nature of the soils overlying it, is susceptible to pollution.
- The protection of current and proposed groundwater source areas is essential for Perth's continued development.
- The wider benefits to the community of maintaining quality of life and standard of living from retention and protection of groundwater quality and quantity, are of

greater economic, social and strategic value than those to be gained from inappropriate development.

- Mixed land use over groundwater areas currently exists in Perth.
- The existing groundwater and environmental protection, and associated land use planning system, in which the Water Authority of WA prioritises and identifies protection objectives for groundwater areas, where the Environmental Protection Authority and the Department of Environmental Protection focus their attention on the recharge areas of the Gnangara and Jandakot Mounds, and the Department of Planning and Urban Development prepares land use management plans is supported. There is scope and need for improvement to this system.
- The Government processes for protection of the groundwater resource and the ecological systems which rely upon them, are limited in their control of and application to proper land use planning in general either because they are statutorily inadequate, cannot adequately take cumulative impacts into account, or because of lack of acceptance by some sections of the development and planning community (as in the case of Environmental Protection Policies).
- The system for groundwater protection and optimising opportunities for land development can be improved by allowing for the preparation of statutory land use and water management plans. These plans should be prepared for the entire hydrologic unit being considered, should take into account objectives for groundwater management and environmental protection, and should afford strong protection for the main recharge areas of the mounds (in line with surface water catchment protection).
- The Department of Environmental Protection believes that development can take place in areas with groundwater provided it:
    - is in accordance with the objectives of the Priority the area has been allocated;
    - takes into account the principles of ecologically sustainable development;
    - defines and minimises risk of degradation of the groundwater; and
    - devises practical and implementable solutions to any problems which may arise.
- The continuation of many of the mixed land uses which exist over groundwater areas is acceptable in terms of the level of groundwater protection required, but it must be recognised that some existing and proposed land uses are not appropriate for specific parts of the groundwater mounds because of the risk of contamination associated with them.
- There are definite trends apparent from the information available as to the effect of certain uses on groundwater, both within and outside Underground Water Pollution Control Areas. Specifically, urban, horticultural and industrial uses have significant unacceptable potential impacts.
- Uses on groundwater recharge areas such as dryland grazing at low stocking densities, recreation, forestry, conservation, protection of remnant vegetation, and controlled Special Rural Zones are generally acceptable.
- Special Rural Zones should not lead to the loss of remnant vegetation and should not replace more benign land uses such as reserves or undeveloped vegetation.
- Given the information available and the valuable nature of the groundwater resource, the precautionary principle and avoidance and minimisation of risk should be employed in any future decisions on land uses over groundwater areas. Risk of groundwater contamination from certain land uses must be considered not only in terms of immediate impacts, but also in terms of long term cumulative impacts.

- Further scientific studies should be undertaken into the specific risks presented by different land uses so that knowledge can be improved, and with this management of the groundwater resource and the land uses which overly it.

Technical information

The following information is largely drawn from the Department of Environmental Protection submission to the Select Committee. Information regarding the potential impacts has been provided for Rural and Special Rural land-uses which occur in the Priority 2 source protection area and for Urban land-use which is proposed by the North-East Corridor Amendment. Information about the potential impacts of roads is also provided.

Existing land-use in the Priority 2 source protection area is rural and the area is substantially cleared of native vegetation. Urban land use is proposed.

Rural land-use

Grazing, fertilising and pest control activities on agricultural land can potentially affect the groundwater quality.

Impacts on groundwater quality from intensive rural uses such as horticulture is well documented (See for example (Sharma 1990) (Gerritse 1990), (McPharlin 1990), and these activities can be prevented or controlled by local authority town planning schemes.

A study by Dames & Moore for the Water Authority of nitrate levels in groundwater within the Jandakot Underground Water Pollution Control Area (UWPCA) in 1989 assessed the annual fertiliser nitrogen application rates for various irrigated rural land uses to be approximately as follows (GRC-Dames & Moore 1990):

- cabbages and onions - 928kgN/ha;
- turf farms - 280 to 600kgN/ha;
- pasture and lucerne - 280kgN/ha;
- floriculture - 450kgN/ha; and
- other irrigated land (orchards, nurseries) - 200kgN/ha.

The high levels of nitrogen load from land use are not currently represented in the quality of the groundwater, being at least an order of magnitude less than predicted. The study concluded, together with the results of (Gerritse, et al. 1988), that the low levels of nitrate currently in Jandakot UWPCA are principally due to bacteriological denitrification. This is a common finding of researchers of nitrogen concentrations worldwide, but the capacity for denitrification is limited by a number of factors and the process is not fully understood; consequently nitrogen loads may exceed a threshold value beyond which nitrogen concentrations increase rapidly. This is commonly referred to as the nitrate 'time-bomb' effect.

Nitrate contamination of groundwater has already occurred within the Water Authority borefield at Gwelup. One of the main sources of nitrogen in the groundwater is believed to be horticultural fertilisers (Barber *et al,* 1993).

Beneath dry-land grazing of leguminous (nitrogen-fixing) pastures, significant leaching of nitrate has been observed. This is associated with nitrogen in manure and urine from livestock. Nitrate accumulates in the soil profile as a result of oxidation of organic nitrogen over the summer when the annual pasture is inactive. During winter rainfall-recharge the nitrate, which is very mobile, may be leached downwards faster than the rate of uptake by growth (Dillon 1993).

In agricultural areas of Europe where nitrogenous fertilisers are used extensively, it has become clear that optimum (economic) application rates for production often result in the exceedance of drinking water guidelines for nitrate(Dillon 1993).

Urban land-use

Urbanisation as a land use has the potential to impact on the quality of the underlying groundwater via the following sources:

- effluent and cleaning fluids from septic tanks;
- domestic garden fertiliser application;
- pesticides applied to buildings for termite protection, and to gardens for pest control;
- uncontrolled disposal of small quantities of solvent, paint, oils and other household materials and wastes;
- disposal of stormwater run-off, which may be contaminated with a variety of substances;
- excessive pumping from private bores causing saline intrusion or migration of contaminated water;
- chemical spills from vehicles using residential streets;

As urbanisation of the North-East Corridor is proposed to be sewered, the issue of impacts from septic tanks is not considered further here.

Domestic garden fertiliser can result in a significant nutrient input to groundwater. Atwood and Barber 1988) estimated that 5,000 tonnes of fertiliser is applied annually to Perth gardens. Of that, an estimated 250 tonnes of nitrogen and 100 tonnes of phosphorus infiltrate into the groundwater (Whelan 1987). A CSIRO study of groundwater contamination at Gwelup found that groundwater downgradient of sewered urban areas developed in the mid 1970's would be expected to show full impact from garden fertilisers in the next century (Barber *et al.*, 1993). Studies in Long Island found that nitrate concentrations in groundwater increased over time despite replacement of septic systems with sewer service ((Flipse, et al. 1984) in (Harper, et al. 1992)).

Special rural land-use

Special Rural Zones allow for a semi-rural land use which is structured for people who prefer low density housing on blocks usually of no less than one to two hectares.

Special Rural Zones can be considered to be a relatively low impact land use in terms of groundwater quality. However, the following activities may contribute to their potential to degrade the quality of underlying groundwater:

- clearing of native vegetation, although limited in extent;
- irrigation, fertilising and use of pesticide on a limited amount of non-commercial horticulture;
- lawn watering and fertilising similar to an urban block;
- keeping of stock and other animals (e.g. poultry), usually limited by local by-laws (e.g. maximum of two horses); and
- use of septic systems for household effluent disposal.
- other uses associated with rural small holdings where businesses are operated from home (e.g. trucking businesses, earth moving machinery).

The cumulative effect of these activities results in a potentially significant impact on groundwater quality, particularly with respect to nutrients. The total nitrogen load for Special Rural Zone properties, for instance, has been estimated at 82kg per property per year, or 41kg/ha/year based on some assumptions regarding irrigated area, animal numbers and so on (GRC-Dames & Moore 1990). Although relatively low compared with more intensive land use, this load represents a potential maximum nitrogen concentration in the groundwater

recharge of in excess of 20mg/L if all the nitrogen were to leach. Whilst only a proportion of the nitrogen would leach, the load is significant.

Roads

As new roads have been proposed over Priority 1 source protection areas the technical information relating to chemical spills and stormwater run-off from roads is relevant.

Chemical spills are a potential point source of groundwater contamination of which there is a significant risk in urban environments. In spills involving vehicular accidents, groundwater pollution results from either material loss via stormwater facilities or direct spillage onto permeable ground. Petroleum hydrocarbons, pesticides and other toxic chemicals are the most likely pollutants to enter the groundwater from these sources.

The West Australian Fire Brigade Annual Report (1992/93) indicates that several hundred spills of liquid occur each year.

The Water Authority has advised that the contaminants of most concern are dense organic liquids with low solubility. Spills of such liquids sink to the bottom of the aquifer, stratify and provide a continuos source of low level toxicity within the groundwater over decades. The removal of these substances from the groundwater is very difficult, if not impossible.

In addition, there is concern regarding the constant low level pollution associated with the normal use of the road, as expressed by the Ecologically Sustainable Working Groups.

> *In addition, the run-off from transport infrastructure is polluted by the emissions from vehicles and by surface and tyre degradation. The fine particulates, the unburnt oil, lead and asbestos dust from the emissions can be washed into surface water streams or can leach into ground water. The volume of traffic has a direct bearing on the degree of contamination of water systems* (Ecologically Sustainable Development Working Groups 1991).

Stormwater run-off from roads carrying high traffic loads (e.g. more than 40 000 vehicles per day) can carry contaminants of concern.

A study in Perth in 1990 found that infiltration basins adjacent to a major road contained high levels of lead (in excess of 3 500 ppm) and heavy metals. These substances were found to be confined to the surface soils of the basins in the short to medium term. It is not known if they could break through in the long term (Appleyard 1994).

Appendix 3

Policy information -

Urban conservation, lakes and wetlands

Appendix 3

Policy information -

Urban conservation, lakes and wetlands

Policy framework

Urban Conservation

The Environmental Protection Authority's strategy for urban conservation has been established through the Conservation Through Reserves study undertaken by the Conservation Through Reserves Committee (EPA 1975, 1976, 1980 and 1983) which are endorsed by Government and through three environmental impact assessments of proposed developments over land with high conservation value which had not been recommended for conservation by the study (Ellenbrook (Environmental Protection Authority 1992a) and Brixton Street September 1991 (Environmental Protection Authority 1991) and July 1992 (Environmental Protection Authority 1992b)).

The Conservation Through Reserves study divided the State into 12 regions or Systems. System Six or the Darling System extends from Moore River in the North to Bunbury in the South, extending inland up to about 45 km. System 6 covers the populated areas in and around Perth where there are often competing land uses.

The Environmental Protection Authority's strategy for urban conservation includes the following elements.

- an adequate and representative system of reserves should be set aside for the conservation of flora, fauna and landscape;
- such reserves should be properly managed and given security of tenure which recognises their conservation value;
- the integrity of such reserves should be maintained;
- the System Six Report (endorsed by Cabinet in 1983) established through the Conservation Through Reserves studies has formed a principle focus for the Environmental Protection Authority's conservation efforts on the Swan Coastal Plain;
- decisions to look at areas outside the Systems' areas are the exception but any proposal which may impact on areas of high conservation value outside the Systems areas should be looked at carefully and referred to the Environmental Protection Authority to be considered for environmental impact assessment. Areas with regionally significant vegetative systems which are endangered may be recommended for protection. Examples of areas which have been assessed by the Environmental Protection Authority and have been found to have regionally significant conservation value which should be protected have been noted above. General criteria for determining regionally significant conservation value include:
    - the regional vegetation complex is endangered (ie. in general less than 10% of the vegetation complex remains and less than 10% is secured for conservation);

- the area should have a unique attribute or special feature such as diversity of plant and animal communities, habitat for species that are scarce or otherwise threatened and in need of protection, contain elements that have scientific and educational value and have a high degree of naturalness;
- the area should have a high degree of representativeness; and
- the area should be managed to ensure viability.

- decisions on managing impacts on individual species which are endangered have generally been the responsibility of the Department of Conservation and Land Management under the Wildlife Conservation Act and the advice of that Department should be sought if species gazetted under the Wildlife Conservation Act may be present. The Department of Conservation and Land Management may refer proposals to the Environmental Protection Authority for assessment; and
- decisions on protecting areas of remnant vegetation outside the above framework for local conservation, linkages, buffers or local community use should be the responsibility of the planning agencies which have the framework to accommodate community interests in protecting the land for local conservation and recreation and to take into account the costs associated with this such as acquisition and the reduction of land for housing and other development.

In adopting this strategy, it is not intended to diminish the importance of the issues associated with local areas which do not have high conservation value or to discourage community concerns, but rather to indicate the role of the planning process in reserving regional open space for Parks and Recreation and ensuring local town planning schemes have regard for matters such as remnant vegetation, wetlands and public open space.

Strategy for protection of lakes and wetlands

The 1992 State of the Environment Report for Western Australia indicated that since European settlement, 70 to 80 percent of wetlands on the Swan Coastal Plain have been affected by urban, industrial and agricultural development. Many wetlands no longer exist, and others have reduced conservation values (Western Australian Government 1992).

There is a growing view in the community that the remaining wetlands of the Swan Coastal Plain are essential for the maintenance of ecological systems and the time has been reached where strong action needs to be taken to protect them (Environmental Protection Authority 1990).

Since 1971, the Environmental Protection Authority has consistently recognised the need to conserve lakes and wetlands and has developed a strategy for wetland protection on the Swan Coastal Plain (Environmental Protection Authority 1993, Bulletin 685).

The Environmental Protection Authority encourages protection of significantly functional lakes and wetlands, that is:

- Lakes nominated for protection in the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992;
- representative wetlands recommended for protection in the Environmental Protection Authority's System Six report;
- wetlands with rare vegetation communities not adequately represented in reserves, or rare flora and fauna (and their habitats); and
- wetland recognised by international agreement because of their importance primarily for waterbirds and their habitats.

Any proposals affecting wetlands which do not fall into the above categories are expected to be managed by the proponent within the management objectives for the relevant category of wetland identified in the Environmental Protection Authority's Bulletin 686, *A Guide to Wetland Management in the Perth and near Perth Swan Coastal Plain Area.*

EPA Bulletin 686 Management objectives for lakes and wetlands

Wetlands are valuable assets because they carry out a number of important processes, either ecological (biological and chemical), hydrological or social. These processes can be called wetland "functions" and are described in the Environmental Protection Authority's Bulletin 685, *Strategy for the protection of lakes and wetlands of the Swan Coastal Plain.*

Different wetlands are important for different reasons. Some wetlands are important to wildlife (with many natural attributes) and some wetlands important to humans (with many human-use attributes). Similarly, other wetlands will be important for both natural and human-use reasons, while others may have little importance on either.

Management objectives have been determined for most of the wetlands in the North-East Corridor. This information is shown in the wetland maps prepared by the Water Authority of Western Australia Water Resources Planning Branch called *Wetland management and the conservation estate - Wetland and natural resource map folios.* This map identifies wetlands and their management objectives at a scale of 1:25 000.

Appendix 4

Technical information

The Swan River

Appendix 4

Technical information

The Swan River

Condition of the Swan River

Concerns from the scientific community about the Swan River are documented in *Swan River - The future, Workshop Proceedings,* published by the Swan River Trust in 1993.

The following points are extracted from the proceedings of the above workshop(Swan River Trust 1993a) pp 144);

> *Monitoring has shown that the Swan River Estuary is nutrient enriched and is showing signs of stress from external inputs. The upper reaches of the Swan and Canning Rivers experience phytoplankton blooms which, on occasions, cause undesirable water conditions. Although not directly attributed to these blooms, fish kills have also been observed. Heavy epiphytic growth on seagrasses and excessive accumulations of macroalgae in the shallows and along the foreshores occur in the middle and lower reaches of the estuary.*

and;

> *The main threat to the ongoing maintenance of estuarine water quality is the nutrient loading to the estuary and the potential for this to increase with the expected population increase in the metropolitan area. It is vital that a better assessment of the assimilative capacity of the estuary is carried out together with a good understanding of nutrient loads from the different land uses and land forms in the catchment. Modelling should then be developed to enable some predictive capability to ensure that future growth and development of the metropolitan area does not push the estuary beyond its assimilative capacity.*

Nutrient loads into the Swan River from different land uses

It is not possible to provide a definitive comment on nutrient loads from different land-uses because of the number of variables associated with the final loading. In rural areas for example, the total nutrient load can be influenced by large individual point sources, fertiliser management practices of individual landholders, soil type and the ease of nutrient transport via water pathways. In urban areas, total nutrient loads can be influence by factors such as fertiliser practices in the catchment, soil type and slope, sewage effluent disposal (ie septic tank or sewerage), and industrial operations in the catchment.

The Swan River Trust has published interim results indicating nutrient loads from 15 different catchments. The average water an nutrient load per hectare from each sub-catchment is provided in Table 1 below (Swan River Trust 1993).

Table 1: Nutrient loads from each sub-catchment of the Swan River

Sub-catchment	Discharge (cubic metres per hectare)	NH_3-N (kg/ha)	NO_3-N (kg/ha)	TN (kg/ha)	SRP (kg/ha)	TP (kg/ha)
Avon River	22	0.001	0.004	0.022	<0.01	0.001
Helena River	532	0.05	0.26	0.62	0.01	0.04
Ellen Brook	438	0.07	0.07	0.86	0.19	0.34
Jane Brook	1212	0.05	0.45	0.95	0.01	0.04
Bennett Brook	912	0.06	0.50	1.45	0.04	0.13
Canning River	1099	0.06	0.95	1.49	0.02	0.08
Blackadder Creek	1800	0.65	2.25	2.09	0.06	0.11
Southern River	1394	0.11	0.95	2.36	0.24	0.40
Yule Brook	2140	0.16	1.13	2.79	0.07	0.23
South Belmont MD	2779	0.71	1.17	3.99	0.29	0.57
Bannister Creek	3434	0.50	1.53	5.25	0.24	0.43
Claisbrook MD	3296	0.60	2.76	6.20	0.14	0.58
Bayswater MD	3859	1.85	2.32	6.51	0.16	1.88
Mills Street MD	3883	1.89	2.19	8.50	0.46	1.00
Susannah Brook	23866	2.48	16.33	39.96	0.71	2.93

High nutrient loads are evident from both catchments which are predominantly urban and predominantly rural. The information provided is insufficient to determine a relationship between land-use and nutrient load.

The Ellen Brook catchment has an area of about 664 square kilometres and has been identified as a significant source of nutrients, on average contributing more phosphorus than the Avon Catchment which is 119 000 square kilometres. However, in 1993, the source of the high nutrient loading had not been identified and it was acknowledged that 'There are a number of possible point sources which could be contributing significant loads of faecal material to Ellen Brook including piggeries and sewerage treatment facilities'. Because Ellen Brook has been identified as a significant source of nutrients, some people argue that urbanising the Ellen Brook Catchment would reduce the current nutrient load coming from the catchment into the Swan River.

Appendix 5

Technical information

Drainage and water management for the protection of the Swan River, lakes and wetlands

Appendix 5

Technical information

Drainage and water management for the protection of the Swan River, lakes and wetlands

Technical framework

Urbanisation effects on water quality and water balance

Urbanisation is widely acknowledged to change water quality and quantity. The following extract from Water sensitive urban (residential) design guidelines for the Perth Metropolitan Region Discussion Paper (Whelans Consultants Pty Ltd, et al. 1993b) summarises this.

> *As urbanisation of previously rural or bushland areas occurs, the hydrological cycle is significantly changed. A water use cycle is introduced to meet human demands for water and waste water. This creates a new* ***water balance****, often with detrimental impact on some elements of the natural hydrology, particularly wetlands.*
>
> *Many of the activities that occur in urban areas produce waste by-products which have the potential to enter the water cycle via run-off or infiltration to the groundwater creating the potential for* ***water quality*** *deterioration.*

Current and recent research into nutrient loading in urban stormwater

Recent research into nutrient load includes;

Water Authority of Western Australia 1991, *Nutrients in Perth urban surface drainage catchments characterised by applicable attributes* Report WS 85

This investigation studied nutrient outputs from various urban catchments according to their soil types, groundwater levels and whether they were sewered or unsewered. The study found that urban surface water run-off from sandy soil catchments contributes roughly 0.1 kg/ha/annum of total phosphorus.

Commonwealth Scientific and Industrial Research Organisation 'Seeking solutions' (From 1992-93 CSIRO Annual Report)

This report is a joint interdepartmental study of nutrient outputs from the Ellen Brook catchment and the effect of land use changes on these outputs. The study involves the Water Authority of Western Australia, the Waterways Commission, the Western Australian Department of Agriculture and CSIRO and will run from 1992 to 1995. The report highlights the export of nutrients from rural areas and interim reports will be produced each year.

Klemm V 1991, *Bayswater Main Drain* Waterways Commission Report No 33.

This study, as well as two years continuous sampling of the Light Street Branch Drain conducted by the Water Authority and Swan River Trust, has shown that the nutrient contribution from Bayswater's residential areas is low. it is now considered that the major contributor of nutrients is probably from past practices at the CSBP fertiliser plant.

The need for regional drainage

Much of the North-East Corridor is seasonally waterlogged (ie pallusplain), urbanisation is dependent upon regional drainage.

Water flows and channel wetlands

Both the volume of water and the seasonality of water flowing in streams is expected to alter significantly as a result of urbanisation (V & C Semeniuk Research Group 1992). A literature review regarding the potential effects of such changes on stream ecology and bank erosion has not been undertaken by the Environmental Protection Authority, and the North-East Corridor Structure Plan does not raise this specifically as an issue.

Lakes and wetlands - impacts of water quality and water level changes

Changes in water quality can lead to wetlands becoming a nuisance, rather than an asset to the community as noted in the following extracts from Chambers and Davis (1989).

> *Wetland food chains can be altered by the poor quality of the water which a wetland receives and these alterations will result in algal blooms and nuisance swarms of midges.*

Prior to noting the above conclusion Chambers and Davis (1989) state;

> *Decomposing algal blooms provide a large food source for detritavores and the growth of larval midges is particularly favoured. As a consequence the management of midge problems at a wetland must involve some treatment of the cause of the problem; the entry of excessive nutrients into the lake and ensuing algal blooms. Decomposing algal blooms may also result in offensive odours and contribute to the increasing incidence of waterbird deaths from botulism.*

Changes in water balance can have significant effects on groundwater levels and wetland vegetation. Froend, et al. (1993) notes that 'Water depth is the most important factor

determining the survival and zonation of emergent vegetation in permanently flooded or waterlogged areas' and in discussing trees around wetlands notes:

> *Rapid changes in environmental conditions such as rapid and prolonged drawdown or flooding will result in severe degradation of the vegetation if the species are unable to respond (alter distribution by reproduction etc) within the period change occurs. For* M preissiana *and other fringing tree species the slower response in population distribution and growth is somewhat compensated for by greater plasticity of the individual, eg alter the root system to "follow" a declining water table. This is demonstrated by the persistence of old parental trees high on the elevation gradient at Banganup, despite decreasing water levels over the decades. However, if the changes are too rapid for the individuals to adapt to, then local extinction will occur at that point on the water regime gradient, or possibly the whole wetland.*

The loss of fringing vegetation as a result of water level changes can compound the problems in respect of water quality, as noted by Chambers and Davis (1989).

> *If the fringing vegetation component is destroyed, as often occurs in urban wetlands, nutrients stored in the fringing vegetation can be released to the wetland, increasing nutrient concentrations to the water column which may lead to algal blooms. The nutrient filter provided by the sedges is also lost and the nutrient uptake by the sediment is reduced, so that further input of nutrients to the wetland may have a greater effect than when the fringing vegetation was present.*

It can be concluded from the above information that management of water quality and quantity in the region is a key to maintaining wetlands which are to be retained and protected in an acceptable condition.

Groundwater quality criteria are specified for the portion of the North-East Corridor covered by the Environmental Protection (Gnangara Mound Crown Land) Policy 1992 and Draft

Environmental Protection Policy for Gnangara Mound Private Land Groundwater 1993. However, *these criteria are not appropriate for surface water in wetlands.*

Stormwater pollution control ponds

Stormwater pollution control ponds have been used extensively overseas and in the eastern states of Australia in an effort to reduce pollutant loads in surface water run-off to acceptable levels. There are two main processes believed to be responsible for water quality improvement in stormwater pollution control ponds - sedimentation of particles to which nutrients and metals are bound, and biological removal mechanisms. Biological removal mechanisms include uptake by plants with subsequent harvesting, or removal at later stages in the food chain (e.g. fish, midges). Key considerations in stormwater pollution control pond design are particle size, pathways for biological removal of dissolved nutrients, detention time and volume of storage in relation to the pattern of incident rainfall.

Biological removal is required for 'dissolved' nutrients. There is some debate about what criteria to use to distinguish between dissolved and particulate nutrients. In Western Australia some agencies consider nutrients bound to particle sizes of less than 0.45 μm to be 'dissolved' (commonly called FRP = filterable reactive phosphorus).

Run-off from hard surfaces (e.g. roads, footpaths, car-parks, roofs etc) typically comprises high suspended sediment and organic detritus (e.g. dog faeces, leaf matter, grass clippings etc) loads which can be removed by sedimentation (State Pollution Control Commission 1989; Bayley, et al. 1989). Accordingly, stormwater pollution control ponds in urban areas need to include sedimentation basins.

Yakamia Wetland in Albany is an example of a stable, fully functional urban wetland filter (Bott 1990).

In contrast, basins to remove nutrients from regional (sub-surface) drainage systems in sandy rural areas need to be designed for biological nutrient removal, particularly where the soils have a low Phosphate Retention Index. The Spectacles, which is a large rehabilitated wetland near Kwinana, is an example of wetland which strips nutrients from rural run-off.

A study of urban run-off in Perth found that phosphorus from the first autumn rains was approximately 50% filterable reactive phosphorus (ie dissolved meaning < 0.45 μm in diameter) and 50% in particulate form (ie particles > 0.45 μm in diameter). However subsequent run-off was approximately 10 % filterable reactive phosphorus and 90% in particulate form. Phosphorus in surface water run-off from urban catchments has been recorded at 0.1 kg/ha/annum, but will vary considerably depending upon rainfall (quantity, distribution and intensity), catchment slope, sewerage disposal practices and soil type.

In some circumstances phosphorus accession to regional drainage systems via groundwater may be significant. In Shelley (near Beatrice Avenue) which is largely serviced by septic tanks reliant on subsoil drainage to provide clearance from groundwater, the contribution of groundwater to the total phosphorus load appears to be significant (Water Authority of Western Australia, pers comm).

Stormwater pollution control ponds are proposed for the area to be urbanised at Ellenbrook and some progress is being made in regard to design criteria for the local and regional drainage system. Based on an assessment of available technical information and the design criteria for local drainage (which includes subsoil drainage) officers of the Water Authority of Western Australia expect that a total nutrient load reduction of at least 50% would be achievable from urban run-off by constructing stormwater pollution control ponds. Load reductions of up to 75% may be achievable, but it would be imprudent to assume this efficiency. Following construction of these ponds a comprehensive monitoring, management and reporting program will be required.

However, there are not yet any stormwater pollution control ponds operating in urban areas on the sandy soils of the Swan Coastal Plain to verify their predicted performance. Two stormwater pollution control ponds have recently been constructed.

During the summer of 1993/94 the Water Authority of Western Australia commenced construction of two stormwater pollution control ponds in the Bayswater Main Drain to determine the effectiveness of such ponds on the Bassendean soil type. The Water Authority of Western Australia expects that it will take about two years before the ponds become effective and has planned monitoring accordingly.

Nutrient removal ponds designed as sedimentation basins in a Jandakot catchment which is currently being urbanised did not reduce nutrient loads during their first year of operation (Water Authority of Western Australia 1994). This is consistent with experience overseas where it has been concluded that stormwater pollution control ponds may take a few years to achieve adequate nutrient removal efficiency (Wetlands Research 1992).

Water Authority of Western Australia predictions for Ellenbrook

Nutrient contributions from groundwater can be high, though this is believed to be dependent on the level at which subsoil drainage has been installed. In the Ellenbrook development proposal the subsoil drains are to be placed at the estimated current average maximum annual water table level. As a result, the groundwater flow, together with its nutrient loadings, is expected to be lower than from those subsoil networks installed in the metropolitan area in the 1950s to the early 1980s. Setting a minimum nutrient stripping pond requirement of 250 cubic metres per hectare of development or seven days detention time is expected to further reduce nutrient exports from new urban areas.

Hydrogeology of the North-East Corridor

The following information is drawn from V & C Semeniuk Research Group, 1992 and it has important implications for local and regional drainage in the North-East Corridor as described below.

The above-mentioned report summarises the hydrogeology of the North-East Corridor as follows:

> *There are four specific important features of the Northeast Corridor area, in relationship to hydrology, that need description and highlighting, because these features have a major influence on the groundwater dynamics of this area, as distinct from other areas elsewhere on the Swan Coastal Plain.*
>
> *Firstly, the area lies within a zone of marked groundwater discharge from the Gnangara Mound because of the draining effects of Ellen Brook, Bennet Brook and the Swan River.*
>
> *Secondly, in a regional stratigraphic setting, the Corridor area lies in a zone of stratigraphic interfingering, which influences small scale movement of water.*
>
> *Thirdly, there is an increased amount of plugging of the vadose zone in the area by the effects of pedogenesis and diagenesis.*
>
> *Finally, there is an increased amount of plugging on the vadose zone in this area specifically by iron precipitates.*

The implications of the complex hydrology are 'that it is not simple to determine small scale hydrological dynamics, and it is at this scale that local vegetation communities may be affected'.

In the North-East Corridor a wetland may, for example, be a clay basin fed from both rainfall infiltration around the wetland and from the Gnangara Mound.

The complexity and our lack of knowledge of the hydrogeology of the North-East Corridor may alter the expected effectiveness of the regional drainage system with regard to water level control for individual wetlands.

Appendix 6

Policy and technical information

Air quality and greenhouse gasses

Appendix 6

Policy and technical information

Air quality and greenhouse gasses

Policy framework

Air quality consultative committee

The Minister for the Environment has established an air quality consultative committee with the following terms of reference;

1. Identify air quality issues of current or potential concern within the Perth region (metropolitan area and adjacent areas);
2. Advise Government of issues which need to be investigated and possibly addressed, recommending work programs and requisite budgets;
3. Facilitate the establishment and management of co-operative investigations, taking the opportunity where possible to co-ordinate and augment work being undertaken under other auspices, in order to provide:
   - scientific data and other information on the status of the air quality issues in question;
   - recommendations for air quality management (both pollution control and planning measures);
   - tools to aid ongoing assessment and decision making (computer models etc);
   - reports, visual productions etc. suitable for public information and education;
4. Recommend policy initiatives for air quality control and advise on the costs, effectiveness and consequences of alternative strategies.

Technical information

Perth airshed studies

The Department of Environmental Protection is currently undertaking two studies of air quality issues in the Perth Metropolitan Region, namely visible haze and photochemical smog. The studies are funded by several state government agencies, including the State Energy Commission of Western Australia and the Department of Planning and Urban Development.

Perth's skies have become noticeably discoloured on many days in the period autumn through spring. There are also several days in the hotter months each year when the city is enveloped in bushfire smoke. The Perth Haze Study, which commenced in early 1994, consists essentially of a program to measure the haze at five sites (Swanbourne, Kenwick, Perth Central Business District (CBD), Caversham and Duncraig) in order to quantify the levels of haze and determine what causes it. Very high levels of haze (visibility reduction) have been measured on several near - calm nights at Duncraig, clearly caused by home fires. Levels at all other sites have been lower but still significant. Home fires will clearly be a focus of the Study recommendations. A final report is due to be released in late 1995.

The Perth Photochemical Smog Study is a joint State Energy Commission of Western Australia and Department of Environmental Protection study which commenced in early 1992 and is due for completion in mid 1995. Photochemical smog is a mixture of irritant gases including ozone and nitrogen dioxide which form when urban emissions from motor vehicles, industrial and other urban sources react over several hours in warm sunny conditions. Significant levels of photochemical smog over Perth are limited almost exclusively to summer and early autumn. This type of smog is generally not visible, although significant levels of photochemical smog may develop within bushfire smoke.

The core activity in the study is the continuous operation of the eight monitoring stations. The Caversham station is in the immediate vicinity of the land which is the subject of this report. Rolling Green is 20 km south-west of Toodyay.

Overall the photochemical smog levels occurring in Perth's air are not severe when compared to the likes of Los Angeles. However, it is apparent that Perth is on the threshold of having a smog problem. Concentrations of ozone (the key indicator) in Perth exceed the World Health Organisation goal of 80 parts per billion (ppb) several times per year. The NHMRC goal of 120 ppb was exceeded once at Caversham in each of 1991 and 1992, before the other stations were installed. Smog concentrations will increase as emissions increase.

In the Perth region the normal cycle for smog formation consists of emissions being blown off-shore in the morning where they react and are then returned as smog in the sea breeze. Smog returning over the city gets a boost from fresh emissions. Since Caversham and Rolling Green lie generally downwind of the CBD it is not surprising that these stations have recorded generally higher levels of ozone than other stations. The high temperatures and strong sunlight during Perth's summer accelerate the smog reactions, so that the smog reaching Caversham is frequently well developed.

However, in the context of this assessment, it is inappropriate to single out the North-East Corridor for special consideration with respect to photochemical smog. Elevated concentrations are not localised; they occur on any given day over a very broad area elongated in the wind direction (eg Caversham to Rolling Green and beyond) generally closely following the arrival time of the sea breeze. Furthermore, there are days such as the 19 February 1994 on which the highest concentrations occur in coastal suburbs. In other words, photochemical smog is a regional problem necessitating regional solutions.

Whilst the study has not reached the stage of formulating recommendations, it is fair to anticipate that recommendations will focus on measures to control major sources of emissions, primarily motor vehicles.

Greenhouse gas emissions

Transport, and particularly private automobile use, is acknowledged to be a significant contributor to carbon dioxide emissions which could result in global warming. In Western Australia transporting people and goods produces about 15% of the State's greenhouse gas emissions. The Draft Greenhouse Strategy Review 1994 states that 'At this time, Western Australia can best focus its efforts to reduce transport emissions by concentrating on private passenger vehicles' and considers that this is best achieved by 'limiting the amount of transport required' and 'using low emissions transport fuels, fuel systems or transport modes'(Greenhouse Coordination Council of Western Australia 1994).